

**Climate Change Learning in an Electricity Utility: Distribution
Division Case Study, Eskom, South Africa**

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**SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE DOCTOR OF
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DECLARATION

Submitted in fulfillment of the requirements for the degree of PhD in Environmental Science in the Graduate Programme in the School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, South Africa, under the supervision of Professor Urmilla Bob.

I, Poobalan Troy Govender, Registration Number 202524817, hereby declare that unless otherwise indicated, this thesis is my work for the Doctor of Philosophy in Environmental Science and has not been submitted in part or full for any other degree purposes at any other University.



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16 March 2018

Date

DEDICATION

This thesis is dedicated to:

Francesco

and

Teriqa-Anne

May climate change awareness and learning, responses and actions by all citizens alter the current negative climate change trajectory, so that Francesco and Teriqa-Anne may be able to realise their full potential and leave a legacy that will outlast and outlive them. May their future generations also prosper and live in a climate-friendly world.

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ABSTRACT

One of the most significant ways in which humans have damaged the environment is the contribution to rapid global warming which causes major changes to the climate on earth, resulting in many negative impacts to humans and the environment. While the world mostly agrees that something needs to be done about climate change, there have been numerous stumbling blocks and setbacks in decisive actions on climate change. Businesses are realising that pro-climate change actions could lead to economic, environmental and health benefits, while also improving the sustainability of the organisation. In order to address climate change, major shifts in public policy and individual behaviour regarding energy, transportation and consumption will have to be made. Improving basic education, climate literacy and public understanding of the local dimensions of climate change are vital for public engagement and support for climate action.

This research explored climate change learning in an electricity utility, using the Eskom's Distribution Division in South Africa. The four objectives of this study included a critical review and assessment of the level of the Distribution Division's climate change programme and environmental practices, an examination of staff perceptions and attitudes towards climate change and the Distribution Division's environmental strategies, an examination of the challenges and opportunities presented by the environmental and climate change crisis for business in South Africa and in particular for electricity utilities in Africa, the development of a set of indicators to inform a framework for internal climate change capacity building programmes for electricity utility companies and the formulation of a policy and programme recommendations.

Existing literature was reviewed, an online survey was conducted with employees, interviews were held with the key informants and focus group discussions were hosted. The research considered the demographic profile of respondents, attitudes to life and environmental issues, options for managing climate change, who respondents considered responsible for climate change action, who could be trusted to take climate change action and the Distribution Division's climate change programme and environmental strategies. The findings of this study indicate that the Distribution Division employees considered career, job or employment and education as a higher priority for society. Water pollution was the most important environmental issue that employees experienced or impacted on their lives at present and this issue was also considered the most important issue globally. Furthermore, employees' self-rated knowledge of climate change was above average and the majority expressed grave concern about climate change. Employees were also of the view that emissions from business or factories were the main cause of climate change. Employees also experienced hotter summers and water shortages which indicated to them that climate change is taking place presently and affects South Africa. The main options for actions that employees put forward were recycling waste and planting of trees. Furthermore, employees trusted themselves the most to take action on climate change and the main choice of format for climate change information that was preferred by employees was talks by experts, using graphs of future trends and pictures of what an area could look like in the future. This research supports the findings of other scholars who indicate that climate change learning and response is generally poor amongst most people, including workers, and that there are some specific interventions that are required to enhance climate change learning in the work environment. A range of options must be considered with the involvement of relevant stakeholders to find practical and meaningful options for climate change learning and response. Hence recommendations

were made in this study to address the level of the Distribution Division's climate change programme and environmental practices, staff perceptions and attitudes towards climate change and the Distribution Division's environmental strategies, the challenges and opportunities presented by the environmental and climate change crisis for business in South Africa and for electricity utilities in Africa. A set of indicators (Table 6.1) to build the climate change capacity of employees and to minimise business and individual Greenhouse Gas (GHG) emissions was also developed within the framework for internal climate change capacity building programmes for electricity utilities. The policy and programme recommendations of this study included the prioritising of climate change learning in business with the necessary resources and leadership requirements, as well as a proposal to rebrand climate change to a more impactful, appropriate, relevant and meaningful term linked to human survival.

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LIST OF ABBREVIATIONS AND ACRONYMS

AC	:	Asset Creation
AR	:	Assessment Report
AR5	:	Fifth Assessment Report
BIPM	:	Business Integration and Performance Management
BP	:	Business Partner
CDM	:	Clean Development Mechanism
CFC	:	chlorofluorocarbon
CH ₄	:	methane
CNC	:	Customer Network Centres
CO ₂	:	Carbon dioxide
CO ₂ eq	:	Carbon dioxide equivalent
COP	:	Conference of the Parties
CSI	:	Corporate Social Investment
CSR	:	Corporate Social Responsibility
^o C	:	Degree Celsius
DEA	:	Department of Environmental Affairs
DEAT	:	Department of Environmental Affairs and Tourism
DEFRA	:	Department of the Environment Food and Rural Affairs
DHO	:	Distribution Head Office.
DoE	:	Department of Energy
ECOU	:	Eastern Cape Operating Unit
FSOU	:	Free State Operating Unit
FTSE	:	Financial Times Stock Exchange
GEF	:	Global Environment Facility
GDP	:	Gross Domestic Product
GHG	:	Greenhouse gas
GM	:	General Manager
GOU	:	Gauteng Operating Unit
HFCs	:	Hydrofluorocarbons
HV	:	High voltage
IISD	:	International Institute for Sustainable Development
INDC	:	Intended Nationally-Determined Contribution
IPCC	:	Intergovernmental Panel on Climate Change
IS	:	Industry Support
km	:	kilometre
KPI	:	Key Performance Indicator
kV	:	kilovolt
KZNOU	:	KwaZulu-Natal Operating Unit
kt	:	kilo ton
LOU	:	Limpopo Operating Unit)
LTMS	:	Long-Term Mitigation Scenario
M.A.G.I.C	:	Management of Applied Green Initiatives and Concepts
M&O	:	Maintenance and Operations
MNCs	:	Multi-national corporations
MOU	:	Mpumalanga Operating Unit
Mt	:	million tons
MV	:	Medium voltage

MW	:	Megawatt
NCOU	:	Northern Cape Operating Unit
NCPC-SA	:	National Cleaner Production Centre of South Africa
NEMA	:	National Environmental Management Act, No. 107 of 1998.
NGO	:	Non-governmental organisation
N ₂ O	:	Nitrous oxide
NWOU	:	North West Operating Unit
OU	:	Operating Unit
PFC	:	perfluorocarbon
Sappi	:	South African Pulp and Paper Industries
SDG	:	Sustainable Development Goals
SF ₆	:	Sulphur hexafluoride
SHEQS	:	Safety, Health, Environment, Quality and Security
SMART	:	Specific, Measurable, Attainable, Realistic and Timely
SOE	:	State Owned Enterprise
SPSS	:	Statistical Package for the Social Science
TASK	:	Tuned Assessment of Skills and Knowledge
ToC	:	Theory of Change
UK	:	United Kingdom
UN	:	United Nations
UNCED	:	United Nations Conference on Environment and Development
UNEP	:	United Nations Environment Programme
UNFCCC	:	United Nations Framework Convention on Climate Change
USA	:	United States of America
WESSA	:	Wildlife and Environment Society of South Africa
WCOU	:	Western Cape Operating Unit
WG	:	Working Group
WMO	:	World Meteorological Organisation

CHAPTER ONE

INTRODUCTION

1.1 Preamble

Climate change threatens hard-won peace, prosperity, and opportunity for billions of people. Today we must set the world on a new course. Climate change is the defining issue of our age. It is defining our present.

(United Nations [UN] News Centre, 2014: 1)

According to Aryal (2015), it has become increasingly apparent that climate change is one of the paramount challenges to humankind and all other life on Earth and that global climate change has been identified as the cause of worldwide changes in seasonal patterns, weather events, temperature ranges, and other related occurrences. Stern (2016) identified climate change as one of the two serious challenges facing humans - the other being poverty. Furthermore, he points out that there is a great risk for a safe and thriving world in the future, if these two issues are not addressed adequately and promptly. Chougrani (2016) further indicates that climate change will contribute to eco-refugees of about half a billion people, less biodiversity, fewer forests, eruptions of violence over water and land disputes.

Eskom, Distribution Division is one of the largest employers in South Africa with a large workforce, spread across the nine provinces. Could such a large and relatively affluent workforce make a significant contribution to addressing climate change within the organisation through better decision-making on climate change and more efficient resource use and in their own lives through sustainable consumption? Through the stated four objectives of this research, it is hoped that a better understanding of climate change learning in the Distribution Division is obtained to inform and guide the Distribution Division and other similar large businesses on addressing climate change through an empowered workforce. The specific research questions will attempt to determine what is the priority for employees, how they recommend tackling climate change and the status of climate change learning in the Distribution Division. Added to the challenges of the research is that the Distribution Division has not undertaken an organisational carbon footprint study.

Costanza *et al.* (2016) point out that the current state of the environment has resulted in a wide range of measures aimed at both moderating and adjusting to these new environmental problems. Additionally, the most multifaceted and pervasive of these issues is global warming which triggers climate change. As a result, recent attention has been given to developing an internationally driven response to global warming through economic as well as environmentally-based arguments (Rosen and Guenther, 2015).

According to Akpan (2017), it is important for everybody to be interested and take action on climate change. Stern (2016) contends that climate change requires an urgent global response, as the scientific evidence is overwhelming and that climate change presents very serious global risks. Additionally, the causes and consequences of climate change are global and therefore international collective action will be pivotal for an effective, efficient and just response on the scale required. Aryal (2015) indicates that many different science experts have cautioned that the negative impacts of climate change will become much more intense and frequent in the future, particularly if environmentally destructive human activities continue relentlessly.

According to Woodruff (2016), it is not possible for anyone to predict the consequences of climate change with complete certainty. However, Stern (2016) indicates that climate change risks are currently better understood, for example, Bangladeshi farmers and Cairo city-dwellers are at severe risk of flooding and storms; southern Europe and parts of Africa and the Americas are threatened by desertification and hundreds of millions of people may need to migrate as a result, posing an immense risk of conflict. Additionally, in the coming few decades, robust action to reduce emissions (as a mitigation measure) should be seen as investment, and a cost incurred now to avoid the risks of very severe consequences in the future. Myers *et al.* (2017) also point out that human-caused climate change will influence the quality and quantity of food production and the ability to distribute it equitably. Mechler and Bouwer (2015) suggest that climate change costs will be manageable, and there is likely to be a wide range of opportunities for growth and development along the way, if firm climate change investments and actions are made wisely and early. Scott *et al.* (2015) and Wittneben and Kiyar (2009) report that the Intergovernmental Panel on Climate Change (IPCC), which is an association of hundreds of scholars reviewing the latest scientific findings, reported in 2007 and confirmed again in 2015 that the evidence for human-induced climate change was

overwhelming and unequivocal. The IPCC (2014) advocates that tackling global warming is one of the greatest challenges to humankind in the twenty-first century.

Carrico *et al.* (2015) maintain that in recent years the scientific community has concluded that the effects of climate change are already occurring and the IPCC (2014) states that existing greenhouse gas (GHG) concentrations make further warming inevitable. Keskitalo (2012) asserts that scientists and policy-makers have acknowledged that there is a need for measures to adapt to climate change, which usually involves infrastructure or technological changes to cope with the impacts of climate change, in addition to efforts to reduce GHG emissions.

The South African Department of Environmental Affairs and Tourism (DEAT) (2006) and, most recently, Fløttum and Gjerstad (2017), Jewitt *et al.* (2015), Mastrorillo *et al.* (2016) and van Wilgen *et al.* (2016) point out that South Africa is also vulnerable to the effects of climate change. In addition, the effects of climate change on human and natural systems are becoming increasingly evident in South Africa, such as the net drying of the western half of the country, increase in rainfall on the eastern escarpment, health issues (for example, the spread of malaria), changes in the distribution and availability of water resources, changes to biodiversity and ecosystems, and changes in patterns of agriculture (Fant *et al.*, 2016; Henneman *et al.*, 2015). Pasquini *et al.* (2013; 2015) state that South Africa is no different from other developing countries and also faces the climate change challenge as well as many demanding social, economic and environmental stressors. Furthermore, Daron (2015) and Freund (2016) indicate that there are numerous and diverse challenges in South Africa, and includes a lack of political leadership, corruption, a lack of policy coherence and skills scarcity.

Cartwright *et al.* (2012), Henneman *et al.* (2016) and Midgley *et al.* (2007) also point out that while South Africa must respond to the challenge of planning and implementing climate change adaptation strategies, the country has to also address service delivery backlogs. In addition, the process of including climate adaptation considerations into governmental policies and practices in developing countries, such as South Africa, is expected to be challenging because of existing strains on resources and capacity, given the social, economic and political structures of these countries. Mantel *et al.* (2015) and Thambiran and Diab (2011) report that climate change is expected to worsen the problems of the poorest

communities, who are least likely to be able to respond or adapt. Conway *et al.* (2015), Mantel *et al.* (2015) and Ziervogel *et al.* (2014) assert that climate change poses a significant threat to South Africa's water resources, food security, health, infrastructure, as well as its ecosystem services and biodiversity. Moreover, these impacts pose critical challenges for national development, given South Africa's high levels of poverty and inequality. Additionally, to date, the impact of climate change on the private sector has not been an explicit focus in national assessments in South Africa.

Some of the barriers that need to be overcome for the adoption of climate change considerations include a lack of awareness of opportunities (Armah *et al.*, 2015), competing priorities (Burch, 2010a) and a lack of community or political will to act (Matthews *et al.*, 2015). Notwithstanding, local authorities have the potential to promote the adoption of climate change considerations through the control of critical functions and existing policies. Furthermore, the study by Pasquini *et al.* (2015) suggest that barriers common to the global North and the global South (at least in middle-income nations) need to be addressed by all governments if climate change adaptation is to be achieved at the local level. Jones and Phillips (2016) and Okereke (2007) argue that businesses are an integral part of society and businesses are now also faced with the twin challenges of reducing emissions to mitigate climate change and preparing for the impact of climate change on their operations.

This study examines climate change understanding and learning in business, with a case study in the Distribution Division of Africa's largest electricity utility, Eskom which is a State Owned Enterprise (SOE) in South Africa. Eskom is the foremost business in South Africa that provides the majority of the country's energy needs. According to Dlamini *et al.* (2015), Kroth *et al.* (2016) and Winkler (2005), energy is critical to virtually every aspect of the economic and social development of South Africa. Additionally, electricity can contribute to both local environmental degradation (such as air pollution) and global environmental problems (principally climate change), depending on the way it is produced, transported and used. However, Kroth *et al.* (2016) and Winkler (2005) indicate that providing affordable, adequate and reliable modern electricity to most South Africans remains a major challenge, even though access to electricity has increased from one-third to two-thirds of the population since 1994. Arndt (2016) though argues that South Africa's future energy needs must be balanced with the country's environmental commitments and socio-economic needs. Conway *et al.* (2015) and Winkler (2005) stress that the current methods of producing and using

energy in South Africa, have environmental and health implications that increasingly endanger the welfare of communities. Additionally, one of the key challenges for the electricity business in South Africa is therefore to move to a cleaner energy supply and more efficient use, while continuing to extend affordable access, in particular for poor rural and urban communities (Arndt, 2016; Fant *et al.*, 2016).

According to Arndt *et al.* (2016) and Henneman *et al.* (2016), South Africa relies heavily on coal and fossil-fuel based ore to meet increasing energy demands. Henneman *et al.* (2016) and Lin *et al.* (2015) further point out that South Africa's reliance on fossil fuel power generation (which makes South Africa the 13th largest emitter of GHGs in the world) also contributes to local human and ecological health problems. Watson and Johnson (2010) advocate that there needs to be a more sustainable use and sources of energy due to the growing environmental concerns (and in particular climate change), exponential population increase and the rate of coal depletion. This view is also supported by van Vuuren *et al.* (2017) who explain that there needs to be greater emphasis on resource efficiency and more environmentally-friendly consumption and production patterns of energy to reduce GHG emissions.

In addition, the Distribution Division connects an average of 437 new homes every day. Eskom is wholly owned by the South African government and 25 875 employees work for the organisation, of which approximately 15 501 (60%) are in the Distribution Division, representing the largest percentage of employees of any particular Division in Eskom (Eskom, 2015b; 2016a).

Watson and Johnson (2010) point out that the supply (or distribution) of conventional electricity is presently dependent on a grid system, powered by coal in South Africa and that it is not economically or environmentally feasible to expand this grid to rural and deep rural areas. According to Eskom (2015a), this grid system is managed and operated by the Distribution Division whose mandate is to operate its network assets and provide reliable electricity by building, operating and maintaining distribution infrastructure (powerlines, substations, transformers and other ancillary electrical equipment), while also acting in the national interest by actively partnering with the wider business in resolving distribution business issues and enhancing stakeholder relations. Eskom (2013a) describes the distribution asset base that is comprised of 48 278 km of sub-transmission lines, operating at voltages of

33 kilovolt (kV) to 132kV, 281 510 km of reticulation power lines, operating at voltages of 11kV and 22kV and 7 436 km of underground cables of various voltages. This distribution network represents the largest power line system in Africa (Eskom, 2015a). These 337 224 km of powerlines and associated electricity infrastructure traverse diverse terrains and topographies across the country and Eskom (2015c) maintains that the structural integrity and operating performance of such an electricity system is vulnerable to extreme weather conditions, especially those which were designed without consideration for climate change impacts. According to Department of Environmental Affairs and Tourism (DEAT) (2006), 91.1% of the total carbon dioxide (CO₂) emissions in 1994 in South Africa came from the energy sector and DEAT (2011) contends that the energy sector was the largest contributor to CO₂ emissions in South Africa, contributing an average of 89.1% between 2000 and 2010. Additionally, this dependence on fossil fuels for the generation and distribution of energy is largely to blame for South Africa's disproportionate contribution to global carbon emissions. Furthermore, Bazilian *et al.* (2010) and Herman *et al.* (2015) argue that reducing GHGs are alien to traditional energy sector's 'core' objectives, such as reliable electricity supply, and can be inconsistent with the well-established financial, technical and risk perspectives of electricity utilities.

Furthermore, the access to electricity versus climate change debate in South Africa is aptly reflected by Pielke (2010: 1):

When Gross Domestic Product (GDP) growth comes into conflict with emissions reduction goals, it is not going to be growth that is scaled back...when rich countries wanting emissions reductions run into poorer countries wanting energy, it is not going to be rich countries who get their way. When energy access depends upon cheap energy, arguments to increase energy costs or deny energy access are not going to be very compelling.

According to Eskom (2015c), the organisation will continue to focus on improving and strengthening its core business of electricity generation, transmission, trading and distribution. This invariably means an increase in CO₂ emissions from Eskom's power stations. Eskom (2015a) indicates that the amount of CO₂ emitted has increased from 203.7 million tons (Mt) in 2005, to 223.4 Mt in 2014. Furthermore, emissions have been increasing over the last decade due to the dominance of coal in Eskom's energy mix and the increasing

demand for electricity (Department of Environmental Affairs [DEA], 2013; 2014; Eskom, 2008; Karanfil and Li, 2015).

Given the climate change challenges and the response required of business, and in particular due to the contribution of electricity utilities to climate change, the Distribution Division must take meaningful action, not only to be a responsible corporate citizen, but also because responding appropriately to climate change reduces risks to its own business. Labriet *et al.* (2015) point out that the energy sector is not only a major contributor to GHGs, it is also vulnerable to climate change and will have to adapt to future climate conditions. According to Nakumuryango and Inglesi-Lotz (2016), managing climate change risks effectively will therefore enable Eskom to fulfil its key mandate from government of providing energy access to rural and marginalised communities, as cited in the White Paper on Renewable Energy and indicated in the Sustainable Development Goals (SDGs) (Lu *et al.*, 2015; Simon *et al.*, 2016). Eskom (2012a) points out that one of the strategic imperatives for the organisation to reduce its environmental carbon footprint and pursuing low carbon growth opportunities. Eskom is also implementing a proactive approach to identify and manage the inevitable impacts of climate change to its business operations thereby ensuring a secure and reliable supply of electricity going forward (Eskom, 2015d). However, the aforementioned approach has not been assessed to determine its efficacy and effectiveness in the Distribution Division. Due to the size of the Distribution Division's workforce, as well as employees' relative affluence (and concomitant consumption patterns), when compared to other South Africans in the formal job sector (Business Tech, 2015; Eskom, 2015a), the Distribution Division's employees have a huge role to play in responding to climate change meaningfully as well as demonstrating responsible environmental behaviour. The pro-climate change behaviour that is investigated and proposed in this study could be a model for others in business to emulate so as to also change their own employees' consumption patterns and behaviour to move towards sustainability. Since the reduction in CO₂ emissions is unlikely to come from a move away from fossil fuel power generation (DEA, 2014) towards more sustainable forms of energy generation (at least for the foreseeable future), a more meaningful response to climate change and environmental issues from the organisation's large and relatively well-paid workforce will contribute more significantly to addressing the climate change crisis, as opposed to relying on technological solutions.

Moreover, climate change awareness and understanding will raise employee and consumer expectations for actions, as Voyer *et al.* (2017) and Chymis *et al.* (2017) maintain that corporations are increasingly accountable not only to their Board of Directors and to shareholders, but to stakeholders (employees, customers and the public) who are affected by the actions of the Board. This is further reinforced by de Oliveira and Jabbour (2017) who advocate that environmental improvements can be achieved through legal enforcement, supply chain pressure, and voluntary engagement in Corporate Social Responsibility (CSR). In addition, stakeholder expectations of secure energy provision versus concerns over climate change will place increasing pressure on utilities (Bauer *et al.*, 2016), leading to adverse media and customer comments and potential loss of consumer and investor confidence. With rapid urbanisation it will become increasingly difficult to meet local community demands for essential services, such as electricity, water and sewerage and as well as future technological advances in transportation such as electric vehicles (Zhang, 2016).

According to Stewart *et al.* (2013), recent moves by national and local policy-makers have sought to encourage individuals to engage in a wide range of pro-environmental practices to address both discrete environmental problems and major, global challenges such as climate change. In addition, there is a wide range of measures aimed at both mitigating and adapting to new environmental problems. Barker (2017), Steg *et al.* (2015) and Van der Linden (2015a) suggest that one of the issues that have become prominent in discussions of how to mitigate and adapt to environmental problems is broadly known as ‘behaviour change’. This premise places emphasis on the role of consumers as the primary agents of positive change.

Such an approach positions consumers as the key reference point for promoting environmental sustainability with a greater emphasis on the role of individuals in creating social change through the fusing of consumption and citizenship (Giddens, 1991; Nguyen *et al.*, 2016; Testa *et al.*, 2015). The vast majority of the Distribution Division’s employees have an important role to play in pro-environmental behaviour as they are one of the high-end consumers in South Africa due to their relatively good income and standards of living (Business Tech, 2015; Maloa, 2016).

1.2 Motivation and need for the study

According to the IPCC (2014), Knutti *et al.* (2016), Oppenheimer and Anttila-Hughes (2016) and UN (2007), there is sufficient scientific evidence to indicate that the planet is experiencing increased warming primarily from GHGs emitted from human activities. Furthermore, the IPCC (2014) indicated that it is likely that there would be further warming and greater changes in the global climate system during the 21st century if GHG emissions remain the same or increase above the current emission levels. There appears to be an overwhelming consensus from key segments of society including politicians, scientists, civil society, the media and ordinary citizens that climate change is real and worrying (Bernauer *et al.*, 2016; Dunlap, 1998; Dunlap and McCright, 2015; Ross *et al.*, 2016).

However, according to Chopra (2012: 14), “people are doing the best that they can from their own level of consciousness”. Therein lays the crux of turning around the climate change crisis. This implies that for more resolute and individual responses to issues like climate change and responsible environmental behaviours, there is a need to increase the awareness of people, and in particular employees in business, including in Distribution Division where consumption patterns among employees are likely to be higher than the average South African, since Eskom has been voted the top South African employer for many years (Eskom, 2011a). Additionally, Eskom’s annual wage bill is approximately R17 billion and Eskom is a major driver of the South African economy, estimated to account for approximately 3% of South Africa’s GDP (Business Tech, 2015; Eskom, 2011b; Maloa, 2016).

There are initiatives in Eskom to address climate change and environmental challenges at the strategic level (Eskom, 2011c). However, the relevance, appropriateness or effectiveness of such initiatives in changing behaviour patterns or climate change awareness and training, has not, to the author’s knowledge, been examined. According to Lotz-Sisitka *et al.* (2010), the past ten years have been an active period for re-conceptualising education and training in South Africa, particularly in the previously neglected area of workplace-based learning. However, Lotz-Sisitka *et al.* (2010) and Manuti *et al.* (2015) point out that formal and informal learning in the workplace has also created the space for new innovative programmes to emerge that respond to emerging issues in society, such as increased environmental degradation, climate change, increased health risks and new social and economic challenges. Competencies in areas such as environmental planning and administration, legislation, communications, social justice or ethics, education and training, as well as monitoring, evaluation and research,

according to Jabbour (2015), are required for effective environmental management. For South Africa such competencies must be within a sustainable development framework in relation to the country's key sustainable development policies and legislation (Jones and Honorato, 2016; Lotz-Sisitka *et al.*, 2010; Zaman *et al.*, 2016).

To ensure compliance to the range of environmental legislation in South Africa, most industries, including Eskom have put in place some climate change strategy or policy, with a focus on one way, top-down communication to employees about the organisation's climate change commitments. Lotz-Sisitka *et al.* (2010) and West (2015) argue that such an approach presents a weak framework for environmental education and training, as mere knowledge transmission and awareness-raising have long been proved to be ineffective in broadening participation and accordingly propose that for effective education and training competence, a more in-depth, participatory approach to education and training is required. However, effective education and competence in climate change-related matters is hampered by the general lack of understanding by the majority of employees of climate change and its impacts, and the lack of internally-trained and competent climate change training service providers (Hornsey *et al.*, 2015).

One of the key recommendations of Eskom's Climate Change Strategy Review (Eskom, 2010a), developed in 2009 was that the organisation needed to undertake internal awareness-raising sessions initially for managers and committees as well as staff involved in project approvals and more broadly in the organisation. To the author's knowledge, this has not been done or even plans developed to implement this recommendation. Furthermore, the veracity, need and appropriateness of the Distribution Division's climate change initiatives have not been determined empirically. According to Eskom (2012a), the organisation recognises the need to align its Corporate Social Investment (CSI) activities to that of its business strategies and the communities where the Distribution Division operates. In support, Aigner (2016), Epstein (2007) and Ralston *et al.* (2015) contend that modern understanding of corporate responsibilities has broadened well beyond the traditional conception that a corporation's obligation begins and ends at maximising value for its owners. It is generally accepted in modern democracies that an organisation's 'social licence to operate' must also include the minimisation of the organisation's negative impacts of their operations on the environment and surrounding communities (Flint and Maignan, 2014; Fort, 2007; Kolk, 2015). This study will contribute to make the Distribution Division's CSI programme more relevant and meaningful

in the context of addressing the negative impacts of climate change and environmental degradation caused by the organisation's own activities.

Eskom's climate change initiatives are relatively recent and very electricity-specific, focusing primarily on applications and markets for energy efficiency and renewable energy technologies (Eskom, 2012a). The only indicator used in Eskom is the annual emissions (in Mt) of CO₂ which, as reported earlier in this proposal, is worryingly increasing with each year. The energy efficiency and renewable energy projects do a reasonable job of specifying project-specific performance indicators during the project design and approval process. But these indicators, as May *et al.* (2015) suggest, tend to measure separate project activities or their direct outputs rather than outcomes and the attainment of broader objectives. In addition, Bakara *et al.* (2015) claim that the energy efficiency performance indicators selected are sometimes not readily measurable or, if measurable, are lacking documentation as to when, how or indeed whether the indicators have been measured. Eskom and in particular the Distribution Division clearly need additional performance indicators (Table 6.1) and methods to measure the results of its climate change initiatives. There is a need to go beyond the results from individual projects, and look at overall climate change and environmental performance, particularly at the employee engagement level. Good climate change performance indicators would enable Eskom to effectively implement its Global Climate Change Policy (Eskom, 2011c) and improve its overall environmental performance, thereby making a meaningful contribution to addressing climate change.

According to Pádua and Jabbour (2015), performance indicators are measures, qualitative or quantitative, used to reflect progress toward achievement of objectives, whereas sustainability indicators measure broad physical, economic, energy and environmental factors at a macro-level. Fisher *et al.* (2015) and Kylilia *et al.* (2016) comment that programme performance indicators must focus on the degree to which a programme has achieved its intended results. Furthermore, measurement of 'ends' (achievement of objectives) or 'means' (methods to achieve objectives) or a combination at any point along the continuum from ends to means, is what is required of programme indicators (Aldy and Pizer, 2016) such as for Eskom's Global Climate Change Programme.

DEAT (2011), Roberts (2016) and Steinberger *et al.* (2016) report that South Africa has ratified both the United Nations Framework Convention on Climate Change (UNFCCC) and

its Kyoto Protocol. Furthermore, South Africa will also continue to meaningfully engage in the current multilateral negotiations to further strengthen and enhance the international response to the climate change crisis. However, to fulfil its climate change obligations, South Africa must, according to DEAT (2011), Henneman *et al.* (2016) and Klausbruckner *et al.* (2016):

- Mainstream climate change considerations into social, economic and environmental policy;
- Further develop and support research and systematic observation organisations, networks and programmes as well as efforts to strengthen systematic observation, research and technical capacities, including promoting research and systematic observation in areas beyond national jurisdiction; and
- Develop and implement education, training and public awareness programmes on climate change and its effects to promote and facilitate scientific, technical and managerial skills as well as public access to information, public awareness of and participation in addressing climate change.

This research is meant to contribute (in part) to the above-mentioned objectives, in support of South Africa's commitments to the UNFCCC.

Duffield and Whitty (2015) comment that learning in organisations have four key dimensions, namely, skills and knowledge, physical technical systems, the integration of social and environmental matters in decision-making, and values and norms. In addition, Fernández-Mesa and Alegrea (2015) suggest that the fourth dimension, values and norms, determines and controls the type of knowledge that is sought and nurtured in the former three dimensions. Furthermore, values are a screening and control mechanism and effectively communicating knowledge, values and norms inspires employees to contribute and support the organisation's overall strategy, and is critical to implementation of the business plans (Afsar *et al.*, 2016).

Jørgensen and Termansen (2016), Tzemi and Breen (2016) and Yohe *et al.* (2004) argue that focusing only on near-term mitigation of GHG would be unwise. Moreover, such an approach would impose immediate costs and have uncertain long-term benefits (Howell and Allen, 2017). Brügger *et al.* (2015) and Yohe *et al.* (2004) propose a different approach where people are made aware and hence become so concerned about the potential damages associated with climate change that they will take action of their own accord.

It is also necessary to explore climate change issues within the electricity distribution business, and to evaluate current practices in light of future climate possibilities (Short, 2015). Additionally, there has been little research that systematically explores orientations toward climate change within the electricity sector globally or locally, although there have been studies in other sectors. For example, a study by Morton *et al.* (2010) explored the beliefs about climate change and the perceived need for adaptation within the building industry. Another study by Hertin *et al.* (2003) considered the possible effects of climate change for the house-building sector in United Kingdom (UK) and highlighted the competing pressures that guide climate change decision-making in this sector such as changing technologies, shifting consumer expectations, emergence of new competitors, and changing regulations. The co-evolution of the climate change problem and strategic responses particularly for business (Penna and Geels, 2015) focused on the American car industry, while the 2016 study on industrial carbon and water footprints focused on the food industry (Ridoutt *et al.*, 2016). The limited scope of the studies by Burton *et al.* (2010) and Ofoegbu *et al.* (2016) covered only the general public's awareness of climate change in South Africa, and was not related to business, utilities or government departments. Ruepert *et al.* (2016) point out that there are a number of different barriers that affect employees' response to pro-environmental behaviours in the workplace such as workers' interdependency between physical infrastructures and social institutions which reinforces environmentally-detrimental behaviours. Some other barriers include aggressive marketing that perpetuate desires for consumption and links to status and cultural value (Huysman *et al.*, 2016); lack of knowledge (Allred *et al.*, 2016); displacement of blame (Bache *et al.*, 2015) and in-depth and fundamental knowledge of the employee's climate change response, according to Knight (2016), is limited to non-existent in business.

Pro-climate change behaviours must be approached as something that people see value in and automatically respond to (Dal *et al.*, 2015). This was underscored by Hoffman (2006) who indicated that many companies who have struggled to obtain employee support for GHG reductions, have focused on the importance of an effective, easily understandable communication strategy, for example, Whirlpool refrains from using technical climate change terms with employees, but instead uses familiar words such as energy efficiency in their climate change communication. In essence, Scheele (2015) recommends that climate change communication must be approached in the same way as brand communication. Additionally, positive climate behaviours must be considered similar to the way that marketers approach

acts of buying and consuming, especially in the developed world. Pollitt (2015) propose that climate change must not be continued to be driven as a public service or crusade but rather as a brand that can be sold. However, according to Kauffman (2016), climate change activists, who are essentially environmentalists and community workers, would consider such an approach unsuitable and inappropriate or against their principles.

Although the Distribution Division has a huge footprint (DEA, 2014) and is a significant role-player in the South African economy and in Africa (Adom, 2015), there is a dearth of published papers on the organisation, especially in the context of environmental management, sustainable development and climate change. This research, in part, aims to address this shortcoming.

Research in relation to climate change in industry has tended to focus on organisations rather than on employees within these organisations. The case studies examined in the discussion below indicate the key barriers that organisations face in relation to integrating pro-environmental behaviour.

Hertin *et al.* (2003) argue that the problem of limited motivation within the building sector to engage proactively with climate change is due to the absence of strong external pressure to incorporate climate change issues into decision-making, that is, regulation or taxation, and the existence of forces that directly work against this, such as the cost of climate-related measures combined with limited liability for future buildings. Shackleton *et al.* (2015) confirm that barriers to climate change response include biophysical, knowledge and financial constraints. In addition, the currently loose incentive structure is likely to lead to climate change adaptation being driven by merely complying with legal requirements as a minimum, rather than optimising opportunities for significant and long-term responses (Hertin *et al.*, 2003; Jones *et al.*, 2015; Shackleton *et al.*, 2015). Jones *et al.* (2015) further point out that there are challenges in how medium- to long-term climate information is produced, communicated and utilised in sub-Saharan Africa and elsewhere. Camacho and Glicksman (2016) and Jones *et al.* (2015) argue that climate relevant decisions are likely to be made in response to specific events and governed by the practical constraints that surround these such as time, money, and regulation rather than by more long-term goals and ideals, for example, to design and construct buildings that will remain resilient and functional given changing future climate scenarios. Such a situation, according to Hertin *et al.* (2003), in

combination with the inherent uncertainty of climate change, may leave some sectors to rather ‘wait and see’ than take action now. Such a scenario is also highly likely in the Distribution Division.

According to Burke *et al.* (2015a), Hansen and Cramer (2015) and Reid and Vogel (2006), the focus of much of the research on climate change for many years has been on impacts associated with many different climate stressors such as drought, floods, and sea level rise. However, Huq and Reid (2004), Pelling *et al.* (2004) and Rosenzweig and Neofotis (2013) suggest that attention to vulnerability, shaped by multiple causes that aggravate and may enhance impacts to climate stress, is becoming an important research arena requiring more data, informed from local studies, particularly in those countries where climate change may limit development activities. Adaptation and coping with climate variability and change are also key themes in current global climate discussions and policy initiatives (Hansen and Cramer, 2015; Rosenzweig and Neofotis, 2013).

To better understand the dynamic nature of climate change vulnerability and employee’s understanding, coping and adaptation strategies, this research investigates which issues employees think are the most pressing, what climate impacts are being felt, and how employees are responding to climate change. According to Ziervogel and Taylor (2008), people experience and respond to stressors on many scales. Chen (2015), for example, explains that people’s pro-environmental behaviour is strongly influenced by the actions of others. In this research, particular focus was placed on the Distribution Division to understand employees’ climate change perceptions and behaviour.

1.3 Aim and objectives

1.3.1 Aim

This particular research involves a critique of the Distribution Division’s response as well as the Distribution Division’s internal capacity building around climate change and environmental management towards responsible environmental behaviour of employees. The overall aim is to critically examine the Distribution Division’s CSI programme with a specific focus on climate change and the internal programmes to modify employee behaviour. The intention is also to develop a framework and programme to address electricity utility-specific climate change and environmental challenges systematically.

Given the aforementioned background and the dearth of studies that critically examines electricity utilities' responses to climate change and responsible environmental behaviour of employees, the aim of this study is to undertake an incisive examination of employees' behaviour and responses to the climate change and environmental challenges in Africa's foremost electricity distributor, the Distribution Division in the Eskom Holdings Company.

1.3.2 Objectives of the research

The objectives that frame the research focus of this study are to:

- Critically review and assess the level of the Distribution Division's climate change programme and environmental practices.

The Distribution Division has been implementing environmental management strategies since 1990, and recently developed a Climate Change Strategy to align with Eskom's Global Climate Change Policy. However, to date, to this researcher's knowledge, there has been no assessment or measurement of the effectiveness of these initiatives and, if indeed, these initiatives are making a meaningful contribution to sustainable development in the Distribution Division.

- Examine staff perceptions and attitudes towards climate change and the Distribution Division's environmental strategies.

There are a few specific groups of individuals in certain departments that are involved in climate change-related issues in the Distribution Division. There has not been a broad involvement of employees at all levels, as suggested in DEAT's National Climate Change Response White Paper (DEAT, 2011).

- Examine the challenges and opportunities presented by the environmental and climate change crisis for business in South Africa and in particular for electricity utilities in Africa.

There is a dire need for more meaningful and effective responses from business, particularly the electricity business, to the climate change crisis, not only to protect itself from reputational, legal and financial risks; but also to support the principles of sustainable development and make an important contribution to the global effort to slow down climate change.

- Develop indicators to inform a framework for internal climate change capacity building programmes for electricity utility companies.

To the author's knowledge, there is a dearth of climate change indicators and capacity building for electricity utilities, particularly around employee engagement. In South Africa, the focus has been on energy efficiency primarily to manage the shortage of generation capacity and the increasing demand for electricity (Pretorius *et al.*, 2015a). However, Bauer *et al.* (2016) argue that this energy efficiency initiative has often been erroneously considered by many (mainly within Eskom) as a climate change initiative.

- Formulate policy and programme recommendations, based on the findings.

According to Leal-Arcas (2013) and Zaman *et al.* (2016), developing countries such as India, China, Mexico, Brazil and South Africa are being placed under increasing pressure to address their response to climate change. Additionally, these countries are beset with poverty challenges, making economic growth and development, based primarily on fossil-fuel power generation, a priority. Relevant, appropriate (in terms of the developing status of these countries) and meaningful policies and programmes will go a long way to provide an assurance to stakeholders, including foreign investors, that electricity utilities in these countries are on the right path, in terms of climate change action.

1.4 Overview of the theoretical framework

This research was conducted within the frameworks of sustainability science, stakeholder engagement, organisational learning and climate change adaptation. According to Bieluch *et al.* (2017), to understand and address the sustainability of natural and human systems, there is a need to include various forms of knowledge, experiences, values and resources. This approach is critical to contextualise the science of sustainability to climate change, and this research therefore considered some of understandings of sustainability, including the UN's SDGs.

The multi-conceptual theoretical framework that guides the research draws from established approaches in the environmental sciences field. It also recognises that environmental sciences

as a field is embedded in the natural, physical and social sciences. Thus, given the focus of the study on organisation learning to promote pro-environmental behaviour, the research integrated both environmental, for example, sustainability and climate change adaptation and social, for example organisational learning and stakeholder engagement conceptual frameworks to develop an appropriate theoretical lens for the study.

The high uncertainty of climate change makes strategic planning by government and private sector organisations difficult due to the availability of a wide array of potential scenarios and decision alternatives (Wood *et al.*, 2017). Therefore, stakeholder engagement becomes critical in developing a robust pro-climate change response. Stakeholder engagement can take many forms and mediums, and due to the impact of social media currently (Manetti and Bellucci, 2016), engagement with stakeholders cannot be ignored. Furthermore, stakeholder engagement extends to a range of issues. Graafland and Smid (2017) contend that stakeholder engagement is fundamental for organisations to obtain their social license to operate in an increasingly democratic, empowered, aware and connected world; where communities clamour for service delivery and consultation in what is meted out to them.

Matthews *et al.* (2017) are of the view that organisational learning can contribute to the sustained improvement of an organisation over time. Additionally, organisational-level changes resulting in sustained benefits can be derived from individual identified improvement opportunities through organisational learning. The organisational learning theories that are discussed in this study include Ajzen's Theory of Planned Behaviour, the Norm Activation Model and the Value-Belief-Norm Theory of Environmentalism.

Li *et al.* (2017) comment that adaptation to climate change is critical for developing effective climate change response strategies, while Simonovic (2017) is of the view that adaptation to climate change is complex and involves increasing risk. Additionally, there is a need to involve many decision-makers, conflicting values, competing objectives and methodologies, multiple alternative options, uncertain outcomes, and debatable probabilities to address the challenging issue of climate change adaptation.

1.5 Research methods and data sources

This study uses the standard quantitative and qualitative methods to generate data relating to the research objectives. Bryman (2015) and Katz (2015) point out that quantitative methods result in numeric data, which can be usually analysed by a computer or recognised by statistical tests and models. The primary data sources used in this study includes the use of a survey questionnaire (Appendix 1), as well as focus group discussions (Appendix 2) and key informant interviews (Appendices 3 and 4) in relation to the qualitative approach adopted. This research also includes a review of information acquired from reports, policies, speeches, published works, as well as a review of articles and journals which were secondary sources.

A multi-disciplinary research methodology was adopted for this study, due to the nature of the research. Both quantitative and qualitative data collection approaches were used to achieve the above objectives. The case study is Eskom's Distribution Division. Employees were selected from across different occupational levels in the organisation. The case study sites included the nine Operating Units (OUs) in the Distribution Division, which are aligned to the provincial boundaries and are known as the Western, Eastern Cape, Free State, Northern Cape, North West, KwaZulu-Natal, Gauteng, Mpumalanga and Limpopo OUs.

Few studies provide a comparative basis to assess whether occupational and literacy levels, as well as historical disadvantages and quality of life influence responses to climate change and environmental responsible behaviour (Newman and Fernandes, 2015). These aspects are included in the research design. An online survey questionnaire formed the primary means through which data was collected. The survey was designed along the lines of the objectives and the guiding questions of the research. The survey questionnaire employed fixed-response questions on Distribution Division's response to climate change (climate change capacity building and engagement of employees in relation to the organisation's climate change policy and strategy), cultural and socio-economic characteristics (place of employment, department, level or grade in the organisation, education, age and gender) of employees and open-ended questions that elicited information on employee perceptions and attitudes towards climate change and Eskom's response to this issue.

Interviews and the questionnaires were conducted in English. The online survey was self-administered by the researcher with the help of the Distribution Universal Access Planning and Strategic Support Department (based in MegaWatt Park, Johannesburg) and was hosted

on the Distribution Division's Intranet homepage. The survey was open for completion during the period of 01 July 2015 to 31 March 2016.

In order to determine the effectiveness of the research instrument, the questionnaires were pre-tested among a few selected employees. This assisted to clear up vagueness and made the questionnaire more relevant and appropriate to employees and the Distribution Division's activities and functions.

The study also interviewed relevant managers and resource persons in Eskom as well as from pertinent government departments, academia and Non-Governmental Organisations (NGOs), for background information on climate change in the context of power distribution in South Africa. These key informant interviews complemented the quantitative surveys. In addition to the quantitative survey and key informant interviews, focus group discussions were undertaken in three of the OUs with key role-players who were purposefully chosen. The focus group discussions involved discussions on the objectives raised focusing on the role of Distribution Division to climate change and the possible impacts of climate change. The data generated from quantitative surveys and focus group sessions were statistically examined using a range of statistical analysis tools and ranking option assessments.

This study therefore undertook primary research using multiple methods that complement each other and draws from both quantitative (survey questionnaires) and qualitative (key informant interviews and focus group discussions) approaches. Such relative and rigorous multiple methods approach have not been undertaken previously in the electricity distribution business. Thus, this research methodology for utilities will be a supplementary contribution of this research. The process of triangulation which, according to Hussein (2015) and Olsen (2004), is the use of multiple methods which cuts across the qualitative-quantitative divide was also used. The various sources of information validated and clarified the data by deepening and widening an understanding of the main issues under examination. Furthermore, triangulation supports interdisciplinary research.

1.6 Chapter sequence

Chapter One provides an introduction to climate change and the contribution of the electricity business to this global problem, the need for the study to be undertaken within Africa's

foremost electricity distribution utility, the Distribution Division, the aims and objectives for undertaking the research, an overview of the theoretical framework on which the research is based and the methodologies used. This chapter also includes a brief description of the case study.

The conceptual or theoretical framework is presented in Chapter Two. This chapter provides a summary of the four key theoretical frameworks examined, namely, sustainability science, stakeholder engagement, organisational learning and climate change adaptation theory.

In Chapter Three, pre-existing literature on climate change in relation to the electricity distribution business and climate change and environmental management learning that occurs in business, is extensively reviewed. The chapter also includes a discussion on global and local climate change, especially some of the predicted impacts for South Africa and the various international instruments to respond to climate change. The organisational structure, educational levels of employees and business resources for climate change capacity building are underscored. The literature review also assesses climate change learning in large corporations. Environmental responsiveness from employees and managers, pertinent to climate change are also integrated into the discussion.

In Chapter Four, a detailed description of the case study is provided and the research methodologies outlined. The quantitative research consisted of an online survey questionnaire, while the qualitative research involved key informant interviews and focus group discussions. The sampling process employed in this research is also described for the online survey, key informant interviews and the focus group discussions. A discussion on the validity and reliability, and an analysis of data is also included.

Chapter Five presents an analyses of the qualitative and quantitative data collected during the research, as well as the outcome of the statistical analysis, which included the reliability test using Cronbach's alpha score, factor analysis using the Kaiser-Meyer-Olkin and Bartlett's Tests and the Rotated Component Matrix. The survey results provide information on the demographic profile of respondents which included the survey response per OU, department, Tuned Assessment of Skills and Knowledge (TASK) grade, educational level, age and gender of respondents. Data was also obtained for employees' attitudes to life and environmental issues, employees' choices for responding to climate change, employee's views on who has

the responsibility to address climate change, and the Distribution Division's climate change programme and environmental strategies.

The final chapter of the research consists of a summary of the main findings of this study. This chapter includes an attempt to provide valuable suggestions and recommendations based on the climate change responsiveness required of large electricity utilities such as the Distribution Division, as well as presenting a framework for an internal climate change capacity building programme for an electricity utility.

One of the objectives of this research is to bridge the gap between climate change science and people, so that a wider and more inclusive response to climate change occurs, across communities and business. Embedded in the objectives of this research are three main issues, namely:

- the need for employees to have some climate change-related orientation in their work to minimise or eliminate legal risks and project (infrastructure) risks as well as enhance profits and the reputation of the organisation, and reduce their own contributions to climate change;
- to understand where the Distribution Division employees stand in terms of their current perceptions and understanding about climate change; and
- to make recommendations that can enhance climate change learning in business, especially for utilities.

1.7 Conclusion

According to the National Climate Change Response White Paper (DEAT, 2011:p10) and international climate change commitments, South Africa is required to:

- mainstream climate change considerations into social, economic and environmental policy;
- develop and support research and systematic observation organisations, networks and programmes;
- strengthen systematic observation, research and technical capacities, including promoting research and systematic observation in areas beyond national jurisdiction;

- develop and implement education, training and public awareness programmes on climate change and its effects to promote and facilitate scientific, technical and managerial skills; and
- provide public access to information, public awareness of, and participation in addressing climate change.

This research contributes to at least three of the above-mentioned important commitments and hence will enable the Distribution Division to make a meaningful contribution to climate change mitigation and adaptation, and to support government's National Climate Change Response. Furthermore, such a study will influence employees, at one of South Africa's largest employers, to review and revise their own current consumption patterns. An increased awareness of climate change issues among its own employees will also inform the holding company, Eskom, to review and improve its long-term climate change response strategies and policies, within technical and financial constraints.

The research develops programmes and indicators (Table 6.1) for electricity utilities to respond meaningfully to the climate change crisis, especially for African electricity utilities. The study will also assist employees and citizens understand climate change better and their role in slowing down rapid global warming and environmental degradation. Academic publications and capacity building will also be a focus of this research.

CHAPTER TWO

THEORETICAL FRAMEWORK

2.1 Introduction

According to Baird *et al.* (2014), some of the key issues relating to global environmental change is how contemporary environmental challenges are understood and the corresponding requirements of the governance processes. Crona and Parker (2012: 32) state:

Humanity faces increasingly intractable environmental problems characterised by high uncertainty, complexity, and swift change. Natural resource governance must therefore involve continuous production and use of new knowledge to adapt to highly complex, rapidly changing social-ecological systems to ensure long-term sustainable development.

Ofoegbu *et al.* (2017) point out that the effectiveness and efficiency of the climate change coping strategies that are adopted by some people are greatly constrained by factors that are related mostly to their socio-economic characteristics, for example, skills level, educational status and health, and the functionalities of infrastructure and services in their communities. Recent research on environmental governance, particularly by Armitage *et al.* (2012) and Crona and Parker (2012), are paying increasing attention to issues such as the ability to adapt, flexibility and learning. Fazey *et al.* (2007) and Plummer and Armitage (2010) assert that innovative governance mechanisms, coupled with the potential for social learning with collaboration, build environmental adaptive capacity of individuals and communities. The recent systematic reviews of the increasing literature on social learning in natural resource management by Rodela (2011) and Rodela *et al.* (2012) found that few studies even attempt to empirically assess learning effects of specific interventions on participants.

Angeler *et al.* (2016) claim that problems that defy easy definition, and thus solutions, such as climate change, are often the starting point of many discussions on environmental governance. It is now increasingly evident that a solution that is focused on learning to address difficult problems is now commonplace and a good start (Brook *et al.*, 2016). It is therefore not surprising that several concepts have emerged in this context such as 'social learning' (Lotz-Sisitka *et al.* 2016), 'collaborative learning' (Vinke-de Kruijf and Pahl-Wostl, 2016), 'learning communities' (Bamberg *et al.*, 2015) and 'communities of practice'

(Bradbury and Middlemiss, 2015). In view of these numerous arguments, a good understanding of climate change learning is therefore vital to respond to the present day and highly complex environmental challenge of climate change. In contextualising the research problem, sustainability science, stakeholder engagement, organisational learning and climate change adaptation theories are considered as the theoretical frameworks that underpin this research. Sustainability and climate change have many common elements that require collaborations (Tozer, 2018). Additionally climate change affects development and effective mitigation and adaptation actions will need to be tempered by sustainability due to the cost implications for such actions required over an extended period of time. Fiack and Kamieniecki (2017) and Hobday *et al.* (2018) indicate that climate change affects a range of stakeholders that include government, financial institutions, and activities in the primary, secondary and tertiary sectors of the economy. Additionally, workers and community members are also affected. There is also a lack of understanding of climate change or inconsistent and inadequate capacity to address climate change by these various stakeholders (Fytili and Zabaniotou, 2017). Daddi *et al.* (2018) and Hobday *et al.* (2018) are of the view that climate change learning at the organisational level will greatly assist with sustainable natural resource management and better decision-making on climate change.

The multi-conceptual framework presented identifies the importance of ensuring that the following issues and variables or aspects are examined in the research being undertaken:

- Examining and balancing economic, social and environmental dimensions;
- Social differentiation among groups;
- Integrating the science of climate change into organisational learning; and
- Consultation, participation and stakeholder engagement.

2.2 Sustainability Theory

Ciegis *et al.* (2009) and Lankosk (2016) acknowledge that there has been many different interpretations of sustainability and sustainable development over a long period of time. Additionally, in the business context, Lankosk (2016) states that sustainability can be understood variously as the economic, ecological and social enhancement of business operations, or an organisation ensuring it does not compromise the life-supporting capacities of the planet's ecosystems or that the value of a business is at it fullest, and does not decline

over time. Gilbert (1996) considers sustainability as the enhancement of environmental, social and economic resources in order to meet the needs of current and future generations in relation to intergenerational equity, intra-generational equity and carrying capacity. Sustainability and the relevance in addressing climate change is described by Lal (2016) as environmental sustainability, which requires that the source and sink functions of the environment should not be degraded, namely that natural capital remains intact which implies that the extraction of renewable resources should not exceed the rate at which they are renewed, the absorptive capacity of the environment to assimilate wastes should not be exceeded, and the extraction of non-renewable resources should be minimised and should not exceed agreed minimum strategic levels. Mani *et al.* (2016) suggest that social sustainability, which requires that the cohesion of society and its ability to work towards common goals be maintained and that individual needs, such as those for health and well-being, nutrition, shelter, education and cultural expression should be met, while Chong *et al.* (2016) is of the view that economic sustainability is when development, which moves towards social and environmental sustainability, is financially feasible.

In support of worldwide sustainability, the global community, under the auspices of the UN, agreed on a set of SDGs which were drafted in 2014, and put into effect in early 2016. According to Hajer *et al.* (2015), these SDGs are an enhancement of the original UN Millennium Development Goals of 2000. Bexell and Jönsson (2016) maintain that the SDGs have been developed mainly to tackle global poverty and consist of seventeen key goals, namely:

- (1) end poverty in all its forms everywhere;
- (2) end hunger, achieve food security and improve nutrition and promote sustainable agriculture;
- (3) ensure healthy lives and promote well-being for all at all ages;
- (4) ensure inclusive and equitable quality education and promote lifelong learning opportunities for all;
- (5) achieve gender equality and empower all women and girls;
- (6) ensure availability and sustainable management of water and sanitation for all;
- (7) ensure access to affordable, reliable, sustainable and modern energy for all;
- (8) promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all;

- (9) build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation;
- (10) reduce inequality within and among countries;
- (11) make cities and human settlements inclusive, safe, resilient and sustainable;
- (12) ensure sustainable consumption and production patterns;
- (13) take urgent action to combat climate change and its impacts;
- (14) conserve and sustainably use the oceans, seas and marine resources for sustainable development;
- (15) protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss;
- (16) promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels; and
- (17) strengthen the means of implementation and revitalise the global partnership for sustainable development.

While the goals were developed to cover all three dimensions of sustainable development, namely, economic growth, social inclusion and environmental protection (Lu *et al.*, 2015), it is evident that climate change is a cross-cutting issue, and more importantly Goal 13 focuses specifically on the need for urgent action on climate change.

Laugs and Moll (2017) point out that there are many divergent views about what sustainability really is stemming from differing beliefs, values and assumptions about the nature of reality and humankind-environment relationships which includes the ‘expansionist’ or ‘cornucopian’ worldview to the ‘ecological’ or ‘steady-state’ worldview. Accordingly, the expansionist view externalises the problem, effectively blaming it on a defective environment which then needs to be fixed while the ecological view traces the current global environmental crisis to its source, namely, that nature and behaviour of people themselves are the main problem that require attention. This is supported by Baumgartner (2011), Ciegis *et al.* (2009) and Kajikawa *et al.* (2014) who argue that it is important to involve many different people or sectors in ensuring sustainability since sustainability science is multi, inter and transdisciplinary. This is underscored by Fink (2016) who asserts that action on climate change must be speeded up and human beings’ disconnection from nature, which is the main problem, needs to be addressed. Furthermore, such an approach takes cognisance of the

valuable role nature and nature-based solutions can play in addressing climate change and its implications for broader sustainability.

Adger (2010) argues that climate change will severely hamper the pursuit of sustainability as climate change affects economic, social and natural systems. In addressing climate change, it is not practical to merely consider the environmental issues. As Adger (2010) and Araos *et al.* (2016) highlight, the role of the social component of sustainability and indicate that society has inherent capacities to adapt to climate change. Furthermore, in responding to climate change effectively, von Stechow *et al.* (2015) are of the view that all the different facets of sustainability must be addressed, as recent studies have indicated that the overall cost of achieving multiple sustainability objectives is reduced through well-designed and all encompassing climate change programmes.

Geng *et al.* (2016) note that one of the main challenges in developing countries, for example, South Africa, is how to increase the standard of living and at the same time encourage the reduction of GHG emissions. He believes that while there are no easy solutions, these can be solved by the creativity of humans. According to Hallegatte (2009), although many decisions on developments have only short-term consequences or are only weakly climate sensitive, most people are in agreement now that many decisions need to take into account climate change. Additionally, many decisions require long-term commitments and need to be very climate sensitive, such as urbanisation plans, risk management strategies, infrastructure development for water management, electricity or transportation, and building design and norms. Kamal *et al.* (2015) and Sun *et al.* (2015) support this argument as they contend that urbanisation plans influence city structures over even longer timescales and that decisions, investments and infrastructure (including electricity) are also vulnerable to changes in climate conditions and sea level rise. This is also maintained by Schroth *et al.* (2015) who are of the view that decisions relating to land-use planning, building and housing, transportation infrastructure, urbanisation and energy production and transmission involve long-term planning, long-term investments and some irreversibility in choices that are exposed to changes in climate conditions.

Burke *et al.* (2015a) and Stern (2016) maintain that climate models may be unable to provide the information current decision-making frameworks need, until it is too late to avoid large-scale retrofitting of infrastructure. Furthermore, Dunford *et al.* (2015a) explain that climate

models are also based on a set of common assumptions and hence, the range of their results underestimates the full range of uncertainty and hence institutional or financial tools can also contribute to solutions for climate change challenges, and not only technical approaches.

The social component of sustainability is highlighted by Armah *et al.* (2015) and Kimengsi *et al.* (2016) who believe that climate change intervention strategies must be customised for specific behaviours and populations and that knowledge and research on psychological barriers to mitigation is essential. Kurz *et al.* (2015) maintain that more intervention studies are also required and that these strategies are most successful when they are systematically planned, implemented and evaluated. Gifford (2011) continue that while research in self-reported pro-environmental behaviour is valuable, there should be a focus on pro-environmental and on low-GHG impact behaviours, as well as more emphasis on observed, high-impact behaviours. Brügger *et al.* (2015) and Wiest *et al.* (2015) are of the view that since climate change is not only a behavioural problem that requires an interdisciplinary approach, environmental psychologists and other social scientists have an important role to play in promoting behavioural changes. Accordingly, climate change is not only a matter of mitigation but also about individuals who will have to adapt to the changes. Brügger *et al.* (2015) maintain that climate change will alter the lives of people everywhere, and understanding how these billions of affected individuals help to mitigate it, or not, and adapt to it effectively, or not, is an essential part of the general task of confronting the challenges it poses. Barr *et al.* (2011a) assert that as environmental issues are embedded within financial and practical decision-making, many daily practices are regarded as part of the normal and routine ways in which families and households managed their affairs and people associated certain embedded environmental practices with what can be characterised as localised, tangible and short-term, even politicised concerns. This is supported by Schlosberg and Coles (2016) who argue that studies of local environmental issues was characterised by strong associations with personal impacts, both in space and time.

To maintain economic, environmental and social sustainability, Barr *et al.* (2011a) indicate that there are two challenges for promoting pro-environmental behaviour that must be considered:

- a new and powerful set of environmental dialogues associated with climate change have emerged and such discourses disrupt the citizen-consumer balance and the

related assumptions that some advocates of a social practices approach have made about the role of ‘environment’ in studying and defining practice.

- the new climate-focused discussions are characterised by conflict and contrast, for example, for the consumer, traditional and largely unquestioned environmental practices are at odds with actions that are required for climate change, for which there is uncertainty, unclear accountability, no sense of urgency and a limited sense of place.

Additionally, these points of ‘social-ecological’ conflict are what define the emergence of the new climate-focused discourses and it is expected that conflicts are likely to become greater, as climate change continues to grow as a political imperative. As a consequence, Stapleton (2015) points out that there is a shift in the way that academics and practitioners conceptualise and promote environmental practice, in an era of socio-ecological conflict.

According to Barr *et al.* (2011a), Brügger *et al.* (2015) and Stapleton (2015), the first shift is based on the assumptions across the practices and contexts of an individual’s lifestyle and seeks to promote behaviour using consumption-based marketing techniques. As Peattie and Peattie (2009) indicate, the adoption of market-orientated strategies to deal with sustainability dilemmas pose a number of problems, not least the ‘consumption problem’ which Osman *et al.* (2016) claim is an attempt to use commercial and marketing-based methods to reduce consumption. Frank *et al.* (2015a) are of the view that to use the ‘consumer-citizen’ perspective (which crosses boundaries of practice and therefore place) necessitates agreement and consensus on what constitutes an appropriate level of consumption. Such levels are generally agreed and unquestioned for accepted and normalised environmental practices. This is different for climate change which represents a contested area, where there is uncertainties of knowledge, responsibility, scale and sites of practice. Barr *et al.* (2011a) believe that individuals with strong commitments towards the environment associated with established practices, which hold few uncertainties, often separate out these pro-environmental commitments from those which relate to new forms of environmental practice related to climate change. Geels *et al.* (2015) maintain that one of the key challenges in developing climate change policy is to understand and acknowledge how issues like climate change are framed by consumer-citizens in relation to different forms of practices.

Another important issue for climate change policy are questions about the current levels of consumption and thus the effectiveness of citizens’ responses. Frank *et al.* (2015a) and Geels

et al. (2015) consider that understanding the underlying assumptions of the social practices on which such behaviours are based, for example, the importance of tourism consumption must first be addressed, before the need to consider the effectiveness of promoting changes in behaviours, for example, the reduction in the number of flights taken. These conflicts and disruptions that are emerging in the light of climate change, according to Barr *et al.* (2011a), influence how research should be re-positioned. Stern and Dietz (2015) argue that the social practices approach, as currently formulated, need to be repositioned by environmental social scientists, and that such researchers must encompass the emergent and powerful discourses surrounding climate change and the conflicts that this can involve. According to Grundmann (2016) and Victor (2015), the focus here needs to be on reframing the ways that the ‘environment’ is considered in the wider context of practices and does not mean that the assumptions or intellectual basis for understanding social practices must be rejected.

According to Gregory-Smith *et al.* (2015), it is important to contextualise practice when interpreting ‘environmental behaviour’ which enables people to frame such actions around values, ethics, norms and social structures. Stern and Dietz (2015) point out that climate-centred dialogues together with values, ethics, norms and social structure hold a place in the everyday framing of practice and that such discourses also become a part of the context for social practices, which deserves a clear focus in the framing and inquiry of environmental social science studies. Moreover, in an era of climate change, those who seek to side-line the ‘environment’ in studies of social practice must reconsider their approach, and consider the environment as part of the underlying contexts that may be affecting both attitudes and established practices (Allen, 2016; Grundmann, 2016).

Kenis (2016) asserts that the re-positioning of the social practices approach requires a review of conventional citizen–consumer assumptions and Jagers *et al.* (2016) maintain that there is a need to recognise that as new and contested forms of environmental discourse emerge, points of conflict between ‘citizenship’ and ‘consumption’ will occur that challenge individuals to reflect on their roles in this context. Dietz (2015a) recently argued that a wider perspective on the citizen-consumer weakens the case for advocating a neo-liberal approach towards promoting ecological citizenship through mainstream, market-oriented practices.

Blok *et al.* (2015) and Young *et al.* (2015) suggest that this contradiction reveals a critical point about individualistic conceptualisations of environmental behaviour, which are

characterised by the (re)balancing of consumption norms, habits and routines with notions of ecological responsibility. Barr *et al.* (2011a) and Walker *et al.* (2015) argue that the challenges individuals face in reacting to issues such as climate change often present points of conflict for consumers who in the recent past have managed to find a balance between consumption and citizenship. Walker *et al.* (2015) continue that for many, climate change implies changes in consumption that challenge and conflict with established modes of practice in certain contexts and thus present a barrier to adopting and embedding new forms of behaviour. Additionally, a bigger challenge is the extent to which the citizen-consumer behaviour is aligned to a realistic and sustainable pathway of individual responsibilities and consumption needs when considered in the context of climate change. According to Ruepert *et al.* (2016), such a challenge necessitates a deeper understanding, by researchers, of the role of individuals and also a review of the individualistic stances adopted by some researchers in environmental behaviour studies.

Norris *et al.* (2016) suggest that the socio-ecological conflicts which can emerge for individuals raises questions about policy, practice and more fundamentally the role of citizens as consumers in an age of climate change. Such fundamental social and economic re-framing was advocated by Seyfang (2005: 303):

...to build a social context consistent with an enabled ecological citizenry, governments must look to the alternative perspective to sustainable consumption which aims to provide this context through radical changes to lifestyles, infrastructure and social and economic governance institutions, in order to redirect development goals and reduce absolute consumption levels – thereby reducing ecological footprints.

The socio-ecological conflicts that emerge around an issue like climate change therefore raise fundamental questions about the social and economic structures on which ever-increasing levels of individual consumption and thus consumer practices are based (O'Rourke and Lollo, 2015). Environmental social science must therefore address these questions of conflict and their broad implications for society so that there is an urgent and meaningful contribution to climate change actions by people. While Lorenzoni *et al.* (2007) and Whitmarsh (2009) have for some time done work on climate change-focused environmental discourses, Barr *et al.* (2011a) argue that climate change presents a far more disruptive challenge for consumers, bringing into question the assumptions about everyday practice and the very role and

importance of current consumption levels. Spaargaren and Mol (2008) indicate that the role of consumers lead us to question and re-position both the debates on citizen-consumers while Verbeek and Mommaas (2008) claim that it is necessary to review the social practices approach that have come to dictate much of the knowledgeable landscape in environmental social science. O'Rourke and Lollo (2015) further point out that in changing the focus of consumers to respond to climate change, more emphasis needs to be placed on realising the limits of the citizen-consumer concept and recognition of the need for researchers to engage with new and problematic environmental discourses (such as climate change) that challenge the relations between a post modern and impulsive notion of the citizen with entrenched consumption habits. Additionally, such an approach accepts the notion of the citizen-consumer in particular settings, but requires the power relations citizens have in particular spaces and places to be reframed and, eventually, to recognise that the challenges posed by climate change will not be fully addressed by such an approach. Schaltegger *et al.* (2016) point out that sustainability issues in business is receiving increasing attention and that there are some obvious areas of further work, especially due to business impact on a range of sustainability issues with a global scope such as climate change. For a business enterprise, sustainable development means adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today while protecting, sustaining and enhancing the human and natural resources that will be needed in the future (Huckle and Wals, 2015; International Institute for Sustainable Development [IISD], 1992; Kolk, 2015). This general understanding of sustainable development appears to capture the spirit of the concept as originally proposed by the World Commission on Environment and Development (Steen and Palander, 2016) and recognises that sustainable economic development must meet the legitimate needs of a business enterprise and its stakeholders which includes, at a minimum, shareholders, lenders, customers, employees, suppliers and communities who are affected by the organisation's activities.

2.3 Stakeholder Engagement Theory

Laplume *et al.* (2008) assert that it is important for organisations to know and understand all their stakeholders (customers, public, employees) and take into consideration the interests of all stakeholders and not only of their shareholders. Ostrom (2010) proposes that to successfully address climate change in the long run, encouraging simultaneous actions at multiple scales is an important strategy to address this problem as substantial changes in the

day-to-day activities of individuals, families, firms, communities, and governments at multiple levels, especially in the more developed world is required. Additionally, stakeholder engagement is gaining prominence currently, due to the unethical practices, negative environmental impact and disregard for human rights, by an increasing number of businesses and according to Leonardi (2015) and Manetti and Bellucci (2016), the impact of social media. Luoma-aho (2015) further confirms that stakeholder engagement now extends to issues such as advertising, environmental management, marketing and online journalism.

According to Bieluch *et al.* (2017), partnerships from different research disciplines provide the opportunity to consider various forms of knowledge, experiences, values and resources by bringing together interdisciplinary scientists with stakeholders in understanding sustainability issues. Additionally, it is also important to understand the social, psychological and contextual variables impacting relationships since building partnerships is a complex process.

Furthermore, Luoma-aho (2015) points out that stakeholder engagement or mutual dependence is essential for sustaining a positive relationship between an organisation and its stakeholders. However, according to the situational theory of publics, stakeholders are not involved or interested at all times, and can be active or inactive at intervals, depending on their interest in an issue (Ciszek, 2015). This could be relevant to climate change issues, especially as climate change concerns generates increased interest during natural disasters or media attention and wanes when such incidents subside (Gavin, 2016).

The role of stakeholders in addressing environmental issues is supported by Montabon *et al.* (2016) who advocate a re-focusing of environmental behaviour research to focus on the everyday and ordinary practice of daily life. Furthermore, Hallegatte (2009) maintains that a range of soft options such as land-use plans, climate change capacity building, insurance schemes or early warning systems will have an influence on business investment choices and household decisions and in turn also influence the hard (technical) investments. Additionally, soft adaptation options are also reversible solutions, for example, an insurance scheme can be adjusted every year, unlike a water reservoir. Additionally, the risk of 'sunk costs' if climate projections are wrong is much lower for institutional and financial strategies than for technical adaptation projects, which makes them more suitable to the current context of high uncertainty. This view is further strengthened by van Sluisveld *et al.* (2016) who claim that while there is a focus on technical solutions in order to meet the 2°C climate target (such as

renewable energy, carbon capture and energy efficiency technologies) it is not easy to reduce global warming from carbon price driven technical solutions alone. Hence, van Sluisveld *et al.* (2016) suggest that there is a need to focus more on non-economic and non-technological drivers of energy system transformations, which are generally not overtly included in long-term scenario studies. Moreover, Axon (2016) is of the view that social solutions have not been seriously considered, as there has been an over-reliance on technological responses to climate change. In the Distribution Division due to the current financial challenges, the soft non-technological driven option such as capacity building to influence lifestyle changes is likely to be the practical solution to the climate change challenges facing the electricity industry rather than opting for expensive technological solutions.

According to Hallegatte (2009), end-users such as managers, planners and engineers must understand that it is not possible for climate scientists to solve this problem by providing certain and accurate climate forecasts timeously, as scientific uncertainty will prevent climate models from providing this information soon. The problem is further compounded since natural variability makes it difficult to detect and attribute climate changes, as Cooke (2015) illustrates that end-users, therefore, have to change the way they make decisions, to introduce climate uncertainty in their everyday operations. Burke *et al.* (2015b) point out that uncertainty is already central in many economic decisions such as energy prices and exchange rates and since future technological developments are volatile and uncertain, and cannot be forecasted with precision, future climate conditions must be added to this already long list of uncertain factors, to make sure that all the information climate scientists can produce is used in the most adequate way. If uncertainty is taken into account in all long-term decisions, many infrastructure projects will be better adapted in the future, and climate change impacts will remain lower and more manageable (Burke *et al.*, 2015b). Additionally, only such an anticipatory adaptation strategy can buy us the time we need to wait for (still-to-be implemented) mitigation policies to become effective.

Lee *et al.* (2015a) and Rauken *et al.* (2015) indicate that effective decisions of end-users is highly dependent on their level of climate change awareness and capacity, as a literate end user will be able to adapt much better to the uncertain factors around climate change. Ferguson *et al.* (2016) also suggest that in times of particular global financial and economic limitations, business response to addressing climate change is critical, as there are implications for a variety of consequences for businesses in regards to operational, public

relations and financial aspects. Lövbrand *et al.* (2015) argue that to understand the social science of the environment, researchers must attempt to uncover the underlying processes that lead individuals (or households) to consume in different ways. This approach will reveal the underlying demands that individuals make on the use of vital resources such as energy or water, as it is important to understand that such consumption is part of everyday, normal practice, and must not be viewed as either pro- or anti-environmental (Pink and Mackley, 2016). Dietz (2015b) further comments that trying to understand why certain individuals do or do not ‘commit’ to environmental practices is concerned with coming to an understanding about the very basis of consumption itself.

Tasquier *et al.* (2014: 821) point out that “environmental issues are intellectually stimulating for learning science, but seem not to be enough for fostering a behavioural change”. This view is supported by Dietz (2015b) who claims that the emergence of issues such as global climate change is beginning to challenge our understandings of how individuals engage with environmental issues and the ways in which environmentally significant practices are influenced by scientific understandings in different consumption settings. Barr *et al.* (2011a) maintain that in global climate change responses, there is much emphasis on ‘low carbon’ lifestyles that necessitate changes in behaviour across a wide range of practices, including energy consumption, water use and waste disposal at home, work, whilst travelling and in places of leisure and tourism. An analysis of these stakeholder issues is therefore vital for a better response to climate change, even in the Distribution Division. Brügger *et al.* (2015) point out that climate change is a behaviourally complex and publicly contested environmental issue as there are many potential barriers and conflicts in addressing the issue effectively, and social researchers therefore need to develop new understandings of socio-environmental practices. Furthermore, when existing and embedded practices are challenged through unsettling and disruptive processes, conflicts with the consumer–citizen response to climate change emerge. Barr *et al.* (2011a) identify four main factors that cause the conflicts with response to climate change:

- new and contested forms of knowledge;
- contested ascriptions of responsibility;
- alternative conceptions of scale; and
- new sites of practice for activism.

Although there is a paucity of research on stakeholders' climate change awareness, particularly for Africa (Bryan *et al.*, 2016; Ofoegbu, 2016), Knight (2016) identified the following three general trends:

- awareness of climate change is greater in countries that are wealthier and more highly educated, and is not influenced by political orientation or vulnerability;
- perceived risk is greater in countries that are wealthier, left-leaning, and more vulnerable to climate change, and not affected by unemployment; and
- perceived human cause is greater in countries that are wealthier, left-leaning, more vulnerable, and more highly educated.

This is underscored by Wiest *et al.* (2015) who illustrate that concern about climate change has increased over the past two decades, whereas Clayton *et al.* (2015a) maintain that climate change is not one of the public's main environmental concerns as it is ranked as less important than many other social issues like the economy and terrorism, especially in developed countries. McCright *et al.* (2016) maintain that in the European Union, climate change is strongly influenced by politics.

Furthermore, recent work on climate change by Ford and King (2015) indicate that the prolonged and occasionally extreme media attention afforded to issues like climate change creates greater levels of uncertainty and a distance between expert and public knowledge. Ross *et al.* (2016) indicate that there is an unwillingness or inability of citizens to assume responsibility for certain issues on climate change. This is reflected in the research on the 'psychology of denial' (Brügger *et al.*, 2015) where individuals adopt strategies to ascribe responsibility for global climate change to other, externalised actors and this externalisation of climate change is regarded as 'shifting the blame'. Furthermore, Barr *et al.* (2011a) maintain that the notion of responsibility and its role in promoting (or restricting) forms of environmental practice is another important issue and not only the problem of conflicting knowledge. Bache *et al.* (2015) and Bliuc *et al.* (2015) claim that this is complicatedly bound up with issues of trust and political accountability. Kenis (2016) asserts that environmental responsibility has become a central component of the citizen–consumer debate, whereas Kennedy and Bateman (2015) maintain that reframing of citizenship, is considered as a reflexive and distributed mode of expressing ethical and political concerns. Barr *et al.* (2011a) are of the view that the roots of promoting citizen environmental responsibilities within a consumption framework is linked by common acceptance of individual and collective rights and responsibilities. Selman and Parker (1997) commented earlier that this

pseudo-political agenda underlined many environmental campaigns such as the spread of Local Agenda 21 projects that have urged citizens to ‘Think Globally, Act Locally’.

Lorenzoni *et al.* (2007) indicate that discussions on climate change are held around extreme variations in stated outcomes alongside the disagreement amongst scientific experts and that there is a worrying gap emerging between scientific consensus and public ambiguity. However, whilst public engagement with climate change as a topic is relatively high, the understanding of climate change, its implications and socio-ecological consequences is weak (Masud *et al.*, 2015). Cloyd *et al.* (2016) provide many reasons for the lack of meaningful engagement on the part of the public. Newell and Dale (2015) and Whitmarsh (2009) explain that recent research has sought to discover the links between public engagement and the popular media and found that media has brought up important discussions on climate change and, more significantly, the ways in which the public is being pressured to change their behaviour in response to this issue such as scepticism (distrust) and uncertainty (doubt). This distrust and doubt about climate change, according to Mayer (2016), is often displayed in the media which leads to conflicts about the idea of being a ‘responsible’ citizen within the context of the current consumption patterns. Furthermore, earlier findings on public understanding of climate change in the UK by Hargreaves *et al.* (2003) and Ford and King (2015) assert that such perceptions are worsened by media portrayal of climate change, which tends to highlight scientific and political disagreement. This is confirmed by Jang and Hart (2015) who indicate that stakeholders often cite the poor or low attention paid to climate change by the media as a reason for uncertainty about the presence and seriousness of the issue, and in some cases as a clear reason for an unwillingness to engage. Chang *et al.* (2016) claim that stakeholders are strongly influenced by the media and other interest groups. Moreover, Carlson and McCormick (2015) and Jang and Hart (2015) indicate that the distrust in information sources, in particular mass media and business, is another barrier as media are perceived as prejudiced, exaggerated and inconsistent in their coverage of issues like climate change, and much of the information produced by business is considered ‘greenwash’ and marketing ploys. Some stakeholders, according to Manuel-Navarrete and Pelling (2015) and Ojala (2015), distance themselves from environmental pressure groups as they perceive that there is bias in information from such groups. Clayton *et al.* (2015b) point out that the source of information is also important for stakeholders as it demonstrates the credibility of the climate change information. Additionally, many stakeholders are of the view that information from a tertiary institution such as a university is most trustworthy.

Studies by Kempton (1997) and Norton and Leaman (2004) in the United States of America (USA) and another British survey by Poortinga *et al.* (2006) indicate widespread awareness and general concern about climate change, but limited behavioural response. This is supported by more recent research by Brügger *et al.* (2015), Devine-Wright *et al.* (2015) and van der Linden *et al.* (2015) who indicate there is a growing concern about climate change even though few citizens are actively involved in pro-climate change actions. Another key issue is that people's response to climate change is better when they understand the causes of climate change, as opposed to those who do not understand the causes (Blaum *et al.*, 2016).

Many years ago, the UK Department of the Environment Food and Rural Affairs (DEFRA) indicated that environmental issues which are of great concern for people in England included disposal of hazardous wastes, livestock breeding methods, water and air pollution, loss of plants or animal life, tropical forest destruction and ozone depletion (DEFRA, 2002). Furthermore, earlier studies by Bord *et al.* (2000), Norton and Leaman (2004), and Poortinga and Pidgeon (2003) illustrated that health, security and other social issues were more important than environmental issues for the British public. Capstick *et al.* (2015) recently indicated that the public perceptions of climate change is different among different nations and that perceptions also change over time. These different views and priorities of stakeholders provide a challenge in addressing climate change learning and proposing pro-climate change actions at the local level. This understanding is critical essential in the development of any climate change capacity building programme.

The views of stakeholders are important (Luoma-aho, 2015), even on climate change issues. Lorenzoni and Pidgeon (2006) explain that even though climate change is considered socially relevant, most individuals do not feel it poses a prominent personal threat. Hence, climate change has been ranked low and reflects a general perception amongst the public that the issue is removed in space and time. For example, Lorenzoni *et al.* (2007) illustrate that studies in 2004, in the UK, indicated that 52% of people believe that climate change will have 'little' or 'no effect' on them personally. Furthermore, Whitmarsh (2008) found that in 2004 85% of UK residents believed the effects of climate change will not be seen for decades. Notwithstanding, the climate change views of especially young people have changed recently (Corner *et al.*, 2015). Studies by Capstick *et al.* (2015) illustrate that concern about climate change has increased over the past two decades. According to van der Linden (2015b), although climate change is not one of the public's main environmental concerns, people

associate climate change with negative feelings and maintain that they are very concerned. Furthermore, recently Corner *et al.* (2015) indicate that while issues of importance for the British are unemployment, the National Health System, inflation and rising prices; climate change and energy are now ranked as the fourth important issue.

Christersson *et al.* (2015) suggest that the few people who actually make attempts to conserve energy do so for financial and health reasons rather than for environmental ones. Moreover, Clayton *et al.* (2015a) and Corner *et al.* (2015) point out that there has been a dearth of studies that addresses stakeholders' understanding of climate change, in particular in business, and their willingness to alter behaviours in relation to climate change. To the researcher's knowledge, no such studies have also been done in South Africa or in the electricity distribution sector.

Engaging stakeholders on climate change issues is challenging, as the 'value-action' or 'attitude-behaviour' gap of stakeholders, according to Clayton *et al.* (2015a), is illustrated by the difference between public awareness and concern about climate change on the one hand, and the limited behavioural response on the other. Additionally the public perceive a wide variety of barriers to engaging with climate change. Brügger *et al.* (2015) and Ross *et al.* (2016) suggest that there are only a few examples in the literature which explicitly address these barriers and the literature that covers barriers tend to focus mainly on the psychological barriers of dissonance and denial to behavioural change in light of alternative energy futures. Moreover, Carlson and McCormick (2015) indicate that there are other barriers, including social and institutional, which must be considered when dealing with stakeholders' response to climate change.

Another issue to consider when engaging with stakeholders, as Bamberg *et al.* (2015) illustrate, is that social identity is an important influence on people's energy use and therefore poses a difficulty in changing consumption behaviours. Gifford (2015) confirms that such an attitude, as with other environmental and political issues, indicates the deep exclusion and lack of trust felt by the people. Some of the aforementioned barriers are also encompassed in the Ipsative Theory of Behaviour (Klöckner, 2015) which identifies internal and external conditions as potential constraints to pro-environmental action. According to Daae and Boks (2015), the Ipsative Theory of Behaviour holds that an individual's behaviour may be

constrained or hindered by a lack of real or imaginary opportunities, imposed by the individual's internal as well as external conditions.

Brügger *et al.* (2015) and Shackleton *et al.* (2015) suggest that barriers to climate change experienced by stakeholders can be classified as two distinct, but interrelated, levels, namely, individual and social. Furthermore, the existence of widespread and ingrained social barriers poses particular challenges for climate change mitigation efforts, and undermines reliance on voluntary action by individuals (Biesbroek *et al.*, 2013). Some of the individual barriers which are essential for effective stakeholder engagement, suggested by Eisenack *et al.* (2014) and Lorenzoni *et al.* (2007) include:

- lack of knowledge;
- uncertainty and scepticism;
- distrust in information sources;
- externalising responsibility and blame;
- reliance on technology;
- climate change perceived as a distant threat;
- importance of other priorities;
- reluctance to change lifestyles;
- fatalism; and
- helplessness.

Adger *et al.* (2013) identified the lack of basic knowledge about causes, impacts and solutions to climate change as one of the most easily identifiable individual barriers to climate change response.

According to Carlson and McCormick (2015) and Lorenzoni *et al.* (2007), social barriers are subdivided into the following four issues:

- lack of action by governments and business;
- 'free rider effect';
- pressure of social norms and expectations; and
- lack of enabling initiatives.

The identification of lack of action by business is relevant and significant for the Distribution Division, and will need to be addressed to motivate the behaviour of its own employees.

Pasgaard *et al.* (2015) and Shi *et al.* (2015) also explain that although information is readily available to stakeholders, it is not taken up or translated into knowledge or action, for the following reasons:

- Lack of knowledge about where to find information;
- Lack of desire to seek information;
- Perceived information over-load;
- Confusion about conflicting information or partial evidence;
- Perceived lack of locally-relevant information, for example, about impacts or solutions;
- Format of information is not accessible to non-experts;
- Source of information is not credible or trustworthy, particularly the mass media;
- Confusion about links between environmental issues and their respective solutions;
- and
- Information conflicts with values or experience and is therefore ignored.

Sherwood *et al.* (2015) show that there are divergent ways of understanding climate change that draw on broader discourses than simply scientific knowledge. Additionally, although the general public interpretation of climate change may denote confusion initially, this is not necessarily the case, as this is a valid way of seeing the world from a lay person. An example by Masud *et al.* (2015) illustrates this, where climate change is brought under an umbrella of environmental issues without being seen as distinct. Moreover, a lack of knowledge by stakeholders may contribute to a sense of uncertainty about climate change and pro-climate change actions.

The vacillating involvement of stakeholders as identified by Lee *et al.* (2015a) can be understood from the observations of McCright *et al.* (2016a) that there is a general difficulty in interpreting scientific uncertainty and complexity by stakeholders, unlike scientists who are trained to recognise that uncertainty is an integral element of the process of discovery and debate. According to Whitmarsh (2011), uncertainty amongst stakeholders is the scepticism about the reality of climate change, the human influence on the climate, and the necessity and the effects of mitigation actions. Bliuc *et al.* (2015) and Whitmarsh (2011) observed that scepticism can arise from a particular worldview such as fatalism or lack of clear political engagement on the issue. Furthermore, McCrea *et al.* (2015) confirm that fatalism acts as a

barrier to engagement of people, as such individuals are of the view that there is no value for them to get involved, as the problem has gone too far already and is irreversible by human action. Herein also lies a key challenge in engaging with the Distribution Division stakeholders, and in particular employees who may also experience similar feelings.

Understanding how stakeholders view climate change and its impacts is important in engaging with such constituencies. Brügger *et al.* (2015) indicate that some people perceive climate change to be distant in space and time and unlike environmental concerns which tends to focus on the local issues with tangible impacts, the examples and imagery of climate change mostly related to people in other locations or in the future, especially by those who are well-off (Arnall and Kothari, 2015). Furthermore, Wiest *et al.* (2015) claim that some people tend to frame change in terms of their local surroundings. Kurz *et al.* (2015) explicitly recognise the difficulty people have of visualising the consequences of their current activities, for example, energy use and linking them to future climate change. Brügger *et al.* (2015) further maintain that there is an evolutionary tendency for people to pay attention to immediate and personally relevant issues.

Another key issue for stakeholders is that while most people accept that individuals play a role in causing climate change and that they should be involved in action to mitigate it, there are less opportunities for effective individual action on climate change as compared to local environmental issues which are more visible to the individual (Lorenzoni *et al.*, 2007). According to Bamberg *et al.* (2015), stakeholders are also of the opinion that the action of large emitters will have a greater impact than individual actions and that as climate change is a collective problem, it should be tackled at a collective level. Additionally, such individuals feel that it is not worthwhile taking action at an individual level, given its limited effectiveness.

While non-technologically driven options such as capacity building to influence lifestyle changes are likely to be practical solutions to the climate change challenges (van Sluisveld *et al.*, 2016), stakeholders are likely to be concerned that they have to change their lifestyle in order to take action on climate change. This unease (and reluctance to act) is mainly because many people feel that they would have to endure great discomfort and sacrifice standards of living and social image to respond to the climate change crisis (O'Rourke and Lollo, 2015). Axon (2016) and Simon and Leck (2015) point out that people tend to be reluctant to

consider changing many of their routines and habits, and to consider alternative options, even when these may be more individually and environmentally beneficial. Phillips and Dickie (2015) explain that most people's carbon-dependent lifestyles make some unconscious habitual behaviours become socially-acceptable such as driving to work, frequent long-haul holidays and weekend breaks, leaving appliances on and the weekly supermarket buying. Thulemark *et al.* (2016) further assert that such ingrained behaviours become unquestioned and there is a stubbornness to change, as ownership and consumption, for example, of cars and electronic goods, are important status symbols in our society. Additionally, people feel they are expected to achieve this since the perceptions of needs and expectations of people change once they become accustomed to a particular standard of living. Grasso and Markowitz (2015) support this argument, as they assert that people's revised expectations are spread in arguments about the quality of life, and once absorbed into daily routine become interpreted as 'needs' rather than 'wants'. Moreover, such barriers contribute to stakeholders doubting their effectiveness and externalising responsibility for mitigation efforts from the individual to the international level.

People have particular views on politics and business (O'Brien, 2015) and these issues are important when engaging with stakeholders. Bain *et al.* (2016) state that many people are of the view that there is limited political action by local, national and international governments such as the lack of commitment to mitigate GHG emissions or lack of evidence of substantial action by governments. Lack of action by business is also considered a barrier to people's personal engagement on climate change (Barker, 2015). However, Kopnina (2016) claims that business is usually and traditionally identified as scapegoats for environmental degradation and climate change. Pasgaard *et al.* (2015) point out that the lack of action by others in society is also a barrier to individual actions, as people are reluctant to change their own behaviour when they feel others would not follow suit. This is in line with Hochberg and Brown (2015) who referred to such a situation as the problem of free riding and the tragedy of the commons. Additionally, people tend to prioritise personal and financial concerns over environmental issues and individuals who consider that their actions would be more widespread, if proposed actions were equitable and fair for everybody. Shi *et al.* (2015) further claim that lack of action by some stakeholders is due to the lack of enabling infrastructures and mechanisms, such as lack of affordable and reliable public transport, higher prices of environmentally-friendly goods, design of the built environment encouraging car use and the lack of incentives to prevent pollution, for example, lower car taxes for more

efficient cars. Recycling (Gould *et al.*, 2016) and energy conservation (Asensio and Delmas, 2016) in the home are some of the most common actions that people are willing to take and there is general resistance to changing travel habits. Moreover, incentives and technological solutions for energy policies receive more support than taxes or higher bills.

Morton *et al.* (2010) state that investigating the beliefs, attitudes and orientations toward climate change issues that currently exist among stakeholders helps to identify potential opportunities for creating change as well as the likely points of resistance. Additionally, there are a number of factors that may be of importance in trying to understand what influences stakeholders' responsiveness to climate change, for example, the extent to which people believe that climate change is real, is one key predictor of willingness to take action on climate change. Capstick *et al.* (2015) suggest that accurate knowledge about the causes of climate change is vital for responsible decision-making as climate change is considered one of those difficult issues, is linked to energy consumption, and there is a need for a radical change in values, behaviour and institutions towards lower consumption patterns.

As an example of the radical changes required, Scott and Barrett (2015) acclaim that the need for widespread social change, including by individuals, was the basis for the UK Government's ambitious target of reducing CO₂ emissions by 80% by the year 2050. However, Clayton *et al.* (2015b) explain that there has been inadequate attention given to behavioural change in the UK's climate change policies and that the country has relied primarily on voluntary reduction of energy use by individuals, which has been supported by the provision of information, economic incentives and subsidies to such stakeholders. Newell *et al.* (2015) contend that the reticence of government emanates from a number of factors, notably the fear of electoral protest, their close relationship with business, a focus on economic growth, and the short-term priorities of government which are linked to its limited period in office.

van der Linden *et al.* (2015b) suggest that stakeholder engagement, as a way to involve the public in decision-making about science issues, is a great concern. However, Eden (1996) earlier maintained that the methods used to educate the public, change behaviour and gain support for policy has focused primarily on the provision of scientifically sound information. However, according to Tal and Wansink (2016), societal values, personal experience, and other contextual factors influence the understanding of science. According to Lee *et al.*

(2015b) and van der Linden *et al.* (2015), stakeholder engagement involves cognitive, affective and behavioural aspects and therefore engagement implies a personal state of connection with the issue of climate change, rather than mere public participation in policy-making only. Bain *et al.* (2016) argue that it is not enough for people to know about climate change in order to be engaged; they also need to care about it, be motivated and be able to take action. However, Ross *et al.* (2016) assert that energy conservation can be practised without an understanding of climate change, for example, if financially motivated. Additionally mitigation policies are likely to be ineffective or rejected by a public who do not understand the issues. Cropanzano and Dasborough (2015) explain that the three facets of engagement are not related in a linear fashion, rather they comprise complex behavioural ecologies. Azevedo (2015) believes that behaviour change can precede cognitive or affective change. In turn, cognitive, affective and behavioural aspects of engagement are in large part a product of social and institutional contexts (van der Linden, 2015b). Furthermore, Dietz (2015a) indicates that there are a range of influences on individual attitudes and behaviour towards environmental issues such as past behaviour, knowledge, experiences, feelings, social networks, institutional trust and demographic background.

Gifford (2011) explain that the need to conduct research and interventions will grow, as the impacts of climate change are more widely experienced. Additionally, a number of focus areas for future research on anthropogenic climate change mitigation is suggested. For Bisaro and Hinkel (2016) and Fujii (2017), the following five issues for stakeholder engagement is important:

- climate change research should include, wherever possible, measures of actual (rather than self-reported) environmental behaviour;
- the reliability and validity of self-reports should be examined;
- the difference between impact and intent-oriented actions must be considered;
- efforts should be made to study high-GHG impact behaviours, such as the choice of travel mode and energy consumption, as opposed to low-GHG impact behaviours, such as avoiding or not using plastic bags; and
- the focus should be on the strength of effects on the environment, and whether those are importantly influenced by psychological variables or are open to well-designed interventions.

Accordingly, Hoover and Harder (2015) postulate that researchers need to focus on the role and power of individuals to effect change, due to the possible enormity of climate change as a social (as well as natural) crisis. Additionally, such a focus will lead to wider and important interrogations of the relationship between individuals and the state, and the ways in which behavioural change as a political discourse is encouraged and governed. As Barbaro *et al.* (2015) note, there are substantial limitations in the focus on individuals and the logic of the Attitude-Behaviour-Choice model of policy-making within a consumer-focused society. Huysman *et al.* (2016) suggest that climate change undermines the logic of the 'citizen-consumer' through the emergence of seemingly contradictory ecological practices for individuals as well as researchers and practitioners. Additionally, to undo this concept requires a questioning of the citizen-consumer model of behavioural change and a focus on how climate change is repositioning the perceived value of environmental practices from being part of everyday life to being essentially in opposition to existing forms of consumption. Dietz (2015a) and Shove (2010) point out that understanding the shifts in behavioural change is important as such appreciation provides good knowledge of the wider political debate on how radical social change can be brought about through collective and deliberative processes, to address the conflicts that emerge around climate change. Such an approach can only lead to new ways of dealing with climate change and prepare societies for dealing with other global challenges (Dilling and Berggren, 2015). Klenk *et al.* (2015) suggest that developing sustainable solutions to climate change involves all societal stakeholders including government, commerce and business, interest groups and the wider public. Furthermore, according to Dilling and Berggren (2015), involvement of stakeholders indicates that some strategies for engagement are more conducive for policy intervention, which tends to operate on short timescales. Additionally, attempts to engage the public will be more effective if they are part of, and seen to be part of, a coherent and consistent response to climate change. However, for effective stakeholder engagement on climate change issues a number of matters need to be addressed. According to Boon (2015), there is a need for basic information provision to address the ignorance about climate change and its implications for individuals. Carlson and McCormick (2015) and Kimengsi *et al.* (2016) believe that such basic knowledge will encourage people to channel their energies into appropriate activities, especially for those willing to mitigate climate change. Carlton and Jacobson (2016) also recommend that climate change-related regulatory and economic measures be communicated in an acceptable and transparent manner. Myers *et al.* (2015) suggest that information needs to be provided in context, according to its reliability with mainstream scientific opinion and

in relation to previous findings. Lewandowsky *et al.* (2015a) claim that there is a role for science education (formal and professional) to promote understanding of the scientific process, including the inherent uncertainty about climate change. Ford and King (2015) suggest that the media also needs to be educated on climate change, specifically developing skills to think critically about climate change media content and advertising. There is also a great need to educate younger generations on environmental action and climate change (Corner *et al.*, 2015; Haynes and Tanner, 2015).

In support of a constructive response to mitigation efforts, Brügger *et al.* (2015) and Capstick *et al.* (2015) suggest that information should also be communicated in a meaningful way and must link stakeholders' concerns and interests and that people need to understand that there are additional benefits to reducing emissions such as saving money, improved air quality, quieter streets and personal fitness, as the provision of information at the point of energy use reinforces the connection between personal action and impact on the climate, and makes climate change more noticeable and the climate change solutions more personally relevant. Burchell *et al.* (2016) and Laskari *et al.* (2016) indicate that speedy communication is effective in stimulating emotional, behavioural and intellectual aspects of engagement on climate change. This is underscored by Karlin *et al.* (2015) who point out that the provision of immediate feedback on energy use, through household energy meters, effectively reduces people's consumption. The Distribution Division can play an important role here, as the main electricity distributor across South Africa, in influencing its stakeholders' response to climate change. However, all employees must also have an understanding of climate change to be able to convey this to its approximately 5.5 million direct customers (Eskom, 2015c). Chai *et al.* (2015) maintain that sustained support, such as household interventions and positive reinforcement (in terms of public recognition, social interaction and material rewards), can in turn inspire effective behaviours to be maintained. According to van der Linden (2015a), incentives such as the energy saving awards can also stimulate a sense of collective effectiveness, can highlight good practice and play a role in fostering action within a social context.

Brügger *et al.* (2015) and Capstick *et al.* (2015) argue that it is not sufficient just to have information and understanding about climate change, even for the motivation to act, although such knowledge is important for engagement. Accordingly, supportive institutions and infrastructure such as affordable and efficient public transport is important to enable action at

an individual level as well as initiatives to purposely change routine behaviours need to be designed and interventions specifically to encourage consideration of alternatives such as free bus tickets, congestion charging and bike-to-work breakfasts (Ryan, 2015). Furthermore, Childers *et al.* (2015) and Shaw and Bunce (2015) indicate that demonstration projects of low-emission technologies, decentralisation of energy systems, including micro-generation, and carbon neutral or low carbon buildings can also show people what is achievable.

Bamberg *et al.* (2015) point out that there are different responses amongst stakeholders to climate change, as some people may take voluntary actions while others are not prepared to make any changes without external pressure. Hence, Corry and Jørgensen (2015) suggest that a stronger governing and economic framework is needed to encourage climate change mitigation actions. Furthermore, O'Brien (2015) advocates that in current society, regulation is necessary to drive fairer, collective solutions to climate change and highlight the seriousness of climate change and the necessity to act. Additionally though, regulation and economic measures only do not necessarily change values underpinning behaviour. Raineri and Paillé (2015) and Rumore *et al.* (2016) therefore propose that long-term and deeply-rooted social change for sustainability (in support of pro-climate change behaviour) can be promoted gradually through education, creating community values and environmental citizenship in combination with a framework of incentives.

It is important that societal viewpoints of climate change be integrated within the policy process on an on-going basis (Knutti *et al.*, 2016), as there is a need to explore the understanding of climate change by diverse stakeholders through time and that such understanding should influence policies accordingly. In support, Bernauer *et al.* (2016) are of the view that public involvement in the policy process must be a more open and consistent approach to addressing climate change, and will therefore contribute to overcoming political distrust from many stakeholders. In addition, effective climate change management requires a longer-term perspective and systemic change. Making progress on the UK Government's ambitious CO₂ emissions reduction target (Scott and Barrett, 2015) will therefore require the engagement of the public on climate change matters, as there is a need for a drastic change in values, behaviour and institutions towards a pattern of lower consumption. Corry and Jørgensen (2015) suggest that for pro-climate change behaviour there must also be genuine political and widespread social commitment, even at the individual level. Additionally, there are still barriers to the public's response to climate change, although public awareness and

concern about climate change may have increased since early studies were undertaken. However, these barriers have not been fully addressed by government and many of these existing barriers continue to be hindrances to more sustainable lifestyles in general (Leck and Roberts, 2015; Shackleton *et al.*, 2015).

2.4 Organisational Learning Theory

According to Argote and Miron-Spektor (2011), learning in organisations which occurs over time, is a change in the organisation that occurs as the organisation acquires experience. Additionally, such learning involves a range of different areas such as organisational behaviour and theory, cognitive and social psychology, sociology, economics, information systems, strategic management, and engineering. Moreover, Argote and Miron-Spektor (2011) indicate that knowledge transfer is also very important in organisations due to distributed work arrangements, globalisation, the multi-unit organisational form, and inter-organisational relationships such as mergers, acquisitions and alliances which is also relevant to the Distribution Division due to its current organisational structure and processes. Huber (1991), however, views organisational learning as a change in the range of potential behaviours. Furthermore, Manuti *et al.* (2015) suggest that organisational learning occurs in a context which includes the organisation and the environment in which the organisation is influenced by stakeholders such as competitors, clients, institutions, employees and regulators, as well as volatility, uncertainty, interconnectedness and generosity. Additionally, the organisational context also includes characteristics of the organisation such as its structure, culture, technology, identity, memory, goals, incentives and strategy, and also includes relationships with other organisations through alliances, joint ventures and memberships in associations. While key technologies for reducing the emission of GHGs are available in all relevant sectors including energy supply, transport, buildings, business, agriculture, forestry and waste; O'Brien (2015) argues that solutions through non-technological means such as lifestyle changes and management practices are important. Again, the role and importance of understanding climate change learning, as a non-technological solution, provides the validation for this research.

According to Sorensen *et al.* (2016), environmental learning in organisations have four key dimensions, namely, skills and knowledge, physical technical systems, the integration of social and environmental matters in decision-making, and values and norms. Additionally,

the fourth dimension, values and norms, determines and controls the type of knowledge that is sought and nurtured in the former three dimensions and values serve as screening and control mechanisms. Also, effectively communicating knowledge, values and norms inspires employees to contribute and support the organisation’s overall strategy who are critical to its implementation. This is supported by Pallett and Chilvers (2015) who are of the view that learning in organisations is not a private issue, but a social matter. Moreover, what is already known or believed by others in an organisation and what kinds of information is present influences how individuals learn in an organisation. Duffield and Whitty (2015) believe that social and cultural factors also provide solutions to organisational learning. Sujan and Furniss (2015) support this thinking, as they are of the view that culture plays a significant part in knowledge management, organisational learning, and in the effectiveness of learning mechanisms. Paulin and Suneson (2015) further point out that knowledge sharing is best performed through the communication of individuals. Two good methods of knowledge sharing commonly in use are networking (Nesheim and Hunskaar, 2015) and mentoring (Vivas-López *et al.*, 2015.). Additionally, this also has relevance for climate change learning, especially between employees in a large organisation such as the Distribution Division. Hart *et al.* (2016) are of the view that knowledge in organisations is also available from the organisation’s routines, processes, practices and norms and not only rooted in documents or in archives. This is significant for climate change learning in the Distribution Division, given the organisation’s entrenched and numerous processes and practices. Another relevant issue

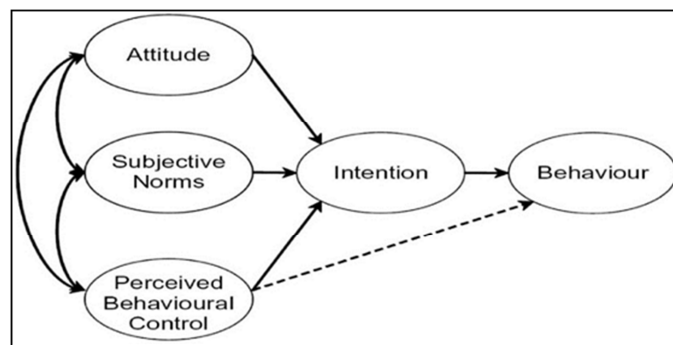


Figure 2.1: Ajzen’s Theory of Planned Behaviour (adapted from Ajzen, 1991: 179–211)

for climate change learning in organisations is what Tong *et al.* (2015) indicate, namely, that an organisation knows something if just one person knows it and if the organisation culture and structure enables that knowledge opportunity to be used effectively. This type of

knowledge transfer may be a challenge for large and hierarchical organisations such as the Distribution Division. There are a number of notable models that offer insight into explaining how pro-environmental behaviour is learnt and actioned, such as the Theory of Planned Behaviour (Klöckner, 2015), the Norm Activation Model (van der Werff and Steg, 2015) and the Value-Belief-Norm Theory of Environmentalism (Han, 2015; van der Werff and Steg, 2015).

The Theory of Planned Behaviour which is one of the most predictive persuasion theories, is a theory that links beliefs and behaviour (Ajzen, 1991). Figure 2.1 indicates that attitude, subjective norms, and perceived behavioural control together shape an individual's intentions and behaviours. Additionally, although a poor gauge of behaviour, attitudes do influence intentions and behaviour. The link in Figure 2.1 should ideally be between behaviour and actual behavioural control, rather than to perceived behavioural control.

Due to the difficulty of assessing actual control, perceived behavioural control has been considered as an approximate. Hence communication strategies need to be drawn up to target the affecting factors. The relative importance of each component can vary across individuals and contexts. According to Han (2015) and Kaiser and Gutscher (2003), behaviour is driven by beliefs about the likely consequences of an action (favourable or unfavourable), perceived social pressure or subjective norms and perceived behavioural control over the action. The stronger these factors are, the more likely someone is to form a behavioural intention to take action.

Han (2014) explains that in Schwartz's Norm Activation Model there is a link between altruistic and environmentally-friendly behaviour. Furthermore, van der Werff and Steg (2015) point out that pro-environmental behaviour is likely if people feel a moral obligation to perform the behaviour (Figure 2.2). However, Harland *et al.* (2007) propose that situational activators, efficacy and ability, and its personality trait activators, awareness of consequences and denial of responsibility, are generally ignored in the Norm Activation Model and that the inclusion of such additional activators improve the Norm Activation Theory's potential to explain pro-environmental behaviour. Additionally, personal norms significantly mediate the impact of activators on pro-environmental behaviour. According to Stern *et al.* (1999), personal norms can influence individual choice about pro-environmental actions for those behaviours not controlled by other related factors (Figure 2.2).

Figure 2.2 also demonstrates that this process model of altruistic behaviour first requires the attention or awareness of the individual to environmental issues, which influences motivation to act and the development of the feeling that it is the individual's moral duty to consider protection of nature. This is followed by the evaluation and defence phase where the individual considers that if the cost of assistance is more than the effort or expense, then the likelihood of a pro-environment response is low. This then leads to behaviour which involves taking action that creates cognitive harmony and reducing cognitive dissonance (Pradhananga et al., 2017). Furthermore, Lind et al. (2015) indicate that such a response represents an internalised sense of obligation to act in a certain way, as norms are activated when an individual believes that going against these norms would have negative effects on things they value and that by taking action, they would bear significant responsibility for those consequences.

The importance of environmental learning is underpinned by the Norm Activation Model in which the environmental awareness of an individual is the first step towards promoting sustainability and eco-conscious behaviour (Dalvi-Esfahani *et al.*, 2017). Han (2015) points out that values serve as screening and control mechanism and effectively communicating knowledge, values and norms inspires employees to contribute and support the organisation's overall strategy and is critical to its implementation.

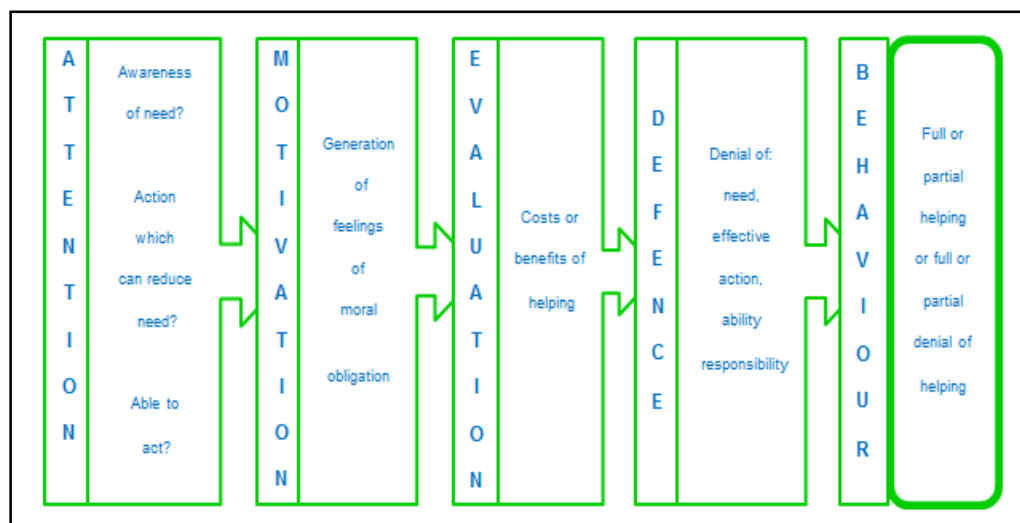


Figure 2.2: The Norm Activation Model (adapted from Harland *et al.*, 2007: 324)

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Figure 2.3 illustrates that behaviour is influenced by biospheric, altruistic and egoistic values and beliefs such as ecological worldview, adverse consequences for valued objects and perceived ability to reduce threat. The pro-environmental personal norms, which refers to the sense of obligation to take pro-environmental actions, motivates behaviour. Prati *et al.* (2017) are of the view that individuals who accept a movement's basic values or believe that valued objects are threatened, and believe that their actions can help restore those values, experience an obligation (personal norm) for pro-environment action are predisposed to provide support. Additionally, this support is dependent on the individual's abilities and limitations.

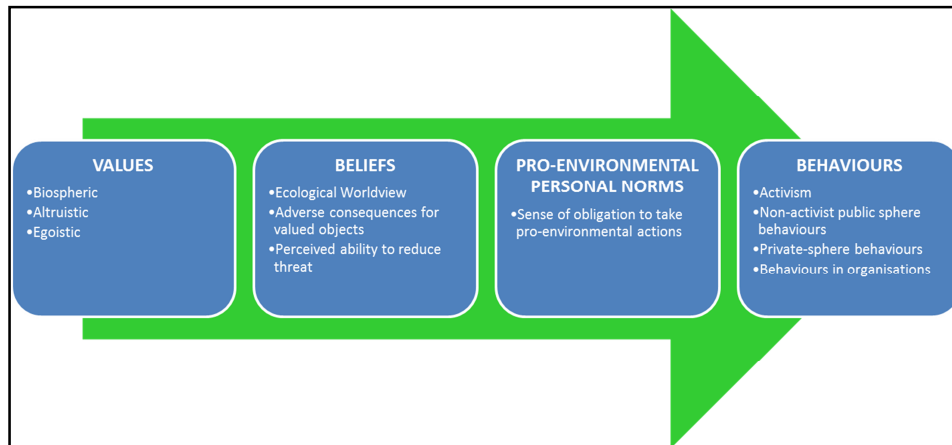


Figure 2.3: The Value-Belief-Norm Theory of Environmentalism (adapted from Stern *et al.*, 1999: 84)

Notwithstanding, there is a need for organisation learning interventions to address climate change for compelling business reasons. Rahman and Kirkman (2015) indicate that the Kyoto Protocol, which is the legally binding international agreement to reduce GHG emissions worldwide, influences climate and economic policy at the national level and plays a prominent role in global politics. According to Slawinski and Bansal (2015), companies therefore have to consider climate change issues as an economic factor in their business

strategy. Toole *et al.* (2016) point out that climate change is economically advantageous and that the regulatory business environment is already influenced by climate change. Additionally, financial institutions have to increasingly consider climate risks as worldwide economic losses due to natural disasters accumulate, climate change-related risks and opportunities have to be integrated into core financial operations. Kareiva *et al.* (2015) further maintain that this occurs with direct implications for financing business investments, as rating agencies who work for large investment funds, are looking for solutions from businesses to tackle the challenge of climate change. Additionally, rating agencies who screen companies for environmental and sustainability factors often exclude poor performers. Nikolaou *et al.* (2015) indicate that the climate change views of stakeholders such as consumers, customers, clients and voters (not only government), is also important for companies. Carlson and McCormick (2015) further indicate that people are concerned about the environment and want problems to be tackled, and that in recent times, companies have responded to this increasing environmental ethic of the public, by reporting on GHG emissions in sustainability reports. Furthermore, Ortas *et al.* (2015) show that stakeholders are not just interested in the environmental statistics reported in annual reports but also expect solutions and answers to the environmental impact of business operations. Begum and Pereira (2015) claim that there are business opportunities in the climate change space and that financial benefits are accrued when businesses introduce new goods or innovative methods of production. Additionally, some companies have already grasped this opportunity by understanding the legal requirements for carbon trading, how to measure their GHGs, how to undertake a carbon inventory and measure their carbon footprint at their sites and investing in clean, sustainable, alternative or zero emissions technologies (Orsato *et al.*, 2015). Grasso and Markowitz (2015) point out that it is important for businesses to consider ethical issues such as the external cost of their contributions to climate change in broader terms, for example, fossil fuel consumption leads not only to the disruption of weather patterns which impact directly on business's operations and infrastructure, but also affects social and ecological systems in other parts of the world and in the future.

Dietz *et al.* (2016) argue that every organisation will be affected by climate change in different ways. Linnerooth-Bayer and Hochrainer-Stigler (2015) assert that it is critical for a business to assess the particular situation it finds itself in, before embarking on a climate change response. Nikolaou *et al.* (2015) further maintain that climate-proofing operations will become increasingly important to the survival of the business, especially as climate

change will continue to increase the frequency and intensity of extreme weather events. Dahan *et al.* (2015) are of the view that every organisation is part of a larger community and that it is therefore important for business to also help others adapt to climate change, to prevent social unrest. Linnenluecke *et al.* (2015) and Lo and Yu (2015) suggest that the following nine adaptation options should be considered by business managers:

- Reduce reliance on scarce resources;
- Consider climate change impact on different locations;
- Set up adequate insurance for the business and for others;
- Consider potential contributions to community adaptation needs such as flood defences to prevent increased social unrest and climate refugees;
- Communicate effective ways to adapt to climate change;
- Act early on climate change legislation;
- Anticipate emerging policy developments;
- Recognise new business opportunities to support adaptation needs; and
- Recognise new markets as weather patterns change.

Slawinski and Bansal (2015) are of the view that the key issue to operationalise climate change responses is to integrate mitigation thinking into all decisions across the organisation's operations and, according to Gasbarro and Pinkse (2015), this can only be achieved with a higher level of climate change awareness.

The urgent need for a scientific study of climate change learning is strengthened by the acknowledgement of the increasing role of humans in contributing to climate change, as emphasised in numerous recent reports (Myers *et al.*, 2017). The IPCC (2014) states that human influence on the climate system is clear and since human influence has been the dominant cause of the observed warming since the mid-20th century, humans are therefore central to addressing climate change. According to Lee *et al.* (2015a), there has been a substantial rise in awareness worldwide about climate change in fields such as architecture, urban planning, water management, and other types of planning. Additionally, the proponents of such developments are concerned about how climate change will influence these activities. Howell and Allen (2017) comment that values, motivations and formative experiences underlie pro-environmental behaviour, but are often considered in isolation from each other. Additionally, altruistic concerns about climate change impacts on future human generations

and on poorer or more vulnerable people are considered more motivating than other reasons for pro-climate change actions.

2.5 Climate Change Adaptation Theory

Eriksen *et al.* (2015) assert that there are a range of climate change solutions available, but many are fraught with problems. Additionally, due to past (and continuing) emissions, adaptation is necessary to address impacts resulting from the already unavoidable warming of the planet. This is underscored by Murphy *et al.* (2016) who describe adaptation as a response to climate change that aims to counter the effects of global warming by reducing the vulnerability of social and biological systems to relatively sudden change, especially as global warming and its effects will last many years, even if GHGs are stabilised soon. For Millner and Dietz (2015), adaptation is especially important in developing countries since those countries are predicted to bear the brunt of the effects of climate change. Additionally, the adaptive capacity of people is unevenly distributed across different regions and populations, and developing countries generally have less capacity to adapt.

Furthermore, Harrison *et al.* (2015) point out that the degree of adaptation correlates to the situational focus on environmental issues and therefore adaptation requires the situational assessment of sensitivity and vulnerability to environmental impacts. Mokrech *et al.* (2015) contend that adaptive capacity is closely linked to social and economic issues. Additionally, while there is a wide range of adaptation options available, there is a need for more adaptation choices even though there are some unknown barriers and costs to adaptation (Eriksen *et al.*, 2015). A significant point raised by Tashman *et al.* (2015) is that there is a need for the development of innovative adaptation strategies able to cope with the uncertainty on future climates, and for more involvement of climate information end-users, for example, employees, because adaptation strategies cannot be developed without these key stakeholder. Werners *et al.* (2015) contend that limits to adaptation emanate from within society and is therefore dependent on ethics, knowledge, attitudes to risk and culture and that these barriers, according to Armah *et al.* (2015), can be addressed through many interventions, including climate change capacity building.

Bours *et al.* (2014) suggest that Lewin's Theory of Change (ToC) is a suitable model for climate change adaptation, as this approach enables stakeholders to embed an intervention

within a larger strategy. Additionally, the ToC is also flexible and practical as it clearly indicates a vision of meaningful social change, that systematically maps out specific steps towards achieving successful adaptation actions. Since the ToC is a dynamic process, the climate change adaptation strategy can be reviewed regularly and modified to reflect emerging conditions and new knowledge. The ToC is one of the more robust models for designing and evaluating climate change adaptation, especially as climate change is complex (Cameron, 2011), multifaceted (Grasso and Markowitz, 2015) and is a long-term issue (Slawinski and Bansal, 2015). Bours *et al.* (2014) point out the following advantages of applying the ToC to climate change adaptation:

- While climate change may be a global issue, adaptation essentially happens at a local level and the ToC allows for such contextual analysis to local adaptation programme design and evaluation, without prescribing one solution for all situations.
- Diverse projects and programmes can be linked together into a clear and strategic portfolio that enhances linkages across climate change adaptation sectors and scales.
- Monitoring and evaluation of adaptation programmes must consider dynamic and emerging conditions, as is likely under climate change. Continuous evaluation of needs, allows stakeholders to reflect changes in the social, political or natural environment in their adaptation, since the ToC is flexible and cyclical in nature.
- Programme assumptions and thresholds that provide guidance for development in a particular direction is considered in this model. This logical approach enables an understanding of the effectiveness of particular interventions and therefore allows for revision or update of an adaptation strategy.
- Stronger relationships with partners and stakeholders is facilitated as there is free discussions regarding perspectives and values, which is critical for climate adaptation projects as such projects invariably need to consider trade-offs between all stakeholders.
- The organisation's influence and effect on long-term change, and the recognition of work done by others, are stressed in this model, which is important for an evolving adaptation strategy.
- To develop practical climate change adaptation, it is important to consider lessons from previous programmes and the ToC allows this.

- The flexibility of ToC accommodates the uncertainties that are inherent in adaptation processes, as it is very difficult to predict the social, economic and political consequences of climate change.

According to Tashman *et al.* (2015), adaptation strategies that look profitable when considering only one sector may be sub-optimal at the macro-economic scale because of negative externalities, for example, the high and controversial electricity tariff increase requested annually by Eskom to fund its new build projects, and the proposed climate change adaptation systems for its ageing infrastructure. This is underscored by Seo (2015) who maintains that public authorities will have to be aware of this risk and monitor the emergence of new externalities from adaptation behaviours. Alshehry and Belloumi (2015) also believe that there will be an increase in energy costs and carbon pricing, as stricter mitigation strategies are likely to be introduced especially if climate change and its impacts appear to be worse than expected in fifty years. High energy consuming adaptation options, therefore, seem to be particularly non-robust to unexpected climate evolutions and certainly will not be suitable for the Distribution Division, given the financial constraints within the organisation. Frank *et al.* (2015b) continue that over the next few decades, the main change global warming will bring may be the uncertainty regarding future climate conditions, which was marginal during previous centuries and, therefore, was often neglected in decision-making. Furthermore, uncertainty in future climate change (Burke *et al.*, 2015b) is so large that it makes many traditional approaches to designing infrastructure and other long-lived investments inadequate (Childers *et al.*, 2015).

Termeer *et al.* (2017) are of the view that small changes may be required for climate change adaptation before any major changes can occur. Additionally, it is important to confront innate social and mental blocks to address climate change inactions. Depoers *et al.* (2016) point out that to undertake the system thinking required to tackle climate change, one of the first things that all businesses need to do is to measure the GHGs of its operations. In undertaking a GHG inventory at the organisational level, Yang *et al.* (2016) suggest that the following five aspects must be considered:

- Quantify direct GHG emissions from operations;
- Report GHG emissions and compare across the sector;

- Assess GHG emissions from the value chain, including suppliers and users of products;
- Locate position of organisation within system of production and consumption; and
- Evaluate the effect of the organisation on other systems.

Montoya-Torres *et al.* (2015) assert, however, that measuring carbon emissions is not straight forward for many types of operations and requires some learning in the organisation. Due to the lack of this essential climate change learning in the Distribution Division, this first step of undertaking a GHG inventory in the organisation, in the recent past by consultants (Eskom, 2010b), has been incomplete, poorly understood and problematic, in spite of the time and resources that was allocated for this project. Pineda (2016) believe that management can only take steps to mitigate climate change once they are aware of the role of its business operations on the climate system.

In terms of the Norm Activation Model (Harland *et al.*, 2007), climate change learning is therefore essential and a prerequisite to measuring one's carbon emissions and, according to Wittneben and Kiyar (2009), such learning can facilitate the following climate change behaviours in business:

- Capitalise on energy efficiency gains;
- Switch to renewable energy sources;
- Collect and apply best practice examples;
- Increase expectations of suppliers and consumers;
- Encourage individual behavioural change within the business's reach;
- Integrate mitigation thinking into all decisions across operations;
- Develop novel approaches to reducing GHG across the system of production and consumption;
- Communicate achievements in lowering emissions; and
- Assist in furthering effective climate policy.

The IPCC (2014) report states that there is sufficient and unmistakable evidence that humans are causing global warming and that tackling climate change is one of the greatest challenges to humankind in the 21st century. Begum and Pereira (2015) assert that businesses, which are an integral part of society, have to deal with the impact of climate change on their operations, and also how to reduce their emissions to curb the increasing global warming of the planet.

Bremer and Linnenluecke (2017) demonstrate that in the energy sector, both environmental attitudes and knowledge of climate change play a significant role in the perceived importance of climate change adaptation. Additionally, the understanding of organisational risks facilitates the relationship between climate change attitudes and knowledge, and pro-climate change actions. Moreover, there is a need for climate change learning for business leaders. While there have been many presentations and discourses in the Distribution Division about responding to climate change over the past five years, the business case or rationale for an effective and meaningful response to climate change or the engagement of employees has not, to the researcher's knowledge, been researched or documented.

2.6 Conclusion

By undertaking a study of the climate change learning of employees in an electricity utility, this research contributes significantly to ascertain whether a business's climate change strategies and policies will be effectively implemented and whether an electricity utility will be able to make a meaningful difference to the climate change challenges, much of which is caused by the utility itself. Climate change learning in the Distribution Division will be a sustainability issue, given the resource implications in the organisation. It is also imperative to engage with all employees at different levels, as these stakeholders' views and knowledge on climate change are key to robust organisational learning to adapt and respond to climate change effectively and efficiently. The SDGs (Hajer *et al.*, 2015) provide the backdrop for ensuring the sustainability of climate change learning, while Ajzen's Theory of Planned Behaviour (Ajzen, 1991), the Norm Activation Model (Harland *et al.*, 2007) and the Value-Belief-Norm Theory of Environmentalism (Stern *et al.*, 1999) provide relevant models to understand the drivers for pro-climate change behaviour and what is required in organisations to move towards such behaviours. However, as other factors influence people's understanding of climate change, and not only scientifically sound information (Tal and Wansink, 2016), it is important to engage with all stakeholders to understand their issues and concerns. Furthermore, for meaningful pro-climate change behaviour (Cropanzano and Dasborough, 2015), understanding the views and concerns of stakeholders is fundamental, and addressing the soft non-economic and non-technological drivers of energy system transformations (van Sluisveld *et al.*, 2016), such as climate change capacity building (Carter *et al.*, 2015) are important.

The study cross-tabulates experiences, perceptions and action responses of electricity utility employees across the Distribution Division. The multi-conceptual perspective used in this study provides a framework to examine a range of relevant issues pertaining to climate change learning in business and guides the methodological approach adopted as discussed in Chapter Four.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

The human, environmental and financial cost of climate change is fast becoming unbearable. We have never faced such a challenge. Nor have we encountered such great opportunity. A low-carbon, climate resilient future will be a better future. Cleaner. Healthier. Fairer. More stable. Not for some, but for all. There is only one thing in the way. Us. We.

Secretary-General Ban Ki-moon, General Assembly, 23 September 2014. Opening remarks at the 2014 Climate Summit (UN News Centre, 2014)

This study examines climate change understanding and learning of employees in industry, with a case study in Africa's largest distribution electricity utility, the Distribution Division of the Eskom Holdings Company which is a SOE.

There is an increasing recognition of the links between effective climate change response and people's (including employee) understanding and engagement on climate change issues (Clayton *et al.*, 2015a). According to Demski *et al.* (2017), people who experience climate change impacts such as flooding become more aware of climate change issues, which also generate a noticeable response and greater perceived personal vulnerability and risk perception relating to climate change. Brügger *et al.* (2015), Hoover and Harder (2015) and Pasgaard *et al.* (2015) maintain that there are great concerns about the general public's and employees' responses to climate change, with numerous barriers preventing their effective engagement on this issue. However, in-depth and fundamental knowledge of the employee's climate change response, according to Knight (2016), is limited to non-existent in business. Kang *et al.* (2017) point out that businesses have implemented very limited precautionary mitigation and adaptation actions, even though there has been increasing concerns about climate change. Additionally, some of the significant factors that force business to consider pro-climate change actions include the concerns of the business about future climate change impact, organisational capacity such as leadership, staff capacity and the existence of a relevant division or department to coordinate climate change issues. The aforementioned factors are also likely to apply to electricity distribution utilities. Therefore the literature

reviewed in this chapter contributes significantly to the knowledge and understanding of climate change learning and the required responsiveness of employees for the electricity utility sector. Schaltegger *et al.* (2015) point out that climate change is one of the main global issues that have drawn broader public, political and corporate attention in recent years. Furthermore, Hansen and Cramer (2015) indicate that climate change problems such as floods, rising sea levels, water scarcity, droughts, soil erosion, destructive fires, decreasing fish populations and forced migrations of people which negatively impacts on sustainability; affects most countries, industries, markets and people. Betzold (2015) further emphasises that the impact of climate change to global, social and economic systems is also likely to have an impact on those who are not directly affected by climate change disasters, due to the interconnectedness of industries and global trade. The Distribution Division employees also need to understand that their contribution to climate change whether at the personal level or in the business decisions they make, has long-lasting impacts across the world.

The DEA (2009) and Klausbruckner *et al.* (2016) point out that climate change is a global issue but also affects South Africa. According to Kreft *et al.* (2014), South Africa was ranked 37th in the Global Climate Risk Index of the 196 countries in the world. Shisanya and Mafongoya (2017) support the view that the low levels of adaptive capacity of people, especially those in rural areas, and the high dependence on rain-fed agriculture makes Southern Africa one of the most vulnerable regions to climate change. The major treaties on climate change such as the 1992 UNFCCC and the 1997 Kyoto Protocol have been signed by South Africa, although South African obligations regarding these agreements are determined according to the principle of common but separated responsibility (Pillay, 2015). Furthermore, the DEA (2009) and Nasr *et al.* (2015) indicate that in Annex I of the Kyoto Protocol, South Africa is listed as a developing country and therefore has no obligations to reduce GHG emissions. Notwithstanding, at the 2009 15th UNFCCC Conference of the Parties (COP), in Copenhagen, South Africa committed itself to reduce its GHG emissions by 34% by 2020 and by 42% by 2025 (UNFCCC, 2011), but this was conditional upon South Africa receiving technical and financial support from the developed countries.

This literature review entails an examination of the following thematic aspects:

- Global climate change, including the various international instruments and institutions to respond to climate change

- Climate Change in South Africa
- Industry and Climate Change
- The Distribution Division and Climate Change
- Climate Change Learning

Environmental responsiveness from employees and managers, pertinent to climate change, are also integrated into the literature review. The scope of the literature review for this type of study is described by Mugenda and Mugenda (1999: 29) who state that “the review of literature involves the systematic identification, location and analysis of documents containing information related to the research problem being investigated” and the importance is underscored by Sekaran and Bougie (2016) who claim that such a review sets the stage for a good conceptual framework.

3.2 Climate Change

Both Hansen *et al.* (2016) and the IPCC (2014) claim that the scientific evidence indicating that climate change presents very serious global risks is overwhelming and therefore Keohane (2015) suggests that an urgent global response is required. It is not possible to accurately predict the consequences of climate change with complete certainty (Burke *et al.*, 2015b), but there is sufficient knowledge to understand that the risks and the benefits of strong, early action considerably outweigh the costs. Farmer *et al.* (2015) and Stern and Dietz (2015) point out that human actions contributing to climate change over the coming few decades could create risks of major disruption to economic and social activity in the latter part of the 22nd century and even in this century, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. Wittneben and Kiyar (2009) report that the evidence for human-induced climate change is overwhelming and indisputable. The IPCC (2014) confirms that climate change has worsened as GHGs, mainly from human activities, are the highest in history. Kennedy (2017) points out that there is agreement among most scientists that human activity is changing the earth’s biosphere and geology and that climate change caused by global warming is increasing rapidly along with rising sea levels, extreme weather conditions and diminishing biodiversity. Additionally, climate change impacts will worsen in the coming decades which will impact on future generations and those living in poverty the most.

The UN (2015) maintains that climate change and environmental degradation undermine any progress achieved in various aspects of human effort, including poverty eradication, as poor people suffer the most, especially since GHG emissions have increased by over 50% since 1990. Rogelj *et al.* (2015) stress that the urgent and critical challenge for the global community is addressing the relentless rise in GHG emissions which triggers climate change impacts.

3.2.1 Global Warming

Fekete *et al.* (2016) explain that the atmosphere, which is composed of different gases, circulates energy from the equator, where the Sun's radiation arrives most intensely, to the poles via weather systems such as cyclones, storms and weather fronts. Additionally, one of the most important circulation systems that the atmosphere supports is the hydrologic cycle which regulates precipitation in its various forms across the world. However, Tian *et al.* (2016) point out that GHGs that remain in the atmosphere for decades and longer, and which impede the escape of longwave radiation, adversely affects the efficient function of the hydrologic cycle. Hope *et al.* (2017) are of the view that global warming is caused by the rising levels of GHGs. According to the IPCC (2014), the major GHGs are CO₂, methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), per fluorocarbons (PFCs) and sulphur hexafluoride (SF₆). Seneviratne *et al.* (2016) explain that one of the most common GHGs is CO₂ which is an essential link between plants and animals, and as plant material decomposes, bacteria and other organisms consume the mass, releasing more CO₂ back to the atmosphere. Jeffery *et al.* (2016) explain that in the absence of oxygen, bacteria produce CH₄, another common GHG. Upadhyaya (2016) claims that since the beginning of the Industrial Revolution, in the mid-18th century, intense and inefficient burning of wood, charcoal, coal, oil and gas, accompanied by massive land-use change, has resulted in increased concentrations of GHGs in the Earth's atmosphere. The IPCC (2014) reports that the current CO₂ level is higher than it has been in at least 800 000 years and while some volcanic eruptions have released large quantities of CO₂ in the distant past, human activities now emit more than 135 times as much CO₂ as volcanoes each year. Additionally, human activities currently release over thirty billion tons of CO₂ into the atmosphere every year. According to the UNFCCC (2011), the WMO describes the build-up of GHGs in the atmosphere as resulting from the growing use of energy and expansion of the global economy. This is underscored by Bouman *et al.* (2015) who indicate that the combustion of fossil fuels to generate electricity is the largest single source of CO₂ emissions. Industrial processes also use

electricity and therefore indirectly cause the emissions from this consumption (du Can *et al.*, 2015). Several processes also produce CO₂ emissions through chemical reactions that do not involve combustion, for example, the production and consumption of mineral products such as cement, the production of chemicals and metals such as iron and steel (Li *et al.*, 2015). Dimitriou *et al.* (2015) and Taptich *et al.* (2015) further explain that the combustion of fossil fuels such as gasoline and diesel to transport people and goods via road vehicles, air travel, marine transportation, and rail is the second largest source of CO₂ in the world.

The IPCC (2014) reported that electricity and heat production, industry and transport sectors contributed 60% of the total global direct GHG emissions of the global forty-nine Gt CO₂ equivalent that was released in 2010 (Figure 3.1). Of the total global emissions from electricity and heat production, 23% was from buildings and industry (Figure 3.2).

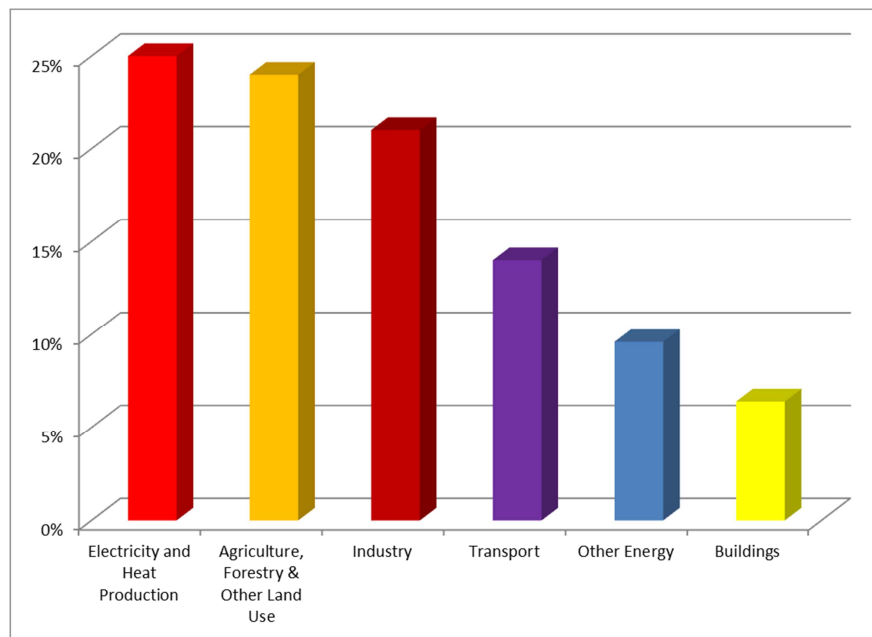


Figure 3.1: Total global direct GHG emissions by economic sector (adapted from the IPCC, 2014: 44)

Other human-related source of GHG, according to Leip *et al.* (2015), is from domestic livestock such as cattle, buffalo, sheep, goats and camels who cumulatively produce large amounts of CH₄ as part of their normal digestive process. Bhada-Tata and Hoornweg (2016) explain that waste from homes and businesses also generate CH₄ emissions in landfills as the waste decomposes. Purohit and Høglund-Isaksson (2016) comment that F-gases have no

natural sources and only come from human-related activities such as aluminium and semiconductor manufacturing. The human sources of N₂O include agriculture, fossil fuel combustion, wastewater management and industrial processes (Reay, 2015).

The increased amounts of GHGs from all these anthropogenic activities result in a significant increase in the temperature of the earth, which leads to the warming of the earth that triggers climate change (Upadhyaya, 2016). The IPCC (2014) describes the greenhouse effect (or global warming) as the gradual increase, observed or projected, in global surface temperature, as one of the consequences of increasing anthropogenic emissions of GHGs into the atmosphere.

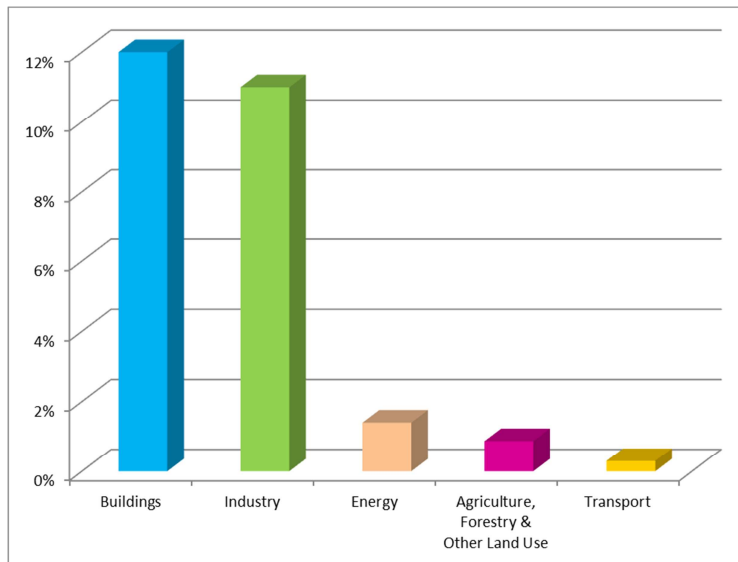


Figure 3.2: Indirect CO₂ emissions by economic sector (adapted from the IPCC, 2014: 44)

Hansen *et al.* (2016) point out that the rapid warming of the planet triggers off unpredictable and often devastating changes to our climate. This is underscored by the IPCC (2014) who state that climate change is the fluctuation in the state of the climate system over time, due to natural variability or as a result of direct and indirect human activities. The IPCC (2014) further asserts that the continued emission of GHGs will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems.

3.2.2 Contributions of humans to climate change

According to Myers *et al.* (2015), there is almost global consensus among the scientific community that there exists a causal relationship between human activities and climate change. This is underscored by Bouman *et al.* (2015) who claim that there is compelling evidence that rapid and unpredictable changes in climate results from the combination of natural variability and human influences, in particular land-use changes and GHGs emitted from the use of fossil fuels. This is further emphasised by Hope *et al.* (2017) who assert that global warming is caused by anthropogenic release of CO₂.

The IPCC (2014) maintains that human influence on the climate system is clear, and recent anthropogenic emissions of GHGs are the highest in history. Human-induced GHG emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever (Taylor *et al.*, 2016). According to Stott (2016), such anthropogenic drivers have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century. Cook *et al.* (2016) also confirm that human influence has been the dominant cause of the observed warming since the mid-20th century and that it is also likely that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations. Olivier *et al.* (2015) explain that North America and Europe have produced around 70% of all the CO₂ emissions due to energy production, while developing countries have accounted for less than 25%. However, Geng *et al.* (2016) assert that most future emissions growth will come from today's developing countries, including South Africa, because of their rapid growth in population and GDP, and their increasing share of energy-intensive industries. Liu *et al.* (2016) suggest that limiting climate change, in particular from human-induced sources, will require substantial and sustained reductions of GHG emissions.

3.2.3. Climate change impacts

According to Hansen and Cramer (2015), in recent decades changes in climate have caused impacts on natural and human systems on all continents and across the oceans. Additionally, these impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to changing climate. Elmhagen *et al.* (2015) suggest that such changes would transform the physical geography of the world and a radical change

in the physical geography of the world will have significant implications for human geography such as where and how people live.

Janković and Schultz (2015) report that there is growing observed evidence of increased severe weather events, flooding and diminished ice cover, all of which can be attributed to climate change. Özokcu and Özdemir (2017) and Valiente-Banuet *et al.* (2015) support this assertion by also indicating that there have been increases in the intensity, duration and spatial extent of droughts; higher atmospheric temperatures; warmer sea surface temperatures; changes in precipitation patterns and diminishing glaciers and snowpack. Furthermore, Gosling and Arnell (2016) also indicate that climate change is likely to exacerbate water availability and quality, which will have a wide range of implications for business, as renewable surface water and groundwater resources will be reduced in most dry subtropical regions, intensifying competition for water among different sectors. Hansen *et al.* (2016) show that the atmosphere and ocean have warmed, the amounts of snow and ice have diminished and sea level has risen. Additionally, changes in many extreme weather and climate events have been observed since about 1950. Dai *et al.* (2015) indicate that surface temperature is projected to rise during the 21st century under all assessed emission scenarios. It is very likely that heat waves will occur more often and last longer (Watts *et al.*, 2015) and that extreme precipitation events will become more intense and frequent in many regions (Lau and Kim, 2015).

This is underscored by the scientific reports which indicate that many species face an increased extinction risk due to climate change during and beyond the 21st century, especially as climate change interacts with other stressors (IPCC, 2014). According to Parmesan and Hanley (2015), most plant species cannot naturally shift their geographical ranges sufficiently fast to keep up with current and high projected rates of climate change in most landscapes. Terry and Rowe (2015) believe that most small mammals and freshwater molluscs will not be able to adapt fast enough to the changes in climate projected for this century. Additionally, it is expected that species extinction rates will increase, whereas in the past species became extinct without the current levels of anthropogenic climate change. The IPCC (2014) reports that the sustainable yield of fish stocks and other ecosystem services will be at risk, due to projected climate change by the mid-21st century and beyond, as there is great risk to worldwide marine species redistribution especially in sensitive regions. This view is shared by Deutsch *et al.* (2015) who indicate that marine organisms will face progressively lower

oxygen levels and high rates and magnitudes of ocean acidification, as rising ocean temperature extremes increase the risks. Pandolfi (2015) comments that coral reefs will be susceptible to damage and Royles and Griffiths (2015) indicate that polar ecosystems are highly vulnerable. Williams *et al.* (2016) indicate that coastal areas which are already impacted by human activity, pollution, invasive species and storms will be under increasing stress due to changes in climate. Additionally, much of the current coastal development reduces the ability of natural systems to respond to climate changes. This is underscored by Ross *et al.* (2015) who indicate that sea level rise could also erode and flood coastal ecosystems and eliminate wetlands. Carson *et al.* (2016) further confirm that coastal systems and low-lying areas are at risk from sea level rise, which will continue for centuries, even if the global mean temperature is stabilised.

Kolieb and Harrould-Kolieb (2011) assert that climate change will continue to be a driver of conflict, especially in the poorest, least-developed regions. Rose (2015) suggests that climate change is set to continue to have negative impacts on human security, especially for the most vulnerable countries including several African countries. Additionally, it is likely that climatic and weather shifts may result in higher incidences of communal tensions and armed conflicts (often of the intra-state variety involving non-state actors). Raleigh and Urdal (2015) also indicate that incidences of conflict and major impacts of climate-change often compound the severity of the other. Kelley *et al.* (2015) further point out that those communities that are prone to conflicts are often the ones with the lowest climate change adaptive capacity and that there could be an increased risk of violent conflicts as climate change will intensify known drivers of these conflicts, such as poverty and economic shocks.

Dawson *et al.* (2016a) claim that climate change worsens other threats to social and natural systems, placing additional burdens, particularly on the poor, and undermines food security. This is underscored by Hertel (2016) who claims that global temperature increase combined with increasing food demand, would pose large risks to food security globally. This view is further supported by Ewert *et al.* (2016) who explain that more extreme temperature and precipitation can prevent crops from growing and extreme events, especially floods and droughts can harm crops and reduce yields. Varanasi *et al.* (2015) are of the view that many weeds, pests and fungi thrive under warmer temperatures, wetter climates and increased CO₂ level; and this will trigger off an increase in the use of pesticides and fungicides which may negatively affect human health and the environment.

Sejian *et al.* (2015) maintain that heat waves, which are projected to increase under climate change, could directly threaten livestock. Additionally, such heat stress can increase vulnerability to disease, reduce fertility, and reduce milk production, while hot dry conditions may threaten pasture and feed supplies as well as increase the prevalence of parasites and diseases that will affect livestock due to warmer conditions. The IPCC (2014) supports this view as in recent decades changes in climate have caused impacts on natural and human systems throughout the world. Moreover, impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to changing climate.

According to Melillo *et al.* (2014) climate change will have costly impacts on both life and property. Keenan (2015) notes that climate change will likely alter the frequency and intensity of forest disturbances, including wildfires, storms, insect outbreaks, and the occurrence of invasive species. Franchini and Mannucci (2015) and Watts *et al.* (2015) explain that a warmer climate is expected to both increase the risk of heat-related illnesses and death and worsen conditions for air quality and that there will likely be an increase in the frequency and strength of extreme events that threaten human safety and health as well as allow some diseases to spread more easily.

Arnell (2016) indicates that countries around the world will likely face climate change impacts that affect a wide variety of sectors, from water resources to human health to ecosystems. Arnell *et al.* (2016) confirm that impacts will vary by region and by population and emphasise that many people in developing countries are more vulnerable to climate change impacts than people in developed countries. Schäfer *et al.* (2016) also indicate that climate change impacts across the globe can also have national security implications. Dunford *et al.* (2015b) claim that climate change will affect certain groups more than others, particularly groups located in vulnerable areas especially the poor, young, old or sick. Additionally, people's jobs and livelihoods will be at risk and there will be mass migration of people within countries and between countries and small islands. Furthermore, the lack of resources and social capacity do not allow people living in poverty to move away from extreme weather threats (Sprigg and Steinberg, 2016).

Chinowsky *et al.* (2015) indicate that higher temperatures, more severe storms, and higher storm surges will likely damage transportation infrastructure. Additionally, there will be

delays and temporary and permanent closures of coastal roads, railways and airports that are vulnerable to sea level rise. According to Wang *et al.* (2016), water supply and quality will be negatively affected by warming temperatures, changes in precipitation, sea level rise, increased flooding and drought, water quality impairment and salt water intrusion to coastal water supplies. Moreover, many sectors including energy production, infrastructure, human health, agriculture, and ecosystems will be affected by changes to water resources.

According to Childers *et al.* (2015) and the IPCC (2014), climate change in urban areas is projected to increase risks for people, assets, economies and ecosystems including risks from heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution, drought, water scarcity, sea level rise and storm surges. Dunford *et al.* (2015a) further indicate that such risks are amplified for those lacking essential infrastructure and services or living in exposed areas including rural areas which are expected to experience major impacts on water availability and supply, food security, infrastructure and agricultural incomes, including shifts in the production areas of food and non-food crops. Tucker *et al.* (2015) believe that climate change impacts are projected to slow down economic growth, make poverty reduction more difficult, further erode food security and prolong existing and create new poverty traps, the latter particularly in urban areas and emerging hotspots of hunger. Winsemius *et al.* (2015) believe that in many places, changes in the climate affect the nature, magnitude and frequency of a number of existing stressors experienced, while in others it may present completely new threats, such as flooding caused by rising sea levels and disease outbreaks in areas where they have not previously occurred. According to the IPCC (2014), many aspects of climate change and associated impacts will continue for centuries, even if anthropogenic emissions of GHGs are stopped and that limiting climate change would require substantial and sustained reductions in GHG emissions which, together with adaptation, can limit climate change risks. Adamo (2015) supports this by advocating that climate change impacts on human and natural systems will be severe and potentially irreparable unless strong actions are taken to stabilise atmospheric GHG concentrations.

3.3 Climate change instruments and institutions

Aldy and Pizer (2016) and Nissinen *et al.* (2015) comment that concerns about global climate change due to the greenhouse effect have led policy-makers from many countries to consider ways of limiting emissions of GHGs, particularly CO₂ emissions associated with the

generation of energy from fossil fuels. According to Vogel and Henstra (2015), there are two distinct categories of policy instruments that are pertinent to global climate change, namely:

- domestic policy instruments which seek to enable individual nations to achieve their specific targets or goals; and
- international (bilateral, multilateral, or global) instruments which can be employed jointly by groups of nations.

However, Winkler and Dubash (2015) believe that most countries will only adopt strict climate change policies if they are of the view that there will be positive net benefits, including international funding for them. Aldy and Pizer (2016) are further of the view that successful policies to address this global environmental problem will require the adoption of international agreements. Hence, both domestic and international policy instruments must be considered. According to du Pont *et al.* (2017), a global agreement was put in place in 2016 in Paris, which included a formidable goal to eliminate net GHG emissions towards the end of this century, and to limit global warming to well below 2°C. However, the current combined emission reduction commitments from countries will not be adequate to keep global temperatures rising above 2°C.

O'Rourke and Lollo (2015) point out that climate change role-players understand that achieving practical steps to address climate change will demand some difficult political, social and individual choices. Furthermore, Kennel *et al.* (2016) recognise that the sciences should be the source of information and evidence for decisions aimed at preventing human impact on the climate system. In addition, Eriksen *et al.* (2015) advocate that these decisions also involve value judgements which will be defined by socio-political processes influenced by development, equity and sustainability considerations, together with consideration of uncertainties and risk. Eckersley (2012) further contend that traditional forms of science and policy-making, however, cannot alone find solutions to such a complex and pervasive issue, as climate change is shrouded in several layers of scientific uncertainty, and entails high stakes for all concerned.

Both the IPCC (2014) and Wiest *et al.* (2015) support the view that since climate change is global in its causes and consequences, international collective action will be critical in driving an effective, efficient and equitable response on the scale required. Brügger *et al.* (2015)

claim that effective decision-making to limit climate change and its effects can be informed by a wide range of analytical approaches for evaluating expected risks and benefits, recognising the importance of governance, ethical dimensions, equity, value judgments, economic assessments and diverse perceptions and responses to risk and uncertainty. Macintosh *et al.* (2015) explain that the design of climate policy is influenced by how individuals and organisations assess risks and uncertainties and that there are many assessment methods in the economic, social and ethical fields to assist decision-making, which take account of a wide range of possible impacts, including low-probability outcomes with large consequences. However, according to Perry (2015), these methods cannot identify a single best balance between mitigation, adaptation and residual climate impacts.

Winsemius *et al.* (2015) argue that the livelihood resources and response options of the poor are usually narrower and poor people are more climate-sensitive than the rich. Hence, Tanner *et al.* (2015) recommend that strengthening the social, economic and environmental resilience of the poorest and the most vulnerable against climate change is the most urgent challenge in addressing climate change.

3.3.1 The Intergovernmental Panel on Climate Change (IPCC)

According to Edenhofer and Seyboth (2013) and Hulme (2017), the IPCC was established in 1988 jointly by the WMO and the United Nations Environment Programme (UNEP). Hickman (2015) indicates that the IPCC is the leading international body for the assessment of climate change. Additionally, in the twenty-eight years since its founding, the IPCC has become a key framework for the exchange of scientific dialogue on climate change within the scientific community as well as across the science and policy arenas.

Oppenheimer (2017) and Shapiro *et al.* (2010) point out that the IPCC's main objective is to prepare, based on available scientific information, assessments on all aspects of climate change and its impacts. Additionally, the IPCC is tasked formulating realistic response strategies and also assessing in a comprehensive, objective, open and transparent manner the scientific, technical and socio-economic information relevant to understanding the scientific basis for the risk of human-induced climate change, and its potential impacts and options for adaptation and mitigation opportunities. Hulme and Mahoney (2010) maintain that there is an expectation that the IPCC reports are neutral with respect to policy, although they may need to deal objectively with scientific, technical and socio-economic factors relevant to the

application of particular policies. Additionally, since 1992, the IPCC has regularly delivered the most comprehensive scientific reports about climate change produced worldwide, called the Assessment Reports (AR), the latest being the Fifth Assessment Report (AR5) which was released in 2014, and consists of three Working Group (WG) reports and a Synthesis Report which integrates and synthesises material in the WG reports for policy-makers.

3.3.2 Agenda 21 and the UNFCCC

Weiss (1992) explains that the United Nations Conference on Environment and Development (UNCED), commonly referred to as 'The Earth Summit', was held from the 3-14 June 1992, in Rio de Janeiro, Brazil and was attended by 172 governments, 108 Heads of State or Government, and about 2 400 representatives of NGOs. According to Pallemerts (2003), the main outcomes of UNCED were Agenda 21, the Rio Declaration on Environment and Development, the Statement of Forest Principles, the UNFCCC and the United Nations Convention on Biological Diversity.

Spangenberg (2002) describes Agenda 21 (which is a reference to addressing issues by the 21st Century) as a 300-page document divided into forty chapters that have been grouped into four sections, namely:

- Section I: Social and economic dimensions is directed toward combating poverty, especially in developing countries, changing consumption patterns, promoting health, achieving a more sustainable population, and sustainable settlement in decision-making.
- Section II: Conservation and management of resources for development and includes atmospheric protection, combating deforestation, protecting fragile environments, conservation of biological diversity (biodiversity), control of pollution and the management of biotechnology and radioactive wastes.
- Section III: Strengthening the role of major groups such as children, youth, women, NGOs, local authorities, business and industry, and workers; and strengthening the role of indigenous peoples, their communities, and farmers.
- Section IV: Means of implementation includes science, technology transfer, education, international institutions and financial mechanisms.

This study aims to contribute to Section III and IV of Agenda 21 in particular, due to the relevance to climate change learning. Walker (2017) asserts that stakeholder engagement, in support of sustainability, is embedded in Agenda 21 which emphasises the need to nurture environmental and ethical awareness, values and attitudes, skills and behaviour.

According to Pallemmaerts (2003), the primary authority for the UNFCCC is the COP where member countries (or 'Parties'), negotiate the provisions set out in the UNFCCC and the Kyoto Protocol. O'Brien *et al.* (2006) explain that the negotiations at COP are critical to ensure that important decisions are made and actions taken to meet the requirements of the UNFCCC and the protocol. Hjerpe and Linnér (2010) report that the annual COP has been attended by many government delegates from all countries, and many stakeholders including observer organisations, NGOs, Inter-Governmental Organisation and journalists. Each year, a different continent hosts the COP and in 2011, it was Africa's turn, when the COP17 was hosted in Durban, South Africa (Jones *et al.*, 2012) and the most recent COP22 was held in Marrakech, Morocco, from the 7-18 November 2016 (Annesi-Maesano, 2016; Cozier, 2017). According to Eskom (2015e), all the decisions and deliberations undertaken under the UNFCCC affect Eskom in one way or another, as South Africa is one of the parties to the UNFCCC and Eskom is the single largest emitter of GHG in South Africa and, according to Eskom (2016b) and Pollet *et al.* (2015), contributes around 45% to the total national GHG emissions of the country.

The administrative and technical support for the work of the UNFCCC and the Kyoto Protocol is provided by the UNFCCC secretariat which is based in Bonn, Germany (Moncel and Asselt, 2012). According to Rong (2010), although South Africa is a party to the UNFCCC and the Kyoto Protocol, the country is listed as a non-Annex 1 country, namely, South Africa is therefore not subject to the emission reduction targets as the developed countries are. The South African DEA is the authority responsible to draft and administer all UNFCCC related strategies, policies and programmes to ensure compliance (Winkler and Marquand, 2009).

3.3.3 The Kyoto Protocol

According to Breidenich *et al.* (1998), UNFCCC representatives from countries around the world met in December 1997 in the city of Kyoto in Japan to discuss and develop an international policy in response to human-caused climate change. UNFCCC (2011) states that

the landmark agreement reached at this event became known as the Kyoto Protocol to the UNFCCC. Almer and Winkler (2017) and Iwata and Okada (2014) explain that this international treaty binds most developed countries (called Annex 1 countries) to a cap and trade system for the six major GHGs and that emission quotas were agreed by each participating country, with the intention of reducing their overall emissions by 5.2%, of their 1990 levels, by the end of 2012. Additionally, under the treaty, for the 5-year compliance period from 2008 until 2012, countries that emit more than their quota will be able to buy emissions credits from nations that meet or exceed their quota. Almer and Winkler (2017) point out that even though timeframes were set for reaching the emission reduction targets, the following challenges in enforcing this protocol exist:

- the USA refused to ratify the protocol although it is one of the biggest emitters of GHGs;
- the difficulty to enforce the targets and penalise non-conforming countries, without impacting on sovereign rights;
- only thirty-six industrialised countries have targets, which covers only a portion of global GHG emissions; and
- the rapid growth in emissions from both developed and developing countries (such as China, India and South Africa) will counteract the emission reductions achieved from the group of industrialised countries which have ratified the protocol.

Lau *et al.* (2012) claim that major GHG emitters who are among the Kyoto Protocol ratifying developed nations exhibit the potential to achieve the desired Kyoto pledges through the aid of the Clean Development Mechanisms (CDM), mainly from using renewable energy, as proposed in the Kyoto Protocol (UN, 2010). However, after more than twenty-two sessions of the COP and twenty years since the Kyoto Protocol was drafted, there has not been much progress on achieving the emissions target due to the various disagreements between countries, as the UN (2015) acknowledges that achievement of the goals have been uneven and that there are shortfalls in many areas, for example, between 1990 and 2012, global emissions of CO₂ increased by over 50%.

However, there is an anticipated improvement in addressing climate change as du Pont *et al.* (2017) and Falkner (2016) explain that at the COP21 in Paris a legally binding treaty on climate action which contains emission reduction commitments from 187 countries starting in

2020, and which is hoped will keep the warming of the planet in check, was proposed. Additionally, this Paris Agreement will only enter into force once fifty-five countries covering 55% of global emissions have acceded to it. According to Dimitrov (2016), there is still a long way to go in achieving the targets of the Kyoto Protocol to make a significant reduction in the GHGs, as there is likely to be another long process before all fifty-five countries agrees.

According to Sebos *et al.* (2016), the Kyoto Protocol drafted at its first meeting two categories of response, namely mitigation and adaptation. Stern (2016) asserts that many adaptation and mitigation options can help address climate change, but no single option is sufficient by itself. Additionally, effective implementation depends on policies and cooperation at all scales and can be enhanced through integrated responses that link adaptation and mitigation with other societal objectives. Baker *et al.* (2012) de Coninck and Puig (2015) point out that effective adaptation and mitigation responses will depend on policies and measures across multiple scales: international, regional, national and sub-national. IPCC (2014) underscores this in claiming that mitigation and adaptation are complementary approaches for reducing risks of climate change impacts over different time scales.

3.3.3.1 Mitigation

The IPCC (2014) describes mitigation as a human intervention to reduce the sources of GHGs or enhance the sinks of GHGs. Hall and Clayton (2009) point out that there is an inherent fear in how people approach mitigation, as climate change and its impacts, such as the loss of a beach or extreme weather events, are considered bad news and most people see many challenges to addressing climate change. Therefore most people resist any ideas of adopting a mitigating strategy in their operations. Carrico *et al.* (2015) explain that mitigation typically involves measures to reduce the emission of GHGs by reducing reliance on fossil fuels. van Vuuren *et al.* (2017) suggest that lowering anthropogenic GHGs would require a number of mitigation strategies working together such as resource efficiency, sustainable production methods and investment in human development, which is relevant to this study. According to Girod *et al.* (2014) and Stewart *et al.* (2013), some of the ways to mitigate GHG emissions include:

- reducing demand for emissions-intensive goods and services;

- increased efficiency, which can save both money and emissions;
- action on non-energy emissions, such as avoiding deforestation; and
- switching to lower-carbon technologies for power, heat and transport.

Embedded in all these recommendations is the important role of the individual (Swim and Becker, 2012). Girod *et al.* (2014) further point out that cost will differ considerably depending on which combination of these methods is used, and in which sector. Santucci *et al.* (2015) advise that taking strong action to reduce emissions must be viewed as an investment, a cost incurred now and in the coming few decades to avoid the risks of very severe consequences in the future. Additionally, if prudent investments in mitigation are made early, costs can be managed and a wide range of opportunities for growth and development will emerge.

Luderer *et al.* (2016) point out that to limit warming to below 2°C relative to pre-industrial levels requires substantial emission reductions over the next few decades and near zero emissions of CO₂ and other long-lived GHGs by the end of the century. Sorrell (2015) argues that there are significant technological, economic, social and institutional challenges in attempting to implement such reductions. Additionally, these challenges increase with delays in additional mitigation and the absence of key technologies. However, the IPCC (2014) explains that mitigation options are available in every major sector and that mitigation can be more cost-effective if using an integrated approach that combines measures to reduce energy use and the GHG intensity of end-use sectors, de-carbonise energy supply, reduce net emissions and enhance carbon sinks in land-based sectors.

According to the IPCC (2014), mitigation involves some level of co-benefits and of risks due to adverse side effects. Additionally, these risks do not involve the same possibility of severe, widespread and irreversible impacts as risks from climate change. Hence near-term mitigation efforts reduce the risks. Moreover, without additional mitigation efforts beyond those in place today, and even with adaptation, warming by the end of the 21st century will lead to high to very high risk of severe, widespread and irreversible impacts globally. Rogelj *et al.* (2015) emphasise that without mitigation beyond those in place today, global emissions growth is expected to persist, driven by growth in global population and economic activities.

Additionally, without any mitigation, global mean surface temperature is likely to increase steadily.

Rosen and Guenther (2015) and Roy *et al.* (2015) suggest three essential elements of policy for mitigation, namely, a carbon price, technology policy and, importantly, the removal of barriers to behavioural change, and that excluding any one of these elements will significantly increase the costs of action. von Stechow *et al.* (2015) highlight some of the challenges to mitigation:

- Political and technical obstacles in the way of cutting emissions in developed and developing countries;
- Inevitable climate changes as projected by the IPCC;
- Changes in climate due to factors other than human-induced climate change; and
- Increasing climate impacts due to the increasing vulnerability of society due to population growth and technological change.

This is backed up by the UN (2015) which reports that in spite of some mitigation efforts across the world, GHG emissions are increasing. IPCC (2014) suggests that climate change is a collective action problem at the global scale, because most GHGs accumulate over time and mix globally. Additionally, emissions by any agent (for example, individual, community, company and country) affect other agents and effective mitigation will not be achieved if individual agents advance their own interests independently. Moreover, cooperative responses, including international cooperation, are therefore required to effectively mitigate GHG emissions and address other climate change issues. However, Long (2016) indicates that with the recent change of administration in the USA, there is likely to be a change or setback in the global climate change agreement accompanied by a change in focus in the USA due to President Trump's support of continued coal usage and the withdrawal of the USA from the 2015 Paris climate agreement.

3.3.3.2 Adaptation

The IPCC (2014) explains that adaptation refers to managing the impacts of climate change which, according to Sovacool *et al.* (2017), involves taking practical actions to cope with risks from climate impacts, protect communities and strengthen the resilience of the economy and infrastructure. Sovacool *et al.* (2017) suggest that adaptation can reduce the risks of

climate change impacts, but there are limits to its effectiveness, especially with greater magnitudes and rates of climate change. Nicholls *et al.* (2007) show that, by the year 2070, up to 140 million people and approximately US\$35 000 billion of assets could be dependent on flood protection in large port cities around the world because of the combined effect of population growth, urbanisation, economic growth and sea level rise. Gifford *et al.* (2011) assert that for climate scientists, adaptation usually refers to structural adaptations made to address current and impending physical impacts of climate change, such as building a sea wall in anticipation of rising sea levels. However, adaptation options are many and range from technological options such as increased sea defences (Firth *et al.*, 2013) or flood-proof houses on stilts (Sutradhar *et al.*, 2015), to what Capstick and Pidgeon (2014) believe is behaviour change at the individual level, such as the sparing use of water in times of drought and other pro-climate change actions (Staats *et al.*, 2004).

Brügger *et al.* (2015) suggest that there is a need for psychological adaptation since human behaviour causes climate change, humans can also respond and adapt to it. UNEP (2009) suggests that some adaptation choices to minimise the damage from climate change could include early action to improve seasonal climate forecasts, food security, freshwater supplies, disaster and emergency response, famine early-warning systems and insurance coverage. Reed *et al.* (2013) indicate that adaptation actions to reduce the risks of flooding include both structural, for example, dam building and non-structural such as insurance measures, forecasting and warning plans, and flood-proofing and elevation. Thieken *et al.* (2016) suggest that there is a wide range of adaptive structural and non-structural measures that could be adopted for climate change impacts. According to Sovacool *et al.* (2017), adaptation to climate change must address three broad issues to strengthen ecosystems, communities and human organisations, namely: infrastructural, organisational and social adaptation. Additionally, adaptation to climate change must also be considered as a multidimensional process which not only involves structural measures, but also includes climate change awareness of local communities; educating the public, government officials and business leaders about emergency preparedness and climate risks; and empowering local communities to decide on infrastructure investments. Obtaining feedback from stakeholders and civil society is also critical for successful adaptation programmes.

According to Butler *et al.* (2015), adaptation is made up of actions at all levels of society, by individuals, groups and governments. Additionally, the protection of economic well-being or

improvement of safety could be the motivation for adaptation measures. There are many different adaptation methods as Millner and Dietz (2015) suggest through market exchanges and, according to Adger *et al.* (2013), through extension of social networks or through actions of individuals and organisations to meet their own individual or collective goals. Adaptation can be undertaken by an individual for personal reasons or by governments and public bodies to protect their citizens (Wamsler and Brink, 2015). Rosenzweig *et al.* (2017) point out that adaptation options exist in all sectors, but their context for implementation and potential to reduce climate-related risks differs across sectors and regions although the effectiveness of adaptation can be enhanced through a range of actions, including international cooperation as some adaptation responses involve significant co-benefits, synergies and trade-offs. Lavorel *et al.* (2015) point out that there will be more challenges for many adaptation options as climate change increases. Murphy *et al.* (2016) believe that it is crucial for effective selection and implementation of adaptation strategies, that adaptation planning and implementation can be enhanced through complementary actions across levels, from individuals to governments. Additionally, national governments can coordinate adaptation efforts of local and sub-national governments, for example, by protecting vulnerable groups, by supporting economic diversification and by providing information, policy and legal frameworks and financial support. Moreover, local government and the private sector are increasingly recognised as critical to progress in adaptation, given their roles in scaling up adaptation of communities, households and civil society, and in managing risk information and financing (Porter *et al.*, 2015).

Societal values, objectives and risk perceptions according to Deng *et al.* (2017), influence adaptation planning and implementation at all levels of governance and that diverse interests, circumstances, social-cultural contexts and expectations must be acknowledged and recognised as this will benefit the decision-making processes. Fernández-Llamazares *et al.* (2015) argue that although indigenous, local and traditional knowledge systems and practices, including indigenous peoples' holistic view of community and environment, are a major resource for adapting to climate change, these have not been used consistently in existing adaptation efforts as the effectiveness of any adaptation strategy is enhanced when such forms of knowledge are integrated with existing practices. Biesbroek *et al.* (2013) report that some of the common limitations that hinder adaptation planning and implementation include limited financial and human resources, limited integration or coordination of governance, uncertainties about projected impacts, different perceptions of risks, competing values,

absence of key adaptation leaders and advocates, limited tools to monitor adaptation effectiveness as well as insufficient research, monitoring and observation, and the finance to maintain them.

Ford *et al.* (2015) comment that adaptation can be reactive (after impact takes place) or anticipatory (before impact takes place). According to Green *et al.* (2017), adaptation can therefore be carried out in response to or in anticipation of changes within existing situations and in social systems. Runting *et al.* (2017) point out that adaptation decisions are often made by a variety of actors, including private decision-makers, public agencies, governments and civic society with groups and individuals being drawn from varied backgrounds, economic sectors, settlements, communities, cultures and ecosystems. Ziervogel and Taylor (2008) note that although adaptation is understood as an instinctive and ongoing process of finding ways to respond to stresses that reduce or combat negative impacts and harness potential benefits of change, it needs to be explicitly supported and enhanced due to the new and severe challenges presented by global climate change. Adaptation to climate change is only just starting to emerge in policy and practice in southern Africa, although regionally there has been an increase in adaptation funding from international donors who work with local stakeholders but who control the funding and determine the focus (Daron, 2015).

While Buizer *et al.* (2016a) are of the view that other adaptation strategies such as improving access to climate information to change policies is necessary, Batel *et al.* (2016) believe that it is important to recognise that the political and socio-cultural environment is often as important in determining adaptation strategies and actions as the physical conditions. Additionally, adaptation is often highly constrained by prevailing circumstances, and support is needed at multiple levels to build adaptive capacity and support community-level development. Lawrence and Haasnoot (2017) maintain that strategies and actions can be pursued now which will move towards climate-resilient pathways for sustainable development, while at the same time help improve livelihoods, social and economic well-being and effective environmental management.

Lawn (2016) advocates that sustainable development when aligned with any climate change policy must include both adaptation and mitigation and that any delays in mitigating the build-up of GHGs could result in reduced options for climate-resilient pathways and adaptation in the future. Furthermore, Keskitalo *et al.* (2016) indicate that effective

implementation depends on policies and cooperation at all scales and can be enhanced through integrated responses that link adaptation and mitigation with other societal objectives; as adaptation and mitigation responses are underpinned by common enabling factors such as effective institutions and governance, innovation and investments in environmentally sound technologies, and infrastructure, sustainable livelihoods and behavioural and lifestyle choices. Tellingly, Demski *et al.* (2017) claim that GHG emissions, vulnerability to climate change and the capacity for adaptation and mitigation are strongly influenced by livelihoods, lifestyles, behaviour and culture. Also, the social acceptability and the effectiveness of climate policies are influenced by the degree to which they create incentives for people or the appropriate changes in lifestyles or behaviours that is applicable to a specific area or region (Grundmann, 2016). Thornton and Comberti (2017) further emphasize that successful implementation relies on relevant tools, suitable governance structures and, importantly, an enhanced capacity to respond. Peters *et al.* (2015) stress that GHGs will have to be reduced by at least 80% below the absolute level of current annual emissions and to achieve this is a major challenge in the world currently. Hammond and Pearson (2013) also indicate that there will be huge costs incurred as the world shifts from a high-carbon to a low-carbon trajectory. However, Orsato *et al.* (2015) are of the view that there will also be business opportunities as the markets for low-carbon, high-efficiency goods and services expand.

3.3.3.3 Clean Development Mechanism (CDM)

Rahman and Kirkman (2015) describe the CDM as a provision of the Kyoto Protocol that allows Annex 1 countries, for example, Germany to help meet their binding targets of curbing anthropogenic GHG emissions by reducing emissions in developing countries, for example, South Africa. Bréchet *et al.* (2016) further explain that the CDM provides an incentive for developed countries to invest in sustainable development projects that reduce emissions in developing countries, usually at lower costs than that of projects in their own such as a rural electrification project using solar panels or the installation of more energy-efficient lights, for example, the recent compact fluorescent light bulb project in South Africa to help with energy efficiency (Seeliger and Turok, 2016). This is supported by Zainuddin *et al.* (2017) who indicate that CDM enables the transfer of technology from developed countries to developing countries and also promotes sustainable growth. Everard *et al.* (2017) also claims that this mechanism stimulates sustainable development and emission reductions, while giving industrialised countries some flexibility in how they meet their emission reduction

targets. This is underscored by Zainuddin *et al.* (2017) who claim that environmental regulations, competitiveness and financial benefits have a positive impact on CDM implementation. However, according to Koo (2017), the social and environmental impacts of CDM projects have not been extensively assessed.

3.4 Climate change in South Africa

Klausbruckner *et al.* (2016) assert that South Africa is a country with an emerging economy, which has the second largest development in Africa. According to Zhao *et al.* (2015a), the low energy prices that attracted and supported energy intensive industries was instrumental to the economic success of South Africa in the past and also led to high emissions per capita of GHG from the predominantly coal-fired power industry. Steinberger *et al.* (2016) confirm that South Africa is a relatively significant contributor in Africa and the world, to global climate change with significant GHG emission levels from its energy-intensive, fossil-fuel powered economy.

According to Amjath-Babu *et al.* (2016), while Africa as a whole has contributed least to global GHG concentrations in the atmosphere, Africa faces some of the worst consequences and generally has the least capacity to cope with climate change impacts. This is underscored by the DEA (2004) and Kolieb and Harrould-Kolieb (2011) who state that climate change is predicted to have a significant negative impact on the human security of many people on the African continent. UNEP (2009) described Africa as very vulnerable to climate change and climate variability due to endemic poverty, weak institutions, and complex disasters and conflicts. Additionally, the IPCC (2014) indicates that drought has spread and intensified since the 1970s, and the Sahel and southern Africa have already become drier during the 20th century. Lee and van de Meene (2012) claim that human-induced climate change is a critical challenge, posing substantial risks even at the local level. A consideration that has been taken into account in the South African climate change adaptation strategies is that poorer households in the country are likely to be more vulnerable to adverse effects of climate change (DEA, 2013; Freund, 2016).

Ziervogel and Taylor (2008) indicate that South Africa has a climate that is variable on a number of time scales. This is underscored by Pasquini *et al.* (2013) who comment that there will be significant climate change impacts in South Africa, according to the current global

climate change models. This is underscored by Ziervogel *et al.* (2014) who point out that climate change is a key concern within South Africa, as mean annual temperatures have increased by at least 1.5 times the observed global average of 0.65⁰C over the past five decades and extreme rainfall events have increased in frequency. Fitchett *et al.* (2016) indicate that climate change poses a significant threat to South Africa's water resources, food security, health, infrastructure, as well as its ecosystem services and biodiversity.

According to Bellprat *et al.* (2015), historical records show that South Africa's climate has wet and dry phases associated with floods and droughts, strongly influenced by El Niño or the Southern Oscillation events, which are expected to become more frequent as a result of climate change. Additionally, the analysis of the historical records indicates significant increases in the intensity of extreme rainfall events and increasing air temperatures. Changing patterns of rainfall and temperature are likely to affect rates of soil erosion and water availability (Mastrorillo *et al.*, 2016; van Wilgen *et al.*, 2016), the threat of waterborne diseases as well as indirect health effects (Wright *et al.*, 2015), the frequency and magnitude of drought events (Edossa *et al.*, 2015), crop yields and food security (Ray *et al.* 2015), rural livelihoods, biodiversity and ecosystem services (Midgley and Bond, 2015).

Conway *et al.* (2015) maintain that due to South Africa's economic dependence on the primary sector such as agriculture, fisheries and mining, the country, like many other developing countries, is especially vulnerable to the effects of climate change. This is of great concern, especially as about 64% of people in South Africa are employed in the primary sector (Devarajan *et al.*, 2015). Cartwright *et al.* (2012) and Midgley *et al.* (2007) maintain that local governments need to engage with the challenge of planning and implementing adaptation strategies, given that South Africa is predicted to also suffer from the impacts of climate change. Ofoegbu *et al.* (2017) comment that in South Africa climate variability and change are affecting rural people and their livelihoods negatively and those whose lives are based on forest resources are most vulnerable.

Shackleton *et al.* (2015) point out that challenges in South Africa are numerous and varied, including a lack of political leadership, corruption, a lack of policy coherence or skills scarcity, and service delivery backlogs which are likely to impact on the effectiveness of the country's climate change response. Importantly for this research, Ziervogel *et al.* (2014) point out that the impact of climate change on the business sector has not been an explicit focus in national assessments. Additionally, a fully coordinated and concerted response is not

imminent, even though there have been numerous negotiations since 1992 and some degree of global cooperation between governments.

Ziervogel and Taylor (2008) suggest that in South Africa, climate change has gained importance only from 2007, with government taking a number of important steps and that climate change has also been identified as one of the 'grand challenges' to be addressed in the next ten years by the Department of Science and Technology. Altieri *et al.* (2016) report that a Long-Term Mitigation Scenario (LTMS) process, presenting a range of mitigation and climate action options for South Africa was developed by the DEAT, which provided a clear South African position on climate change. Additionally, the LTMS guided big cities such as Cape Town, Durban and Johannesburg to include climate vulnerability, impact assessments and adaptation options in their plans. Pretorius *et al.* (2015b) point out that at the 2009 COP15 negotiations in Copenhagen, South Africa voluntarily announced that it would act to reduce domestic GHG emissions by 34% by 2020, and by 42% by 2025, depending on the availability of adequate financial, technological and other support. Additionally, while these are ambitious and laudable targets, there is no obligation on South Africa to accomplish this, as the achievement of this is subject to financial assistance from developed countries. Poignantly, Pollet *et al.* (2016) underscore this by indicating that the South African government's commitment is contingent on obtaining financial and technological support, with the legislation to support GHG reductions still to be developed. This implies that if South Africa does not obtain the necessary funding and support, it cannot be held accountable for the non-achievement of those bold commitments.

Klausbruckner *et al.* (2016) explain that the South African National Climate Change Response Green Paper recommended the use of market-based instruments, specifically carbon taxes, to induce behavioural changes that contribute to lower GHG emissions in the country. Additionally, it is argued that all countries could price carbon domestically, outside of an international arrangement, as opportunities to pursue emission reductions and to generate revenue simultaneously. Oueslati (2015) points out that environmentally-related taxes have an important role to play in discouraging activities that impose high social costs and in helping to ensure that economic growth and development are sustainable. Moreover, Gevrek and Uyduranoglu (2015) suggest that a carbon tax can contribute to public awareness of climate change.

Amjath-Babu *et al.* (2016) suggest that South Africa needs to urgently strengthen the resilience of society and the economy to the anticipated climate change impacts. Additionally, the country needs to develop and implement policies, measures, mechanisms and infrastructure that protect the most vulnerable. Ziervogel *et al.* (2014) support this view and confirm that climate change mitigation has been a focus for a number of years in South Africa due to the acknowledgement that the country's per capita emissions are as high as many countries globally. Alloggio and Thomas (2013) point out that South Africa's new National Development Plan 2030 goes some way towards reframing climate change as a development challenge and several government departments across national, provincial and local level are now developing climate change strategies and plans.

According to Klausbrückner *et al.* (2016), South Africa's 2011 National Climate Change Response White Paper was the first clear outline of the South African government's strategy and responsibilities relating to mitigation and adaptation, albeit fourteen years after the Kyoto Protocol. Anyanwu *et al.* (2015) explain that this climate change response consists of the following:

- the need for coordination of responses between sectors, although a strongly sectorial approach is adopted and includes a comprehensive section on the overall approach to mitigation which has been repeated in South Africa's Intended Nationally Determined Contributions (INDC); and
- development of policy instruments such as a carbon tax, Desired Emissions Reduction Outcomes for sectors, company-level carbon budgets as well as regulatory standards and controls for specifically identified GHG pollutants and emitters.

There are six goals identified in South Africa's INDC, according to Altieri *et al.* (2016) and DEA (2015):

- development of a National Adaptation Plan as part of implementing the National Climate Change Response Plan by 2020;
- climate considerations into national development, sub-national and sectorial policy framework by 2020/2025;
- building the necessary institutional capacity for climate change response planning by 2025/2030;

- developing an early warning system for key climate adaptation sectors by 2025/2030 and reporting as part of a National Adaptation Strategy with rolling five-year implementation periods;
- development of a vulnerability assessment and adaptation needs framework by 2020 to support a continuous presentation of adaptation needs; and
- communicating past investments in adaptation for international recognition.

However, the South African government has emphasised that the INDCs must be viewed within the context of the country's national priorities such as the creation of decent employment through sustainable economic development, improved education, health and welfare, and access to food, shelter and modern energy services to eradicate poverty and address inequality (Anyanwu *et al.*, 2015). Uddin and Taplin (2015) underline this by stating that the climate change challenges have to be tackled within the context of other major issues in South Africa such as poverty reduction, service provision, economic development, integrated planning and improving social security. Amjath-Babu *et al.* (2016) earlier indicated that due to the high levels of poverty and inequality in South Africa, climate change impacts pose critical challenges for national development. This is underscored by Szabo *et al.* (2016) who are of the view that climate change will hamper the attainment of the SDGs and other important international targets.

3.5 Business and climate change

Bremer and Linnenluecke (2017) assert that climate change will pose considerable risk to organisations in the 21st century. Elijido-Ten (2017) points out that large corporations have strong economic impact and climate change as a net risk will be significant and negatively correlated to sustainability performance. This is underscored by Bouman *et al.* (2015) who claim that there is overwhelming scientific evidence that the atmosphere has been altered primarily due to the burning of fossil fuels and other industrial processes.

Kolieb and Harrould-Kolieb (2011) are of the view that some private sector activities continue to drive climate change, exacerbate communities' climate vulnerabilities, and are drivers of conflict. Additionally, global climate change began with business. It is the emission of massive amounts of CO₂, and other GHGs into the atmosphere, especially from the

burning of fossil fuels, from industrialised societies during the 19th and 20th centuries, according to the IPCC (2014), that is the primary cause of the anthropogenic climate change. Lacy *et al.* (2015) indicate that the largest emitters continue to be corporations, and it is mainly through the activities of oil, coal and gas multi-national corporations (MNCs) that fossil fuels continue to be extracted and burnt.

There are two key climate change issues for business to consider. Depoers *et al.* (2016) and Pan *et al.* (2016) indicate that companies must understand the impact and costs of their own GHG emissions. Gasbarro and Pinkse (2015) suggest that it is also important for businesses to evaluate their vulnerability to climate-related effects such as regional shifts in the availability of energy and water, the reliability of infrastructure and supply chains, and the increasing incidence of infectious diseases.

Furthermore, some of the potential impacts of extreme or destructive weather events on business include:

- security concerns as people (including customers and employees) will be forced to flee and some regions will become uninhabitable (Brzoska and Fröhlich, 2016);
- infrastructure will be damaged or destroyed (Neumann *et al.*, 2015), for example, existing water treatment plants and distribution systems were not built for current and future climate change impacts (Döll *et al.*, 2015);
- ecosystems will fail (Bakun *et al.*, 2015);
- agriculture will be disrupted (Wiebe *et al.*, 2015); and
- more economic instability (Taylor *et al.*, 2016).

Linnerooth-Bayer and Hochrainer-Stigler (2015) expand the issues for business by indicating that some of the direct effects on business include supply chain breakdowns, employee migrations, increases in disease, or even impact on reputation. Additionally, companies will need to evaluate their risks more broadly to identify if environments in which they operate are vulnerable to disastrous and increasing climate change-related events by systematically assessing the vulnerability of these environments to floods, droughts and storms. Moreover, special attention must be paid to business departments that have a limited ability to anticipate and adapt to climate change.

Demertzidis *et al.* (2015) point out that climate change can either be positive or negative for the operation of businesses. This is underscored by Lee *et al.* (2015b) who indicate that climate change can offer good business opportunities such as prospects for many entrepreneurs and prospective investors to exploit a number of new openings such as climate and environment bonds, carbon trading and environmental innovations. For example, Dutta (2016) observed that climate change-related issues were a focus for the UK Financial Times Stock Exchange (FTSE) 100 companies, primarily as a tool to maximise profit and due to institutional pressures. However, Mechler and Bouwer (2015) and Pearse *et al.* (2011) point out that climate change is the possible cause of many financial losses, which might affect an investors' portfolio value. Moreover, the extent to which a company is affected by various climate risks depends on the sector a business operates in, as climate change impacts differs for mining companies, electricity and water utilities, the tourism industry and sport companies (Dunford *et al.*, 2015b).

Coburn *et al.* (2011) and Dietz *et al.* (2016) indicate that climate change risks to businesses can be grouped into four fundamental categories:

- physical risks which include the effects of extreme weather events such as hurricanes, droughts, on businesses' operation and production or on the different stages of the supply chain;
- reputational risks are related to the negative reaction of consumers and local communities against businesses, for example, boycotts and protests due to the improper day-to-day operation of businesses with regards to various climate change aspects, for example GHG emissions;
- additional costs that put a strain on a company's human and financial resources due to the requirement to comply to climate change regulations, such as CO₂ emissions inventory and carbon and energy taxes; and
- litigation risks include penalties, for example, compensation, clean-up and rehabilitation costs and legal defence related to potential legal contravention of climate change laws.

According to Kolieb and Harrould-Kolieb (2011), corporations, in particular MNCs, can still focus on profits, but have great and untapped potential to contribute to climate change adaptation and mitigation initiatives. Additionally, it is the opportune time for the private sector such as businesses, industry and companies to become full partners in addressing

climate change. Dutta (2016) further indicates that while responding to climate change is considered universal imperatives and noble and desirable goals, there is a big challenge for business on how to achieve these in the most efficient manner. There has been considerable research and much popular criticism about the fundamental links between business and climate change. However, according to Andrade and de Oliveira (2015), far less attention has been paid to the positive potential for business involvement in climate change responses. Kolieb and Harrould-Kolieb (2011) argue that the business sector has an ethical obligation to assist those countries whose natural resources have contributed to their profit margins. Additionally, many African countries have often also borne the burden of the environmental impacts from MNCs and are now suffering the effects of climate change. Melillo (2015) therefore advocates that there is much reason and potential for business to tackle climate change.

Lozano *et al.* (2015) point out that it is understood these days that the objective of business is not only to maximise profits for its shareholders, but also a broader mandate that is beyond financial gains. Additionally, this concept is currently exemplified in the theory and practice of CSR or CSI. Pattberg and Widerberg (2016) augment this approach by claiming that progressive thinking, including upholding corporate values and minimising risks to their business, has become a good incentive for business to assume greater responsibility for climate change.

Allen and Craig (2016) suggest that the structure and operation of modern businesses have many values and features that include community issues. Additionally, these values can be leveraged to address society-wide problems like climate change. Dyllick and Muff (2015) and Lozano *et al.* (2015) explain that some of the features of business which contribute to the economy and sustainable growth of a country include the provision of jobs in a society, the provision of further entrepreneurial opportunities for locals, building human and financial capital, developing physical infrastructures, promoting social cohesion, and a source of revenue for governments. Buizer *et al.* (2016b) believe that these characteristics allow the private sector to assist in identifying and assessing how issues like climate change will affect a community, educate stakeholders as to the problems, and even help develop practical solutions, beneficial to the community concerned. Kolieb and Harrould-Kolieb (2011) also suggest that MNCs can lead by example and influence their suppliers such as service providers and contractors to reduce carbon emissions and guide suppliers towards a viable,

low-carbon local economy via the procurement process. Döll *et al.* (2015) are of the view that since water and energy are connected to social, cultural and environmental issues, businesses will find it difficult to achieve the best management outcomes on their own. Additionally, sound water governance, collective action, and partnerships are vital for most solutions to water supply and quality, sanitation and climate change issues. Moreover, efficient and effective responses to water and climate change concerns are enhanced when resources are combined and a wide range of expertise and knowledge, through partnerships for a common goal, are brought together which further emphasises the dire need for climate change learning at the organisational level.

Sabel and Victor (2015) believe that business can also play a vital facilitative and capacity building role that can contribute to climate change responses while Pasquini *et al.* (2013) maintain that business can assist local governments in developing the regulatory infrastructures that encourage, innovation, creativity and opportunities. Hoffman (2016) points out that a business's exposure to carbon controls is not only derived from its own emissions. Slawinski and Bansal (2015) suggest that businesses must also consider potential impacts on their product and service lines, for example, the positive or negative impact on operations and sales by climate change-related factors that place a value on carbon emissions. Additionally, businesses need to consider their competitive positioning by undertaking an assessment with a focus on risk management and bottom-line protection. Birkmann and Mechler (2015) point out that the starting point for addressing climate-related vulnerabilities can be undertaken via the risk management approach, but with time and experience, businesses need to shift their climate-related strategies to emphasise business opportunities. Additionally, top-line enhancements such as the potential for business opportunities based on GHG efficiency are derived from the risk of GHG-intensive operations, products and services. Moreover, effective climate-related strategies connect GHG reductions with a business's core strategy. According to Eleftheriadis and Anagnostopoulou (2015), value can be added to the business strategy through climate change initiatives by protecting reputation, enhancing competitive position and developing new products, as businesses will need to assess whether and how demand for their current and future product and service lines may be enhanced by climate-related developments.

Begum and Pereira (2015) believe that addressing climate change brings significant new opportunities across a wide range of businesses and services, such as markets for low-carbon

energy products. Additionally, it will be important for individual businesses and countries to position themselves to take advantage of these opportunities. Existing inefficiencies can be eliminated by developing and implementing climate change policies that can also create money-saving opportunities (Dramani and Tewari, 2013; Ryan and Campbell, 2012). This is underscored by Paul *et al.* (2017) who point out that climate change has strategic importance for business from two main standpoints: business's mitigation strategies such as process improvement, efficiency in energy consumption and waste disposal, low carbon footprint for new product developments, emission compensation and lobbying to influence climate change legislations, and secondly, adaptation to climate change impacts through water management, weather resistant constructions, captive energy production and addressing customer's climate change concerns.

Burke *et al.* (2015b) emphasise that due to the uncertainty in the extent of the impact of climate change, businesses need to do more because of the size of the negative climate change impacts in the worst-case scenarios. Harrison *et al.* (2015) advocate that developing and implementing a climate change policy can be a catalyst to reform inefficient energy systems and removing distorting energy subsidies. Additionally, it is important to develop and deploy a wide range of low-carbon technologies to achieve the significant cuts in emissions that are needed. Ockwell *et al.* (2015) are of the view that the private sector also has an important role in climate change research and development, and technology diffusion. Moreover, closer cooperation between government and business will further encourage the development of a broad range of low carbon technologies and also reduce costs.

For Wesseh and Lin (2016), the consequence of GHG emissions, in economic terms, is considered an externality, namely, the impacts are experienced by unrelated third parties such as society, and through climate change impacts, impose costs on the world and on future generations. Khan (2015) underscores this by pointing out that such polluters do not bear the full costs of their actions. Additionally, it is necessary for GHG emitters to bear the costs of their emissions, through an appropriate price on carbon, such as through tax or trading or indirectly through regulation. Such instruments will ensure that companies face the full social cost of their emission impacts and will also encourage individuals and businesses to move away from high-carbon goods and services and to invest in low-carbon alternatives.

Ziervogel *et al.* (2014) stress that there must be recognition of the institutional challenges that make it difficult for businesses in both the public and private sectors to work and collaborate effectively to meet the country's adaptation needs. Additionally, there are also many knowledge gaps in spite of the climate and impacts modelling in South Africa for the past twenty years. Barriers that may prevent action, even when measures to reduce emissions are cost-effective, include a lack of reliable information, business costs, the frequent failure to realise the potential for cost-effective energy efficiency measures and significantly, behavioural and organisational apathy (Shackleton *et al.*, 2015). Penna and Geels (2015) describe climate change as one of the grand challenges facing society that requires low-carbon innovation in many sectors and industries and provides the following six challenges, using the car industry as an example:

- climate change constitutes a major threat to core technology of industry, for example, internal combustion engines in the motor industry, and vested interests linked to sunk investments in factories, skills and supply chains for these technologies.
- a reluctance or hesitancy to engage in low-carbon innovations, and active resistance (especially in early phases of the process), to defend their interests and investments.
- if businesses accept the need for low-carbon re-orientation, they will have to invest in drastic, costly and risky innovations especially in capital- and scale-intensive industries such as car manufacturing, research and development factory retooling, new production processes, and establishment of supplier networks can be costly and risky as there is no guarantee that technical re-improvements will succeed.
- with many differing views on climate change, especially the anti-climate change sentiment by some big businesses and politicians, some companies may consider investing in the green revolution a risky move, with long-term strategic implications.
- Businesses' general reluctance and risk-aversion approach requires increasing external selection pressures for a transformation to climate-friendly engineering in business; however, the financial markets are not likely to initiate low-carbon innovations, since avoiding climate change is a collective good problem and because low-carbon innovations offer worse price or performance characteristics.
- initial pressures on business for change come from social movements, public opinion and policy-makers, and in time consumers will also apply the pressure to businesses.

Penna and Geels (2015) further indicate that the aforementioned pressures change with time and this creates further uncertainty for business with regard to re-organising the business model towards low carbon production. Additionally, some of the uncertainty relates to the rigorous or lax climate change regulations or a consumer's willingness or not to pay for low carbon innovations. Hence, in developing their strategies, businesses need to consider not only technical and economic issues, but also socio-political pressures.

It is apparent from the view of Runnells *et al.* (2015) that more climate change laws, such as carbon tax regulations are not the solution to the climate change challenges as environmental law is a good instrument to deter poor corporate behaviour, but it often does not encourage best practice. Liu *et al.* (2015) underscore this by suggesting that companies will tend to focus on minimum compliance to the law, when there are many rules such as legislation, by-laws, ordinances and regulations, as avoiding financial, legal and reputational risks are entrenched in most businesses' corporate strategy anyway. Chang (2015) believes that the focus on legal compliance is a reactive measure and relies on penalties when there is non-compliance and while enforcement of laws may prevent abuses and corrupt performance, it does not prompt positive behaviour.

As a result of the rapid spread and the political and economic influence of the modern corporation across the world, Haque *et al.* (2016) are of the view that it is now necessary in terms of legal requirements, customer requests and good governance that businesses consider innovative ways to assist in helping, especially at-risk communities, adapt to climate change. Nalau *et al.* (2015) indicate that some companies are often unsure when to begin their climate change programme because of perceived risks or uncertainty and are either too early or too late in their climate change initiatives. However, according to Pauw *et al.* (2016), most companies agree that it is important to act now, due to recent changes in the level of external awareness about climate risks, government action, momentum toward stronger national policies, and consumer demand for cleaner and more efficient products. This is endorsed by Breton and Sbragia (2016) who indicate that if climate change strategies are well-timed, companies are more likely to be better prepared for impending legislation and more flexible for long range strategic opportunities. Pauw *et al.* (2016) point out that establishing an appropriate level of commitment is important, as the risk is always of getting too far ahead of the competition. Additionally, businesses find it difficult to plan and spend money on climate change actions such as GHG reductions, due to uncertain demands from government, the

marketplace and the financial community, as well as limited hard data and models to guide strong action. Furthermore, Bliuc *et al.* (2015) are of the view that early action on climate change by most businesses is driven by the managerial imperative to undertake low-risk initiatives that produce immediate or near-term cost benefits, their legal duty to act solely in another party's interests, and to address risks from climate change and from related laws, especially if the business' future asset values and market positioning are affected. Additionally, corporate responsibilities of social and ethical responsibility also motivate business leaders.

Nalau *et al.* (2015) are also of the view that businesses need to influence policy development at the national level, as policies that regulate GHG emissions will impact on resources and hence their competitiveness. Orsato *et al.* (2015) advise that the range of climate change regulations affects different businesses differently and by being involved in policy development, businesses can gain credibility and influence with regulators. Additionally, this type of involvement gives businesses some control of the future of their own business.

Gillard (2016) suggests that those businesses, which in the past have focused on risk management and bottom-line protection and hence engaged in climate-related activities, are now evolving their thinking towards business opportunities that improve revenue streams from climate change activities. Additionally, those businesses that integrate climate change into their core strategies will be well positioned to optimise any opportunities and thereby gain competitive advantage when climate change requirements of business changes.

To respond to climate change, according to Okereke (2007), it is essential that business:

- capitalise on energy efficiency gains;
- switch to renewable energy sources;
- collect and apply best practice examples;
- increase expectations of suppliers and consumers;
- encourage individual behavioural change within the business's reach;
- integrate mitigation thinking into all decisions across operations;
- develop novel approaches to reducing GHG across the system of production and consumption;
- communicate achievements in lowering emissions; and

- assist in furthering effective climate policy.

Interestingly, points five and six above are significant in the context of this study. Tellingly, Ireland (2012) also emphasises that poor management and a lack of capacity are the key challenges for climate change, and not the availability of finance. Additionally, the response to development must now be viewed differently, due to the serious climate change challenges. Hoffman (2016) also suggests that every business should analyse its GHG emissions profile throughout the value chain as this is essential for determining a business's vulnerability to climate change regulations and the market shifts that result. Jensen *et al.* (2015) point out that assumptions should not be made about impacts from carbon constraints on businesses, as there will be different outcomes for different businesses, as some may find only modest impacts, some may find that they are severely disadvantaged, and some may find that carbon constraints pose an opportunity.

Furthermore, Hoffman (2016) stresses that businesses will not know how their business models are impacted upon by climate change, unless it:

- identifies the sources, types, and magnitude of GHG emissions of the business;
- assesses the vulnerability of the business functions to constraints on those emissions;
- understands whether the business is a buyer or seller in carbon markets; and
- compares the vulnerability of the business to other industry peers.

Chang (2015) also propose that an emissions inventory is an essential first step in assessing a business's carbon footprint. Additionally, undertaking a carbon footprint involves a number of essential activities such as deciding what to measure, how to measure it, how to store and analyse that data once collected, and then where to register it for external verification. The GHG Protocol Corporate Accounting and Reporting is a commonly used procedure to compile a company's carbon emission's inventory, according to Depoers *et al.* (2016), which was co-developed by the World Resources Institute and the World Business Council on Sustainable Development and classifies emissions into three categories:

- Scope 1: Direct emissions which come from sources owned by the reporting business and generally include emissions from on-site production processes, the direct combustion of fossil fuels in boilers and furnaces, and on-site power generation.

- Scope 2: Indirect emissions from the use of purchased heat, steam, or electricity, such as emissions from purchased energy, emissions generated by the use of the business's products, material or transport.
- Scope 3: Other indirect emissions from upstream and downstream sources which include induced emissions of purchased goods and services, capital goods, upstream transportation and distribution, business travels, employee commuting, upstream leased assets, use of products and end-of-life treatment of products.

Once the emissions profile has been determined, Depoers *et al.* (2016) and Weinhofer and Busch (2013) suggest that businesses:

- assess the risks and opportunities, as there will be potential impacts on product and service lines;
- evaluate options for technological solutions to reduce emissions;
- set realistic and measureable goals and targets for their emission reductions;
- develop financial mechanisms as there are resource implications for businesses in implementing climate change programmes;
- involve the business at all levels, as employee buy-in is fundamental to the success of any climate-related strategy;
- formulate a policy strategy to consider the various regulatory and good governance climate change requirements against business objectives; and
- manage external relations by engaging external stakeholders such as competitors, organised labour, suppliers, customers, regulators and NGOs.

The recent climate change initiatives in some industry provide important lessons that are relevant for this research. Meadow *et al.* (2015) indicate that due to the long-term and complex nature of climate change, gaining buy-in from employees takes time and effort. Additionally, climate change initiatives that are linked to more familiar issues tend to work best, for example, where companies align climate-change goals to rewards, bonuses and public awards or employ novel techniques such as promoting tree planting, participation in personal GHG reduction programmes or the purchase and use of bicycles and low-emission vehicles by employees.

Jabbour *et al.* (2015) further point out that the support and involvement of senior management to climate change is crucial, as such leaders can deliver speeches, make policy statements, advise government and provide the financial and human resources. Purvis *et al.* (2015) suggest that in any business there will also be some employees or departments who initiate climate change actions, while others will implement and some resist or ignore climate change actions; and it is important to identify these dissimilar factions and work with them differently. Engert *et al.* (2016) emphasise that climate change must be integrated into the core of a business as a strategic issue, and not be a fringe issue. Moreover, to undertake this integration, it is important to have a dedicated department at least until climate change is embedded within the business.

According to Keohane (2015), every business approaches the climate change challenge differently, for example, some businesses are motivated to act due to public pressure from consumers' demands, others by manufacturing process, and some by climate change laws, while some are driven by the financial implications such as profits from climate change investments or losses from climate change impacts. Additionally, climate change strategies cannot be optional or a nice to have to the 'business-as-usual model', as Backman *et al.* (2015) claim that most businesses now understand that climate change is one of the key drivers for a significant change in the way business operates, primarily due to the influence on market competitiveness and stakeholder (including customer) concerns. Dooley (2015) comments that more and more companies understand that climate change affects all companies, albeit differently, and that inaction on climate change is no longer a sustainable option. Additionally, climate change needs to be integrated into a company's core business as businesses have a leadership and fiduciary duty to at least assess their business exposure to climate change and to decide on the necessary and judicious actions that need to be taken. Krabbe *et al.* (2015) assert that the need for corporate action on climate change is now stronger and better understood. According to Coburn *et al.* (2011), prominent companies and their investors are increasingly recognising that there are strategic opportunities in moving to a low-carbon global economy and to respond to the challenges that climate change brings, since the scientific evidence of human-made climate change is becoming more undeniable. This is underscored by Eljido-Ten (2017) who believes that profitability of firms and their recognition or anticipation of climate change opportunities are positively related to sustainability performance.

South African Pulp and Paper Industries' (SAPPI) sustainability policies include a Climate Change Policy that supports SAPPI's Group Sustainability Charter and their overall approach to sustainable development, which is based on a holistic view of Prosperity, People and Planet (the 3Ps) (SAPPI, 2017). Additionally, SAPPI has raised the profile of climate change within the organisation by appointing the Group Head Technology who reports directly to the Group Chief Executive Officer for SAPPI's climate change programmes and plans to combat and adapt to climate change. While the policy focuses on reducing SAPPI's carbon footprint, there are no programmes or statistics on climate change learning for their management and employees. The principles of the Anglo American climate change policy states that the focus in Anglo America is on building internal agility and ensuring resilience to climate change, driving energy and carbon savings throughout the business, developing and implementing collaborative solutions with their stakeholders and contributing skills and knowledge to the development of responsible public policy (Anglo America PLC, 2016). Notwithstanding there is dearth of internal climate change learning initiatives in the policy or performance reporting of Anglo American. According to Transnet (2017), Transnet is collaborating with the relevant authorities on aligning with a National Climate Change Adaptation Strategy. However, the Transnet annual report is silent on any internal climate change learning programmes. The eThekweni Municipality has developed a climate change strategy for the City of Durban (eThekweni Municipality, 2011; 2014; Hunt and Watkiss, 2011). Additionally, the strategy has key objectives for the various sectors within the city that will be driven by the different departments in the municipality. However, there are no climate change learning initiatives for the employees who will be implementing this strategy throughout the city in their various jobs.

3.6 Electricity and climate change

Studies in South Africa, according to Ziervogel *et al.* (2014), have looked at exposure to climate in the context of multiple stressors, for example, water, health, climate and economics. However, to the researcher's knowledge, no published studies have assessed vulnerability to different climate impacts across the electricity distribution sector.

Lee and Ellingwood (2017) and Simonovic (2017) claim that observed changes in climate, and perhaps more importantly projected future changes, may lead to increased risk to human life and infrastructure such as electricity powerlines and associated structures. Ryan *et al.*

(2016) indicate that some effects of a changing climate are already being felt by industry managers worldwide, for example, in 2006, the UK Institute of Civil Engineers stated that Great Britain's infrastructure is beginning to struggle to cope with increasingly frequent extreme events. Additionally, the public have also been warned to expect more inconveniences in the future as climate change will make it increasingly difficult to run power and transport networks in all weather conditions.

The IPCC (2007: 366) states that "an example of an industrial sector particularly sensitive to climate change is energy". This is underscored by van Vuuren *et al.* (2017) who report that heat production and electricity generation and its usage in industry, buildings and other sources of energy accounted for 60% of total global GHG emissions in 2010. Further, Hope *et al.* (2017) assert that there is an insatiable fossil fuel energy demand in the world currently. Schandl *et al.* (2015) comment that the residential sector accounts for 27% of global energy consumption and releases approximately 17% of the global CO₂ emissions. Craig and Feng (2017) report that even though it is known that there are high levels of GHG emissions, residential electricity consumption continues to increase in the US and fossil fuels are the primary fuel source of electricity generation.

Climate change impacts are also experienced by the energy sector, according to Labriet *et al.* (2015), and over the years, there have been significant research efforts on the climate impact of energy related emissions and the impact of climate mitigation policies on the energy sector. Using data on the demand for energy, from thirty-one countries for the period 1978-2000, De Cian *et al.* (2007) and Khosravi and Buyya (2017) suggest that with higher temperatures there will be higher energy consumption during summer in warmer countries and lower electricity consumption during winter in colder countries. Additionally, the demand for electricity will increase by 1.17% in warmer countries and decrease by 0.21% in colder countries, with a 1% increase in summer temperature. Craig and Feng (2017) and Huang and Gurney (2016) underscore this with the view that while the number of heating degree days will decrease, the number of cooling degree days are likely to increase and in response to this, the electricity demand associated with heating may decrease while the demand for electricity related to cooling could increase. This is further supported by Fan *et al.* (2015) and Labriet *et al.* (2015) who indicate that climatic factors, especially in the household sector and the tertiary industry, are more sensitive to the hot and cold events and consequently there will be an increase in electricity usage during hotter months and a

decrease in winter due to warmer winters due to climate change. In addition, Santamouris *et al.* (2015) demonstrates that the impact of climate change on the electricity demand per degree of temperature increase varied between 0.5% and 8.5%.

Sovacool *et al.* (2017) suggest that new infrastructure investments may be necessary to meet increased energy demand, especially peak demand during heat waves. According to Davies *et al.* (2013), climate change could affect the amount of water available to produce electricity or extract fuel and in areas where water is already scarce, competition for water between energy production and other uses could increase. Schaeffer *et al.* (2012) also explain that sea level rise and more frequent intense storms could disrupt energy production and delivery by damaging electricity infrastructure, fuel delivery infrastructure and equipment, power plants and storage facilities.

Cradden and Harrison (2013) further point out that a changing climate has the potential to affect electricity systems in many ways such as pressure to generate electricity from low carbon emitting sources, and the disruption of electricity distribution and transmission networks by the direct and indirect effects of climate change. Additionally, Zhao *et al.* (2015b) indicate that the expected rise in temperatures in the coming decades will result in reductions in power transmission capacity as the threshold temperatures for overhead lines will be reached sooner and indirectly. Additionally, electricity networks will have to be re-designed or re-engineered to cope with increasing installations of renewable generators, as the growth in demand for reliable electricity increases.

Mideksa *et al.* (2010) maintain that thermal and non-thermal power production is also influenced by changes in precipitation and that incidences of extreme weather events could affect the generation and transportation (transmission and distribution) of electricity. Moreover, one of the most important challenges to the electricity sector is a policy response to climate change as the transformation of the whole sector is required to respond appropriately to the many climate change challenges.

To the researcher's knowledge, there is a dearth of published research on the contribution of, and impacts of climate change on the distribution of electricity, as compared to the research on emissions from, or mitigation, by electricity generation. Schaeffer *et al.* (2012) explain that climate variables such as temperature, precipitation, wind speed, wind direction and extreme weather events strongly influence the generation and distribution of electricity.

Additionally, changes in any of these variables would change the supply of power from both thermal and non-thermal sources. This is underscored by Panteli and Mancarella (2015) who believe that extreme weather events could affect the delivery of electricity through disruption of infrastructure, for example, the collapse of electricity pylons or conductors breaking off. For the transmission and distribution of electricity, Oliver *et al.* (2015) indicate that issues such as flooding, collapsing of land and the potential impacts of more frequent extreme events need to be considered, especially in exposed regions. Additionally, the disruption of infrastructure can be mitigated with smart but potentially costly adaptation measures. According to Wang *et al.* (2016), the increasing intensity of storm events increases the risk of damage to electric transmission and distribution lines. Zamuda *et al.* (2013) claim that the trends in climate change impacts could restrict the supply of secure, sustainable and affordable energy critical to economic growth. Ghanem *et al.* (2016) report that since 2000, there have been steady increases in the number of storm-related grid disruptions in the USA and stronger and more frequent winds associated with severe storms, including tropical storms. Additionally, hurricanes have caused damage to electricity infrastructure which resulted in loss of electricity supply. Ward (2014) maintains that these electricity disruptions can result in high costs for utilities and consumers, including repair costs for damaged equipment such as transmission and distribution systems and societal costs of work interruptions, loss of productivity and losses incurred by electricity consumers, especially those who are dependent on electricity for their businesses. This is underscored by the examples provided by Peters *et al.* (2006) who demonstrate that transmission line operation and maintenance in the USA under climate change conditions cost electricity utilities \$270 million and consumers \$2.5 billion per year during 1994-2004 due to interruptions caused by storms on the transmission networks. Moreover, it is not certain how much climate change will increase electricity outage time, but it is possible that climate change-related events could double storm outage durations. There is a paucity of research and statistics of costs for African electricity utilities affected by climate change, as well as estimates of electricity losses attributed to climate change-related extreme events.

Ryan *et al.* (2016) explain that climate-related risks to society and infrastructure are likely to change and it is therefore important for the power industry to consider the possible impacts of future climate change on infrastructure performance. Additionally, there have been few published studies on the potential impacts of climate change on power distribution poles and networks which constitute large and valuable infrastructure assets worldwide. Schaeffer *et al.*

(2012) suggest that an effective climate change adaptation strategy is one of the key means of dealing with increased climate change-related risks to infrastructures. Moreover, such an approach is now being considered in infrastructure management and policy all over the world including the USA military, which has recently announced sweeping changes to operation systems and installations to adapt to climate change impacts now and in the future. Ryan *et al.* (2016) further maintain that understanding the nature and magnitude of predicted climate change impacts on infrastructure networks is vital in order to implement effective climate change adaptation for infrastructure. Additionally, this understanding is not easy for the electricity business for two main reasons:

- the influence of climate change on the power infrastructure performance is a relatively complex interaction of a number of different climatic effects, namely, temperature, rainfall and wind speeds that impact on deterioration rates and loading conditions of powerlines; and
- there is considerable uncertainty associated with the impact of future climate change on powerlines.

The above two issues make it problematic for power infrastructure asset managers to assess impacts, and thus determine if adaptation is required, and if so, what adaptation strategy is most appropriate (Vine, 2012). Makhele (2009) explain that in the electricity distribution business, the risks of climate change-related events include:

- direct physical impacts and vulnerabilities such as damage to infrastructure, equipment and networks;
- regulatory issues, consumer and market preferences, investor concerns, brand and reputational anxieties, and rising energy and fuel costs;
- power failures caused by the extreme weather will cause loss of supply to consumers and consequently there will be major financial losses for utilities and the customers who rely on this service, due to such interruptions and longer term outages;
- customer expectations may not be met during extreme events, and could lead to adverse media and customer dissatisfaction and loss of consumer and investor confidence; and
- degradation of site conditions, damage to assets, decrease in efficiencies of operations, and reduction in the availability and quality of raw materials, for example,

the wet coal problem at Eskom power stations during the prolonged rains, which contributed to the load shedding in South Africa (Eskom, 2011d).

According to Ryan *et al.* (2016), the design, construction, operations and maintenance of electricity infrastructure will need to take into account changing climatic conditions and potential disruptions. Additionally, the rapid urbanisation and the anticipated large-scale migrations which will place increasing pressure on electricity companies to provide additional power generation capacity and reliability of supply within urban areas and high density informal settlements to meet the increased demands from domestic customers. Gosling and Arnell (2016) indicate that global fresh water resources are under increasing stress due to changes to the weather and an increasing population and the electricity sector which is a major user of water will experience serious challenges from less water, declining water quality, and the growing water demand. Additionally, there will be an increased demand for electricity to deliver and treat clean drinking water, provide safe sewerage and waste water treatment systems to an increasing global urban population. van Vliet *et al.* (2016) comment that an increase in the competition for water resources among the electricity sector and other users such as agriculture, fisheries, drinking water, industry and natural habitats caused by climate change impacts will force government to introduce regulatory controls and increase water pricing and these regulatory interventions will pose additional financial challenges to the electricity distribution industry. Arndt *et al.* (2016) report that a carbon tax is expected to be put in place in South Africa shortly and the reporting of emissions is likely to be made mandatory. Furthermore, the rapid urbanisation of towns and cities around the country due to migrations caused by climate change impacts will place more difficulties in meeting the electricity demands from domestic customers, other essential urban utilities (like water and sewerage) and future technological advances in transportation (Werz and Hoffman, 2015). Ang *et al.* (2016) suggest that to address the challenge of climate change, significant levels of emissions reductions from all sections of the economy is required and this can be only be achieved with the twin approaches of efficient use of energy and the de-carbonisation of energy supply (McNab, 2017; Perathoner *et al.*, 2017). van Vuuren *et al.* (2017) advocate that behaviour change can lead to lower demand for energy and hence climate change learning is critical to bring about this change.

One of the growing areas of risk will be employee and consumer expectations, as Chymis *et al.* (2017) maintain that businesses are increasingly accountable not only to their Board of

Directors and to shareholders, but to stakeholders such as employees and the public who are affected by their actions. Newbery (2016) claims that stakeholder expectations of secure energy provision versus concerns over climate change will place increasing pressure on utilities. Additionally, this could lead to adverse media and customer comments and loss of consumer and investor confidence.

Mathur and Chakrabarty (2016) point out that there is a need for urgent action as the demand for energy and transportation is growing rapidly in many developing countries. Tavoni *et al.* (2015) hypothesise that depending on the energy investments made in the next ten to twenty years, there could be two outcomes, namely, high emissions for the next half-century or a move to a more sustainable world with reduced impact on the climate. Lee *et al.* (2017) point out that climate change poses some difficult challenges for electricity utilities, due to increasing environmental awareness, more demanding climate regulations, the growing need for high-quality reliable electricity, and rising customer expectations. Mideksa and Kallbekken (2010) point out that while the climate change research boundaries have advanced significantly in the last few years, there still remains a significant need for more research in order to better understand the effects of climate change on the electricity sector.

3.7 The Distribution Division and climate change

Beck *et al.* (2011) state that the two largest CO₂ emitters in South Africa are Eskom, the nationally-owned electricity utility, and Sasol, a private oil, gas and coal company that operates South Africa's significant coal and gas to liquids operations. Lin *et al.* (2015) indicate that South Africa relies heavily on coal and fossil-fuel based ore for its national energy demands. However, growing environmental concerns, exponential population increase and the rate of coal depletion calls for a more sustainable use and source of energy (Schandl *et al.*, 2015). Furthermore, according to Shahbaz *et al.* (2015), the energy intensity of the South African economy is far higher than that of developing countries, and similar to that of some developed countries, such as the UK.

Klausbrückner *et al.* (2016) claim that the main resource used for power generation in South Africa, is coal and of all the countries in Africa, South Africa emits the most CO₂. Additionally, in 2004, 1% of the global emissions, which is approximately 440 Mt CO₂ eq., were emitted by South Africa and by 2010 the country emitted almost 1.4% of the total

global GHG emissions. This makes South Africa one of the world's most carbon intensive economies. According to Beck *et al.* (2011), increasing the generating capacity, containing costs of energy and obtaining funding to build new capacity are the key priorities of Eskom currently, as this supports growth and development in South Africa. Bohlmann *et al.* (2016) underscore this by indicating that the economy in South Africa requires more electricity to support growth.

Beck *et al.* (2011) continue that including costs for any climate change initiatives in Eskom will be regulated by the National Energy Regulator of South Africa who is tasked with keeping electricity tariffs low and affordable for the majority of South Africans. Additionally, costly mitigation measures such as carbon mitigation through technology or even carbon capture and storage is not likely to be implemented soon in South Africa. Pegels (2010) points out that due to the demand for electricity in South Africa and the quantities required, the switch to renewable cleaner energy is not seen as a viable alternative. This is underlined by Nhamo and Mukonza (2016) who report that although significant progress on solar energy has been made in South Africa, there are still challenges with manufacturing, financing, capacity and competitiveness that hinder the full exploitation of this energy sub-sector. Also, Furtado and Perrot (2015) explain that South Africa's reliance on coal technologies for many decades makes the transition to wind energy difficult even though national energy policy has set renewable energy targets for the country. Furthermore, Thambiran and Diab (2011) assert that efforts in South Africa are primarily focused on reducing grid-supplied electricity, through energy efficiency improvements and not through more renewable energy initiatives. Makhele (2009) indicated that some of the proactive steps taken by many international electricity utilities include carbon emission reporting, reduction in energy consumption, and addressing risks and vulnerabilities.

Some of the main climatic changes impacting the distribution of electricity, according to Eskom (2011d), include increased rainfall intensities and frequencies, floods, lightning, storms, strong winds, sea swells, fires and high temperatures. Additionally, these intense weather events can cause flooding of substations and low temperatures cause ice build-up on electricity conductors which cause the sagging of and damage to conductors. However, the response to these climate change impacts has been limited to technical adaptation (Eskom, 2015f) such as the identification and attention given to critical powerlines in high lightning, wind and snow areas, implementation of medium voltage (MV) insulated coordinates for

high lightning areas and MV transformer fusing, tower footing resistance testing and improvement on high voltage (HV) lines, implementation of national snow bulletins for HV and MV networks at risk to snow, development of solutions to wind exposure for MV networks, and re-designing and strengthening of towers at high risk of climate change impacts. It must be noted that the aforementioned initiatives and actions will need to be undertaken by employees, whose climate change capacity and understanding is unknown, or which has not been determined prior to this research.

Given the financial constraints in Eskom, as well as the other pressing priorities, Fig (2015) is of the view that the hard technological solutions to climate change will not be easy or implemented in the near future. In view of the foregoing, Begum and Pereira (2015) and Lee *et al.* (2015b) contend that the mobilisation of employees to understand and respond to climate change, may yield more significant results to the climate change challenges and may be more cost-effective in the long run. However, according to this researcher, there is a paucity of research or literature on employee engagement regarding climate change in industry and in particular in the electricity distribution utility sector.

3.8 Climate change and learning

In an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge. (Nonaka, 2005: 287)

The IPCC (2014) claims that human influence on the climate system is clear and that recent anthropogenic emissions of GHGs are the highest in history. Gifford *et al.* (2011) confirm that human behaviour is changing the climate, and humans are, in turn, impacted by climate change. Furthermore, according to Lorenzoni and Pidgeon (2006), climate change is not only an environmental issue, but is closely linked to development at personal, social and political levels, which all attempt to shape our choice of future.

Wasdell (2011) claims that the main and critical challenges of dealing effectively with climate change is that there are many powerful countries, MNCs, global industries and financial institutions, who are highly dependent on the constant and increasing exploitation of fossil fuels for their wealth, influence and economic survival. Moreover, this group focuses primarily on financial sustainability and tend to resist any significant move to implement

climate change mitigation strategies, as this will mean limiting their GHG emissions and consequently a loss of revenue. Additionally, millions of dollars are poured into a globally concerted campaign of fossil energy protection. Furthermore, the energy intensive countries with their highly consumptive lifestyles currently depend on the accelerating use of fossil fuels and on the wealth generated by those involved in its extraction and provision. This is underscored by York (2012) who claims that any move to support climate mitigation is often countered by mobilisation of resources to protect the profitability of the fossil fuel domain, using all necessary force and by all available means. This view is further supported by Outka (2012) who indicates that there is conflict between fossil fuel industry and renewables, as each side sees survival as dependent on defeating the opposition and therefore scientific arguments or the lobbying of strategic stakeholders and decision-makers is often matched by equal and opposite intervention on behalf of the power-block whose wealth and survival would be threatened by any mitigation action. Furthermore, Obani and Gupta (2016) point out that the concern about the world recession is threatening to spiral out of control and is driving countries to make financial stability their main priority and the economy and growth of, especially wealthy nations depend on the escalating use of mainly fossil fuels which results in increasing levels of GHG emissions, causing an acceleration of climate change. Politicians obtain their mandate from the views and demands of their respective constituencies (Fung, 2015) but, according to Bliuc *et al.* (2015), since public awareness of climate change is varied or support for decisive action to deal with climate change is deeply divided, the public is unable to give a clear signal to its political representatives. Wasdell (2011) expresses the view that countries that are most vulnerable to the destructive impacts of climate change such as small island states and poor countries that have a clear mandate to act are overshadowed by the rich countries of the industrially developed world. Additionally, many millions of dollars are allocated to the multi-media disinformation campaign mobilised to create public doubt, cripple political decision-making and ensure that no international action could be taken to mitigate the threat of dangerous climate change. Curran (2015) goes on to say that there has always been a resistance and avoidance of any effective action on climate change that threatens the immediate and vested interests, sources of wealth and access to power of the fossil fuel industry and its dependant financial and political institutions. Additionally, under such circumstances, clear, rational and objective communication of the science of climate change does not lead to effective and appropriate action. Carlton and Jacobson (2016) indicate that although rational scientific arguments are necessary, it is not sufficient to bring about a positive response to climate change and the

views of stakeholders and strategic decision-makers are unfortunately often thwarted by others whose priority is finance. Bauer *et al.* (2016) go on to say that since most individuals or businesses are motivated by the defence of wealth and the sources of wealth, any scientific analysis that threatens wealth tends to be suppressed, undermined and countered at all cost. In addition, Taylor *et al.* (2016) confirm that climate science information is undermined as it is perceived to be a threat to economic stability, consumer lifestyle and the debt-based ground of sustained economic growth.

Clayton *et al.* (2015b) suggest that if humans are the source of the problem, they can also be the solution to the problem. There is strong evidence that climate change learning and awareness will play a significant role in addressing the climate change crisis, at all levels, according to Van Wijnbergen and Willems (2015). Guy *et al.* (2014) advocate that fostering a shared understanding of the nature of climate change, and its consequences, is critical in shaping behaviour, as well as in supporting national and international action. This is underscored by Geiger *et al.* (2017a) who suggest that evidence-based communication that includes science knowledge and community-level solutions improve value beliefs and inspire public engagement on climate change. Bofferding and Kloser (2015) are of the opinion that shaping and sustaining future climate policy-making will be facilitated by educating school learners about climate change, while Bliuc *et al.* (2015) contend that there is also a need for broad public and international debate which will support today's policy-makers in taking strong action immediately. Moreover, Kolieb and Harrould-Kolieb (2011) suggest that it is vital for the human race to innovate its way to a solution to climate change, both on the localised and global levels. Dobson and Tomkinson (2012) identify one of the challenges of sustainable development is tackling worldwide problems, like climate change, from positions of little knowledge or influence. Additionally, this is highlighted in the difficulties in tackling the reduction of GHG emissions, at a local level where there is very limited influence beyond the immediate community. Moreover, there are limitations due to other priorities such as meeting basic needs, eradicating poverty, or competition between stakeholders or nations. Faling *et al.* (2012) report that local municipalities in South Africa have other more pressing developmental priorities and hence planning for climate change is still at the policy and discussion level with no real actions in place. It is understood though that municipalities are important role-players in local climate change adaptation (Hackenbruch *et al.*, 2017).

In view of the foregoing, Article 6 of the UNFCCC (UN, 1992; UNFCCC, 2016) provides countries with the guidance on climate change education, training and public awareness. In order to fulfil the requirements of the above-mentioned Convention, countries are required to:

- Promote and facilitate, at the national, sub-regional and regional levels, and in accordance with national laws and regulations, and within their respective capacities, the development and implementation of educational and public awareness programmes on climate change and its effects; public access to information on climate change and its effects; public participation in addressing climate change and its effects and developing adequate responses; and training of scientific, technical and managerial personnel.
- Cooperate in and promote, at the international level, using existing bodies, the development and exchange of educational and public awareness material on climate change and its effects; and the development and implementation of education and training programmes, including the strengthening of national institutions and the exchange or secondment of personnel to train experts in this field, in particular for developing countries.

According to Ziervogel and Taylor (2008), different stakeholders view climate change differently and respond according to their particular experiences and priorities. Additionally, many people develop and implement strategies at various scales to cope with existing challenges and adapt to perceived changes. However, Shackleton *et al.* (2015) comment that such actions and strategies are often constrained by resource deficiencies and to complicate the issues, there is often poor understanding and appreciation between groups of the limitations and frustrations felt by other stakeholders. It can therefore be argued that the lack of effective communication between stakeholder groups such as communities, government officials, employees and researchers restrict involvement in decision-making and disempowers people from responding meaningfully to climate change adaptation and sustainable development. Additionally, such complexities indicate the need for an integrated approach to tackling climate change, with inter-sectorial planning that incorporates climate information into the decision-making processes. Klenk *et al.* (2015) recommend that to improve the climate change response, it is necessary to engage stakeholders better by listening to their needs and perspectives, sharing scientific information, and collectively exploring the likely implications. Additionally, it is also vital that the participation of the

general public is enhanced to enable an active engagement in the process, ensure priorities are sufficiently aligned, and increase awareness of the existing opportunities and limitations. Furthermore, Brügger *et al.* (2015) and Shi *et al.* (2015) maintain that people's willingness to adapt to climate change is determined by their knowledge, understanding, beliefs and attitudes regarding climate change and the environment, both at an individual or cognitive level.

Recent studies undertaken by Pasquini *et al.* (2013) in the Western Cape reveal that climate change is mainly considered an environmental issue and that most respondents were of the view that the environmental department was responsible for dealing with climate change, while Shackleton *et al.* (2015) comment that institutional constraints to climate change adaptation influence the tendency of respondents to view climate change as an environmental issue. However, according to IPCC (2014), many climate-sensitive systems such as food supply, infrastructure, health or water resources are vulnerable to climate change and hence Millner and Dietz (2015) suggest that climate change and adaptation are critical to development and are important issues for many other departments such as planning, engineering and community services. Burch (2010a; 2010b) and Critchley and Scott (2005) argue that organisational segmentation which fails to ensure collaboration among departments and individuals is due to entrenched past practices.

Dobson and Tomkinson (2012) suggest that one of the learning outcomes for those examining sustainability issues, including climate change, is the understanding that change can be achieved through societal change, policy change, technology change or a combination of all three. In other words, by understanding how an environmentalist or a business economist thinks, or considering policies for achieving social or behavioural change, an interdisciplinary approach to climate change can be adopted, rather than looking for technical solutions. Trede and McEwen (2015) suggest that in responding to the challenges of climate change, people learn most from practising in the context that they will be working in their future professional life and that solutions to sustainable development challenges cannot be achieved in isolation as these are complex issues. Additionally, it is important to understand the complexity of sustainable development, and adopt an inter-disciplinary approach that will underpin the systemic approach to addressing these issues. Abdul-Wahab (2003) and Hanning *et al.* (2012) underscore this by concluding that even engineers can expect to come into contact with environmental problems during their career and engineering curricula

therefore should include environmental components such as climate change. According to Morton *et al.* (2010), understanding the psychological orientations toward climate change is important for a proactive approach to incorporate climate change into design and construction. Steentjes *et al.* (2017) also demonstrate that there are important consequences for social and environmental change from how people view the wider social constructions of ethics around climate change.

Colbert *et al.* (2016) contend that people, especially the youth, tend to rely on expensive technology such as smart phones, tablets, the internet, or other Information and Communications Technology for information, learning and entertainment, as it is easier to have information at hand, retrieve it efficiently and there is no need to recall many facts, as the learner just has to learn to operate, access and apply knowledge from these new technologies. According to Stolovitch (2015), a more cost-effective technology for learning is human performance technology, namely, an investment in human capital which focuses on people to ensure that the correct approach is adopted that will deliver the optimum return on investments in training. Additionally, if there are unresolved problems with technology, the beneficial effects of training will not be lost, especially if the focus is on people. In addition, Mahoney and Kor (2015) are of the view that performance is affected by knowledge and skills and is the domain of education, development and training. This is underscored by Elnaga and Imran (2013) who assert that changing attitudes, knowledge and skills of employees will ensure innovative solutions to problems, and although training can contribute to solutions, it cannot stand alone. Additionally, a combination of improved information and documentation, better feedback, special non-standard systems and processes and some briefing, training and education is required to bind it all together.

People's attitudes towards climate change, according to Clayton *et al.* (2015a), consistently indicate similar patterns such as concern for the future, an understanding that some of the impacts of climate change include ocean level rise, more frequent storms, possible water shortages, and general agreement that this is a serious or potentially serious problem. However, Capstick *et al.* (2015) indicate that public unease over climate change is highly dependent on weather fluctuations and media attention, as there is greater anxiety when there is extreme weather events and increased media attention, and vice versa. Brügger *et al.* (2015) suggest that climate change is poorly understood and most people do not find it relevant to their daily lives as it is not something people regularly ponder and worry about.

Additionally, an improved understanding of public perceptions about climate change can contribute to more knowledgeable scientific and policy discussions of climate change. Post (2016) recommends that it is important for scientists and policy-makers to understand the public's different responses to climate impacts as such responses can help to design policies that will be supported or at least tolerated by the majority of people. According to Wittneben and Kiyar (2009), there appears to be an incremental increase in the awareness of climate change issues by managers, although there is still a big gap in climate change education. Stevenson (2017) emphasises that increasing the climate change awareness of all individuals in society today is critical for promoting positive change.

Burke *et al.* (2015a) maintain that emission reductions are not easy, as the majority of countries' economies continue to rely heavily on fossil fuels and Kohler (2013) indicates that with the focus on growth and development in South Africa, the demand for electricity is increasing. Pasquini *et al.* (2015) indicate that at the local government level, municipalities in South Africa acknowledge climate change, but there is limited action. For example, Hunt and Watkiss (2011) reported that the eThekweni Municipality has highlighted the importance of flexibility, experimentation and 'learning-by-doing' in their climate change strategy. One of the main barriers for climate change action by local government is the lack of authority held by environmental departments to address climate change due to the silo approach of government departments which does not support an integrated approach to addressing climate change (Pasquini *et al.*, 2015). It is therefore vital that political and bureaucratic infrastructure changes to support more integrated cross-sectorial responses (Ziervogel *et al.*, 2014).

Simoes *et al.* (2017) and Ziervogel *et al.* (2014) identify some of the following institutional barriers that hinder effective climate change action:

- a lack of capacity (both in terms of numbers of people and expertise);
- high turnover of staff within departments;
- limited understanding of and expertise in tackling climate-related issues;
- the positioning of climate change as an environmental issue rather than as a development issue;
- conservative financial management practices; and

- poor communication and coordination between departments and between different levels of government (especially national to local and provincial to local).

Tyler and Gunfaus (2015) emphasise that relationships between different stakeholder groups in South Africa such as government, civil society, researchers, practitioners and private sector is critical to drive climate change actions although there is currently a weak relationship between these groups. Additionally, it is also important to have truthful discussions between stakeholders of different cultural and educational backgrounds, although this is difficult to achieve especially in a highly unequal society such as South Africa. Buizer *et al.* (2016b) advise that in order to reach a broad audience effectively and credibly, it is essential that the current methods for communicating climate science and impacts are significantly improved.

Gifford *et al.* (2011) are of the view that climate-relevant individual decisions are at the heart of climate change responses. It is important to note the views of Ferguson and Branscombe (2010) who point out that climate change-relevant behaviour is not solely dependent on individuals as the role of the collective psychological processes cannot be ignored. Terwel *et al.* (2010) support this as they indicate that shared emotions and collective decision-making must be considered in order to fully encourage climate change mitigation actions.

There is widespread concern about climate change, but Clayton *et al.* (2015a) and Kurz *et al.* (2015) are of the view that many people fail to engage in behaviours necessary to reduce climate change and that this is due to the gap between environmental attitudes and behaviour. This gap is caused by various barriers which have been identified by Gifford *et al.* (2011) and includes both structural barriers (poverty and infrastructure aligned to climate change mitigation and adaptation requirements) which hinder behaviour change, and psychological barriers. Steg *et al.* (2015) indicate that some barriers are internal such as psychological and others are external such as structural issues, and recommend that some of the solutions to address structural barriers are social programmes and infrastructure improvements even though psychological barriers are more difficult to overcome. To help citizens overcome these identified barriers, Gifford (2011) and Kabisch *et al.* (2016) recommend that psychologists, scientists, technical experts, and policy-makers all work together.

Furthermore, Lorenzoni *et al.* (2007) believe that barriers are perceived at two different levels:

- Individual level barriers include uncertainty, lack of knowledge and reluctance to lifestyle change; and
- Social level barriers include lack of political action, social norms and expectation, and lack of enabling initiatives.

This is underscored by Gifford *et al.* (2015) who identify the following seven categories of psychological barriers to climate change learning: limited cognition, ideologies, other people, sunk costs, distrust, perceived risks and limited behaviour. The aforementioned barriers, which are relevant to this research, can be described as follows:

- Limited Cognition

Gough (2015) asserts that humans are not as rational, as initially assumed. Additionally, this irrational thinking also applies to climate change issues as the slow evolution of the human brain over thousands of years has not changed and human thinking therefore still focuses on the exploitation of resources and mankind's own survival, risks and needs. Brügger *et al.* (2015) point out that such priorities are not aligned with solving climate-related problems, as climate change is a more distant risk with delayed impacts. According to Taylor *et al.* (2009), many people are not likely to respond to climate change, as they are ignorant of the realities of climate change and those who are more aware, are often handicapped to act due to their lack of knowledge about which specific climate change mitigation actions to take, how to undertake those behaviours, and the lack of information on the different benefits of various mitigation activities. Gifford (2015) is of the view that there are many indicators of the environment which are overwhelming for humans which can lead to environmental numbness and can cause people to attend only to selected cues. Additionally, small changes in the climate or the slow increase in air pollution is often not noticeable, for example, when people are unaware of difficult elements in the environment, it is not likely that there will be a change in behaviour. Clayton *et al.* (2015a) argue that regular pro-environmental behaviour is reduced by any perceived or real uncertainty as when there is doubt about climate change, people tend to interpret this as a weakening of evidence for climate change. Additionally, this uncertainty is used to serve people's self-interest and people are therefore less likely to engage in climate change actions. People also tend to undervalue spatially distant risks due to judgemental discounting, for example, McDonald *et al.* (2015) point out that

individuals who believe that environmental conditions are worse in far off places other than their own, are less motivated to improve their local area. Over optimism can be a problem, as Jiménez-Castillo and Ortega-Egea (2015) suggest that people underestimate their likelihood of suffering from environmental risks due to their optimism bias, namely one's ability to take action to reduce climate change is hindered by an underestimation of the risk. Gifford (2015) claims that when individuals feel that they personally have little behavioural control over an outcome, they are not likely to act. Hornsey *et al.* (2015) and Soliman and Wilson (2017) further point out that the perceived lack of control causes people to fail to act as they feel that they have little control over the problem of climate change.

- Ideologies

Olson-Hazboun *et al.* (2017) indicate that a wide range of a person's worldview is determined by a person's political or religious ideology. Corner *et al.* (2014) explain that when a person's value system is not aligned with the required climate change responses, behavioural change is difficult or impossible. Rossen *et al.* (2015) state that the free-enterprise capitalist system encourages scepticism about climate change. Additionally, when people are preoccupied with other issues, support for climate change action is negatively affected. Wang *et al.* (2016) claim that with age, most people get into a comfortable lifestyle and are often not keen to change their comfort zone. Brügger *et al.* (2015) suggest that the climate change challenges require everyone to change the way they live. Feygina *et al.* (2010) illustrate that system justification is when people ignore obvious facts about climate change or refuse to accept advice, hoping that simply denying the existence of climate change will make it go away. Taking action to reduce environmental impact is also hindered by a fervent religious faith in a religious or secular God (Cui *et al.*, 2015). McCubbin *et al.* (2015) quote the example of residents in a low-lying Pacific Ocean atoll, threatened by rising sea levels, who refuse to relocate to safer ground, due their belief that God will not flood the earth, as stated in the Old Testament of the Bible. Some people, according to Cornia *et al.* (2016), believe that humans are no match for the force of nature and hence are not motivated to respond to climate change. Eom *et al.* (2015) explain that over the years, technology and mechanical innovations have improved the standard of living for many people. Additionally, technology also provides solutions for climate change mitigation such as wind turbines and storm surge barriers for adaptation. However, Gifford (2015) indicates that some people are over

confident that technology will resolve all the climate change challenges and therefore are reluctant to adopt personal pro-climate change behaviours.

- Other People

Grossmann (2015) believes that humans are social beings, who interact and compare with each other and Clayton *et al.* (2015a) point out that climate-relevant behaviour is affected by these varying comparisons. Additionally, individuals derive biased and descriptive standards on which to base their own actions from comparisons they make with others. Gifford (2015) suggests that another basis for inaction is the perceived inequality people feel, for example, some people feel they do not have to take action on climate change when others are not doing so. Additionally, some people perceive that those who do nothing about climate change could discriminate against them anyway and hence feel pressured not to behave responsibly. Furthermore, Kazemi and Eek (2008) show that in the face of environmental problems, group and individual goals can affect decisions.

- Investments

Kurz *et al.* (2015) suggest that investments such as money, time or behaviour patterns that individuals make and value can also be harmful to the climate, as it is more difficult to dispose of or not use something, after one has invested in it. For example, if one has purchased a car, one is less likely to cycle or use public transport. François *et al.* (2017) confirm that urban sprawl increases the environmental stress due to increased car use and that GHG emissions from transport is now one of the main source of emissions in cities. According to Lavelle *et al.* (2015), mitigation of climate change impacts are also influenced by habits. Kurz *et al.* (2015) explain that many habitual behaviours such as eating habits or the use of seat belts are difficult to change. The views of Aarts and Dijksterhuis (2000), Bamberg and Schmidt (2003), Carrus *et al.* (2008), Eriksson *et al.* (2008), Klöckner *et al.* (2003), Loukopoulos *et al.* (2006) and Matthies *et al.* (2006) are significant in understanding habitual behaviour, as these studies maintain that the use of vehicles, which have become deeply embedded habits of people, are major contributors to climate change and such use is difficult to change. However, according to Cruz and Katz-Gerro (2016), it is not impossible to change such habits.

Gifford (2015) suggests that most people's priorities and values do not support action on climate change as the drive to progress in life, for example, bigger and better homes and

cars often involves choices that are against climate change behaviour. Lee *et al.* (2015a) found that people regard climate change actions of low importance, when comparing with other concerns they may have. Additionally, behaviours are therefore driven by what people consider high priorities in their own lives.

Cheng and Wu (2015) feel that people attached to a particular place are more likely to care for that place. This is underscored by Florek (2011) who explain that place attachment is the emotional bond between person and place, and is highly influenced by an individual and his or her personal experiences. Scannell and Gifford (2013) also confirm that place attachment motivates place-protective behaviour even on climate change issues. Mihaylov and Perkins (2013) refer to this sense of place as the emotional bond between a person and place, which is highly influenced by that person's personal experiences. Additionally, a positive response to climate change is not forthcoming from those who feel a lack of attachment to an area, especially as people migrate or relocate to different places in their lifetime for employment or through forced climate change migrations. Mobley (2015) are of the view that pro-environmental behaviour is more likely with people who live close to nature, for example, on a farm or in the countryside, as opposed to those who are removed from nature, for example, in a highly urban area or in a block of flats. Notwithstanding, Howell and Allen (2017) are of the view that it is not essential to cultivate the love of nature to encourage pro-climate change action.

- Distrust

Gifford (2015) explains that people are not likely to listen or take advice from others whom they distrust or think of in a negative light and if trust does not exist between citizens and scientists or government officials, resistance may follow. Gifford (2011) maintains that any desired change in behaviour is dependent on at least three trust elements, namely, a person trusts others not to take advantage of them, that people are honest and are motivated by public service, and that any proposed changes are effective, valuable, and equitable. Furthermore, Carlton *et al.* (2015) claim that if there is misquoted climate information or over-optimistic claims about future outcomes, people's trust is lost and when people mistrust the source or credibility of the climate change proposed actions, the likelihood of adopting pro-climate change actions lessens.

Gausset *et al.* (2015) are of the view that people have a choice whether to participate in climate-friendly behaviour options. Batel *et al.* (2016) indicate that as many such climate change initiatives by policy-makers are voluntary, most people often do not participate as they are of the view that initiatives are not in their own interest. According to Greenberg (2015), psychological reactance is when people react strongly against advice, a policy or rule that threatens their freedom and this reactance is primarily based on the lack of trust people have in those who give the advice or set the policy. Ross *et al.* (2016) argue that resistance to mitigation behaviours is therefore a consequence of such reactance, as uncertainty, mistrust and doubt can easily slide into active denial of the problem and may include denial that climate change is occurring, that it has no anthropogenic causes or as McCright *et al.* (2016) suggest, the denial that one's own actions play a role in climate change. Ross *et al.* (2016) explain that some people who undertake pro-environmental behaviour such as using less of a resource or making a significant financial contribution to a climate change-related project, lose interest or stop their pro-environmental behaviour when they observe that those who are corrupt or are free-riders exploit this opportunity for their personal gains, acting in self-interest and harm the climate change cause.

- Perceived Risk

Kurz *et al.* (2015) suggest that people assume there are financial, functional, psychological, physical, social or temporal risks when they have to change their behaviour. There are often doubts and questions about the workings of new technology including electric vehicles or wind power (Geels, 2015). When people consider that a particular climate change action leads to safety and security risks or will expose them to some physical discomfort, they are not likely to adopt that action. For example, Rimano *et al.* (2015) indicate that while using bicycles to travel short distances is non-polluting, it is not safe due to crime or dangerous roads, and hence cycling is not undertaken by many. Kurz *et al.* (2015) are of the view that some people fear that they will incur financial losses if they invest in climate change actions or technologies, especially as most climate change technologies do not have a long history of operating or performance. For example, Joubert *et al.* (2016) indicate that the high cost of installing solar geysers in South Africa requires a long period for the initial capital outlay to be recovered. Additionally, if the home owner moves out of the house earlier, a financial loss will be incurred from this expenditure. According to Corry and Jørgensen (2015), climate change responses are also

not understood and practised by everybody in society, and those who adopt responsible climate change behaviour may be subject to criticism or ridicule from others, which may damage their reputation especially from the majority who do not engage in pro-climate change behaviour. Gifford (2015) suggests that people may feel they wasted much time, energy and finances into undertaking responsible climate change behaviour or investing in climate-friendly technologies, if the benefits are not obvious or experienced within a short period of time.

- Limited Behaviour

Ones and Dilchert (2012) suggest that people adopt behaviours that require the least effort. Additionally, some climate change-related behaviours are easy to adopt but have little impact on GHG emission, while others are difficult and hence Gifford (2015) indicates that higher-cost and more impactful actions will tend to be ignored. Gifford (2013) points out that if the intent of pro-environmental actions is tokenism, then the outcome does not lead to significant environmental benefits. Another issue is the rebound effect, where pro-climate choices may be less effective than they appear, for example, when a mitigating choice such as purchasing a hybrid car is made, but the climate change benefits are diminished or even reversed by subsequent actions, for example, driving longer distances in a hybrid car than in a standard car (Hill *et al.*, 2016).

In a study in Durban by Thambiran and Diab (2011), it was found that it was not sufficient to only educate people about the financial and environmental effects of their private motor vehicle use, as there were numerous other barriers to encouraging people to decrease the actual number of motor vehicle trips and switch to public transport or non-motorised activities such as walking and cycling. Ross *et al.* (2016) describe ‘psychological dissonance’ as one of the barriers where people, for example, are aware of their impacts of driving, but choose to soften the negative impacts of their actions, in order for them to continue with their normal behaviour patterns. Higham *et al.* (2016) point out that another barrier is the difficulty that many experience in giving up their vehicles, which they consider as status symbols. Furthermore, a better public transport system with clean vehicle technologies and fuels or renewable energy resources is not easily available or affordable to the majority (Tyler *et al.*, 2014).

The important role of the individual in pro-environmental behaviour is emphasised by Spaargaren and Mol (2008, 355):

Human agents cannot be properly understood when disconnected from context, from the practices and sites where the routines of daily life are enacted in interaction with both other agents and the structures, products and technologies that help constitute...these practices.

According to Frederiks *et al.* (2015), consumers are an important reference point for promoting environmental sustainability, as environmental issues have social and political implications, especially in western capitalist democracies and the role of individuals in creating social change through the blending of consumption and citizenship is emphasised in mainly developed countries. This is underscored by Clarke *et al.* (2007) and Spaargaren and Mol (2008) who assert that the vital role of 'citizen-consumers' has been recognised by political scientists also. Additionally, such scientific studies of government, political processes and political issues use both political and market-based actions to drive change as they infuse social responsibilities with the dominant consumption patterns. Hence, Hanss and Böhm (2012) suggest that individuals act as agents of change within the capitalist economy using points of consumption as sites of power, by performing a dual role as both citizen and consumer. Barr *et al.* (2011a) maintain that this form of kneejerk reaction has come to characterise the understanding of the role of individuals in policy dialogues and introduces the notion that citizen-consumers are critical to the governance of environmental issues as state or corporate actors in a free market system.

The works of Dobson (2010), Jackson (2005) and Seyfang (2005) have all documented the growth in attention on individuals as a means of tackling environmental problems in Western democracies. Clarke *et al.* (2007) note that there is an extension of responsibility from the state towards citizens and this is an important shift in the relationship between governments and individuals. Panzone *et al.* (2016) explain the role of individuals as consumers and citizens to reduce environmental degradation. Additionally, the rising profile of environmental citizenship is displacing other methods of viewing both society's and individuals' approaches to environmental and social change. Bliuc *et al.* (2015) are of the view that the production, consumption and interpretation of environmental knowledge, which is mainly in scientific and technical terms, is added by and sometimes is in conflict with public knowledge of the (local) environment. Furthermore, Kurz *et al.* (2015) suggest that

certain forms of environmental practice are largely accepted, unquestioned and form part of the everyday, tedious and normal routines of many households anyway. Masud *et al.* (2016) demonstrate that on an individual or mental level, knowledge, understanding, beliefs and attitudes regarding climate change and the environment play an important role in people's willingness to adapt.

Carrico *et al.* (2015) and Geiger *et al.* (2017b) suggest that the methods and mediums used to educate people about climate change also play an important role in shaping pro-environmental behaviour. Additionally, visual communication methods that portray the future of climate change impacts could be a powerful tool for motivating behaviour change in the present. In another recent study in New Zealand (Evans *et al.*, 2014) participants were more willing to undertake emissions-reduction behaviours in their local community, after they were asked a set of questions regarding sea level rise and climate change adaptation measures, compared to those who had not received these questions. According to van der Linden (2015b), such findings support the risk salience hypothesis and the hope that learning about adaptation actually heightens concerns about climate change and the need for mitigation. Interpreting persuasive messages through a person's prior worldview and cultural bias, according to Kahan *et al.* (2011), is important. This is underscored by Stevenson *et al.* (2017) who indicate that the key factor of climate change perceptions among adults is their worldview.

Accordingly, Carrico *et al.* (2015) feel that people interpret messages differently, depending on their ideologies. Additionally, people's pre-existing views and messages that are easily embraced must be in line with one's worldview and supports one's position. Messages that oppose one's pre-existing views are often disregarded or discounted based on trivial cues in the message (Kahan *et al.*, 2011). Leiserowitz *et al.* (2011), McCright and Dunlap (2011) and Smith and Leiserowitz (2012) underscore this by claiming that political ideology is one of the single most important factors in determining an individual's attitudes and beliefs concerning climate change, and is more important than the impact of how the message was framed. In a USA study, Smith and Leiserowitz (2012) found that liberals were consistently the most concerned about climate change and the most supportive of initiatives to intervene, whereas political conservatives were consistently the least concerned and supportive.

According to Ziervogel and Taylor (2008), climate change impacts are not isolated but affect many aspects of the socio-ecological system. Tanner *et al.* (2015) also indicate that there is a link between climate change adaptation and the development challenges a country faces, such as addressing unemployment, improving access to water and sanitation, health care, education and empowering people in decision-making processes. Additionally, it is important for the impacts of climate change to be understood and adapted to in the context of all the various aforementioned linkages. Robertson and Murray-Prior (2016) suggest that addressing these connections is important because people tend to be more aware of and motivated to act on immediate, more tangible stressors than climate change issues. Additionally, climate change impacts are slow and incremental, whereas concerns such as jobs or access to water are immediate.

Clayton *et al.* (2015b) assert that climate change is a central concern of psychology, especially environmental psychology, and other behavioural sciences, since human contribution to climate change is closely related to sustainability behaviour. Linton and Dwyer (2015) also indicate that human behaviour is the least understood aspect of the climate change system. Gifford (2011) underscores this by arguing that human behaviours, which are the main cause of the problem, are least understood. This is indicative of the ever increasing worldwide GHG emissions from human activities despite many official efforts to promote mitigation (IPCC, 2014) and feedback from many citizens that they are taking steps to overcome the problem (Bamberg *et al.*, 2015). This situation represents a great opportunity for this research to understand and promote employee responsibility for pro-climate change behaviour through the understanding of the factors that underlie the anthropogenic causes of climate change and the ways in which GHG-mitigating behaviours may be effectively encouraged.

In a 1993 USA study, Read *et al.* (1994) found that even well-educated citizens did not have a clear understanding that global warming is caused by the increase in the concentration of CO₂ in the earth's atmosphere and that the burning of fossil fuels, especially coal, is the single most important source of CO₂. This is underscored by Lesierowitz *et al.* (2011) and Ranney and Clark (2016) who indicate that most USA citizens do not understand the science of climate change. Carlton and Jacobson (2016) comment that it is important for communications to address the misunderstandings that are most likely to result in incorrect inferences, such as confusion with the problems of ozone depletion and the general blurring

with other environmental problems. All across the world, governments are currently considering costly policy responses to the issue of climate change (IPCC, 2014). According to Stern *et al.* (2016), it is not possible to have intelligent democratic debate on the various climate change choices, unless citizens are better informed.

According to Peng and Liu (2016), the awareness of the environmental impacts on the earth has increased over the last few decades. However, the degradation of the environment has not stopped (Steffen *et al.*, 2015). Hämäläinen (2015) suggests that the interest in the behavioural components of environmental problems in recent years has increased which demonstrates the growing awareness that human action is the critical element in environmental degradation. Additionally, more attention is currently being paid to the behavioural sciences by politicians, natural scientists, and the general public. This is underscored by Batel *et al.* (2016) who explain that understanding the roots of human behaviour that contributes to environmental degradation and suggesting important recommendations as to how to intervene to change this behaviour, is what is required.

Previous psychological environmental research by Grob (1995), Maloney and Ward (1973), Schahn and Holzer (1990) and van Liere and Dunlap (1981) concentrate primarily on environmental concern or attitudes as predictors of environmental behaviour. Clayton *et al.* (2015a) indicate that changing people's attitudes and beliefs by educating and providing them with information is sufficient to change their actual behaviour. Stern and Dietz (1994) are of the view that people feel responsible for environmental action when they are aware of severe consequences (for themselves, other people or non-human species) and when they judge themselves to be responsible for the outcomes. Ernst *et al.* (2017) underscore this by showing that the interaction between environmental attitudes and a sense of personal responsibility is a good indication of involvement in environmental action.

Rotter (1966) and Bandura (1986) in early research considered the effectiveness or personal control by individuals about what they can and cannot do, as an important indicator of the expected behaviour. Accordingly, Hickman and Riemer (2016) are of the view that people are likely to engage in positive environmental actions, when they are aware of the connection between their actions and climate change. In support, Clayton *et al.* (2015a) illustrate that individuals are more likely to engage in environmental behaviour when they believe that they have the capability to help solve environmental problems through their own behaviour, as

there is a connection between moral thinking and concern about environmental problems. Earlier studies by Davidson and Freudenberg (1996), Schan and Holzer (1990) and Wehrmeyer and McNeil (2000) reveal that women were more environmentally concerned than men. This is underscored by Brody *et al.* (2008) who point out that women are more concerned about climate change while Tranter (2011) indicates that women are more likely to actively participate in pro-environmental behaviours and to express a willingness to contribute financially to protecting the environment. However, recent studies by Gupta (2015) and Shivakumara *et al.* (2015) indicate that gender has no significant effect on environmental awareness of, at least, postgraduate students.

Tanner (1999) indicates that performance opportunity has a strong bearing on environmental action, primarily because socio-demographic characteristics have an indirect impact on behaviour due to their connection to external factors which limit or empower collective actions. Furthermore, according to Caldas *et al.* (2015), understanding cultural differences in ecological behaviour is relevant and important, as environmental behaviour is influenced by culture. Additionally, a deeper understanding of limitations is necessary to understand the cultural differences in ecological behaviour. De Groot *et al.* (2013) point out that cultures differ with respect to climate change concern, values, beliefs and morals and there are also cultural differences with respect to structural opportunities and facilitating or inhibiting pro-climate change behaviour.

Gifford (2015) explains that inhabitants on the planet, whether as an individual or as part of a group, are responsible for natural resources that are converted into products and the processing of natural resources in most cases generates GHGs. Baatz (2014) underscores this by contending that the person or individual is the fundamental unit of analysis for the human-caused portion of climate change. Additionally, it is at the individual level where control for improving environmental problems such as climate change rests. Clayton and Brook (2005) believe that in the orthodox thinking about climate change, many feel that psychology has no role to play because of the following commonly held and incorrect views:

- psychology treats people as if they existed in a vacuum and ignores the environment;
- the academic context in which most established psychologists work is not appropriate for the kind of effort needed to combat the consequences of climate change;

- most policy-makers in ministries and departments concerned with environmental problems were not trained in the behavioural sciences; and
- the role of psychology in climate change has so far only been discussed in a limited number of countries.

Gifford (2015) asserts that there exists a level of choice and control over sustainability-related behaviours and actions by every person, whether they are an average citizen or a Chief Executive Officer of an organisation. According to Jagers *et al.* (2016), circumstantial factors and a person's own habits deeply affect the choices people make and behaviour is influenced more by structural factors above or external to the individual than by individual-level influences.

However, Capstick *et al.* (2015) maintain that individuals are the essential key to positive climate change responses as policies, programmes and regulations on their own do not change anything. Additionally, if climate change policies are accepted or embraced by individuals, there will be effective implementation because while policy summons or even prescribes behaviours, it is people who have to accept or refuse its demands. Moreover, until people accept or embrace the climate change policies, behavioural change will not occur. This is underscored by Osbaldiston and Schott (2012) who indicate that while not all people are in positions of power, all people consume materials and energy in their daily lives and, as such, each person can choose to adopt pro-environmental behaviours. Additionally, some people do try to avoid selfish behaviours that contribute to climate change but it is not easy, and many inadvertently revert to actions that are not climate-friendly. The challenge is determining what is required to change people's behaviour (Kurz *et al.*, 2015). Many psychologists who have studied the psychological dimensions of climate change (Dresner, 2009; Heath and Gifford, 2006; McAdam, 2017; Nilsson *et al.*, 2004; Uzzell *et al.*, 2017 and van der Linden *et al.*, 2017) are of the view that to begin with, an understanding of environment-related motivations, attitudes, social and organisation perceptions, rationales, biases, habits, barriers to change, life-context, and trust in government helps. However, Gifford (2015) feels that environmental psychology is not a stand-alone solution. For example, Lewandowsky *et al.* (2015b) advocate that psychologists need to work more closely with environmental scientists, natural scientists, technical experts, policy experts, citizens and local NGOs.

Technology is often promoted as the solution to many problems, including those related to climate change (Wennersten *et al.*, 2015). However, recently some concerns about technology has come to the fore such as the environmental impacts of renewable energy as Filoso *et al.* (2015) explain that growing biofuels requires the use of pesticides, reduces biodiversity, and creates atmospheric pollution when burned, and has already caused large increases in food prices. Wang and Wang (2015) indicate that wind power creates noise, kills many bats and birds, is unsightly, and negatively affects the rural lifestyle. Furthermore, Aman *et al.* (2015) point out that solar power requires the manufacture of photovoltaic cells, which creates a hazardous waste stream of cadmium, lead, silver and other heavy metal by-products, emissions from the manufacturing and distribution process and impacts in the decommissioning and recycling of solar panels. The negative impact of technology such as pollution, health impacts, landfill contributions, accidents, energy consumed in production, and impacts on flora and fauna is often disregarded when the focus is on the business benefits of such technology (Aman *et al.*, 2015; Cuéllar-Franca and Azapagic, 2015). According to Suzuki (2015), the introduction of new technology does not guarantee that it will be accepted and used by citizens and that such a proposed solution is better than the problem, as further investigation of technology could reveal yet to be discovered unknown impacts. Research, such as in this study, which attempts to understand employee understanding and responses to climate change, can provide the foundation for the policies required to encourage people to accept climate change alternatives to technology.

The current climate change crisis, according to Gifford (2015), is also subject to the concept of environmental numbness which implies that most people, most of the time, simply are not thinking at all about environment or climate change issues but, according to Eby *et al.* (2016), are primarily preoccupied with work, finances, family, friends or even sporting events. There are two critical challenges for motivating a more responsible climate change response. Gifford (2011) advocates that there is a need to get as many people around the world as possible actively thinking about climate change. Geels *et al.* (2015) suggest that evidence-based policy that creates accepted structural solutions must be encouraged. In this way, Sheppard (2015) suggests that GHG emissions can be reduced by the informed majority, whilst the rest of the indifferent people on the planet continue with their mundane routines.

Devine-Wright *et al.* (2015) believe that a sense of community or group identity is important but that a sense of community is sadly absent in most parts of the world and when it is absent,

working together to save the earth is very difficult. Lo (2015) provides a good example of this thinking in the example of China who rejected mandatory emission cuts because it was of the view that the wealthy nations created the problem. Additionally, this behaviour demonstrates that people can have a strong identity, for example, with their nation, but lack sufficient identity with the environment to avoid destructive attitudes and behaviour

Blok *et al.* (2015) and Cheng and Wu (2015) point out that knowledge of issues, knowledge of action strategies, locus of control, attitudes, verbal commitment, and an individual's sense of responsibility, are associated with responsible climate change behaviour. Steg *et al.* (2015) put forward that pro-climate change behaviours are more likely from people who believe that they are in control of their lives, who express an intention to undertake pro-environment actions, and who feel some degree of personal responsibility toward the environment, as opposed to those who have an external locus control, have no intention to undertake environmental actions and feel no sense of responsibility. On the other hand, Demski *et al.* (2017) are of the view that people who experience climate change impacts first-hand are more likely to adopt pro-climate change actions, even beyond individual actions. Gifford and Nilsson (2014) and Otto *et al.* (2016) suggest that those who earn more than others are only slightly more likely to engage in responsible environmental behaviours indicating that there is a weak relationship between income and responsible environmental behaviour. Meyer (2015) demonstrates that education does play a role in pro-environmental behaviour, as educated individuals are more likely to engage in responsible environmental behaviours than less educated persons. Morrison and Beer (2016) also indicate that age does play a role in pro-environmental behaviour, as those in the middle age group are the most aware and who are more likely to support environmental initiatives compared to younger and older people.

McQueen and Janson (2016) are of the view that for learning to occur there must be both obvious and unspoken knowledge. Additionally, explicit or obvious knowledge can be separated from the person who holds the knowledge and written down and transferred across time and space, independently of that person, while tacit knowledge depends on close interaction and development of trust and a shared understanding. Leaders play an important role in influencing others by bringing people together and creating an environment conducive to learning (Berson *et al.*, 2015). This is underscored by Saul and Seidel (2011) who identified that in international climate change cooperation, an influential leadership approach was the autonomous leadership style, where a good example is set by nations who formulate goals

and implement policies. Marsden *et al.* (2011) state that an organisation's learning policies and structures is strongly influenced by leaders who also initiate information seeking.

Shreck and Vedlitz (2016) maintain that climate change is a very complex, pervasive and uncertain phenomenon, which is generally difficult for most people to conceptualise and to relate to their daily activities. Masud *et al.* (2015) argue that the reasons for this could be because climate change cannot be easily translated into the language of popular culture. Another climate change learning challenge, according to Capstick *et al.* (2015), is that the various datasets available detailing public opinions and attitudes on climate change differ on a range of factors, including the precise question (phrasing and stimulus terms) posed to study participants, the timeframes of data collection and publication, and the geographical extent of the studies. Kirilenko *et al.* (2015) are of the view that just like for environmental issues, the changing social context at any particular point in time can cause the assessment of the climate risk to be intensified or diminished, for example, the activities of interest groups or media reporting.

In the 1992 Health of the Planet study of twenty-four countries, Brechin (2003) found that citizens from only Japan, Brazil and West Germany ranked global warming among the highest, out of a list of ten environmental issues and also considered global warming as 'very serious' problem for the world. Additionally, citizens in the USA ranked global warming at the bottom of the list. These results are consistent with the findings of a 1997 study among 1 225 US citizens by Bord *et al.* (1998) which indicated that personal and social goals were prioritised over other issues, including environmental ones and compared to all environmental issues, climate change was not the most noticeable or important issue for people. Immerwahr (1999) confirms this as in the USA, the sense of frustration caused by the lack of power or influence of climate change issues, created indecision towards climate change by the public. Other studies notably in the USA by Bostrom *et al.* (1994) and Kempton *et al.* (1995) and in Canada, USA, Mexico, Brazil, Portugal and Russia by Dunlap (1998) have demonstrated that most people believe that climate change is already happening and will continue in the future. The analyses of the 1999 and 2001 studies by Environics International (Brechin, 2003) support the findings that misunderstandings of climate change persist worldwide even in nations considered to have strong environmental values such as Germany. In the 2002 British study (Poortinga and Pidgeon, 2003), respondents were of the view that they could not control risks of climate change by themselves. Similar findings were

observed in Italy and the UK by Lorenzoni (2003). This is underscored by the 2002 UK study by Poortinga and Pidgeon (2003), which indicated that 62% of respondents felt that they were fairly to very concerned about climate change, although their main priorities were health, family, safety and finances.

Lorenzoni and Pidgeon (2006) and Norton and Leaman (2004) in a 2004 study in the UK found that most people have heard of global warming and climate change and even rate it as the most important environmental issue for the world today, although UK citizens considered terrorism and domestic issues as having a higher priority. Capstick *et al.* (2015) indicate that public perception about climate change is relatively unknown worldwide, as most studies have focused on Western nations (particularly the USA) where the trend has been of growing climate change scepticism in the latter 2000s, which is informed by economic and socio-political factors. Additionally, in sub-Saharan Africa and South America, concern about climate change has tended to increase, although more research is required on this issue in developing countries.

Kettle and Dow (2016) and Newell *et al.* (2015) demonstrate that the public tend to mistrust governments, businesses, industry and sometimes experts with regard to the communication of environmental issues and risks. Additionally, the same people are of the view that governments have a high degree of responsibility for solving climate change problems. A study by Zwick and Renn (2002) which asked respondents which institutions they considered should be responsible for controlling climate change risks and which would have the highest public confidence to do so, found that in Germany about 50% of respondents indicated that industry and politicians are responsible, while 42% designated responsibility onto scientists, and interestingly, 27.8% of respondents maintained that individuals were responsible, while 23.7% attributed responsibility to environmental agencies, and 3.3% were of the view that the media was responsible for controlling climate change risks. These responses indicate that individuals feel that their actions will not be effective and, according to Hinchliffe (1996), people's expectation is that institutions need to take more responsibility for solving climate change. Recently, Gifford (2015) pointed out that many people mistrust climate change information that comes from scientists or government officials.

Brügger *et al.* (2015) and Capstick *et al.* (2015) concluded that in all the different studies evaluated, the following eleven trends on the pro-climate change behaviour of individuals have emerged:

- climate change is a complex and sometimes misunderstood issue;
- the public have an indecisive attitude towards climate change, due to the priorities of daily life, as opposed to an awareness of the greater social problem that climate change represents; for USA citizens, their more immediate concerns relate to the potential loss of benefits from current lifestyles if they had to address climate change;
- there is perceived frustration and disempowerment about effective individual mitigation action by most people;
- most postpone any immediate pro-climate change action;
- many also consider that climate change is not a crisis presently, as most laypeople perceive it as a threat and a potential danger to others, namely those more vulnerable or future generations;
- people considered long-term climate change threat as the failure to adequately prevent some of the uncontrollable changes to the climate system from taking place;
- if individuals trust government and relevant organisations for adequately managing risks and delivering the means to achieve change, they are also likely to act, as mistrust in institutions is a determining factor impeding public support for mitigation efforts;
- people are not likely to adopt pro-climate change behaviour, unless they feel empowered to do so and also feel that others in society are also undertaking similar actions;
- empowering people or building their trust is a big challenge, especially for many governments, as governments are perceived as unreliable and not credible in diffusing information or taking decisions about climate change;
- people are not likely to support initiatives addressing climate change unless climate change is a very serious societal or ecological problem, or one that affects people personally; and
- it is suggested that for the USA and Europe, both top-down and bottom-up approaches to climate change management may currently be the most realistic approaches, although the overall combined success of these two approaches depends upon the leadership strength demonstrated by each.

Capstick *et al.* (2015) maintained that according to the British Prime Minister in 2004, a radical revision of current lifestyles to address climate change would not be practically feasible and politically acceptable. Additionally, there is a variety of issues that require more research in the broad areas of climate change perceptions, knowledge, trust and policy, such as the role and nature of trust in public institutions responsible for climate change actions, the issue of leadership and the role of new technologies for mitigation and adaptation. According to Gifford (2015), there is a natural fear in how people approach climate change as negative perceptions and bad news such as the rising sea level, the increasing numbers of hurricanes, or the loss of a beach engenders a perceived lack of behaviour control in undertaking pro-environment actions even when purchasing of goods and services.

In a 2013 detailed and extensive study on barriers to climate change adaptation conducted in South Africa, Pasquini *et al.* (2013) indicated that many similar problems to climate change adaptation were encountered, as in developed countries. Burton *et al.* (2010) explain that in South Africa people are generally reluctant to change their lifestyles to reduce carbon emissions, especially as they see little government or private sector leadership on the issue. Additionally, while it is acknowledged that there are great differences between developed and developing countries, it is agreed that both developed and developing countries need to address these common barriers, if climate change adaptation is to be achieved at the local level.

The support and impetus for climate change education and learning at the global level is primarily driven by Article 6 of the UNFCCC, according to Mochizuki and Bryan (2015), who state that education, training, public awareness, public participation, public access to information and international cooperation on climate change play a vital role in meeting the ultimate objective of the Convention and in promoting climate-resilient sustainable development. Lawn (2016) indicates that at the 2015 COP21 in Paris, countries agreed to cooperate in taking appropriate measures to enhance climate change-related education, training, public awareness, public participation and public access to information, recognising the importance of these steps with respect to enhancing actions under the Paris Agreement. Furthermore, Mochizuki and Bryan (2015) and Salequzzaman and Gorana (2016) suggest that there is broad consensus among countries and other relevant stakeholders that formal, non-formal and informal education in supporting climate change mitigation and adaptation actions is very important. Additionally, a range of educational activities undertaken in all

regions, by most countries and other relevant stakeholders indicates widespread progress in support of climate change learning.

Golub (2015) and Hopkins (2015) point out that in many countries, the declared Decade of Education for Sustainable Development which was from 2005 to 2014, provided a valuable framework for educational activities. Additionally, in a wider context in support of the declaration, many countries are now implementing climate change education through the Global Action Programme on Education for Sustainable Development which is aimed at generating and scaling up climate change education and learning to accelerate progress towards sustainable development, contributing to the UN SDGs and the post-2015 development agenda.

Khan *et al.* (2016) make the following observations from their global review of the history of climate change capacity building:

- due to the make-shift nature of capacity building initiatives which are short-lived and project based, there is still much inefficiency and ineffectiveness in capacity building initiatives;
- it is essential that capacity building grows or originates from within a country;
- countries must own and manage their specific capacity building interventions, while international actors should only support and facilitate;
- funding for capacity building remains low and there is not much research on how much money is spent and quantifying funding is also difficult, especially as most capacity building interventions are an integral part of projects; and
- there is a paucity of scientific assessments of climate change capacity building, although there is ample literature, on capacity building in many other areas of development, and environmental governance that can be found mainly in agency reports.

According to Dagnet *et al.* (2015), the following five shortcomings in climate change capacity building currently exists:

- a general lack of public awareness and support for climate action;
- training for vulnerability and adaptation assessments and methodologies is lacking;

- building and retaining individual and institutional capacity on a long-term basis lacks adequate international support;
- delivery channels, database, experts and research institutions are fragmented; and
- the lack of strong and permanent institutional arrangements and enabling environments.

Some of the key and relevant issues for this research to consider is further provided by Khan *et al.* (2016) and include the following:

- a good understanding of national capacity needs and challenges is pivotal to successful implementation of climate change capacity building at a national and sub-national level. Additionally, this should be guided by a national organisation whose purpose must be to understand and guide suitable national capacity building needs. Moreover, it is important to build institutional capacity to manage a climate-relevant capacity programme within the country programme, and to have long-term, sustainable systems at the national level which does not rely on consultancies or is project related, although this will not be easy.
- There is a need for a long-term, permanent arrangement for capacity building at the international level, which:
 - changes the capacity building funding model to allow for more systematic, dedicated and programmatic funding that allows for country planning and ownership, longer-term sustainability, and capacity retention;
 - improves capacity building research and analysis to include both an overall perspective (such as principles of capacity building), as well as national perspectives (working with local institutions);
 - facilitates and provides guidance to the implementation of capacity building efforts, provides guidance to other actors outside the UNFCCC regarding key issues, gaps, and opportunities in capacity building for climate change; and
 - develops procedures and Key Performance Indicators (KPIs) to evaluate progress on capacity building.
- The establishment of a Capacity Building Mechanism under the UNFCCC, to provide efficient and continuing attention to find capacity building resources and to share with others the lessons learnt and good initiatives of countries who have had

successful climate change capacity building programmes, and providing an adaptable guide to meet local needs.

- There is a need to promote four kinds of key activities at the national level, namely, human resource development, institutional capacity building, developing networks and developing KPIs for capacity building.
- There is a need to support and strengthen national knowledge from international players without displacing or minimising the role of institutions at the national level.
- Investing in capacity building will produce great benefits and enhance the effectiveness of climate action and therefore the value of adequate and appropriately provided support for capacity building cannot be overemphasised.

From the review of the literature, it is apparent that there is dearth of information on climate change learning in business and in particular for the electricity utility business and for Africa, and that there is much climate change learning required in business. Furthermore, climate change learning is not a high priority for business and good practice on climate change learning in this sector is non-existent. Given these challenges, how can industry infuse climate change learning within the organisation? One approach is for business to adopt the principles of a learning organisation to focus on climate change learning, as climate change represents a new challenge for business, and in particular the electricity distribution business. A good starting point for business will be the work on learning in organisations, as Senge (1990: 3) states that learning organisations are:

...organisations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together.

This approach can be adopted and applied to climate change learning for business which is a relatively new concept for business, in particular the electricity distribution industry. According to Fillion *et al.* (2015), only organisations that are flexible, adaptive and productive will excel in situations of rapid change (including the urgency of the climate change response that is required of business) and to achieve this, it is vital for organisations to discover how to tap people's commitment and capacity to learn at all levels.

Fillion *et al.* (2015) further suggest that the main problems in business are that the structures in which people have to function are often not conducive to reflection and engagement, even though all people have the capacity to learn. Additionally, some people may also lack the tools and guiding ideas to make sense of the situations they face. Moreover, a fundamental shift of mind among employees is required if organisations want to consistently increase their capacity to grow and be sustainable over a long period of time. In a truly learning organisation the following two methods of learning must occur:

- adaptive learning, according to Devlin *et al.* (2015), is where computers, which adapt the presentation of educational material according to students' learning needs from their responses to questions, tasks and experiences, are used as interactive teaching devices; and
- generative learning which Fiorella and Mayer (2015) define as learning that involves the active integration of new ideas with the learner's existing knowledge and experiences where the learner activity constructs meaning that enhances people's capacity to create.

According to Aggestam (2015), there are five important characteristics of a learning organisation which will also be relevant for climate change learning in business:

- Systems thinking which requires that all the characteristics must be apparent at once in an organisation for it to be a learning organisation.
- Personal mastery implies that learning cannot be forced upon an individual who is not receptive to learning and hence the commitment by an individual to the process of learning is critical as learning occurs not necessarily through formal training, but most learning in the workplace occurs incidentally. It is therefore important that a culture where personal mastery is practiced in daily life is developed, while a learning organisation has been described as the sum of individual learning, there must be mechanisms for individual learning to be transferred into organisational learning.
- Mental models, which are the assumptions held by individuals and organisations must be challenged as individuals have their own views and ideas, which is what they adopt or follow and organisations also have entrenched ways of doing things, which perpetuates certain behaviours and therefore there is a need to unlearn and discard unwanted values.

- A common vision creates a shared identity that provides emphasis and drive for learning and is important in encouraging the employees to learn and it is therefore important for the vision to be obtained through consultation with all employees at all levels of the organisation, and not thrust upon employees from senior management.
- Team learning is made up of the accumulation of individual learning.
- Employees are able to develop faster and the organisation has better capacity to solve problems due to better access to knowledge, expertise and excellent knowledge management structures that allow for the creation, acquisition and dissemination of information. Implementation of knowledge in an organisation is a key characteristic of a learning organisation, as it is important for employees to feel like they belong to a community so that they commit.

Moser (2016) comments that that producing more climate change messages to convince people to act, is not sufficient but it is necessary for organisations to adopt different and more sophisticated ways, and harness tools and concepts such as those used by brand advertisers, to make pro-climate change behaviour more desirable, rather than merely forcing employees to be dutiful or obedient. Fernandez *et al.* (2016) further suggest that climate-friendly actions need to be attractive, convincing and relevant and must make sense to people. Additionally, in order to achieve this, it is important to work within the cultural norms, value systems and communication contexts that are meaningful to the majority of people, as people know that their behaviour is shaped from the inside by their own cultural values and attitudes. Moreover, it is necessary to make pro-climate change behaviour to be like the ordinary and normal things that most people do - not something alien or strange to their current way of life. Aune *et al.* (2016) underscore this by suggesting that harnessing the everyday routine of the household, could be an effective agent for climate change behaviour, as this allows for pro-environmental behaviour to be integrated into the everyday habits and practices that makes up ordinary, normal life.

Karahan and Roehrig (2015) suggest that using images as well as more balanced approaches helps make desired behaviours attractive and compelling to ordinary people, and enables them to participate more keenly with the desired action. Andrews *et al.* (2016) claim that people can become less involved due to the spread of the fear and gloom about climate change. Additionally, the required climate change behaviour must not be presented as a

rational argument from senior management, enforced onto lower level employees, as it is necessary to use subtle techniques of engagement and work in a more insightful and contemporary way. Yoseph-Paulus and Hindmarsh (2016) suggest that another important adjustment is for business to move away from the culture of top-down authority to a bottom-up or horizontal authority. Additionally, because people increasingly trust other people, even those they have not met more than governments, businesses and other institutions, it is imperative that climate change communication be tackled in a totally different way than previously done. Bliuc *et al.* (2015) underscore this argument by indicating that climate change communications from authority sources and information that continue to instruct, or even be foisted upon people are likely to be less successful than those that considers the bottom-up or horizontal influences.

According to Lamb and Rao (2015), most people, especially in the developed world, have a higher hierarchy of needs than just food, shelter and clothing. Additionally, the need for esteem implies that such people seek success, recognition and status which is achieved by purchasing popular brands and other such goods, services and experiences, and living trendy lifestyles, which make people feel special. Gifford (2015) suggests that this aspect must be considered when trying to influence climate-related behaviour, as people are likely to resist or ignore pro-climate change responses, when they feel that their lifestyle is threatened. Additionally, it is imperative that climate-friendly behaviours are made normal, natural, and the right thing to do, especially for the majority of people who are not involved in climate change issues.

Barr *et al.* (2011b) assert that drastic measures to address climate change such as financial and regulatory changes are not likely to succeed, as much of the literature on this subject clearly indicates that current climate change knowledge and learning is problematic and that there is general denial and unwillingness to ascribe individual responsibility for climate change. Accordingly, Hoffman (2006) provided some significant observations from his work with thirty-one USA companies on how climate change behaviour in industry is approached and what the way forward is for an effective and successful climate change programme, such as:

- support, commitment and involvement from senior leadership and at Board level is required;

- educating management, as climate change is a more difficult subject to convey to management due to the complexity and scope of the issue and the relatively tiny impact of an individual corporation, as well as the uncertainty about many aspects of climate change;
- identification of change initiators, implementers, and resisters as it is important to know who in the company will support climate change initiatives in a company, and who will not, and address them accordingly;
- climate change can be implemented by a wide range of employees in an organisation with the support of a specific department to coordinate;
- those involved in GHG emissions or operations and maintenance play a more important role in implementing reductions or in mitigation actions;
- a robust corporate climate change goal allows all departments including human resources, finance, planning, design and procurement to get involved;
- some departments do not generally get involved in climate change initiatives such as the accounting, finance and marketing departments, while departments responsible for corporate strategy are only moderately involved;
- it is important to also work with those that are resistant to climate change issues;
- developing both cross-functional and specialised teams;
- creating a clear connection between climate change and business strategy;
- implementing specialised internal programmes;
- aligning climate change performance to rewards and bonuses;
- companies need to use some of their traditional practices such as bonuses and rewards, and novel ideas, for example, peer and public recognition, to build internal climate change awareness and to reinforce positive climate change behaviours;
- creating internal marketing and educational programmes;
- purchasing emission offsets; and
- encouraging telecommuting or teleconferencing to reduce the impact of business travel.

Burton *et al.* (2010) stress that in South Africa there is a need to increase public understanding of climate change. Such awareness must be built on peoples' existing awareness of climate change terms and concepts. Additionally, the focus must be on making

climate change locally relevant and strengthening associations between global climate change and the social and economic consequences of climate change in the country.

There is a dearth of research or literature on climate change learning in business. However, Hoffman (2006) suggests that businesses must factor in the time it will take to educate its general workforce and management on climate change issues, especially if they are large companies with multiple sites, such as the Distribution Division. Additionally, climate change training can be time consuming, and must be spread over a period of time, for it to be efficacious, rather than trying to train everybody in a short space of time.

Although Eskom (2015a) reported an approximate 9.6% increase in GHG emissions over the past ten years, there is no mention of climate change as an issue or the company's commitments or programme in the annual report and no information is available on the climate change commitments and initiatives of the organisation to employees or the general public. According to Barr *et al.* (2011a), recent moves by national and local policy-makers have sought to encourage individuals to engage in a wide range of pro-environmental practices to address both discrete environmental problems and major, global challenges such as climate change. Additionally, there are a wide range of measures aimed at both mitigating and adapting to new environmental problems such as climate change, and one issue that has become predominant in discussions of how to mitigate and adapt to environmental problems is known broadly as 'behaviour change'. This research hopes to contribute to the behaviour change of employees in the Distribution Division, and thereby provide guidance to other businesses and also those within the sphere of the influence of employees the Distribution Division.

3.9 Conclusion

The literature reviewed in this chapter shows that the recent and ongoing rise in global average temperature near the Earth's surface is triggering climate change. This rapid warming of the planet is caused by increasing concentrations of GHGs mainly from anthropogenic activities. Climate change causes increased incidents of extreme weather events such as frequent and heavy flooding, tornados and sea level rise. Additionally, climate change will significantly impact on ecosystems, economies and communities, as well as affect infrastructure.

Spurred on by the concerns that climate change brings, the international community has rallied together and put in place a number of international institutions and instruments since 1992 to help obtain global consensus and action to reduce GHG emissions and to help vulnerable communities cope with the impacts of climate change. However, progress on reducing GHGs has been slow and problematic, and GHGs continue to rise steadily and, according to Long (2016), this situation is likely to be exacerbated by the recent change of stance on climate change by the USA, which is one of the largest emitters of GHGs.

This chapter also discussed the climate change impacts and response in South Africa, on business and in particular the electricity utility sector, with special focus on the Distribution Division. In the Distribution Division, climate change is driven from the Corporate Office in the holding company, Eskom, and is mainly focused on mitigation strategies and very little to no focus on the climate change learning of employees. The literature also pointed out that there are numerous challenges in implementing effective climate change learning in business. A number of interesting and relevant barriers and trends in climate change learning and specifically for businesses that are pertinent to this study were also discussed in this chapter.

CHAPTER FOUR

RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

A broad research design approach is adopted in this research and includes a case study and triangulation or mixed methods, involving both qualitative and quantitative approaches. According to Kern (2016), this approach allows a certain degree of triangulation of the findings underlines their interconnectedness and ensures a comprehensive approach. The transition from the basic theoretical hypothesis to the selection of respondents, techniques in data gathering and the data analysis, according to Nieuwenhuis (2011), is considered research design. This is underscored by De Vos *et al.* (2002) and Zikmund *et al.* (2012) who indicate that a structure or a master plan that stipulates the methods and procedures for collecting and analysing data to obtain the required information is also considered research design. Scott (2016), on the other hand, considers research enquiry as the process by which evidence or knowledge is produced and the systematic investigation to examine phenomena. This study provides a qualitative and analytical approach to investigating climate change learning in the Distribution Division of the Eskom Holdings Company. The use of diverse methods in this research provides answers to more than one of the research questions. This method of triangulation of the results reveals parallels and differences between results obtained from the different procedures.

According to Zikmund *et al.* (2012), a structure or a master plan that stipulates the methods and procedures for collecting and analysing data to obtain the required information is considered research design. This research evaluates climate change learning in an electricity utility, using the Distribution Division as the case study. The research focuses on climate change in the context of the climate change international institutions and instruments, and the implications for South Africa and the electricity distribution business, in particular for climate change learning in the Distribution Division. There are a range of methodological tools that can be used to conduct this research due to the nature of the study. It was therefore imperative that the correct and appropriate tools were applied for this particular study.

The overall research aim, research objectives and the logistical aspects such as resources and time available, are essential for a good research design (Robson and McCartan, 2016). The

objectives that frame the research were covered in Chapter One of this thesis. The survey questionnaire, which was used to address the objectives, covered the following key themes:

- Section A: Demographic Profile of Respondents
- Section B: Attitudes to Life and Environmental Issues
- Section C. Options for Managing Climate Change
- Section D. Responsibility and Trust
- Section E: The Distribution Division's Climate Change Programme and Environmental Strategies

The three main methods used to answer the research questions are an analysis of responses to the survey questionnaire, semi-structured interviews and focus group discussions with employees from three of the Distribution Division's OUs. The three OUs selected, namely KZNOU, GOU and WCOU was due to the support, enthusiasm and request of this research from those OUs, as well as the environmental management capacity within those OUs. When the research began, these three OUs were the first to offer to host the focus group discussions. Additionally, GOU was selected as the national government, NGOs and international climate change related entities are located in Gauteng, so as to facilitate their attendance. The methods employed in this research were therefore influenced by the research objectives defined in Chapter One. Hence, this chapter describes the practice of different data collection methods and the factors that influence the choice of suitable data collection methods. The data and information collected on global climate change, climate change in South Africa, climate change and industry including the electricity distribution sector and on climate change learning tend to identify with similar studies in other developing countries.

This research methodology chapter is therefore an attempt to identify and explain the research methods used in this research. A detailed description of the case study is provided and the research methodologies are defined. This chapter also provides a review of research theories, paradigms and methods, and their effect on the research data interpretation.

Moser (2016) indicates that in relation to climate change, there is a need for in-depth research that examines inconsistencies and ambiguities in beliefs, values and actions, for example, how do people reconcile their awareness and concern about climate change with lifestyle choices and pressures and how do they perceive and deal with uncertainty about climate

change. The above mentioned issues are important for informing policy and are best addressed through qualitative research methods. According to Armah *et al.* (2015), Gifford (2011), Kabisch *et al.* (2016) and Lorenzoni *et al.* (2007), the existence, dynamics and effects of various barriers are significant elements of people's responses to climate change. It is therefore appropriate to integrate the findings of such literature to contextualise the barriers to climate change learning in a large SOE such as the Distribution Division.

4.2 The case study: The Distribution Division

According to Bryman (2015), methods of research are linked to different visions of how social reality should be studied and some of these methods include qualitative social research, narrative research, phenomenological methods, grounded theory, ethnographic research, case study research, participatory action research and discourse analysis. In this research, the case study approach was utilised. Stake (1995) suggests that case studies are a strategy of inquiry in which the researcher explores a programme, event, activity, process or one or more individuals in greater detail. Additionally, due to time and activity constraints to conduct case studies, researchers therefore also gather detailed information using a variety of other data collection procedures over a sustained period of time. The decision to use a case study approach in this research was derived from three conditions, according to Yin (2013), namely:

- the type of research question posed;
- the extent of control the researcher had over the process; and
- the degree of focus on contemporary as opposed to historical events.

Fant *et al.* (2016) point out that the major players in the electricity sector of South Africa are Eskom and the Department of Energy (DoE). Additionally, Eskom builds and operates all power stations in South Africa, generates approximately 95% of the electricity used in the country and 45% of the electricity used in Africa. Jamal (2015), Kroth *et al.* (2016) and Mashaba (2014) indicate that Eskom is the world's eleventh-largest power utility in terms of generating capacity, and ranks ninth in terms of sales. Eskom (2015a) points out that the utility which owns and operates fifteen coal-fired, four diesel-fired, two hydro-electric, three pumped storage power stations, one nuclear power station as well as one wind farm and one concentrated solar power plant, with a total generating capacity of 44 281MW, sells power

directly to some 6 000 industrial, 18 000 commercial, 70 000 agricultural and three million direct residential customers, which excludes the bulk electricity supply to municipalities and their own urban customers. Eskom (2015a) and Sadiki (2015) point out that Eskom has 31 107 kilometres (km) of electricity transmission lines that span the entire country and extend into most of the Southern African Development Community countries and approximately 337 224 km of distribution powerlines that take the power to the end users (customers).

In 2002, Eskom was converted from a private entity to a public or SOE by the DoE. According to Thopil and Pouris (2015), in South Africa there are ten base-load fossil fuel power plants and three return-to-service fossil fuel power plants. Additionally, during peak electricity demand times, for example, in winter the RTS plants are operated as base-load stations. According to Eskom (2015b), the utility generated 44 220 Megawatt (MW) of electricity during 2014/15, made up of a range of power generating sources. It is apparent from the Table 4.1 that South Africa is highly dependent on fossil fuel power generation, which produces about 85.38% of the electricity used in the country and only 0.23% comes from wind, a renewable source.

Table 4.1: Eskom generation mix for 2014/15 (Eskom, 2015b: 6)

Type of power generation	Number of stations	Capacity (MW)	Percentage of total capacity
Coal-fired	13	37 754	85.38%
Diesel	4	2 426	5.49%
Nuclear	1	1 940	4.38%
Pumped storage	2	1 400	3.17%
Hydroelectric	6	600	1.35%
Wind	1	100	0.23%

Cowan *et al.* (2014) and Valentini *et al.* (2014) further indicate that South Africa's dependence on fossil fuels for the generation and distribution of energy is largely to blame for South Africa's disproportionate contribution to global carbon emissions. Additionally, the main source of CO₂ emissions is from the energy sector, which generated 91.1% of the total CO₂ emissions in South Africa in 1994.

Furthermore, from this generation mix, especially the seventeen coal-fired and diesel turbine power stations, the organisation emitted approximately 226.17 Mt of GHG in 2014/15. From Table 4.2, the GHGs emitted from Eskom’s power generation in 2014/15 included CO₂, SO₂, N₂O and NO_x; 223.4 Mt of CO₂ was the emitted, making it the main GHG, and NO_x was the least of the GHGs emitted at 937 kilo ton (kt).

Winkler (2005) states that energy is critical to virtually every aspect of the economic and social development of South Africa. Additionally, depending on the way electricity is produced, transported and used, electricity can contribute to both local environmental degradation such as air pollution and global environmental problems, principally climate change. Thambiran and Diab (2011) confirm that the manner in which energy is generated and consumed in South Africa is the source of many environmental challenges, including poor ambient air quality and high GHG emissions.

Table 4.2: Eskom GHG emission inventory for 2014/15 (Eskom, 2015b: 4)

GHG	Quantity emitted in 2014/15
CO ₂	223.4 Mt
SO ₂	1 834 kt
N ₂ O	2 919 t
NO _x	937 kt
TOTAL GHG	226.17Mt

According to Eskom (2012a), the organisation will continue to focus on improving and strengthening its core business of electricity generation, transmission, trading and distribution. This invariably means an increase in CO₂ emissions from Eskom’s power stations. As indicated in the recent annual reports, the amount of CO₂ emitted by Eskom has increased from 224.7 Mt in 2010, to 230.3 Mt in 2011 and 231.9 Mt in 2012, but dropped to 226.17Mt in 2014 (Eskom, 2015a). Eskom (2008) claimed that emissions have been increasing over the last decade due to the dominance of coal in Eskom’s energy mix and the increasing demand for electricity in the country.

Eskom (2015c) states that Eskom, as a company in a developing country, has been participating in the carbon market through the CDM programme. Furthermore, Eskom

(2015d) is of the view that due to the large contribution of the electricity sector to South Africa's total GHG emissions, it is expected of Eskom to reduce its emissions over a period of time, to support the government's ambitious emission reduction targets as stated at COP15 in 2009 (Pretorius *et al.*, 2015b). Altieri *et al.* (2016) state that South Africa's INDC is clear that the country's GHG emissions must fall between 398 Mt Carbon dioxide equivalent (CO₂eq) and 614 Mt CO₂eq by 2025 and 2030 and to achieve this, South Africa has proposed several policy instruments as well as carbon budgets imposed on companies. Caetano and Merven (2017) further advocate limiting the GHG emissions specifically for the electricity sector of 275 Mt CO₂ by 2025. Altieri *et al.* (2016) point out that this GHG reduction target, has direct implications for the choice of energy technology and any new build infrastructure, including solar, wind, gas and nuclear. Eskom (2015d), however, claims that the expected emissions from Eskom's two newly built coal-fired power stations, Medupi and Kusile will still be within the range of South Africa's emission reduction target set for 2025.

The distribution, reticulation or supply of conventional electricity is presently dependent on a grid system, powered by coal and the expansion of this grid to rural and deep rural areas may be economically and environmentally unachievable (UN, 2010). Eskom (2015e) emphasises that global climate change policy and technology trends towards reducing carbon emissions, together with Specific, Measurable, Attainable, and Realistic and Timely (SMART) technologies will impact the South African energy market and Eskom's business model. Furthermore, according to Arndt *et al.* (2016) and Giglmayr *et al.* (2015), the South African Integrated Energy Planning and Integrated Resource Plan for electricity directly impacts on Eskom's prices and financial sustainability. Wakeford *et al.* (2016) suggest that various other pieces of climate change-related legislation will also affect Eskom and it is therefore critical that Eskom promotes an integrated policy approach to avoid any potential misalignment to these policies, plans and legislation which implies that the organisation must ensure compliance to climate change regulations such as carbon tax, requirements for pollution prevention plans, carbon budgeting and GHG emissions reporting. Eskom (2015e) responds by claiming that the organisation will implement climate change and sustainable development strategies as part of the organisation's efforts to mitigate GHGs and entrench sustainable development practices throughout Eskom and in pursuance of this goal, Eskom will develop and implement a Climate Change Strategy to ensure the organisation embraces the principles of sustainable development and becomes climate resilient.

Eskom (2015e) explains further that the five core values of the organisation are zero harm, integrity, innovation, sinobuntu (a sense of care and compassion for all) and customer satisfaction. Additionally, the value of Zero Harm means that Eskom will strive to ensure that no harm befalls its employees, contractors, the public and the natural environment. Moreover, zero harm to the environment is unpacked further as the protection of the environment and reducing the organisation's environmental and carbon footprint through monitoring and reducing particulate emissions, ensuring efficient water consumption, integrating biodiversity considerations into the business, increased utilisation of ash and compliance with environmental regulations.

The South African government's climate change initiatives at the international negotiations and national level are supported by Eskom (Eskom, 2015e) and the organisation is guided by the Eskom Climate Change Six-Point Plan, which is the organisation's Climate Change Strategy in its engagements with government. Eskom (2015c) indicates that the organisation drafted a Climate Change Policy in August 2001, based on five key principles (Eskom, 2011c: 5):

- given that South Africa is particularly vulnerable to the negative impacts of climate change, give priority to action that will mitigate these negative impacts of climate change and global response measures.
- due to South Africa being classified as a developing country and the extensive fossil fuel (primarily coal) reserves in the country, it is envisaged that Eskom will increase GHG emissions over the current planning period (25 years).
- as required by the UNFCCC, continue to build on current data and compile and maintain an inventory of GHGs.
- have a climate change strategy in place that will include consideration of the long-term mitigation and reduction of GHG emissions, and also include technology transfer and risk assessment.
- continue to utilise SF₆ gas as an insulating material in electrical equipment, but the gas will be captured and recycled where possible.

According to Eskom (2004), the above-mentioned policy was only authorised in 2004 by Eskom senior management and included the following nine climate change policy statements:

- (1) coordination of climate change efforts across Eskom and its subsidiaries;

- (2) raising staff awareness and promoting training and capacity building within Eskom and South Africa at all levels;
- (3) establishing an inventory of applicable GHGs, in the context of national policy, namely CO₂, N₂O, CH₄, HFCs and SF₆;
- (4) continuing to participate in, and contribute to, the South Africa's National Committee on Climate Change and other appropriate advisory functions and thus input into the country's policy formulation;
- (5) ensuring input and involvement in climate change projects, particularly energy projects in the region;
- (6) researching and investigating the impacts of climate change and response measures on Eskom's business (climate change debate);
- (7) incorporating climate change issues into long-term planning processes on a 'no regrets' basis, taking into account the inter-relationship between socio-economic factors and the environment;
- (8) identifying and exploring climate change opportunities, such as CDM and Global Environment Facility (GEF), as a step towards the overall process of sustainable development; and
- (9) climate change efforts throughout Eskom and its subsidiaries will be coordinated by the Corporate Environmental Affairs Department as mandated through the Executive Director of Resources and Strategy and the Management Board Environmental Steering Committee.

Two of the aforementioned policy statements are especially relevant to this study. Policy one indicates that climate change will be coordinated across Eskom subsidiaries, which includes the Distribution Division. Policy two makes reference to climate changing learning within the Distribution Division.

In 2007, an Eskom Climate Change Strategy (Eskom, 2008) was developed, and sought to address climate change through a comprehensive Six Point Plan, namely:

- diversification of the generation mix by increasing nuclear, gas, renewables, imports and clean coal;
- energy efficiency by reducing demand by 3 038 MW in the 2012-2017 period and other Internal Energy Efficiency measures, for example the Billion kilowatt/hour Programme;

- development of the Eskom Adaptation Strategy by 2008 which incorporates adaptation to the impacts of climate change, for example, by using dry-cooling on new plant;
- innovation through research and development such as solar thermal plant, smart grids, underground coal gasification;
- development of an Eskom Green Financing Strategy by 2008 to include carbon financing and opportunities for trading in the global CO₂ market; and
- advocacy, partnership and collaboration with national and international stakeholders.

In early 2016, Eskom drafted the Eskom GHG Emission Reporting Procedure (Eskom, 2016). According to Eskom (2011d), a limited and internal research report indicates that climatic changes for the period 2004 to 2009, such as changes in rainfall patterns and temperatures, floods, droughts, lightning and strong winds had significant impacts on two of the sampled power stations which included issues such as wet coal, flooding of dams, water quality and unavailability, high stack emissions and plant performance inefficiency.

Beck *et al.* (2011) point out that Eskom is also active in the distribution of electricity in areas where such a service is not covered by local authorities in South Africa. Eskom Holdings Limited (2011) explains that the Distribution Division covers the final part in Eskom's energy supply chain which is the local distribution of electricity from the smaller sub-stations to the end customer. Eskom (2011d) reports that the main climatic changes such as increased rainfall intensities and frequencies, floods, lightning, storms, strong winds, high temperatures and low temperatures causing snow, ice and mist, and fires affect distribution of electricity. Additionally, there was sagging of conductors due to high temperatures, especially during high electricity demand periods, insulator damage at the substations, damage to conductors due to fires, and the base of pylons inundated with water due to excessive rainfall which resulted in corrosion of towers.

Eskom (2013a) identifies one of the weaknesses in the Distribution Division as the regulatory environmental non-compliance, although the Distribution Division is aligned to Eskom's values, including zero harm. Additionally, the strategic objectives of the Distribution Division include integrated environmental management and compliance, the scope of which is designed to focus on turning around the current business risk associated with

environmental legal contraventions. Additionally, some interventions have been proposed to achieve environmental legal compliance include training, environmental awareness, regular communication and the effective use of trained personnel so as to reduce the business compliance risk. Moreover, climate change as a specific issue is not covered in the Distribution Business Plan. Eskom (2015e) indicates that there will be significant risks to the organisation resulting in irreversible long-term environmental harm and prolonged loss of government confidence and community support, which will further impact on Eskom's reputation if Eskom fails to:

- deliver on its mandate to embed climate change initiatives within the organisation;
- reduce GHG emissions and meet national climate change emission reduction requirements; and
- prepare electricity infrastructure for the inevitable changes to the climate.

To counteract these risks, Eskom (2015e) proposed the following actions:

- developing benchmarked relevant KPIs;
- lobbying and advocacy with government departments;
- engaging with national and international business, for example, the World Business Council for Sustainable Development (WBCSD) for position formulation and benchmarking;
- integrated reporting to inform all stakeholders on Eskom's long-term sustainability;
- continued advice on the role and impact of Independent Power Producers; and
- internal engagements and forums in decision-making.

A pivotal aspect missing from the above-stated treatment actions is an understanding of employees' views and knowledge of climate change as, according to Sadiq *et al.* (2016), such an understanding will ensure a telling involvement of all in the organisation. Additionally, climate change learning is likely to guide the Distribution Division to more meaningful and practical responses to climate change and to ensure better implementation of Eskom's climate change strategy. More importantly, this study will enable employees to understand their role in climate change and, according to Kim *et al.* (2015), provide guidance to the large and relatively affluent workforce in the Distribution Division to make a positive difference. Given the climate change challenges and the response required of business, and in particular due to the contribution of electricity utilities to climate change, the Distribution Division must take

meaningful action, not only to be a responsible corporate citizen, but also because responding appropriately to climate change reduces risks to its own business. Managing climate change risks effectively will therefore enable the Distribution Division to meet its compact with its shareholder of providing energy access to rural and marginalised communities, as cited in White Paper on Renewable Energy (Nakumuryango and Inglesi-Lotz, 2016) and as indicated in the SDGs (Hajer *et al.*, 2015).

As indicated in Eskom's 2012 Integrated Report (Eskom, 2012a), one of the strategic imperatives for Eskom is reducing its environmental carbon footprint, pursuing low carbon growth opportunities and embarking on a proactive approach to identify and manage the inevitable impacts of climate change to its business operations thereby ensuring a secure and reliable supply of electricity going forward. However, the above-mentioned imperative has not been effectively internalised and implemented, particularly in the Distribution Division (Eskom, 2013a). Furthermore, due to the size of its workforce (Distribution, 2012), as well as their relative affluence (and concomitant consumption patterns) when compared to other South Africans in the formal job sector, Eskom (2011b; 2015a) claims that it is important to respond to climate change meaningfully and demonstrate responsible environmental behaviour. Such pro-climate change behaviour, according to Young *et al.* (2015), could be a model for employees in other large businesses to emulate so as to also change their consumption patterns to be more earth-sustaining. Since the reduction in CO₂ emissions is not likely to come from a move away from fossil fuel power generation towards more sustainable forms of energy generation (at least for the foreseeable future), it is imperative that a meaningful response to climate change and environmental issues emanates from the organisation's large workforce.

Eskom (2015a) explains that the Eskom Holdings Company is made of ten divisions, namely, Generation, Transmission, Distribution, Customer Services, Sustainability, Group Capital, Strategy Support, Finance, Human Resources and Security Divisions. The Distribution Division, which is used as a case study in this research and consists of nine provincial OUs, is the largest of all the Eskom divisions with a national footprint and the majority of the employees of the Eskom Holdings Company. Additionally, these nine OUs are aligned with the South African provincial boundaries, and their main function is to build, operate and maintain the distribution network for dispensing electricity to all consumers in the nine provinces excluding supply to large power users such as municipalities, aluminium smelters,

large industry and mines that are supplied directly by the Transmission Division. The nine OUs (Figure 4.1) are Western Cape (WCOU), Eastern Cape (ECO), Free State (FSOU), Northern Cape (NCOU), North West (NWOU), KwaZulu-Natal (KZNOU), Gauteng (GOU), Mpumalanga (MOU) and Limpopo (LOU) (Eskom, 2013a).

According to Eskom (2013a), the management structure of each OU is as follows:

- General Manager's (GM) office;
- Asset Creation (AC) Department (Network Planning, Land Development, Network Design, Programme Management, Electrification Planning and Electrification);
- Maintenance and Operations (M&O) Department (Specialised Maintenance, Network Operations and Support, Plant Management and Zone Management);
- Business Integration and Performance Management (BIPM) Department;
- Safety, Health, Environment, Quality and Security (SHEQS) Department (Safety Management, Contractor Safety Management, Environmental Management and Security Management); and
- Industry Support (IS).

Other services to the OUs are provided by the Eskom Business Partners (BP) such as Human Resources, Finance, Commercial, Communication, Standards Implementation and Eskom Real Estate, and these departments do not report to the management structure within an OU, but have a national reporting hierarchy (Eskom, 2015e).

Eskom (2013a) explains that to operate and maintain the vast network of powerlines and substations, each OU is divided into zones, each zone into sectors, and the sectors are made up of Customer Network Centres (CNCs). The CNCs, which are part of the M&O Department, are the smallest organisational building block that operates and maintains the powerlines and substations in their specific geographical location, for example responding to faults, restoring power and undertaking maintenance on all the electrical equipment (Eskom, 2013a).

All together in the nine OUs, Eskom (2013a) explains that there are twenty-seven operating zones with sixty sectors that manage 305 CNCs. As an example, in KZNOU, there are three zones, eight sectors and forty-five CNCs (Figure 4.2).

Figure 4.2 shows the map of the KZNOU with the division into the three Zones, namely, Empangeni, Newcastle and Pietermaritzburg Zones. The Empangeni Zone is further segmented into three sectors, Newcastle Zone into two sectors and Pietermaritzburg Zone into two sectors. The three sectors in Empangeni are divided into eighteen CNCs, while the Newcastle Zone has eleven CNCs and Pietermaritzburg Zone has sixteen CNCs.

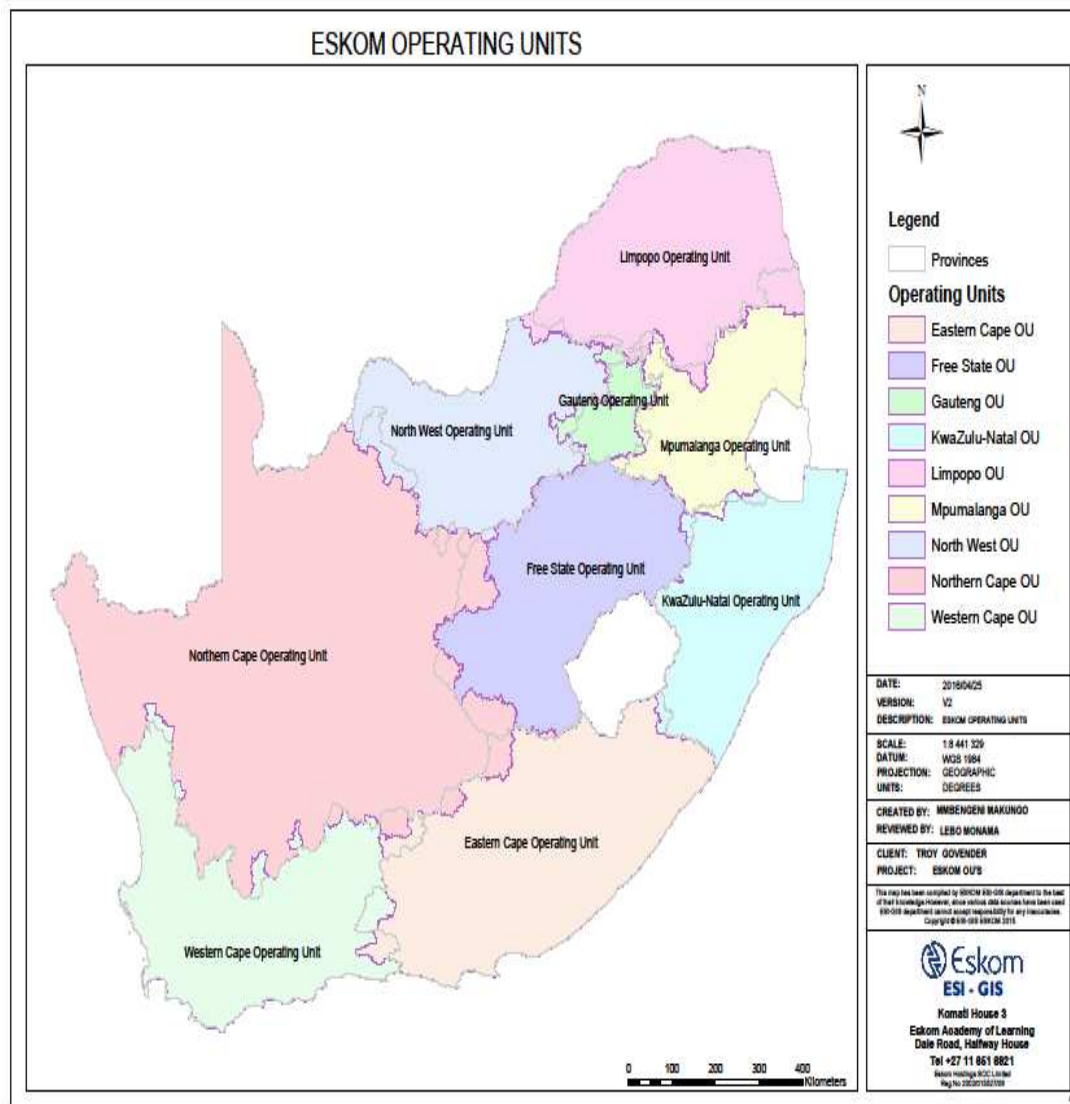


Figure 4.1: The nine OUs of the Distribution Division (Eskom ESI-GIS:1)

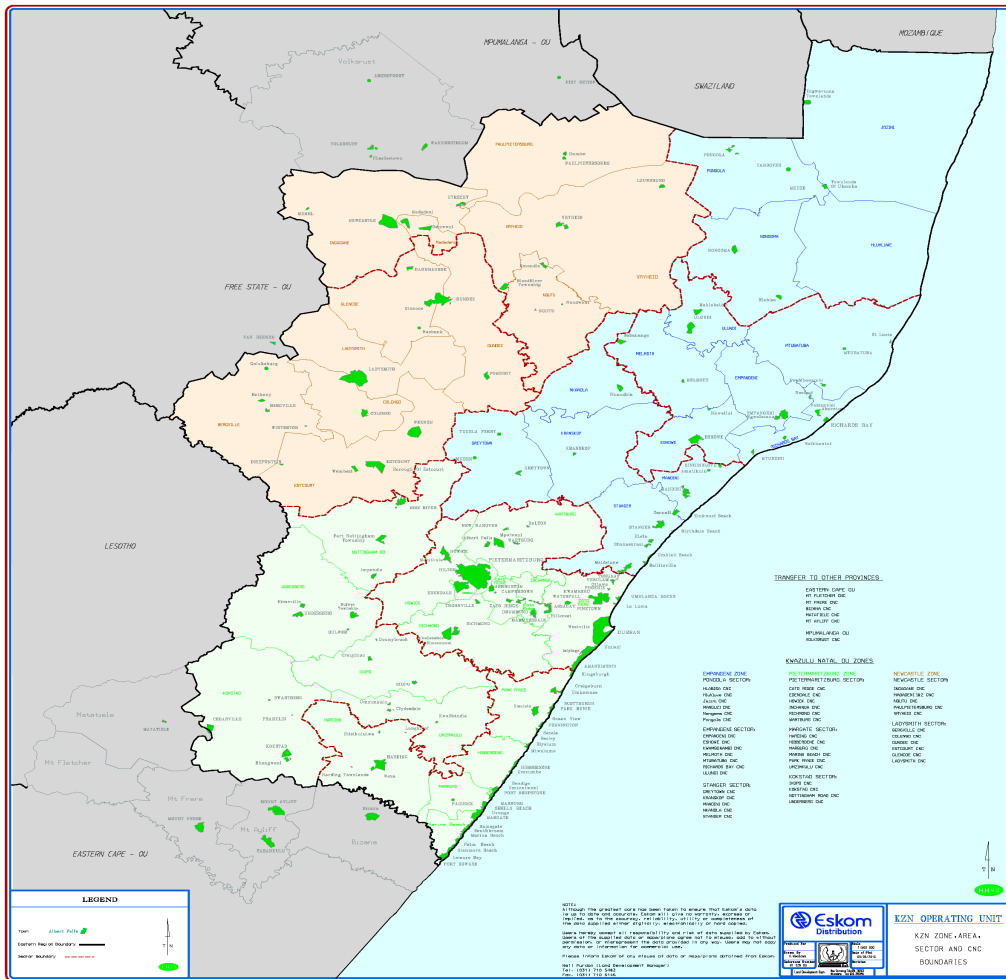


Figure 4.2: Example of an OU (KZN OU) and its Zones, Sectors and CNCs (Eskom, 2013a: 8)

There are approximately 46 682 employees in Eskom and the Distribution Division has the most number of employees with 15 765 or 33.8% employed in the nine Distribution OUs, as indicated in the Table 4.1 below (Eskom, 2015a). Table 4.1 illustrates that the KZNOU has the largest number of employees in the Distribution Division and the NCOU has the fewest employees of the nine OUs. This number of employees in each OU does not include employees from the BP, who were all recently relinked to the corporate functions in Eskom.

According to Eskom (2015e), the Distribution Division’s directive is to operate its network assets (powerlines, substations, and related infrastructure) and provide reliable electricity by building, operating and maintaining distribution assets. Additionally, the Distribution Division is also expected to act in the interest of the country by actively partnering with the wider electricity distribution industry in resolving distribution industry issues and enhancing stakeholder relations.

Table 4.3: Employees in each of the Distribution Division OUs (adapted from Eskom, 2016a)

OU	Number Of Employees
Western Cape	2 001
Eastern Cape	1 801
Free State	1 168
Northern Cape	655
North West	1 401
KwaZulu-Natal	2 464
Gauteng	2 462
Mpumalanga	1 793
Limpopo	2 020
TOTAL	15 765

Eskom (2013a) describes the Distribution Division’s infrastructure as follows:

- 48 278 km of distribution lines: 24 929 km of 132 kV and 23 349 km of 88 kV, 66 kV and 33 kV powerlines;
- 281 510 km of reticulation power lines built and operated at voltages of 22 kV and 11 kV;
- 7 436 km of underground cables: 65 km of 132 kV, 361 km of 88 kV, 66 kV and 33 kV and 7 010 km of 22 kV and 11 kV; and
- 2 800 sub-stations.

Eskom (2015c) explains that this network of powerlines is the largest power line system on the continent of Africa and has a significant footprint in Southern Africa. Some of the challenges within the Distribution Division, according to Eskom (2013a) include:

- Many single powerlines (feeder networks) are more than 100 km in length, supplying customers, and some are as long as 300 km in length;
- a high number of customers per powerline, for example 10 000 customers on a single feeder which puts a constant strain on the powerline network, making the electricity supply susceptible to interruptions;
- not all networks are on an electronic mapping system so that they could be switched off or on remotely; this is essential to isolate faults and restore supply quicker, than dispatching an operator to each and every site especially in remote and unsafe areas;
- an increasing number of employee and contractor injuries and fatalities whilst on duty, as well as an increase in electricity related public injuries and fatalities;
- safety and security of employees, especially those working in volatile areas;
- high levels of theft of electrical equipment and electricity, including illegal connections, which impact the network performance and service levels, and increase costs;
- the clearing of vegetation including indigenous forests and protected trees for the construction and maintenance of powerlines;
- crossing wetlands, streams and rivers during construction, operations and maintenance of powerlines;
- working in close proximity to heritage sites such as tribal graves, monuments, battlegrounds and fossil remains;
- the collision and electrocution hazard posed to birds from the vast network of overhead distribution powerlines which results in injury or death of many birds; and
- acquisition of land and servitudes for electricity infrastructure, coupled with the encroachment of squatters onto the Distribution Division servitudes and wayleaves.

Khan *et al.* (2016) point out that the Electricity Supply Industry in South Africa is a vital link between the supplier (the Distribution Division) and the customers that buy and use electricity. Additionally, the Distribution Division constructs and maintains electrical equipment that transforms the power supply to the type that meets the customer's needs, meters the amount the customer uses, provides the appropriate billing and collects the payments. Moreover, in the past, distribution of electricity was managed by the Distribution Division and a few local municipalities only, and by the early 1990s, there were nearly 500 distributors of electricity in South Africa, but the number of electricity distributors has been

reduced through consolidation to less than 300 electricity distributors, with the Distribution Division being the main and largest distributor of electricity in the country.

Eskom (2015c) indicates that prior to the 2015 COP15 in Paris, Eskom issued eight communiques throughout the organisation, which covered the following climate change themes:

- Towards a global agreement on Climate Change: International negotiations
- What happens at the negotiations?
- Towards a global agreement on Climate Change: Sharing the global carbon budget
- What has happened? The recent COP outcomes
- Some facts on the impacts of climate change
- If we are committed to reducing GHG emissions, why do we need to adapt?
- Eskom Pursues Green Finance Opportunities for Its Low-Carbon Growth
- COP21

These communiques were aimed primarily at management staff in specific departments in the Eskom Holding Company, and largely excluded the Distribution Division. Additionally, these communiques were an update of the COP process and Eskom's involvement and there was also no assessment of the effectiveness of these communiques in the Distribution Division in terms of degree of readership or understanding and employees were not engaged on what would be appropriate mediums to use for such important communication. Moreover, these communiques provided no practical guidelines to promote pro-climate change behaviours among employees (Eskom, 2015c).

The Distribution Division was chosen as a case study for this research because of the:

- need to understand climate change learning in an electricity utility - especially as it is well documented that the Eskom is the main contributor of GHGs in South Africa.
- desire to understand employees' response to climate change so as to develop relevant and appropriate responses.
- necessity of promoting pro-climate change behaviour in the Distribution Division. The Distribution Division is a significant employer in the country with employees who have a relatively good standard of living (Eskom, 2011c). Employees can therefore also have an influence on society at large with respect to pro-climate change behaviour.

- relative ease of obtaining data for such a large industry which has a national footprint.
- aspiration to develop climate change learning guidelines for all other similar utilities, especially in Africa.
- researcher being employed in the Distribution Division as an Environmental Manager.

4.3 Methodological approach

A strategy chosen to answer research questions, according to Robson and McCartan (2016), is research methodology. Furthermore, the application of various methods, techniques and principles to generate scientific knowledge by means of unbiased methods and procedures within a particular discipline, is also considered a research procedure (Creswell, 2013).

As indicated in the conceptual framework presented in Chapter Two, research is guided by the theoretical framework adopted and the researcher's understanding of the issues under examination. According to Repko and Szostak (2016), theoretical views exert an influence and control on methods of knowing, procedures of inquiry and investigation, and such perspectives also provide an intellectual context within which data is acquired, organised, analysed and interpreted. Additionally, research cannot be conducted in the absence of some theoretical perspective. In view of the foregoing, it is obvious that theoretical or conceptual frameworks are important for research to shape how knowledge is understood, what questions are asked, how information is collected and how data is analysed and interpreted. This study is informed by a multi-conceptual framework such as the theories of sustainability, stakeholder engagement, organisational learning and adaptation which influenced the methods chosen.

This study also involved an exhaustive search of the literature entailing the use of over 100 secondary sources of information. The sources cited published works, dissertations, government documents, Eskom documents and reports, internet webpages, and other relevant literature. Reference lists cited in the initial search of secondary sources of information were also reviewed in an effort to find additional information which were not available in the preliminary search of secondary sources.

Understanding a research problem more completely, according to Creswell (2013) and Ivankova *et al.* (2011), involves the use of mixed methods (or triangulation) which is a

procedure for collecting, analysing and ‘mixing’ both quantitative and qualitative data within a single study.

Venkatesh *et al.* (2016) emphasise that it is crucial for the researcher to triangulate in the interest of good research practice. This implies using multiple methods and data sources to augment the legitimacy of the research findings. The use of such multiple methods and sources of data in undertaking a study is necessary to respond to the challenges of the research findings by other interested and affected parties irrespective of the philosophical, epistemological or methodological approach of the researcher.

Data, theory and methodological triangulation (Venkatesh *et al.*, 2016) were used in this study. Several data sources were used, including undertaking research with different individuals and groups, across different locations (nine OUs) in the country, as well as for a period of ten months and over different seasons (time). The theoretical framework chapter indicates that a multi-conceptual framework and multiple methods were used in this study.

In this research both quantitative methods (close-ended survey questionnaires) and qualitative methods (case study, open-ended and perceptual survey questionnaire, focus group discussions and key informant interviews) were used. Rubin and Babbie (2016) contend that when observations and theories cannot easily be reduced to numbers, it is qualitative research that provides a deeper understanding of the participants’ experiences. Additionally, both qualitative and quantitative methods are designed towards understanding a particular area of interest. There are strengths and weaknesses of both approaches. However, when these two methods are used together, it is likely to counterbalance the errors of one method and strengthen the benefits of the other for better research results (Hussein, 2015). According to Molina-Azorin (2016), research methods can be either qualitative, quantitative or both, depending on the nature of the study. However, many different sources of evidence are required when the methodological approach of case studies are used in research (Yin, 2013).

4.3.1 Secondary sources

Dragut *et al.* (2016) maintain that information is available from various sources and that data is seldom exhausted after its main application and may be useful at a later date. Additionally, the theoretical framework and literature review is informed by information which provides the background to the research and a source of data to address specific research objectives.

In this study, an initial literature review was undertaken to develop the research proposal that outlined the motivation for the study, the aim and objectives, the conceptual framework as well as the planned methodological approach. Gaps in the research area were identified through this initial literature search. The scope and context of the study was thereafter determined. The complete research process entailed an extensive literature review which was conducted by sourcing relevant published books and journals. Other documentary sources including reports, policy documents and unpublished articles were obtained from various online libraries. Content analysis approach as described by Cooper (2016) and Robson and McCartan (2016) was used to process the information in this study, and the primary source of information was the online survey questionnaire.

4.3.2 Quantitative Research

Quantitative research methods depend on measurement and the use of various scales which underscores the use of statistics (Bless *et al.*, 2006). Furthermore, according to Niño-Zarazúa (2012), the use of the quantitative method in research is extensively accepted because of the distinct and verifiable data that represents what was measured. Some of the questions that quantitative methods speak to, according to Jackson (2016), include: What the processes are? How often they occur? What differences in their magnitude can be measured over time? McGivern (2006) is of the view that describing patterns and explaining relationships between variables is also possible through quantitative research.

4.3.2.1 Questionnaire

In this study, an online survey questionnaire (Appendix 1) was used as the primary source of data. To observe data which is beyond the physical reach of the observer, according to Patten (2016), a questionnaire is a suitable and familiar tool. Malhotra (2006) underscores this by indicating that the main means of collecting quantitative primary data is the use of a survey questionnaire, which is a formal set of questions for finding information from respondents. Furthermore, the survey questionnaire is a preferred instrument for quantitative research and is an excellent tool for gauging attitudes and the thinking of a population (Robson and McCartan, 2016). Patten (2016) also maintains that survey questions are a means of determining and finding information regarding crucial concepts within the research framework. Questionnaires, according to Adams and Cox (2008), can be in various forms, for example, paper-based or electronic, and contain the questions respondents will be asked to complete whether by themselves or with the help of an interpreter. Moreover, according to

Rubin and Babbie (2016), a survey questionnaire is suitable for obtaining hard evidence, such as factual or descriptive data.

Basil (2017), Leedy and Ormrod (2010), Patten (2016), Rea and Parker (2014) and Robson and McCartan (2016) describe the use of survey questionnaires as a method of obtaining the feelings, beliefs, experiences, perceptions or attitudes of a particular sample of individuals. Additionally, this data collection instrument can be structured or unstructured (Patel and Joseph, 2016) and includes a variety of styles: closed-ended questionnaires, structured interviews and observation using data recording sheets with low design costs. This research required the administration of an online questionnaire that was completed by respondents on their own to retrieve data (based on individual perceptions, concerns and issues) pertaining to their climate change views, concerns and climate change learning in the Distribution Division. In this study, the five sections of the questionnaire moved from general issues initially to more specific issues relating to climate change learning and in the Distribution Division in the latter part of the questionnaire.

The questionnaire (Appendix 1) used in this research covered the following issues:

- Section A: Demographic Profile of Respondents
 - A1. Place of work (OU)
 - A2. Department
 - A3. Band (employee grade)
 - A4. Highest level of education completed
 - A5. Age
 - A6. Gender

- Section B: Attitudes to Life and Environmental Issues
 - B1 (a). Top five issues for society at present
 - (b). Top five issues for industry or business in general at the moment
 - B2. Most important environmental issues experienced by respondent presently
 - B3. Ranking of the importance of a range of environmental issues for the well-being of global society in general
 - B4. Level of understanding of climate change
 - B5. Personal opinion or understanding of climate change

- B6. Concern about climate change at present
- B7. The main issues of concern about climate change
- B8. Identifying the main causes of climate change from a given list
- B9. Any changes noticed in local area or community to indicate that the climate is changing
- B10. Continent likely to be most affected by climate change
- B11. Continent that contributes the most to climate change
- B12. Indication of changes noticed in local area which may suggest that the climate is changing
- B13. View on climate change affecting South Africa
- B14. Time by when climate change will likely affect South Africa

- Section C. Options for Managing Climate Change

- C1. Preparedness to change behaviour to reduce contribution to climate change
- C2. Level of satisfaction that South Africa is doing enough to reduce climate change
- C3. Recommendations or suggestions if South Africa not doing enough

- Section D. Responsibility and Trust

- D1. Who is responsible for making any changes to lessen the impacts of climate change?
- D2. Level of agreement or disagreement on a range of climate change concerns
- D3. Who to trust in making any changes needed to lessen the impacts of climate change
- D4. View on government policy-makers (informed by scientific experts) deciding which measures to adopt against climate change
- D5. View on public involvement in deciding what should be done about climate change
- D6. Who to trust to provide reliable climate change information
- D7. Current source of information on climate change
- D8. Preferred format on climate change information from the Distribution Division

- Section E: The Distribution Division's Climate Change Programme and Environmental Strategies

- E1. Environmental impact of the Distribution Division activities
- E2. Climate Change impact (effect, damage) on the Distribution Division
- E3. The Distribution Division's activities contribution to the climate change

- E4.The Distribution Division’s environmental management strategies
- E5.Awareness of the work the Distribution Division is doing to address climate change
- E6.Personal contribution to achieving the Distribution Division’s Climate Change goals at work
- E7.The Distribution Division’s efforts at addressing climate change
- E8.Employees involvement in the Distribution Division’s environmental management programmes or activities.

Objective one of this research will be covered by section E of the questionnaire. Sections B, C and D covers objective two. Objective three is mainly obtained from Sections B and C of the questionnaire and objectives four and five is derived from the outcomes of the entire questionnaire as well as the literature review.

The development of the questionnaire for this study was aligned to the guidelines by Patten (2016) and Rea and Parker (2014) who suggest that:

- sentences need to be brief and clear, with simple words and that the style of questions must be suitable for the targeted respondents;
- questions must consist of only one thought or idea to reduce confusion and misinterpretation;
- questions must be relevant to the purpose of the survey and be clearly linked to specified objectives and research questions; and
- abstract concepts must be explained, as researchers must not make assumptions about the respondent’s knowledge about the subject.

These guidelines are relevant and applicable in this study as there are differences in educational levels, income, grade levels and environmental literacy across the Distribution Division.

Another important consideration when developing a questionnaire, according to Patten (2016), is that general, non-threatening questions must be asked first and more sensitive, personal questions at a later stage. The questionnaire used in this research considered these features and was structured in relation to thematic issues, namely, socio-demographic variables first, then attitudes to life and environmental issues, options for managing climate

change, responsibility and trust, and lastly, the specific issue of the Distribution Division's climate change programme and environmental strategies.

Bryman (2015) also recommended that a questionnaire should have a preliminary component with clear instructions. This is supported by Patten (2016) who states that such a section will enable respondents to fully understand the study and allow them to comprehensively and willingly participate or not. A letter to introduce the survey, explain the purpose and objectives of the research, the structure of the survey and the feedback mechanisms, as well as that respondents were protected by confidentiality of their responses, was communicated on the opening page of the online survey. An e-mail was also sent to all the Distribution Division employees to encourage them to participate in this survey and each OU was set a target of a minimum of sixty completed surveys per OU, to be tracked on the Distribution Division's Monthly Environmental Performance Index.

There are usually two types of questions in a survey questionnaire: close-ended and open-ended questions. However, close-ended questions are considered as 'forced questions' by Patten (2016). But Tourangeau *et al.* (2014) are of the view that since in close-ended questions the responses are uniform and can be easily coded and processed, closed-ended questions are commonly used in the design of questionnaires. Additionally, close-ended questions also lead to consistent responses which allow systematic comparisons, as was done in this study. When all possible responses cannot be anticipated, Tourangeau *et al.* (2016) is of the view that open-ended questions are invaluable and that open-ended responses require that they be categorised and then coded for statistical analysis. According to Kumar (2011), open-ended questions provide a wealth of information that allows respondents to feel comfortable about expressing their opinions and in a language they are comfortable in. In alignment with the foregoing, this survey included close-ended questions (where a response is selected from a given set of responses) and open-ended questions (where respondents express their own views freely). In this study all close-ended questions, where applicable, also had a specify option to allow respondents the opportunity to add other responses to the list provided for those specific questions. Furthermore, a five-level Likert scale (strongly disagree, disagree, neutral, agree, strongly agree) was used for two of the questions in the questionnaire.

4.3.3 Qualitative research

In addition to the use of quantitative surveys and secondary sources, this study engaged in primary data analysis through the use of focus group discussions (Appendices 3 and 4) and a number of key informant interviews (Appendix 2). There are limitations in terms of time and costs in the collection of primary data. However, validation of the quantitative data collected and hence the minimisation of the margin of error is strongly influenced by the effort put into the collection of data from focus group surveys and from individual or group interviews (Flick, 2017; Hussein, 2015).

The qualitative approach in this study involved the use of focus group discussions and key informant interviews. Also, part of the qualitative technique was the open-ended questions that were included in the structured questionnaire which was discussed in the previous subsection. Qualitative techniques are important to ensure triangulation and, according to Neuman (2011) and Silverman (2016), such methods expand the researcher's understanding of the issues and maximises their confidence in the findings. Additionally, the data in text form is thorough, delicate, nuanced and related to the case study, key informant interviews and the focus group discussions.

4.3.3.1 Key informant interviews

A semi-structured interview was undertaken with eleven individuals: eight Distribution Division employees, one from the Natural Resources and Environment Department of the Council for Scientific and Industrial Research (CSIR), one from the Scientific Services Division of the Ezemvelo KZN Wildlife and one from the Centre for Biodiversity of Conservation South Africa. These individuals were chosen due their involvement and knowledge on climate change related issues, as well as their availability and interest in the outcomes of this research. In addition, the semi-structured interview was also used to elicit the perceptions and concerns of the informants in relation to climate change in Eskom and in particular for the Distribution Division, as well as climate change learning in business. An interview schedule (Appendix 3) was used to guide the conversation which included similar thematic aspects as raised in the questionnaire and the focus group discussions. This approach offered flexibility in the way in which the question could be asked or rephrased and permitted responses to be probed or further questioned for clarification or additional information. Thus, as Kallio *et al.* (2016) suggests, respondents' answers during a semi-structured interview often determine the direction of subsequent questions.

4.3.3.2 Focus group discussions

A focus group is a collection of between six to twelve individuals, who meet to discuss a specific topic that has been set by a researcher (Clifford *et al.*, 2010). This is underscored by Carey and Asbury (2016) who claim that focus group discussions are also viewed as group dialogues that are directed by a researcher with a group of people with similar interests or concerns, to discover more information about a particular subject. Additionally, a focus group must be planned properly with the objective of obtaining insights from participants on a particular (focused) topic in an amicable and safe setting. Essentially, a focus group is small enough for everyone to have a chance to talk and large enough to provide diversity of opinions (Silverman, 2016).

According to Carey and Asbury (2016), some of the advantages of focus group discussions include:

- an opportunity to observe and motivate much engagement on a specific topic in a limited period of time by providing rich information and direct evidence regarding similarities and differences in participants' opinions and experiences; and
- multiple viewpoints are obtained in a short period of time as compared to individual interviews.

Some of the disadvantages of focus group discussions, according to Krueger and Casey (2014), and Stewart and Shamdasani (2014) include:

- increased costs in setting up meetings, for example costs for venue, travel, meals and *per diem* of participants;
- time-consuming, as participants will have to schedule time off their diaries to attend or to travel to the meeting venue;
- facilitator can influence the outcomes (interviewer effect);
- some respondents could be reserved or overwhelmed by other dominant speakers or even readily agree with the group without expressing their personal view;
- invasion of privacy as one of the objectives is to understand the thinking behind the responses; and
- researchers need to be skilled, to manage all comments and inputs objectively and completely.

By understanding these disadvantages, and preparing well, it is possible to limit the potential disadvantages. For this study, some of the identified disadvantages were addressed as follows:

- Eskom venues were used for the meetings which did not involve any costs;
- no meals or *per diem* were provided to participants;
- focus meetings were limited to a maximum of two hours to minimise the time of the participants;
- the facilitator encouraged all participants to participate and controlled the discussions to allow everyone to provide their inputs; and
- a guideline was provided to all participants at the start of the focus group discussions, to assure participants of the confidentiality of their inputs, to motivate open discussions from everybody and discourage any domineering participants (Appendix 4).

The focus group discussions were facilitated by the researcher to discuss climate change learning in the Distribution Division. The focus group discussions were held in English during May and June 2016, in three OUs, namely WCOU, KZNOU and GOU. The three focus group discussions comprised of a total of twenty-four individuals from a range of departments in Eskom and eleven individuals external to Eskom such as UNEP, Wildlife and Environment Society of South Africa (WESSA), Pegasys (a strategic management consultancy), City of Cape Town, eThekweni Municipality, KwaZulu-Natal Department of Agriculture and Environmental Affairs, National Cleaner Production Centre of South Africa (NCPC-SA) and Management of Applied Green Initiatives and Concepts (M.A.G.I.C.). M.A.G.I.C is an innovative cooperative structure which covers the fields of sustainable development and focuses on the public sector constituency.

The three focus group discussions consisted of eighteen female adult representatives and seventeen male adult participants of different age categories. A schedule of guidelines, questions and activities were developed to guide the focus group sessions. The focus group schedule was aligned to the survey questionnaire and issues were further explored during the discussions. Participants were also provided guidelines on the process to be followed, as well as assured of the confidentiality of the discussions. This is consistent with Krueger and Casey (2014) and Then *et al.* (2014) who emphasise the importance of assuring participants of the

ethical considerations taken by the researcher including what is expected of the participants in terms of respecting the views of each other by ensuring that personal details and potentially sensitive material are not discussed outside the context of the group.

In this study, the discussion included attitudes to life and environmental issues, options for managing climate change, responsibility and trust for climate change actions and information, and the Distribution Division's climate change programme and environmental strategies. For two of the important themes in the survey, participants identified a wide range of options for what they considered the most important issues for society at present and in what format they preferred information on climate change from the Distribution Division, to help them decide what they should do about climate change. The wide range of options needed to be prioritised so that decisions could be made on which are the most important issues for society and best format for climate change information to influence the recommendations in this study. Pairwise ranking as suggested by Eriksson (2013) and Hansen and Ombler (2008) was used during the focus group discussions to prioritise the issues and formats, as it is a structured way to rank a large number of issues in a group.

A pairwise ranking matrix was developed for the key issues for the focus group discussions on two main themes, namely, the most important issues for society at present and in what format respondents preferred information on climate change from the Distribution Division. Taking into consideration the views and responses from all three focus group discussions, each issue was compared against the other issue to determine which was more important. This process was repeated for all twelve issues until all possible comparisons had been made and a matrix was completed. The number of times an issue had been found to be more important, was measured by counting the number of times its number appeared in the matrix. The issues that appeared most were ranked high (a value of 1), and those that appeared the least were ranked low (a value of 12).

4.4 The sampling process

Fowler (2013) maintains that there are time and cost implications to survey entire populations and therefore sampling is done, which is the process of choosing from a much greater population from which a generalised statement is inferred, so that the selected part represents the whole group. According to Mujere (2016), a sample is therefore a smaller group obtained

from the reachable population with each member or case in the sample referred to as a subject or sometimes the term 'respondent' or 'interviewee' is used. This is underscored by Rubin and Babbie (2016), who regard sampling as a means of gaining information about the population without the need to examine the entire population and that a researcher can measure variables on the selected sample case and generalise results accurately to all cases, if the sampling is done properly. In this study, employees in Eskom's Distribution Division who had access to the online survey were chosen. A reliable outcome is expected as this sample represents the majority of employees in the Distribution Division located at different sites throughout the country, with varying qualifications, years of service and grade levels in the organisation.

4.4.1 Online Survey

All employees in the Distribution Division, who had internet access, were exposed to this study. The online survey questionnaire was hosted on the Distribution Division Group Executive's Homepage on the Eskom intranet. A communiqué was thereafter sent to employees in all nine OUs who have access to the Distribution Division's intranet homepage, providing them the background to the survey and directing them to the survey site to complete the questionnaire. Employees were provided a hypertext link to directly access the questionnaire or were provided guidelines on how to navigate to the site of the questionnaire. The hyperlink to the survey was as follows:

<http://intranet.eskom.co.za/sites/distribution/DXOGE/Lists/ClimateChangeSurvey/overview.aspx>

Gravetter and Wallnau (2016) indicate that to calculate the sample size it is necessary for the researcher to agree and set down the Margin of Error (confidence interval), Confidence Level and the corresponding z score and the Standard of Deviation for the survey. For the purposes of this research a 95% confidence level and a 5% margin of error was set. Using an online sample size calculator at <https://www.surveysystem.com/sscalc.htm>, the target sample size was calculated to be 375 at 95% confidence level and a 5% margin of error, given that there are 15 765 employees in all nine OUs. However, even though a minimum sample size of 375 would have been acceptable at a 95% confidence level, more employees, namely, 618 responded to this survey.

4.4.2 Key informant interviews

This research included interviews with key informants (Appendix 2) in the area of climate change and learning and environmental management. The key informants were chosen purposively due to their relevance or interest in the subject and represented a range of stakeholders from Eskom, business, government and NGOs.

4.4.3 Focus group discussions

As indicated earlier, Eskom employees and others were purposively sampled to participate in the focus group discussions (Appendices 3 and 4). The focus group held in the WCOU consisted of ten individuals (seven from the WCOU, one from the City of Cape Town, one from Pegasys and one from WESSA). The focus group held in the KZNOU consisted of seven individuals (five from KZNOU, one from the eThekweni Municipality, one from the KwaZulu-Natal Department of Agriculture, Environment and Rural Development). The focus group held in the GOU consisted of sixteen individuals (eleven from GOU, two from UNEP, two from NCPC-SA and one from M.A.G.I.C. The Eskom members that were chosen reflected diversity in terms of departments, grade levels, age, gender and race in Eskom. Those chosen from outside Eskom represented knowledgeable persons in the area of climate change or environmental issues. The schedule described earlier was used to guide the discussions.

4.5 Validity and reliability

According to Silverman (2016), ensuring reliability and validity of the study is pivotal for the credibility of any research. Robson and McCartan (2016) argue that reliability and validity remain appropriate concepts for attaining rigor in qualitative research. Additionally, reliability is defined as the extent to which an experiment, test or measuring procedure yields the same results on repeated trials and validity as the extent to which a concept, conclusion or measurement is well-founded and corresponds accurately to the real world.

Validity and reliability in this study was ensured through:

- The use of recognised guidelines to develop the survey questionnaire (Patten, 2016, and Rea and Parker, 2014), the schedules for key informant interviews (Kumar, 2011) and the focus group discussions (Krueger and Casey, 2014).

- Piloting the questionnaire: the online questionnaire was piloted with sixteen Distribution Division employees from different OUs and at different grades for two weeks. This process identified technical challenges with the online questionnaire, and elicited valuable comments, inputs and suggestions. These suggestions were then included in the questionnaire, and the technical issues were resolved or revised before it was hosted on the Distribution Division's Intranet Homepage.
- The sampling process was chosen to minimise bias. In this study, the survey was issued to all employees in Distribution with Intranet access, without any limitations or restrictions on any particular group or department. Thus, according to Robson and McCartan (2016), each individual, object or event had an equal chance of being included in that sample.

4.6 Analysis of data

According to Jackson (2016), quantitative data, for example, from the survey questionnaire produces results that generalise, compare and summarise, whereas Silverman (2016) is of the view that qualitative data (from the case study, key informant interviews and focus group discussions) yield results that give meaning, experience and views. Robson and McCartan (2016) indicate that quantitative researchers accept that the goal of science is to discover the truths that exist in the world and to use the scientific method as a way to build a more complete understanding of reality.

In quantitative data analysis formal statistical procedures are used and the collection and analysis of data are two distinct and separate phases (Robson and McCartan, 2016). In this study, multiple response questions were analysed and displayed as tables and graphs. The data obtained made no assumptions about the probability distributions of the variables being assessed, although a quantitative survey instrument was used. To identify trends, associations and relationships within the data set, cross-tabulations and chi-square tests were used. The descriptive statistics used also included reliability statistics such as Cronbach's alpha and the factor analysis utilised the Kaiser-Meyer-Olkin and Bartlett's Tests.

According to Balakrishnan *et al.* (2013), the chi-squared statistic is a measure of how similar two categorical probability distributions are. If the two distributions are identical, the chi-

squared statistic is 0, and if the distributions are very different, the result will be a higher number. Additionally, the main aim of the chi-square test is to test how likely it is that an observed distribution is due to chance, often referred to the 'goodness of fit' statistic and the chi-square measures how well the observed distribution of data fits with the distribution that is expected if the variables are independent (Mertler and Reinhart, 2016).

Silverman (2016) points out that most researchers recognise that subjective experiences, in the social context and in historical time are important to understand real life human experiences. Hence, qualitative analysis focuses on revealing information about how people think and feel about the circumstances in which they find themselves, rather than considering whether those thoughts and feelings are valid. Robson and McCartan (2016) indicates that qualitative data analysis requires a range of processes and procedures whereby the researcher moves from the qualitative data that has been collected into some form of explanation, understanding or interpretation of the people and situations that is being investigated. Furthermore, Carey and Asbury (2016) indicate that such analysis is based on informative thinking with the objective to examine the meaning and characteristics of the data. Additionally, some of the important issues to consider when analysing qualitative data is the content of the primary message, the attitude of the participants towards the message and whether the content of the message is meant to represent individual or group-shared ideas. Silverman (2016) suggests that the analysis of focus group discussions should involve:

- Organisation of the data collected;
- Identifying a relevant framework or coding plan;
- Sorting out the data into the framework;
- Using the framework for descriptive analysis; and
- Undertaking second order analysis.

In this study, the following was undertaken to meet the above-mentioned requirements:

- the data was captured on an excel spreadsheet during the focus group discussions by the facilitator;
- pairwise ranking methodology was used;
- the pairwise ranking methodology prioritised the issues of concern for the Distribution Division employees;

- the pairwise ranking methodology indicated which of twelve issues were of greatest concern for the Distribution Division employees, and which of twelve different formats they preferred climate change information and for climate change learning; and
- the pairwise ranking of the three focus group discussions and the results of the survey questionnaire were compared to check for alignment.

The quantitative and qualitative information obtained was analysed thematically. Moreover, secondary sources of information were examined for key issues and concerns emerging from the literature and primary data to provide a more detailed analysis. Data was presented in text format, tables, graphs and figures. The Statistical Package for the Social Science (SPSS) version 24.0 was utilised for the data processing.

The online survey questionnaire was developed with a mixture of single responses, multiple responses and open-ended questions that were administered to employees in Eskom's Distribution Division in all nine of its OUs. Descriptive tabulations such as graphs and tables were derived from the analysis of the empirical data. Chi-square tests, where relevant and necessary, were used to examine relations between specific variables. Furthermore, the inferential statistical calculations were only undertaken, if there was a possible link.

4.6.1 The research instrument

The research instrument consisted of 194 items, with a level of measurement at a nominal or an ordinal level. The questionnaire was divided into five sections which measured various themes as illustrated below:

- Biographical data
- Attitudes to life and environmental issues
- Options for managing climate change
- Responsibility and trust for climate change actions
- The Distribution Division's climate change programme and environmental strategies

4.6.2 Reliability statistics

The two most important aspects of precision are reliability and validity (Diedenhofen and Musch, 2016; Silverman, 2016). Additionally reliability is computed by taking several

measurements on the same subjects. Cho (2016) is of the view that a reliability coefficient, namely, the Cronbach's Alpha Score of 0.60 or higher is considered as acceptable for a newly developed construct. The various reliability statistics for this research were computed using SPSS software. Table 5.1 reflects the Cronbach's alpha score for all the key items that constituted the questionnaire. The reliability scores for all sections exceed the recommended Cronbach's alpha value of 0.600 for a newly developed construct. This indicates a degree of acceptable consistent scoring for these sections of the research.

Table 5.1: Cronbach's Alpha score for key items of the questionnaire

Section	Name	Number of Items	Cronbach's Alpha
B1	(a) Which are the most important issues (top 5) for society at present? (b) Which do you think are the most important issues (top 5) for industry or business in general at the moment?	26	0.936
B2	Which are the most important environmental issues that you experience or impacts on your life at present?	17	0.925
B3	How important do you think the following environmental issues are for the well-being of global society in general?	17	0.913
B8	Which of the following do you believe are the main causes of climate change?	11	0.742
B12	Which, if any, of the following have you noticed (relating to where you have lived) which may suggest that the climate is changing?	9	0.821
C1	Would you be prepared to change your behaviour to reduce your contribution to climate change in any of the following ways?	11	0.846
D1	Whom do you think should be responsible for making any changes to lessen the impacts of climate change?	12	0.947
D2	Please indicate how much you agree or disagree with the following statements about climate change by ticking one box on each row.	11	0.599
D3	Whom would you trust in making any changes needed to lessen the impacts of climate change?	12	0.960
D6	Whom would you trust most to give you reliable information on climate change?	10	0.908
E1	Please rate your level of agreement with the following statements with regard to climate change climate change programme and environmental strategies in the Distribution Division	8	0.763

4.6.3 Factor analysis

Ott and Longnecker (2015) contend that factor analysis is a statistical technique whose main goal is data reduction and a typical use of factor analysis is in survey research, where a researcher wishes to represent a number of questions with a small number of hypothetical factors, for example, as part of a national survey on political opinions, participants may answer three separate questions regarding environmental policy, reflecting issues at the local, state and national level. Additionally, each question, by itself, is an inadequate measure of attitude towards environmental policy but together they may provide a better measure of the attitude. According to Maydeu-Olivares *et al.* (2017), factor analysis can be used to establish whether the three measures do, in fact, measure the same thing and if so, they can then be combined to create a new variable, a factor score variable that contains a score for each respondent on the factor. Additionally, factor techniques are applicable to a variety of situations and a researcher may want to know if the skills required to be a decathlete are as varied as the ten events, or if a small number of core skills are needed to be successful in a decathlon.

The matrix tables are preceded by a summarised table that reflects the results of Kaiser-Meyer-Olkin and Bartlett's Test. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is a statistic that indicates the proportion of variance in variables that might be caused by underlying factors. High values (close to 1.0) generally indicate that a factor analysis may be useful with the data. If the value is less than 0.50, the results of the factor analysis would not very useful. Bartlett's test of sphericity tests the hypothesis that the correlation matrix is an identity matrix, which would indicate that the variables are unrelated and therefore unsuitable for structure detection. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with the data. In all instances for this research, the conditions are satisfied which allows for the factor analysis procedure.

Factor analysis is done only for the Likert scale items and certain components divided into finer components. Since the Kaiser-Meyer-Olkin Measure of Sampling Adequacy values are greater than 0.500 and the Bartlett's Test of Sphericity significant values are less than 0.05, all of the conditions are satisfied for factor analysis for all the questions (Table 5.2).

Table 5.2: Kaiser-Meyer-Olkin and Bartlett's Test

Section	Name	Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
			Approx. Chi-Square	Df	Sig.
B1a	Which are the most important issues (top 5) for society at present?	0.787	510.203	78	0.000
B1b	Which do you think are the most important issues (top 5) for industry/business in general at the moment?	0.810	379.099	78	0.000
B2	Which are the most important environmental issues that you experience or impacts on your life at present?	0.861	732.806	136	0.000
B3	How important do you think the following environmental issues are for the well-being of global society in general?	0.841	927.161	136	0.000
B8	Which of the following do you believe are the main causes of climate change?	0.805	824.897	55	0.000
B12	Which, if any, of the following have you noticed (relating to where you have lived) which may suggest that the climate is changing?	0.771	924.713	36	0.000
C1	Would you be prepared to change your behaviour to reduce your contribution to climate change in any of the following ways?	0.871	649.470	55	0.000
D1	Whom do you think should be responsible for making any changes to lessen the impacts of climate change?	0.895	1647.221	66	0.000
D2	Please indicate how much you agree or disagree with the following statements about climate change by ticking one box on each row:	0.731	1295.304	55	0.000
D3	Whom would you trust in making any changes needed to lessen the impacts of climate change?	0.883	1161.977	66	0.000
D6	Whom would you trust most to give you reliable information on climate change?	0.900	810.965	45	0.000
E1	Please rate your level of agreement with the following statements with regard to climate change in the Distribution Division	0.798	1684.619	28	0.000

4.7 Conclusion

This chapter provided a detailed background of the methodological approaches used in this study. The Distribution Division of Eskom, a SOE, was chosen as a case study for this research for a number of reasons including the need to understand climate change learning in a national electricity utility which is a large employer in South Africa. The quantitative method made use of an online survey questionnaire which was hosted on the Distribution Division's Group Executive's Homepage. The case study, the Distribution Division, the key informant interviews and the focus group discussions represented the qualitative research approach in this study. The sampling processes used for the case study, the online survey, the key informant interviews and the focus group discussions were discussed briefly. The need to ensure validity and reliability was also emphasised in this chapter to ensure the credibility of this study. The techniques in which the quantitative and qualitative data would be interpreted and analysed was stated which included pairwise ranking, the chi-square technique and the use of SPSS for the statistical analysis of the data. The techniques implemented in this study to overcome some of the potential flaws and to ensure a robust analysis of the focus group discussions were also discussed.

CHAPTER FIVE

DATA DESCRIPTION AND ANALYSIS

5.1 Introduction

According to O'Neil and Schutt (2014), data analysis is a process that involves examining, clarifying, converting and modelling statistics the objective of which is to discover useful information to make deductions and support decision-making. Moreover, Wigboldus and Dotsch (2016) suggest that mismatched outputs, results that never get discussed or used, or key findings can be overlooked, if data analysis is not thought out or done properly. The various data analysis methods used in this study was discussed in detailed in Chapter Four. This chapter will present the results of both the quantitative and qualitative techniques used in this study. Hence, the online survey results are analysed and reported on within the context of the key informant interviews and the focus group discussions.

It is essential to undertake a comprehensive analysis of employees and workplace dynamics to understand climate change learning in a large electricity utility such as the Distribution Division. The literature review in Chapters Two and Three of this study indicated that there are many interrelated linkages between climate change and learning. The results obtained from the research conducted on climate change learning in the Distribution Division are presented in this chapter.

This chapter also addresses the research objectives of the study through the statistical analysis of components such as demographic profiles of respondents, understanding of current issues for society and industry, employees' options for managing climate change, employees' views on who is responsible for, and can be trusted on, climate change, as well as their views on the Distribution Division's climate change programme and environmental strategies.

An analysis of the quantitative data using both descriptive and inferential statistics, integrated with the qualitative data, is used to:

- Review and assess the level of the Distribution Division's climate change programme and environmental practices;
- Examine staff perceptions and attitudes towards climate change and the Distribution Division's environmental strategies;

- Examine the challenges and opportunities presented by the environmental and climate change crisis for business in South Africa and in particular for electricity utilities in Africa;
- Develop indicators (Table 6.1) to inform a framework for internal climate change capacity building programmes for electricity utility companies; and
- Formulate policy and programme recommendations, based on the findings.

The questionnaire was the primary tool that was used to collect data and was distributed to approximately 7 000 of the Distribution Division employees who have access to the Distribution Division's Intranet Homepage. The data collected from the responses was analysed using SPSS version 24.0. The results present the descriptive statistics in the form of graphs and tables and cross-tabulations for the quantitative data that was collected. Inferential techniques include the use of correlations and Chi-square test values which are interpreted using the p-values.

5.2 Demographic profile of respondents

An analysis of the demographic profile of respondents is vital in such a research as it provides a context to understand the influences they could have on the attitudes and perceptions of climate change learning in the Distribution Division. The demographic profile also provides insight into the culture of the respondents which, according to Caldas *et al.* (2015), influences environmental behaviour. Baatz (2014) contends that since it is at the individual level where pro-climate change behaviour rests, it is important to understand individuals' demographic profile. The respondent's OU and department in which they work, their TASK grade level in the organisation, highest level of education completed, age and gender are discussed below.

5.2.1 The survey response per OU

The online survey questionnaire was hosted on the Distribution Division Group Executive's Homepage on the Eskom intranet and available to employees with intranet access in all nine Distribution Division OUs. From Figure 5.1, of the total 618 respondents who completed the survey, the largest number of respondents (19.10%) is from the NWOU. FSOU had the second largest number of respondents with 18.12% of the completed surveys, while KZNOU

made up 16.50% of the completed surveys. MOU had the lowest response rate with only 0.49% of the total number of surveys completed in the Distribution Division.

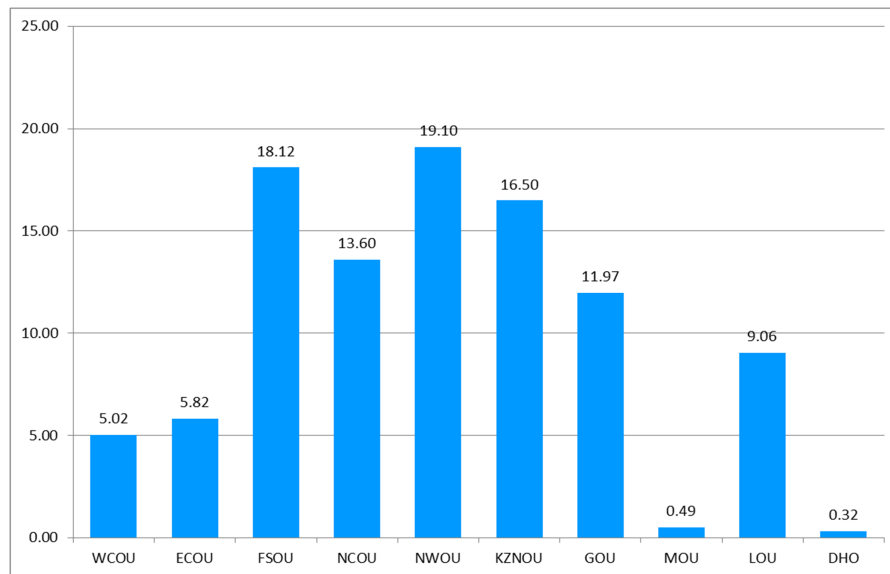


Figure 5.1: The OU in which respondents work (n=618, in %)

The response rate is not reflective of the provincial spread of employees in the Distribution Division (Figure 5.2) as the response rate is inversely proportional to the number of employees per OU, for example, NWOU has 8.89%, FSOU has 7.41% and MOU has 11.4% of the Distribution Division employees. KZNOU with 15.6% and GOU with 15.6% of the Distribution Division employees were the only OUs to be closely aligned with the response rate.

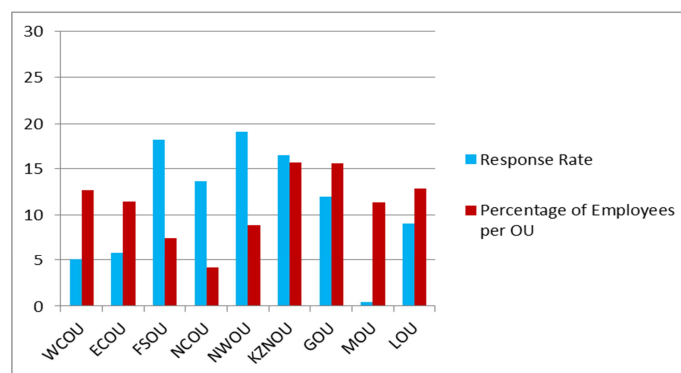


Figure 5.2: Response rate per OU vs percentage of employees per OU (n=618, in %)

From the focus group discussions it emerged that the survey response rate was influenced by the varying degrees of communication and promotion in the different OUs due to variable commitment or concern about environmental and climate change issues of the respective OU managers. Another contributing factor cited by the focus group discussions for the low responses from some OUs, for example, the ECOU and MOU is that these OUs focused on their Environmental Management Systems (EMS), International Standards Organisation EMS standard (ISO14001) certification audits during 2015. Hence the attention and emphasis in these particular OUs was on obtaining the certification and not on the completion of this survey, which was not considered a high priority.

5.2.2 The department in which respondents work

Employees in the GMs’ office, AC, M&O, BIPM, SHEQS and IS Departments as well as the those that provide a service to the OU, such as the BP and the Distribution Division Executive’s office participated in this survey.

According to Figure 5.3, the most responses came from the M&O Department with 44.34% of the total surveys completed, 29.44% of employees from AC, and 11.33% of employees from the BPs completed this survey. There was a very low response rate from the BIPM Department and the GMs office, with only 2.1% and 0.65% of the total surveys completed by these departments, respectively. The response rate is aligned to the number of employees in these departments as M&O has the largest number of employees, followed by AC and BPs (Eskom, 2015a).

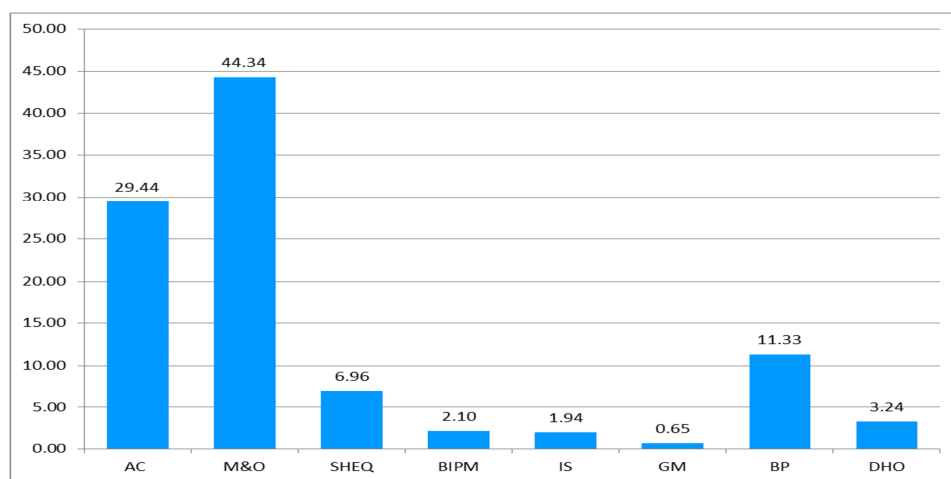


Figure 5.3: Respondents’ department (n=618, in %)

This was confirmed by the focus group participants who stated that there are more employees in total in the M&O department followed by the AC in all nine OUs. Additionally, most of the work in the OUs is in the M&O and AC environments.

5.2.3 The TASK grade of respondents

The Distribution Division utilises the TASK grading system for its employees (Eskom, 2013b), which was developed in the early eighties and replaced the Paterson Grading system in Eskom. According to Van Rooyen (2007), TASK is a system of job evaluation that uses defined skill levels and factors to grade all posts in the organisation thereby increasing objectivity and reliability within the process of grading posts. Additionally, the TASK grading system is applicable to a wide variety of organisations across the full economic sector in the country and it is used broadly by most businesses.

In the Distribution Division the TASK grading system is applied as indicated in Appendix 5. This survey was available to employees in all eleven TASK grades in the Distribution Division who had Intranet access. According to Table 5.2, 39.97% of responses came from employees in the T11-T13 band, which is made up of mainly engineers, CNC Senior Supervisors, Senior Technicians, Officers, Project Coordinators, Land Surveyors and Advisors. According to the focus group discussions, it must be noted that in the Distribution Division, the majority of employees in the M&O and AC departments fall within the T11-T13 TASK grade. Employees in the TASK grade M14-M15 and T9-10 made up 11.81% of this survey, while 11.49% was from the T0-T8 TASK grade and 6.96% was from the SSE/EE and above grades. The focus group discussions expressed concern that no employees in the P17-18 and S17-18 TASK grades completed the survey.

Table 5.3: TASK grade of respondents (n=618, in %)

TASK Grades in Distribution Division	Frequency	Percentage
SSE/EEE and above	43	6.96
M17-M18	35	5.66
P17-P18	0	0.00
S17-S18	0	0.00
M14-M16	73	11.81
P14-P16	29	4.69
G14-G16	16	2.59
P11-13	25	4.05
T11-T13	247	39.97
T9-T10	73	11.81
T4-T8	71	11.49
Other	6	0.97

It was pointed out that employees in this grade are the senior advisors and corporate consultants who develop strategy and business plans for the Distribution Division and their involvement and response to the survey would have been valuable, as the survey would have provided these employees with meaningful information to influence the Distribution Division strategy to integrate climate change-related issues into the business plan.

5.2.4 Educational level of respondents

Better-educated individuals tend to be more knowledgeable, concerned and involved in pro-environmental activities, including climate change mitigation actions (Diamantopoulos *et al.*, 2003). This is underscored by Meyer (2015) who indicates that education does play a significant role in pro-environmental behaviour and De Rose and Testa (2014) who also believe that educated people tend to be more concerned about environmental issues, including climate change. In this survey, 41.9% of the respondents have a diploma or certificate as their highest level of education, 23.5% of the respondents have a postgraduate qualification, 12.9% have an undergraduate degree and 11.33% have only a secondary school education. Interestingly, 7.94% of the respondents only have a primary school qualification as their highest level of education (Figure 5.4). Nearly 19.27% of respondents have no post-matriculation qualification, while the majority (80.73%) have a post-matriculation qualification, which indicates that a fair proportion of the respondents have a higher qualification. Hence, the responses gathered in this study are from an informed (learned) source.

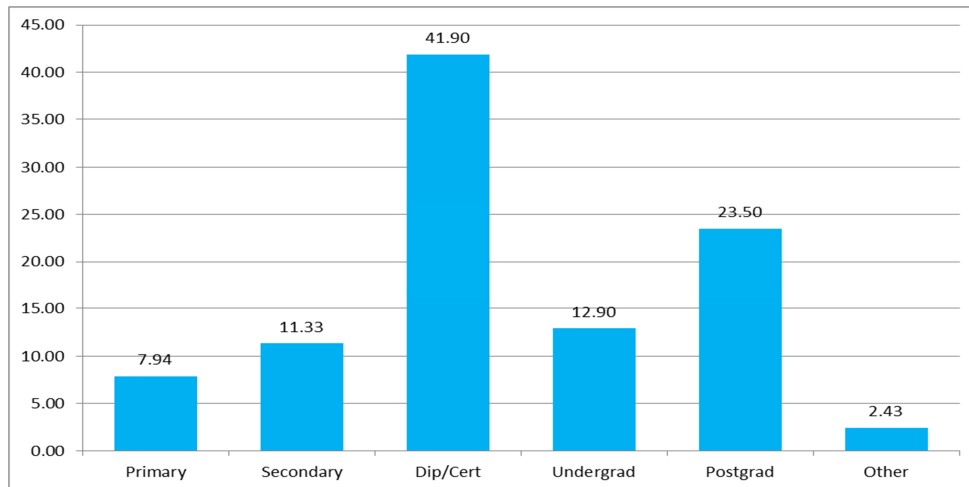


Figure 5.4: Highest level of education of respondents (n=618, in %)

In view of the relatively good education level of the majority of the Distribution Division employees and Meyer’s (2015) view about the role of education, it is likely that employees in the Distribution Division would be more receptive to pro-climate change behaviours which are examined in this study. Three of the key informants suggested that the different levels of education and attitudes in the Distribution Division contribute to resistance to change and difficulties in altering employee's views and opinions.

One of the key informants was of the view that the challenge in changing workplace behaviour to address climate change was “dependent on education and upbringing”, another indicated “levels of education” while the third was of the view that “environmental values should be taught in schools and by parents”. The level of education was not raised as an issue by the focus group discussions.

Due to the change in the social bases of environmental concern, education no longer has a simple positive effect on concern (Chankrajang and Muttarak, 2017; Hamilton, 2009), which implies that there are other factors that need to be considered in attempting to understand environmental concerns. However, education represents an important strategy to move from mere perceptions of climate change risks to action (Xue *et al.*, 2016) and therefore for the Distribution Division, there is a great need for climate change learning to improve pro-climate change actions.

5.2.5 Age of respondents

There is much debate about age and environmental knowledge, attitudes and behaviour and there is no clear trend due to various reasons. Additionally, young people are generally unable to engage in significant climate change mitigation behaviour because of their lack of finances (Al-Shemmeri and Naylor, 2017; Diamantopoulos *et al.*, 2003; Morrison and Beer, 2016). On the other hand, Whitmarsh *et al.* (2011) indicate that younger people tend to be more concerned with environmental problems such as climate change, which indicates a negative association of age with environmental attitudes and concerns.

The total sample in this study was divided into six age groups due to the wide distribution of age categories of employees in the Distribution Division. The range of the age of respondents is from 18 years (school leavers) to 65 years (those whose normal retirement is imminent) and the mean age is 31-40 years. From Figure 5.5, 30.7% of the respondents are 31-40 years old, and these also make up the largest portion (42.53%) of the Distribution Division employees (Eskom, 2016a) and 23.3% of the responses are from those 51-60 years old. Interestingly, fewer young people participated in the survey, as reflected by the relatively lower percentage (21.9%) for those below 30 years old, compared to those between the ages of 31-50 years old (50.9%) and those over 50 years old (27.2%). The majority of the respondents are over 30 years (78.2%). This indicates that the responses gathered are mainly from an adult (mature) source. The responses are reflective of the age demographics in the Distribution Division, as there are more employees in the 31-40 and 41-50 year age groups and fewer employees in the 18-20 and 61-65 year age groups (Eskom, 2016a). The focus group participants also commented that they are aware that there are few employees between the ages of 18-20 and 61-65 years in the Distribution Division, due to the organisation's recent discontinuation of bursaries and the graduate-in-training programme for youth, and the recent early retirement packages offered to long serving employees, namely, those over 60 years of age.

The responses in this study does not support Morrison and Beer (2016) who claimed that those in the middle age group are the most aware and who are more likely to support environmental initiatives compared to younger and older people. In this study, there is a higher proportion of responses (45.56%) in relation to the number of employees in the 18-30 year age category in the Distribution Division. The response rate of those over 60 years is

5.06% and from those 30-60 years is 14.64% of the total number of employees in those particular age categories in the Distribution Division (Eskom, 2015a).

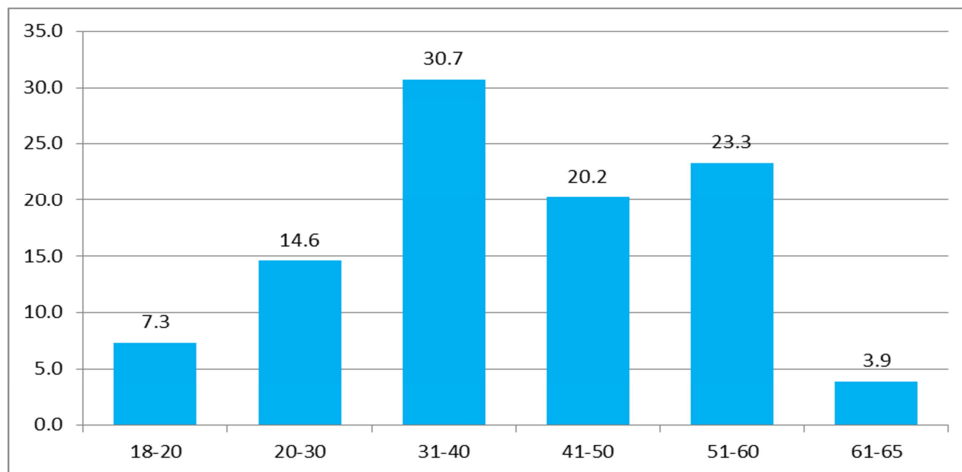


Figure 5.5: Age of respondents (n=618, in %)

5.2.6 Gender of respondents

The UN's Agenda 21 considers women as one of the major groups in tackling environmental issues and suggests that their capacity must be strengthened (Fredericks, 2014). The National Environmental Management Act in South Africa (NEMA) also asserts that women play a vital role in environmental management and women must therefore be supported and involved in finding solutions to environmental problems. Figure 5.6 indicates that the overall ratio of the responses of males to females is approximately 3:2, namely, the majority of respondents (62.3%) were men, while only 37.7% of the respondents were women in this study. From the focus group discussions, it was indicated that the higher proportion of male respondents may reflect the gender balance in the Distribution Division and in particular in the engineering and technical departments such as M&O and AC departments, from which the majority (73.7%) of surveys were completed. This is confirmed by Eskom (2016a) who indicate that there are approximately 77% males and 23% females in the Distribution Division. However, there was a better response rate from female employees than male employees, as the response from females represented 6.36% of the female population in the Distribution Division, whereas the response from males represented only 3.18% of total number of males in the Distribution Division.

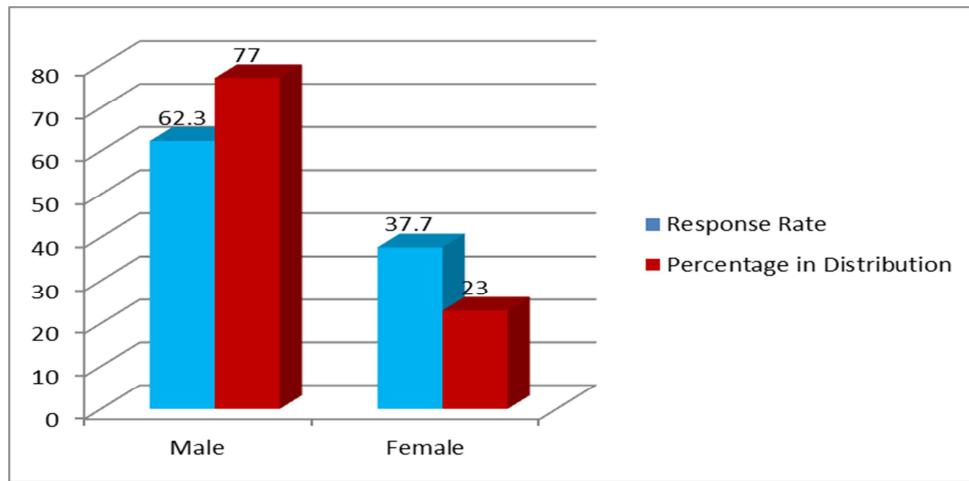


Figure 5.6: Gender of respondents versus percentages of males and females in the Distribution Division (n=618, in %)

From Table 5.4, the responses from males are the majority in the age categories 18-20, 31-40, 41-50, 51-60 and 60-65 years while the only age category where the female responses were the majority is the 21-30 years. Within the category of males only, 28.1% of males in this survey were between the ages of 51-60 years, which represented 17.5% of the total sample, while 39.9% of females in this survey were between the ages of 31-40 years which is 15% of the total sample.

Gender has no significant effect on environmental awareness, according to Gupta (2015) and Shivakumara *et al.* (2015). However, this study supports the earlier findings of Brody *et al.* (2008), Davidson and Freudenberg (1996), Schan and Holzer (1990), Tranter (2011) and Wehrmeyer and McNeil (2000) who indicate that women were more environmentally concerned than men and that women are more likely to actively participate in pro-environmental behaviours as indicated by the better response rate for the completion of this climate change survey in this study.

Table 5.4: Overall gender distribution by age of respondents (n = 618, in %)

		Gender		Total	
		Male	Female		
Age (years)	18 - 20	Count	42	3	45
		% within Age	93.3%	6.7%	100.0%
		% within Gender	10.9%	1.3%	7.3%
		% of Total	6.8%	0.5%	7.3%
	21 - 30	Count	43	47	90
		% within Age	47.8%	52.2%	100.0%
		% within Gender	11.2%	20.2%	14.6%
		% of Total	7.0%	7.6%	14.6%
	31 - 40	Count	97	93	190
		% within Age	51.1%	48.9%	100.0%
		% within Gender	25.2%	39.9%	30.7%
		% of Total	15.7%	15.0%	30.7%
	41 - 50	Count	80	45	125
		% within Age	64.0%	36.0%	100.0%
		% within Gender	20.8%	19.3%	20.2%
		% of Total	12.9%	7.3%	20.2%
	51 - 60	Count	108	36	144
		% within Age	75.0%	25.0%	100.0%
		% within Gender	28.1%	15.5%	23.3%
		% of Total	17.5%	5.8%	23.3%
60 - 65	Count	15	9	24	
	% within Age	62.5%	37.5%	100.0%	
	% within Gender	3.9%	3.9%	3.9%	
	% of Total	2.4%	1.5%	3.9%	
Total	Count	385	233	618	
	% within Age	62.3%	37.7%	100.0%	
	% within Gender	100.0%	100.0%	100.0%	
	% of Total	62.3%	37.7%	100.0%	

This was underscored by Ortega-Egea *et al.* (2014) who indicate that women express environmental concern and are involved in environmentally significant behaviours on issues such as recycling and energy conservation, more than men. However, UNFCCC (2016) identified a gender gap in public participation for climate change policies and actions at the country level. This study on climate change learning can therefore contribute to addressing the aforementioned gender gap, as it demonstrates that women are prepared to be involved in climate change-related issues in view of their greater involvement proportionately than males in this study.

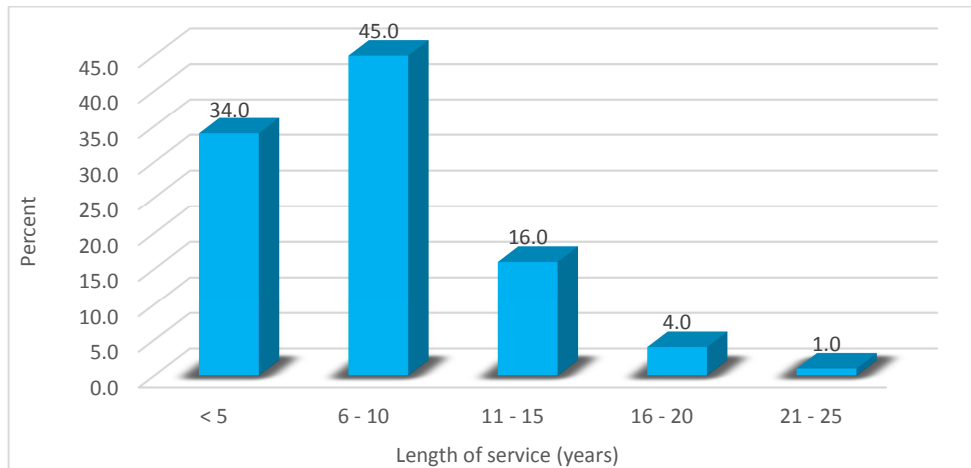


Figure 5.7: Length of service of the respondents (n=618, in %)

From Figure 5.7, at least two-thirds of the respondents (66%) have been in the employment of the Distribution Division for more than five years. This indicates that the majority of responses in this study are from experienced workers. The range of respondents' length of service in the Distribution Division was from less than five years to those who had about 25 years of service. About one-third of the respondents (34%) have less than five years working experience in the Distribution Division, while the average number of years of the respondents is 9.6 years of service.

5.3 Employees attitudes to life and environmental issues

In the USA, personal and social goals are prioritised over other issues, including environmental matters (Bord *et al.*, 1998), whereas in the UK, the main priorities of British people in 2002 were health, family, safety and finances (Poortinga and Pidgeon, 2006). According to Anyanwu *et al.* (2015), in South Africa, the focus is poverty eradication, job creation and addressing inequality. In this study, the Distribution Division employees were requested to consider and indicate the top five most important issues for society presently from the following: career or job or employment, conflict and war, corruption, education, environmental issues, famine and hunger (food security), financial situation, health, population growth, poverty, quality of life, and safety and crime. Respondents also had the opportunity to specify any other issues not on the list provided.

Table 5.5: Top five issues for society presently (n=430, in %)

Most important issues for society presently	Frequency (Top 5)	Percentage	Rank
Career or job or employment	64	14.88	1
Conflict and war	9	2.09	12
Corruption	29	6.74	8
Education	61	14.19	2
Environmental issues	33	7.67	6
Famine and hunger (food security)	21	4.88	10
Financial situation	31	7.21	7
Health	49	11.40	4
Population growth	12	2.79	11
Poverty	28	6.51	9
Quality of life	35	8.14	5
Safety and crime	52	12.09	3
Other (specify)	6	1.40	13

The top five issues rated by the respondents from Table 5.5 are career or job or employment (14.88%), education (14.19%), safety or crime (12.09%), health (11.4%) and interestingly, environmental issues (7.67%). Conflict and war, as well as population growth were not considered a high priority by the majority of the respondents, as only 2.09% and 2.79%, respectively, identified these issues as important. This was endorsed by the results of the three combined focus group discussions who ranked conflict and war, and population growth low (11 and 12, respectively) in the pairwise ranking exercise (Table 5.6), as the group were of the view that these issues did not affect South Africa directly or immediately. For the focus group discussions, famine and hunger (food security) and safety or crime were rated as first and second priorities, respectively. Of the eleven key informants, six rated poverty, three rated education and two rated safety or crime as the most important issues facing society currently.

It is significant that the Distribution Division employees rated environmental issues in the top five issues for society at present. Except for the issue of career or job or employment which was the top issue for respondents and poverty which was the main issue for key informants, some of the other survey responses are underscored by the key informants, who indicated that issues most important for society included education, crime, unemployment, health services, finances, water quality, climate change and food security. This is further emphasised by the focus group discussions that ranked safety and crime, and poverty as 2nd and 3rd, respectively.

Table 5.6 provides the results of the combined pairwise ranking for the three focus group discussions of the most important issues for society presently that emanated from the focus group discussions.

Table 5.6: Pairwise ranking of the most important issues for society presently

Most important issue for society presently	Frequency	Rank
Career or job or employment	19	5
Conflict and war	3	11
Corruption	19	5
Education	17	7
Environmental issues	6	10
Famine and hunger (food security)	30	1
Financial situation	16	8
Health	21	4
Population growth	1	12
Poverty	24	3
Quality of life	12	9
Safety and crime	27	2

Interestingly, environmental issues were ranked 10th by the focus group discussions but 6th in the survey. In view of the foregoing, one can conclude that in this study, education and safety or crime is perceived to be the most important issues for society presently. The prioritising of personal goals such as career or job or employment and safety and crime in this study, align with the findings of Bord *et al.* (1998) and Poortinga and Pidgeon (2006). In an organisation like the Distribution Division with its good conditions of employment and its relatively good salary for its employees (Business Tech, 2015; Eskom, 2015b), and as most employees are career-orientated, it is not unexpected that career or job or employment is ranked the top issue by the majority of employees as the issue of great concern to society. The findings of this study (of a utility in the developing world) are consistent with Capstick *et al.* (2015) who indicate that economic and socio-political factors are of greater importance for most people in developed countries. Hence, there is no difference between people's view presently of what is important in both the developing and developed world.

In this study, the issues of career or job or employment, conflict and war, corruption, education, environmental issues, famine and hunger (food security), financial situation, health, population growth, poverty, quality of life and safety and crime were put to the Distribution Division employees who were to indicate which they considered the top five

most important issues for business presently. From Table 5.7, the top five issues of importance for business according to the survey respondents were the financial situation (15.05%), career or job or employment (13.98%), safety and crime (11.83%), education (11.56%) and corruption (11.29%).

Table 5.7: Top issues for business presently (n=372)

Most important issues for business presently	Frequency (Top 5)	Percentage	Rank
Career or job or employment	52	13.98	2
Conflict and war	9	2.42	12
Corruption	42	11.29	5
Education	43	11.56	4
Environmental issues	41	11.02	6
Famine and hunger (food security)	10	2.69	10
Financial situation	56	15.05	1
Health	27	7.26	7
Population growth	10	2.69	10
Poverty	13	3.49	9
Quality of life	22	5.91	8
Safety and crime	44	11.83	3
Other (specify)	3	0.81	13

Although not in the top five, environmental issues were rated 6th with at least 11.02% of respondents rating this issue as important for business. Moreover, the key informants had some similar opinions on what they considered important for business, namely, finance was identified by all key informants as the most important issue facing businesses currently. For this study, therefore, finance is the top issue of importance for business.

In recent times, the objective of most businesses has shifted to more than mere financial gain or increasing profits, but on the practice of CSR (Lozano *et al.*, 2015). For Eskom, increasing the generating capacity, containing costs of energy, and obtaining funding to build new capacity are the priorities (Beck *et al.*, 2011). In the Distribution Division, the important issues are to deliver quality performance of the electricity network, significantly improving employee safety, reducing the regulatory compliance gap given the available funding, increasing overall efficiency and productivity, supporting the government's Universal Access Programme, and partnering within the industry to deal with common industry and policy issues (Eskom, 2013a).

It would appear that the respondents' personal concerns and the current political and financial situation in the country have a bearing on issues that respondents considered important for business, namely, financial situation, career or job or employment, safety or crime and corruption. Additionally, key informants expressed the view that climate change will affect business due to the expected and increased costs, legal implications and disruptions to infrastructure from climate change impacts and the responses needed.

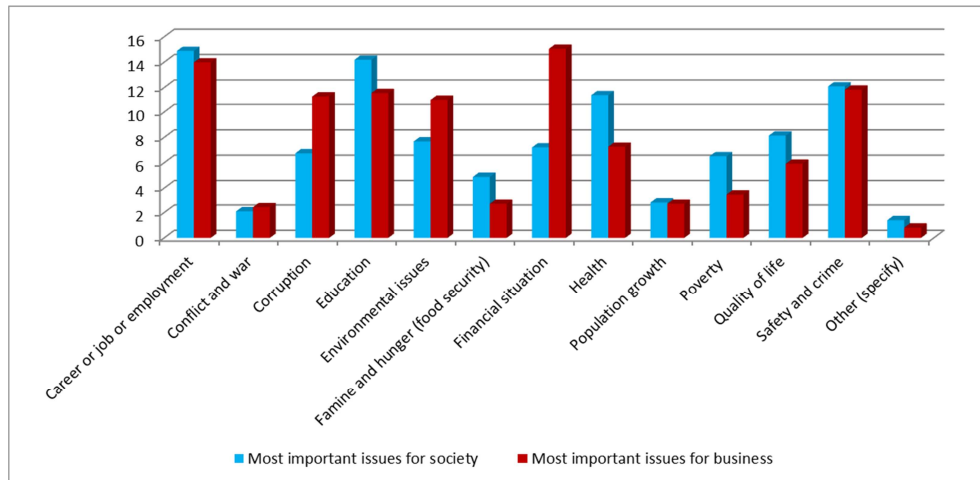


Figure 5.8: Comparison of most important issues for society and for business (n= 618, in %)

A comparison of what respondents considered important for society and for what is important for business (Figure 5.8) reveals some alignment, especially in relation to issues such as career or job or employment, and safety and crime. Furthermore, respondents thought that education, health, poverty and quality of life issues were more important for society than for business. Issues that were more important for business than for society included corruption, environmental issues and the financial situation.

The view that financial issues and career or job or employment for business are most important by the majority of respondents is linked to Gifford's (2015) view that most people's priority is progress in life which includes bigger and better homes and cars and Poortinga and Pidgeon (2003) who demonstrated that people's main priorities were health, family, safety and finances. From this study, the priorities of South Africans currently are therefore no different from citizens in developed countries.

Climate change poses substantial risks at the local level (Lee and van de Meene, 2012). Evans *et al.* (2014) further demonstrate that people were more willing to undertake pro-climate change behaviour when asked about local issues. This response to local issues can be linked to Florek's (2011) place attachment concept which indicates that pro-climate change actions are highly influenced by an individual and his or her personal experiences in their local environments.

In this study, respondents had to consider a range of environmental issues they experienced such as air pollution (from factories and cars), chopping down of trees or forests, extreme weather conditions (for example, floods and droughts), fossil fuel use, genetically modified crops, hazardous waste (chemicals, radioactive, medical), land pollution (waste or litter), loss of wildlife (animals), nuclear power, ozone depletion, pesticides and herbicides, poor farming practices, population explosion, poverty, traffic congestion, water pollution (contamination of rivers and sea) or to specify other important environmental issues not on the given list. Only those rated 5 (very important) were taken for statistical analyses from a scale of ranging from 1 (not important at all) to 5 (very important) or Don't Know (DK) – hence multiple responses. According to Table 5.8, of those that were ranked 5 (very important), 11.26% of respondents indicated that they consider water pollution (contamination of rivers and sea) as the most important environmental issue that they experience at present. Extreme weather conditions, for example, floods and droughts and land pollution (waste or litter) were both rated second highest (9.27%) as an issue experienced by respondents. The current drought in South Africa and the water restrictions (Jonker, 2016) in most municipalities could be a contributing factor to respondents rating water pollution (contamination of rivers and sea) as their greatest concern. Many of the key informants also indicated that water is the biggest issue for South Africa currently especially as some of them were presently experiencing water restrictions. The second highest rating of extreme weather conditions, for example, floods, droughts and land pollution (waste or litter) by respondents indicates that respondents have experienced some of the impacts of climate change. Focus group participants provided examples of their extreme weather experiences such as the recent flash floods in Cape Town, Durban and Johannesburg.

For this study, respondents had to rate the importance of the following environmental issues for the well-being of global society in general: air pollution (from factories and cars), chopping down of trees or forests, extreme weather conditions (for example, floods and

droughts), fossil fuel use, genetically modified crops, hazardous waste (chemicals, radioactive, medical), land pollution (waste or litter), loss of wildlife (animals), nuclear power, ozone depletion, pesticides and herbicides, poor farming practices, population explosion, poverty, traffic congestion and water pollution (contamination of rivers and sea). There was also the option to provide additional issues, if these were not covered in the specified list provided to respondents.

Table 5.8: Most important environmental issues that respondents experience (n=453, multiple responses)

Most important environmental issues that respondents experience	Frequency (Very important)	Percentage	Rank
Air pollution (from factories and cars)	40	8.83	4
Chopping down of trees or forests	30	6.62	7
Extreme weather conditions, e.g. floods and droughts	42	9.27	2
Fossil fuel use	14	3.09	14
Genetically modified crops	16	3.53	13
Hazardous waste (chemicals, radioactive, medical)	28	6.18	8
Land pollution (waste, litter)	42	9.27	2
Loss of wildlife (animals)	33	7.28	6
Nuclear power	12	2.65	16
Ozone depletion	25	5.52	9
Pesticides and herbicides	14	3.09	14
Poor farming practices	20	4.42	12
Population explosion	25	5.52	9
Poverty	34	7.51	5
Traffic congestion	25	5.52	9
Water pollution (contamination of rivers and sea)	51	11.26	1
Other (specify)	2	0.44	17

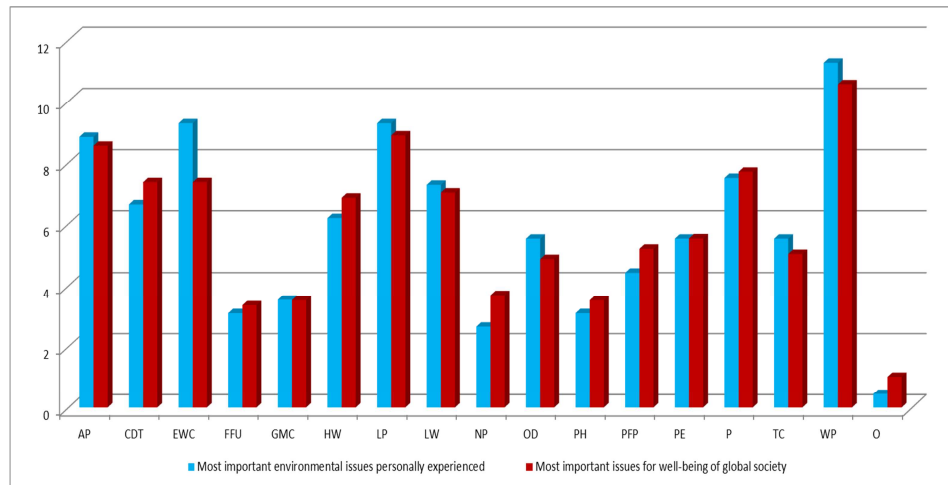
In considering what respondents thought was important issues for global society, respondents were required to answer on a scale ranging from 1 (not important at all) to 5 (very important) or Don't Know (DK). Only those rated 5 (very important) were taken for statistical analyses. At least 10.55% of respondents were of the view that water pollution (contamination of rivers and sea) was the most important issue for global society, while 8.88% indicated that land pollution (waste or litter) and 8.54% that air pollution (from factories and cars) was the most important issue for global society and 7.71% of respondents indicated that poverty was the most important environmental issue for global society (Table 5.9). Four of the key informants also raised water as an issue of concern for society.

Table 5.9: Most important environmental issues for the well-being of global society (n=597, multiple responses)

Most important environmental issues for the well-being of global society	Frequency (Very important)	Percentage	Rank
Air pollution (from factories and cars)	51	8.54	3
Chopping down of trees or forests	44	7.37	5
Extreme weather conditions, e.g. floods and droughts	44	7.37	5
Fossil fuel use	20	3.35	16
Genetically modified crops	21	3.52	14
Hazardous waste (chemicals, radioactive, medical)	41	6.87	8
Land pollution (waste, litter)	53	8.88	2
Loss of wildlife (animals)	42	7.04	7
Nuclear power	22	3.69	13
Ozone depletion	29	4.86	12
Pesticides and herbicides	21	3.52	14
Poor farming practices	31	5.19	10
Population explosion	33	5.53	9
Poverty	46	7.71	4
Traffic congestion	30	5.03	11
Water pollution (contamination of rivers and sea)	63	10.55	1
Other (specify)	6	1.01	17

Furthermore, from Figure 5.9, there is very close alignment between the environmental issues respondents experienced and what they thought was also important for the well-being of global society. It would therefore appear that respondents' own experiences are also related to their concerns for the world. The key informants were also of the view that global environmental problems are also allied to individual concerns, as one of the informants stated that "the way we live and our experiences are directly linked to the problems in the world". This close connection between a person's own environmental experiences and views of global environmental issues bodes well for pro-climate change behaviours, as it provides the basis for greater support of climate change learning initiatives (Quigley and Lyons, 2017).

Some respondents felt that the experiences of extreme weather were a more important issue for them than for the well-being of global society. This could be as a result of the experiences of the frequent flash floods experienced by many in South Africa, as mentioned by the focus group participants.



AP	Air pollution (from factories and cars)	OD	Ozone depletion
CDT	Chopping down of trees or forests	PH	Pesticides and herbicides
EWC	Extreme weather conditions, e.g. floods and droughts	PFP	Poor farming practices
FFU	Fossil fuel use	PE	Population explosion
GMC	Genetically modified crops	P	Poverty
HW	Hazardous waste (chemicals, radioactive, medical)	TC	Traffic congestion
LP	Land pollution (waste, litter)	WP	Water pollution (contamination of rivers and sea)
LW	Loss of wildlife (animals)	O	Other (specify)
NP	Nuclear power		

Figure 5.9: Comparison of most important environmental issues respondents experienced with most important environmental issues for the well-being of global society (n=618, in %)

It is increasingly recognised that there is a strong link between effective climate change response and people’s understanding of the issues (Clayton *et al.*, 2015a). This is underscored by Ziervogel *et al.* (2014) who suggest that the limited understanding of climate-related issues is also a barrier to effective climate change action in South Africa and Guy *et al.* (2014) who advocate that an understanding of climate change is important in shaping behaviour, as well as in supporting national and international action.

To obtain an understanding of the level of climate change understanding, a Likert scale was used for respondents in this study to indicate, on a scale ranging from 1 (nothing at all), 2 (below average), 3 (average), 4 (above average) to 5 (a lot) or Don’t Know (DK), their knowledge of climate change. Figure 5.10 indicates that 36.7% of the respondents self-rated their knowledge of climate change above average, while at least 19.3% indicated that they knew a lot about climate change. A small percentage (11.8%) indicated that they knew nothing at all about climate change. The level of climate change knowledge of key

informants was good, primarily due to their work in environmental management and their previous studies.

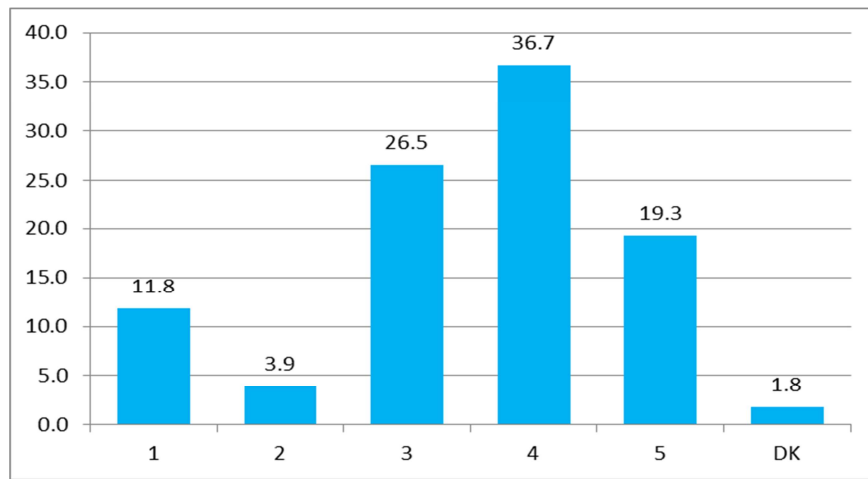


Figure 5.10: Respondents' understanding of climate change (n=618, in %)

The Chi-square test reveals that there is a significant relationship between the level of climate change knowledge and grade ($p=0.001$), educational level ($p=0.001$), age ($p=0.001$) and gender ($p=0.000$). The different grades, educational level, age and gender of the respondents therefore play a role in respondents' climate change understanding. The majority of respondents who knew a lot about climate change are those 60-65 years, males, those in the P11-P13 grade, employees who work in the GM's office, those with an undergraduate degree and employees from the MOU.

This is a significant finding, as it indicates that presently the Distribution Division employees perceive to have a better understanding of climate change (less than 16% knew nothing at all or whose knowledge was below average), as opposed to Brechin (2003) who pointed out that misunderstanding of climate change is worldwide. Furthermore, Read *et al.* (1994) indicated that even well-educated citizens in the USA did not have a clear understanding of global warming and Ranney and Clark (2016) who believe that most USA citizens do not understand the science of climate change. The responses in this study could be attributed to other factors such as the educational level of the respondents which, as indicated earlier, demonstrated that at least 80% of respondents in this study have a post-matriculation qualification. Additionally, respondents in this study work for an electricity utility that has

known significant environmental and climate change impacts, as opposed to the ordinary citizens that were involved in both the aforementioned USA studies.

Brügger *et al.* (2015), Masud *et al.* (2016) and Shi *et al.* (2015) maintain that people's willingness to adapt to climate change is determined by their knowledge and understanding of climate change. This level of understanding of climate change in the Distribution Division therefore augers well for implementing pro-climate change behaviour in the organisation and can contribute to supporting national and international climate change initiatives.

The majority of respondents (63.82%) described climate change well, referring to changes in weather patterns and extreme weather events such as droughts and floods. This was supported by the key informants whose understanding of climate change also related to changes in weather. Worryingly though, 9.74% of respondents described climate change as the depletion of the ozone layer, indicating a lack of understanding about the science of climate change. This finding is in support of Carlton and Jacobson (2016) who commented that there is some confusion with ozone depletion and climate change. At least three respondents were of the view that climate change is not a serious issue, but has been sensationalised for the generation of income by government, for example, through proposed carbon taxes. However, 23.46% of respondents were able to correctly describe the various causes of climate change including human consumption and exploitation of resources, destruction of forests and use of fossil fuels. This is also underscored by all the key informants who emphasised the role of humans in the increase of global GHGs.

It appears that the Distribution Division employees, who are predominantly South Africans, have a fairly good understanding of climate change. This understanding was also reflected by the key informants who indicated that climate change was the rapid changing weather patterns which cause sea level rise, floods, cyclones and droughts. This is in contrast to Lorenzoni and Pidgeon (2006) who indicate that for most individuals in the US and in Europe, climate change is a complex and sometimes misunderstood issue. Brechin (2003) also explains that there is misunderstanding of climate change worldwide, including Germany which is known to have a higher level of environmental literacy. Therefore, the recommendation from UNFCCC (2016) of the need for technical, financial and human resources to scale up climate change education at the local level will be enhanced by the Distribution Division employees due to their basic understanding of climate change.

Education plays an important role in climate change concerns (De Rose and Testa, 2014), while cultures differ with respect to climate change concerns (De Groot *et al.*, 2013). In this study, to determine the level of concern of climate change, respondents were requested to indicate their concern about climate change on a scale ranging from 1 (not much at all), 2

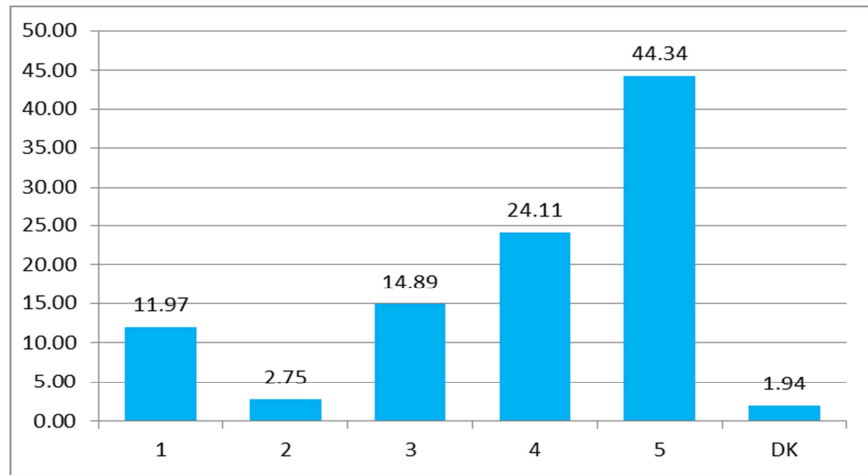


Figure 5.11: Respondents' level of concern about climate change, n=618 (in %)

(little), 3 (somewhat), 4 (much) to 5 (very much) or if they did not know (DK). From Figure 5.11, 68.45% of the respondents are much to very much concerned about climate change. However, 14.89%, were somewhat, 11.97% not much at all and 2.75% of the respondents indicated that they were a little concerned about climate change.

The findings in the Distribution Division are aligned to the 2002 UK study by Poortinga and Pidgeon (2003), which indicates that 62% of respondents felt that they were fairly to very concerned about climate change and of De Rose and Testa (2014) who point out that in Europe approximately 50% of citizens were concerned that climate change was a problem. However, Capstick *et al.* (2015) indicate that although there have not been many such studies in sub-Saharan Africa and South America, concern about climate change has tended to increase in recent times.

Since the majority of the respondents in the Distribution Division are concerned about climate change, any climate change learning interventions is likely to be embraced and supported better, as Clayton *et al.* (2015a) suggest that there is a connection between environmental behaviour and concern about environmental problems. Furthermore, Aldy and Pizer (2016) and Nissinen *et al.* (2015) comment that concerns about global climate change is

an important factor in developing ways to limit emissions of GHGs. Since the majority of respondents in this study are much concerned about climate change, it is likely, as Brügger *et al.* (2015) and Capstick *et al.* (2015) point out, that people will more readily support initiatives addressing climate change. However, concern for climate change does not necessarily mean that pro-climate change behaviour will be adopted (Clayton *et al.*, 2015a; Kurz *et al.*, 2015) due to a range of structural and psychological barriers (Gifford, 2011).

Most individuals in developing countries have an indecisive attitude towards climate change, due to other priorities such as the potential loss of benefits from current lifestyles if they had to address climate change, while many also consider that climate change is not a crisis presently (Brügger *et al.*, 2015; Capstick *et al.*, 2015). In this study, the majority of the respondents (54.72%) were mainly concerned about weather-related issues such as floods, droughts and heat waves that will lead to death or destruction. The key informant interviewees also linked climate change to extreme weather events such as destructive convectional thunderstorms, high temperatures and water shortages. These views could be attributed to the media attention to extreme weather events, as Capstick *et al.* (2015) indicate that there is greater concern about climate change when there is increased media attention. Some recent weather related events in South Africa that has received extensive media coverage and which is likely to have influenced respondents' concerns include the 2011 floods in Free State and Eastern Cape (Smithers, 2012), 2012 floods in Mpumalanga (Pyle and Jacobs, 2016), 2013 floods across South Africa (Manhique *et al.*, 2015), the water crisis currently in South Africa (Jonker, 2016) and the numerous and increasingly frequent thunderstorms and destructive flash floods in the country (Blamey *et al.*, 2016). Some respondents (8.81%) in this study were concerned about the loss of biodiversity (deforestation and species loss) from climate change, while 8.6% were concerned about water related issues. Food shortages and famine were concerns for 6.1% of the respondents. A few respondents (2.31%) were concerned about the future of humankind, including their children, which also demonstrated a lack of concern for others.

While most in developed countries are of the view that climate change is a threat to more vulnerable or future generations (Brügger *et al.*, 2015), this study indicates that citizens in South Africa are experiencing the effects of climate change first hand, and are now able to make the linkages. Respondents' personal experiences will therefore aid climate change learning and can be used to improve pro-climate change behaviour, as Demski *et al.* (2017)

demonstrated that people who experience climate change impacts first-hand are more likely to adopt pro-climate change actions.

Energy generation from fossil fuels is the largest single source of CO₂ emissions (Bouman *et al.*, 2015; IPCC, 2014; UNFCCC, 2011). IPCC (2014) ranked agriculture, forestry and other land-use second and industry third as the main contributors of GHGs. The respondents in this study had to consider and indicate which of the following had a significant impact as a main cause of climate change: changes in land-use, deforestation (cutting of trees or forests), emissions from industry or factories, emissions from vehicles (cars, trucks and buses), energy generation from fossil fuels (coal, oil and gas), natural changes in climate, nuclear testing, ozone layer depletion from chlorofluorocarbons (CFCs), volcanic eruptions, waste disposal, human consumption patterns or to specify any other cause not listed.

To determine what respondents believe are the main causes of climate change, respondents were required to rate twelve given issues on a scale of no impact, little impact or significant impact. Only those rated significant impact were taken for statistical analyses. According to Table 5.10, 14.01% of the respondents considered emissions from industry or factories as the main cause of climate change, followed by deforestation (cutting of trees or forests) (12.59%) and energy generation from fossil fuels (coal, oil and gas) (11.17%). The Chi-square test reveals that there is a significant relationship between respondents belief that the main cause of climate change is emissions from industry or factories and employee grade only ($p=0.15$). Respondents' selection of emissions from industry or factories as the main cause of climate change is therefore influenced by their grade in the Distribution Division. The majority of respondents who selected this main cause are males, those of the ages of 51-60 years, employees at grade SSE/EEE and above, employees in the GM's office, those with a primary school educational level, and employees from the MOU and the Distribution Head Office (DHO).

The ranking of energy generation from fossil fuels (coal, oil and gas) third in this study, is not consistent with the findings of Bouman *et al.* (2015), IPCC (2014) and UNFCCC (2011) and could be attributed to what East (2016) terms 'respondent bias', as most respondents were not keen to implicate Eskom (their employer) as the main cause of climate change which generates electricity mainly from fossil fuels. This was underscored by the focus group discussions who suggested that the denial of the facts could be due to respondents'

employment in Eskom. Other significant causes of climate change identified by respondents included emissions from vehicles (cars, trucks and buses) at 10.64% and waste disposal at 10.46%.

Table 5.10: Main causes of climate change (n=564, multiple responses)

Main causes of climate change	Frequency (Significant impact)	Percentage	Rank
Changes in land use	33	5.85	8
Deforestation (cutting of trees or forests)	71	12.59	2
Emissions from industry or factories	79	14.01	1
Emissions from vehicles (cars, trucks, buses)	60	10.64	4
Energy generation from fossil fuels (coal, oil, gas)	63	11.17	3
Natural changes in climate	36	6.38	7
Nuclear testing	30	5.32	9
Ozone layer depletion from CFCs	58	10.28	6
Volcanic eruptions	23	4.08	10
Waste disposal	59	10.46	5
Human consumption patterns	52	9.22	7

The understanding of the main causes of climate change, namely, the top five causes by the majority of respondents (58.87%) is a positive outcome, as Feygina *et al.* (2010) indicate that when people know the facts about climate change, they are more likely to accept advice and do something about it. The indication that ozone layer depletion is a cause of climate change is of concern, and indicates a low level of climate change understanding by 10.28% of respondents, and hence the need for climate change learning. Additionally, Carlton and Jacobson (2016) suggest that it is essential to address misunderstandings about climate change and Stern *et al.* (2016) are of the view that if people are not well informed, discussions on pro-climate actions become difficult. However, Longo *et al.* (2017) are of the view that being knowledgeable or aware does not necessarily translate into behavioural change due to various individual or institutional barriers.

The key informant interviewees though were of the opinion that not only was climate change caused by emissions but also suggested that human behaviour and human activities contributed to climate change. This better understanding of the main causes of climate change by the key informant interviewees is likely due to the level of environmental education and the nature of the work of the key informants who were purposively chosen for this study due to their work in the environmental and climate change space. The focus group discussions

were of the view that the lack of clear understanding of the main cause of climate change in the Distribution Division indicates a low level of climate change learning and that any previous climate change learning interventions have not been effective.

Climate change impacts include floods, rising sea levels, water scarcity and droughts (Hansen and Cramer, 2015). The expected and substantial changes in rainfall distribution will affect the intensity and frequency of droughts (Beniston, 2015; Beniston *et al.*, 2011). Childers *et al.* (2015) and IPCC (2014) confirm that climate change is projected to increase risks for people, assets, economies and ecosystems, including risks from heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution, drought, water scarcity, sea level rise and storm surges. In this study, an overwhelming 85.75% of respondents indicated that they have noticed changes in their local environment that provides evidence that the climate is changing, whereas 9.4% have not noticed any changes, and only 4.85% did not know if there were changes in their local area or community. From Figure 5.12, 17.26% of respondents in this study say that they have experienced hotter summers and water shortages in their local areas, while 14.18% have noticed changes in the pattern of seasons and 12.3% more frequent violent weather, which indicates to them that the climate is changing. Some (10.64%) noticed more storms and floods, while 8.98% indicated that soil erosion for them is an indicator of the changing climate.

While research indicates that in developed countries there is the view that climate change is a threat to more vulnerable or future generations (Brügger *et al.*, 2015), this study indicates that citizens in South Africa are experiencing the effects of climate change first hand, and are now able to make the linkages. Respondents' personal experiences will therefore aid climate change learning and can be used to improve pro-climate change behaviour, as Demski *et al.* (2017) demonstrated that people who experience climate change impacts first-hand are more likely to adopt pro-climate change actions. It is necessary to understand local climate change impacts, as Pasquini *et al.* (2013) suggested that this understanding facilitates climate change adaptation at the local level. Scannell and Gifford (2013) also believe that place attachment motivates local pro-climate change actions. Furthermore, to address climate change holistically, Kolieb and Harrould-Kolieb (2011) recommends that innovative solutions must be found, even at the localised level. The results of the personally-experienced climate change issues in this study provide a good basis for addressing the key climate change learning topics at the local level. In recent decades changes in climate has caused impacts on

natural and human systems throughout the world (IPCC, 2014). People’s attitudes towards climate change consistently indicate similar patterns, especially for the future and an understanding of the impacts of climate change such as ocean level rise, more frequent storms and possible water shortages, indicate a general agreement that this is a serious or potentially serious problem (Clayton *et al.*, 2015a).

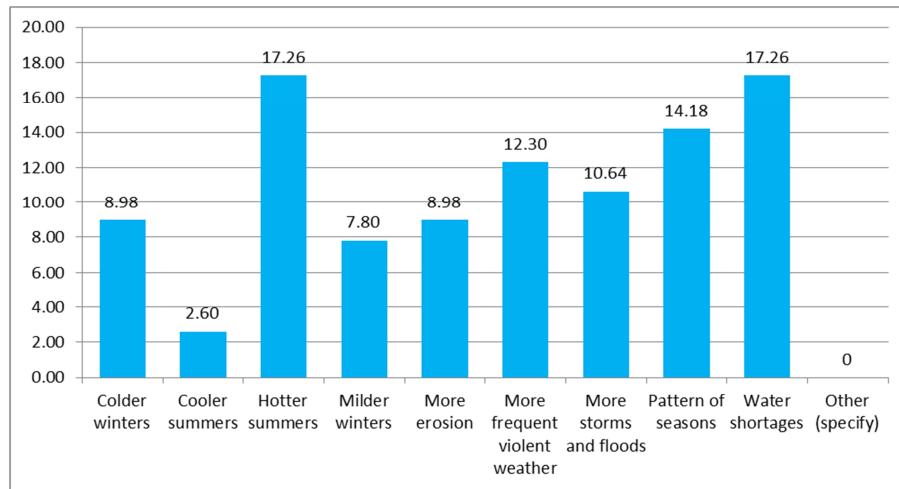


Figure 5.12: Changes noticed in local environment (n=618, in %)

Climate change is a critical challenge at the local level (Lee and van de Meene, 2012) and it is therefore important to appreciate community level indicators. People’s perception of the adverse consequences for valued objects such as their homes and cars can also influence individual choices about pro-environmental actions, according to the Value-Belief-Norm Theory of Environmentalism (Stern *et al.*, 1999). Furthermore, the recognition of local level impacts by respondents is significant as McDonald *et al.* (2015) point out that people are likely to undertake pro-climate change actions, if they are aware of local climate change impacts, as opposed to those who consider that climate change occurs or is worse in far off places only. Furthermore, this understanding of local level impacts can also contribute to the production, consumption and interpretation of more meaningful environmental knowledge, as Bliuc *et al.* (2015) are of the view that scientific and technical terms used in climate change learning is enhanced by public knowledge of the local environment. Furthermore, Demski *et al.* (2017) indicate that people who experience climate change impacts such as flooding are often inspired to undertake behavioural intentions beyond individual sustainability actions that can include support for mitigation policies and personal climate adaptation in matters unrelated to the direct experience.

Poor people suffer the most from climate change (Tucker *et al.*, 2015; UN, 2015) and most poor people live in Africa (Asongu and Nwachukwu, 2017; Beegle *et al.*, 2016). According to Rose (2015), climate change is set to continue to have negative impacts on several African countries. The aforementioned findings are confirmed in this study, as from Figure 5.13, 43.8% of respondents were of the view that Africa will be most affected by climate change, followed by Antarctica (20.3%) while 19.6% of the respondents did not know which continent would be affected the most and only 0.4% of the respondents were of the view that Australia would be affected by climate change. The lack of knowledge of the climate change impacts on Asia by respondents is noteworthy.

The Chi-square test reveal that there is a significant relationship between respondents' view on which continent is likely to be most affected by climate change and employee grade ($p=0.40$), level of education ($p=0.000$) and age ($p=0.000$). Respondents' understanding that Africa will be affected the most by climate change is therefore influenced by their grade, level of education and age. The majority of respondents in the different categories who held this view are from the NWOU, work in the GM's office, are employees in the M17-M18 grades, those who have a postgraduate degree, are between 31-40 years and are male.

The view of the respondents is shared by Kolieb and Harrould-Kolieb (2011) who confirm that that climate change is predicted to have a significant negative impact on many people on the African continent and UNEP (2009) described Africa as very vulnerable to climate change and climate variability due to endemic poverty, weak institutions, and complex disasters and conflicts. Once again, the respondents' views bode well for pro-climate initiatives and actions in Africa, as people acknowledge that Africa will be most affected by climate change. This finding reinforces what Cheng and Wu (2015) and Florek (2011) referred to as place attachment while Scannell and Gifford (2013) suggest that place-protective behaviour on climate change issues is therefore more likely.

Human activities currently release over thirty billion tons of CO₂ into the atmosphere every year (IPCC, 2014). North America and Europe have produced around 70% of all the CO₂ emissions due to energy production, while developing countries have accounted for less than 25% (Olivier *et al.*, 2015). However, most future emissions growth will come from today's developing countries, including South Africa, because of their rapid growth in population and

GDP, and their increasing share of energy-intensive industries (Geng *et al.*, 2016). Currently, Asia contributes the most to climate change (Liu, 2016).

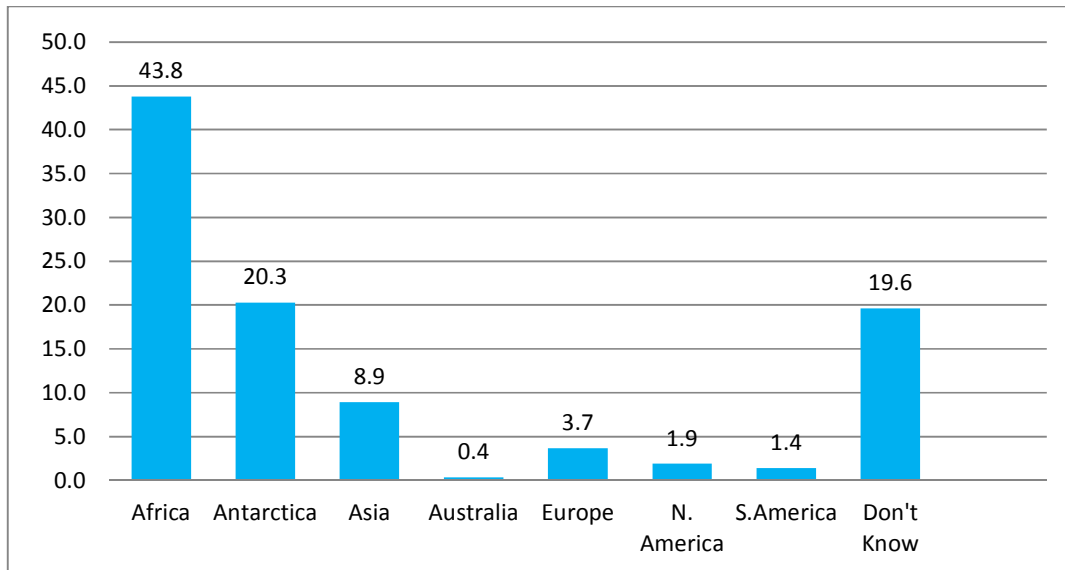


Figure 5.13: Continent most affected by climate change (n=618, in %)

In this study, 26.31% of the respondents did not know which continent contributed the most to climate change and only 22.46% were of the view that Asia contributes the most to climate change while 21.57% indicated that North America contributes the most to climate change (Figure 5.14). Interestingly, 15.08% of the respondents indicated that Africa was the main continent that contributed to climate change.

The Chi-square test reveals that there is a significant relationship between respondents' view on which continent contributes the most to climate change and employee grade ($p=0.004$), level of education ($p=0.000$), age ($p=0.000$) and gender ($p=0.000$). Respondents' lack of knowledge about where the most GHGs are coming from is therefore influenced by their grade, level of education, age and gender. The majority of those who did not know which continent contributed the most to climate change were mainly from the WCOU, those in the BP Department, are T04-T08 grade employees, those with a diploma or certificate, are 60-65 years and are female.

This lack of understanding of the continents that contribute to climate change, especially of those who did not know and who indicated Africa, represented 41.39% of the respondents.

From the comparisons in Figure 5.15, it is clear that while respondents indicated that Africa and Antarctica will be affected the most by climate change, respondents also understood that these continents contribute less to the problem, whereas respondents were of the view that

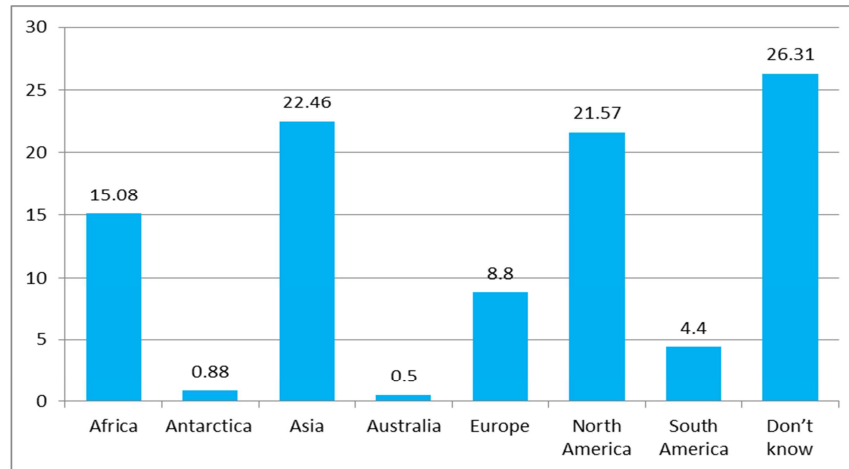


Figure 5.14: Continent that contributes the most to climate change (n=618, in %)

Asia, Europe, North America and South America contribute more to global climate change, but are less affected by it. This view is partially confirmed by Althor *et al.* (2016) who claim that the highest GHG emitting countries are among the least vulnerable to negative impacts of future climate change, while countries with low or moderate GHG emissions are very vulnerable to negative impacts of climate change and that this situation will significantly worsen by 2030.

The better understanding of those who contribute and those vulnerable to climate change must be integrated into climate change learning, as this knowledge could be a good motivator for pro-climate change actions in Africa as well as provide the basis for individuals to organise and lobby with international organisations such as UNEP and the UNFCCC to put more effort in addressing emissions in developed countries.

There will be significant climate change impacts in South Africa (Pasquini *et al.*, 2013) which includes a significant threat to South Africa's water resources, food security, health, infrastructure, as well as its ecosystem services and biodiversity (Fitchett *et al.*, 2016). In this study, an overwhelming majority of respondents (96.84%) believe that climate change will affect South Africa, while a minority (0.88%) believe that South Africa will not be affected.

Furthermore, 70.1% of the respondents were of the view that climate change is affecting South Africa presently, while only 26.57% considered that climate change will only affect South Africa in the future. The Chi-square test reveals that there is no significant relationship between respondents' views on whether climate change will affect South Africa and employee grade, level of education, age or gender.

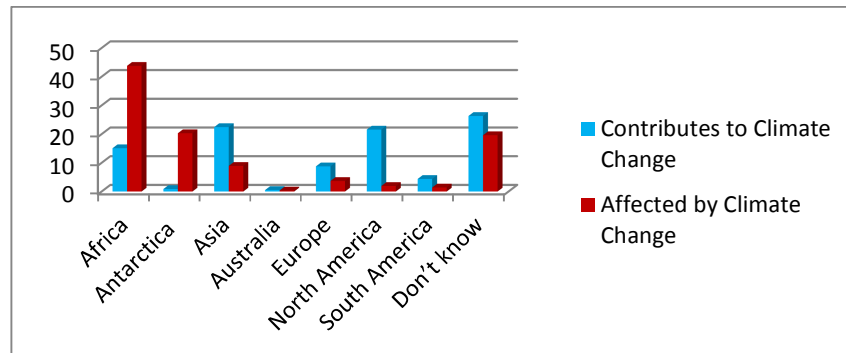


Figure 5.15: Comparison of affected continents versus continents that contribute the most to climate change

Hence, grade, level of education, age and gender have no influence on whether climate change will affect South Africa. The majority who stated that South Africa will be affected by climate change were mainly from the DHO and the MOU, those in the BIPM and IS Departments and the GM's office, are M14-M16 and M17-M18 grade employees, those with a secondary school level of education, are 51-60 years and more males than females.

The views of respondents in this study is in contrast to many in the developed world who consider that climate change is not a crisis presently as most perceive it as a threat and a potential danger to others, namely, those more vulnerable or future generations (Brügger *et al.*, 2015; Capstick *et al.*, 2015). Furthermore, there has not been much research on people's climate change awareness in developing countries or in the world recently (Capstick *et al.*, 2015). This study therefore addresses this gap and provides useful insight to this research objectives of examining staff perceptions and attitudes towards climate change and the challenges and opportunities presented by the environmental and climate change crisis for business in South Africa and in particular for electricity utilities in Africa.

5.4 Employees choices for responding to climate change

Climate change actions involve a variety of actors such as private decision-makers, public agencies, governments and civic society with groups and individuals being drawn from varied backgrounds, economic sectors, settlements, communities, cultures and ecosystems (IPCC, 2014). However, in any organisation the level of climate change involvement differs between people and between departments (Purvis *et al.*, 2015). Climate change actions are also further influenced by comparisons people make with others (Clayton *et al.*, 2015a).

In this study, respondents were given various behaviour options to reduce their contribution to climate change such as using renewable energy sources (solar and wind), paying higher prices for energy from wind and solar, planting trees, recycling waste (paper or glass), reducing air travel, reducing car travel, reducing waste disposal, using more energy efficient appliances, consuming less, or changing eating or dietary patterns, for example, less meat consumption. Respondents were also asked to indicate other possible actions they were prepared to take that were not covered in the list provided.

According to Figure 5.16, 12.92% of the respondents were prepared to recycle waste (paper or glass), 12.78% were prepared to plant trees, 12.78% were keen to use more energy efficient appliances and 12.33% were in a favour of renewable energy sources such as solar and wind, to reduce their contributions to climate change. The Chi-square test reveals that there is no significant relationship between respondents' pro-climate change behaviour preference of recycling waste and their grade, level of education, age and gender. Hence, grade, level of education, age and gender play no role in the respondents' preparedness to recycle waste (paper or glass) to reduce their contribution to climate change. Those who were most keen to recycle waste (paper or glass) were mainly from the FSOU, NWOU and KZNOU, in the O&M and AC departments, are T11-13 grade employees, those with a diploma/certificate level of education, are 31-40 years and male.

The preference for recycling waste, planting trees, using more energy efficient appliances and renewable energy sources such as solar and wind is telling and indicates that respondents see this as an easy but tangible action for addressing climate change. Das (2016) points out that planting trees minimises the impacts of GHG emissions. Such actions will also support the international call for the planting of more trees to offset GHG emissions, such as the UNEP Billion Tree Campaign, 'Plant for the Planet' (Glick *et al.*, 2016). Planting trees is also an

easier alternative than some of the more costly and inconvenient technological options (Jakob and Steckel, 2014) or other behaviour changes required. Key respondents were not aware of any pro-climate change initiatives in the Distribution Division to change practices or behaviour. It would therefore appear that the pro-climate change behaviour options selected by the respondents is through individual awareness or their own initiatives, and is not related to any Distribution Division learning initiative.

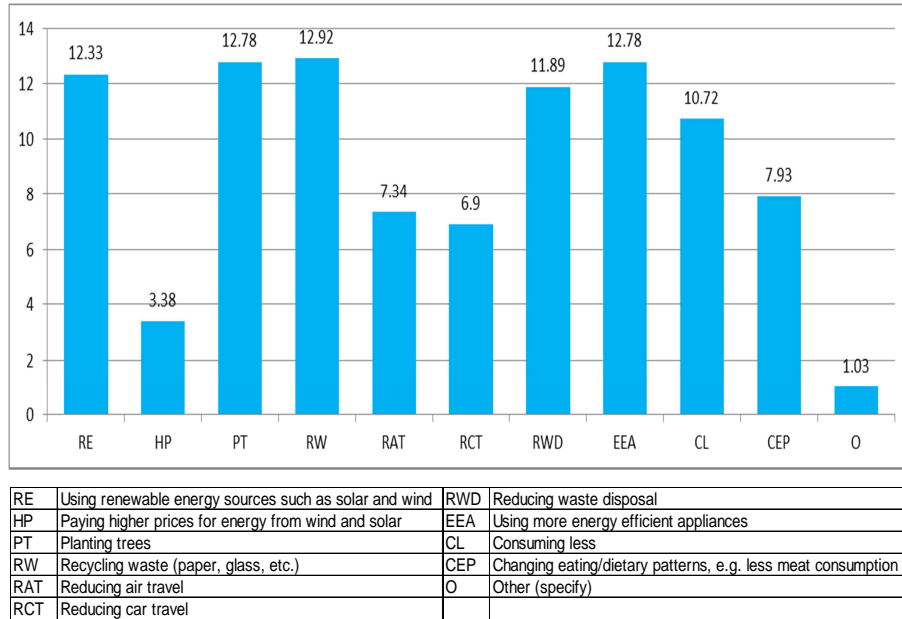


Figure 5.16: Behaviour options to reduce climate change (n=618, in %)

Both the WCOU and KZNOU focus group discussions were of the view that planting trees was an important pro-climate change action. It is also important that tree planting not be done merely for public relations purposes only.

In this study, few respondents (3.38%) were prepared to pay higher prices for renewable energy such as wind and solar. The Chi-square tests reveal that there is a significant relationship between respondents' reluctance to pay higher prices for energy from wind and solar and employee grade ($p=0.008$) and level of education ($p=0.048$) only. Respondents who were reluctant to adopt this behaviour to reduce their contribution to climate change are therefore influenced by their grade and level of education, whereas age and gender does not play a role. The majority of respondents who were reluctant to pay higher prices for energy from wind and solar are from the ECOU and MOU, work in the IS Department, are

employees in the SSE/EEE and above grades, those who have a secondary school level of education, are between 60-65 years and are male. A conundrum that is evident is that respondents in the SSE/EEE bands and those between 60-65 years are not keen to pay higher prices for energy from wind and solar even though they are senior and long serving employees who are the highest paid in the Distribution Division. The reluctance of those whose highest level of education is at secondary school is likely to be the lower paid employees in the Distribution Division.

It is noteworthy that the Chi-square test reveals that respondents' OU, department, grade highest level of education, age and gender does not influence respondents' choice of behaviour to reduce their contribution to climate change such as using renewable energy sources (solar and wind), planting trees, recycling waste (paper or glass), reducing air travel, reducing car travel, reducing waste disposal, using more energy efficient appliances, consuming less or changing eating or dietary patterns, for example, less meat consumption. Of the 7.93% of respondents who opted to change their eating or dietary patterns, the majority are from the NCOU, the GM's office, those at grade G14-G16, respondents whose highest level of education is secondary school, those who are 31-40 years and females.

Given that Eskom's fossil fuel power generation is considered the main contributor of climate change in South Africa (Eskom, 2015e) and is rated as one of the top five contributors of climate change by respondents in this survey. It is interesting that respondents were not keen on paying for cleaner energy, as only 3% choose this option to reduce climate change. This response is in line with Ones and Dilchert (2012) who indicated that people adopt behaviours that require the least effort, which in this case is represented by the reluctance to sacrifice their income. This reticence to pay for cleaner energy sources also supports the assertion by Lorenzoni *et al.* (2007) that people are reluctant to change their lifestyles. Furthermore, it is important that pro-climate change behaviours are made normal and routine, as Gifford (2015) advises that people are likely to resist or ignore pro-climate change actions, when they feel that their lifestyle is threatened. Respondents reluctance is also linked to Geels (2015) comment that technology often comes with many concerns such as high costs (Beck *et al.*, 2011; Joubert *et al.*, 2016). This study provides further evidence that technology is not likely to be the solution to climate change challenges, but rather the emphasis should be on climate change learning to motivate pro-climate change behaviour.

The focus group discussions expressed the view that employees' current habits and lifestyle make willingness to change difficult. People are also reluctant to adopt pro-climate change behaviour if they do not trust government and institutions charged with creating the means to manage climate change for the public (Brügger *et al.*, 2015; Capstick *et al.*, 2015).

South Africa volunteered to reduce its GHG emissions by 34% by 2020, and by 42% by 2025 (Pretorius *et al.*, 2015b). Additionally, a clear South African position on climate change is articulated in the LTMS process which presents a range of mitigation and climate action options for the country (Altieri *et al.*, 2016). In this study, the majority of respondents (63.04%) were of the view that South Africa is not doing enough to reduce climate change and only 20.3% believed that South Africa is doing enough, while 16.66% did not know. Furthermore, 42.18% of respondents were of the view that more needs to be done concerning education and awareness of climate change at school, government and business level, including the Distribution Division, while 27.43% were of the view that there needs to be more emphasis on technology to address the climate change challenges, such as reduction of fossil fuel energy generation and a move to renewable energy alternatives (solar or wind), and more efficient private and public transport systems, 17.4% of respondents were of the view that there needs to be stricter laws and better enforcement to address climate change. Some respondents (8.26%) indicated that more needs to be done in the area of water conservation and prevention of water pollution.

The Chi-square test reveals that there is a significant relationship between respondents' view that South Africa is not doing enough to reduce climate change and age ($p=0.010$) and gender ($p=0.017$). Respondents' view that South Africa is not doing enough to reduce climate change is therefore only influenced by age and gender. The majority that share this view are males, those between 51-60 years, those with a postgraduate degree, employees at the M17-M18 grade, those who work in the GM's office and those who work in the WCOU. This indicates that well-educated respondents and managers do not have confidence in what the country is doing to address climate change.

Public perception about climate change is informed by economic and socio-political factors (Capstick *et al.*, 2015). Furthermore, political ideology is one of the single most important factors in determining an individual's attitudes and beliefs concerning climate change (Smith and Leiserowitz, 2012). The lack of knowledge of South Africa's response to climate change

by a high percentage of respondents in this study supports Gifford (2015) who points out that many people mistrust climate change information that comes from government officials. This could be further evidence in support of the notion by Kettle and Dow (2016) and Newell *et al.* (2015) that due to the public's mistrust of governments, respondents in this study are not aware or ignore what government is doing and that a wide range of a person's worldview is determined by a person's political or religious ideology (Olson-Hazboun *et al.*, 2017). In this study those who perceive that South Africa is not doing enough to reduce climate change are from the WCOU, the province (in terms of the South African political landscape) in which the opposition party is the majority which could influence their views on what national government is doing about climate change. Furthermore, people are not likely to listen or take advice from those they distrust or think of in a negative light such as government officials (Gifford, 2015), as governments are perceived as biased, unreliable and not credible in diffusing information or taking decisions about climate change (Brügger *et al.*, 2015; Capstick *et al.*, 2015).

The lack of awareness of government initiatives is an important issue that must be addressed in climate change learning, to enable workers to separate their political views from being aware of the climate change actions taken or needed in South Africa. Otherwise citizens are likely to make unrealistic or uninformed demands on government. This could in turn frustrate government officials who may then be reluctant to involve all stakeholders.

The findings in this study indicate a gap in climate change knowledge which needs to be addressed in any climate change learning initiative, as Clayton *et al.* (2015a) advocated that understanding the issues around climate change, facilitates better engagement and action. This is also underscored by Guy *et al.* (2014) who advise that understanding of climate change is critical in shaping behaviour. Furthermore, Brügger *et al.* (2015) and Shi *et al.* (2015) assert that issues such as knowledge determine people's willingness to adapt to climate change.

5.5 Responsibility for addressing climate change

Climate change action is required from all levels of society, by individuals, groups and governments (Butler *et al.*, 2015). Additionally, climate change actions can be enhanced across all levels, from individuals to governments (Murphy *et al.*, 2016) while Swim and

Becker (2012) believe that the individual plays an important role in climate change actions. In this study, respondents were asked to consider the following role-players who could be considered as responsible for making changes to lessen the impacts of climate change such as business and industry, environmental organisations, Eskom, family or friends, individuals or

Table 5.11: Responsible for making changes to lessen the impacts of climate change (n=618, in %)

Role-players responsible to lessen the impacts of climate change	Frequency (High Responsibility)	Percentage	Rank
Business and industry	84	10.75	1
Environmental organisations	69	8.83	6
Eskom	74	9.50	5
Family or friends	53	6.80	11
Individuals or citizens	58	7.43	10
Local government	79	10.11	3
Myself (respondents)	65	8.32	8
National government	83	10.62	2
Provincial government	79	10.11	3
United Nations	67	8.57	7
NGOs or Civil Society Organisation	61	7.81	9
Other (specify)	9	1.15	12

citizens, local government, myself (respondents), national government, provincial government, UN, NGOs or Civil Society Organisations or others.

To ascertain who respondents felt was responsible for making changes to lessen the impacts of climate change, respondents were required to indicate their view on the scale from 1 (high responsibility) to 3 (no responsibility) or Don't Know (DK). There were multiple responses to the eleven role-players listed. Only the responses to 1 (high responsibility) were used in the analysis. According to Table 5.11, there was more or less an even spread of who respondents considered responsible for making any changes to lessen the impacts of climate change. However, 10.75% considered that business and industry were most responsible, while 10.62% of the respondents indicated that national government was responsible, and 10.11% felt that both provincial and local governments were responsible.

The Chi-square test reveals that there is a significant relationship between respondents who considered that business and industry is responsible to lessen the impacts of climate change and educational level ($p=0.017$), gender ($p=0.005$) and department where respondents work ($p=0.023$). Respondents' view that business and industry is responsible to lessen the impacts

of climate change is therefore influenced by educational level, gender and the department in which employees work. The majority that share this view are males, those between 31-40 years, those with an undergraduate degree, employees at the P14-P16 grade, those whose department is the GM's office and those who work in the DHO and in the WCOU. This indicates that well-educated respondents and managers do not have confidence in what the country is doing to address climate change.

Friends or family, citizens or individuals and respondents themselves were not considered responsible for making changes to lessen the impacts of climate change, as these were ranked 11th, 10th and 8th, respectively. Only 8.32% of the respondents felt that they were personally responsible for making any changes to lessen the impacts of climate change, which was ranked 8th overall. The majority of key informants were of the view that business is not responding sufficiently to the climate change challenges, and those that are known to respond have limited actions or other motives for their climate change programmes, for example, the Eskom energy efficiency initiatives (Eskom, 2008).

These findings support Kettle and Dow (2016) and Newell *et al.* (2015) who were also of the view that governments have a high degree of responsibility for solving climate change problems. Additionally, local government and the private sector are increasingly recognised as critical to climate change, given their roles in scaling up adaptation of communities, households and civil society and in managing risk information and financing (Porter *et al.*, 2015). National governments can coordinate adaptation efforts of local and sub-national governments, by protecting vulnerable groups, by supporting economic diversification and by providing information, policy and legal frameworks and financial support (Murphy *et al.*, 2016).

The low percentage of respondents that felt personally responsible for making any changes to lessen the impacts of climate change is also reflective of the views of Brügger *et al.* (2015) and Capstick *et al.* (2015) who indicate that people are not likely to adopt pro-climate change behaviour, unless they feel empowered to do so and also feel that others in society are also undertaking similar actions. This lag in climate change responsibility is cause for great concern, and must be addressed in any climate change learning intervention, as the literature has clearly demonstrated that individual actions on climate change is also important and sorely needed. Spaargaren and Mol (2008) emphasise the important role of the individual in

pro-environmental behaviour. This is underscored by Frederiks *et al.* (2015) who claim that there is an important role for individuals in creating social change through the blending of consumption and citizenship in support of the pro-climate change actions.

Climate change-relevant behaviour is not solely dependent on individuals, and the role of the collective psychological processes cannot be ignored (Ferguson and Branscombe, 2010). Individual level barriers such as uncertainty, lack of knowledge and reluctance to lifestyle change also influence climate change response (Lorenzoni *et al.*, 2007).

Table 5.12: Likert Scale on climate change actions at the individual level (n=618, in %)

	RESPONSIBILITY	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	We can all do our bit to reduce the effects of climate change					73
2.	Climate change will seriously affect our weather					72.73
3.	I would only do my bit to reduce climate change if everyone else did as well	43.30				
4.	The government should provide incentives for people to look after the environment					28.57
5.	It is already too late to do anything about climate change	58.76				
6.	Climate change is something that frightens me				31.96	
7.	I'm unclear whether climate change is really happening	50				
8.	Radical changes in society are needed to tackle climate change					50
9.	People are too selfish to do anything about climate change				30.21	
10.	The evidence for climate change is untrustworthy		33.67			
11.	Claims that human activities are changing the climate are exaggerated	31.25				

In this study, the Likert Scale was used for respondents to indicate their level of agreement (strongly disagree, disagree, neutral, agree and strongly disagree) on nine climate change issues, which sought to understand climate change actions at the individual level. According to Table 5.12, respondents in this study believe that every individual can take pro-climate change actions, as 73% of respondents strongly agree and 20% of respondents agree that 'we can all do our bit to reduce the effects of climate change'. The Chi-square test reveals that there is a significant relationship between respondents' view that we can all do our bit to reduce the effects of climate change and only gender ($p=0.030$). Respondents' view that we

can all do our bit to reduce the effects of climate change is therefore influenced by gender and not any of the other demographic variables.

The majority that share this view are females, those between 31-40 years, those with a postgraduate degree, employees at the M17-M18 grade, those whose work in the SHEQS and those located in the LOU. This implies that respondents feel in control, it is not too late and that everybody can do something about climate change. Such a response provides a good basis for including pro-climate change action tips in all learning interventions as pro-climate change behaviours are more likely from people who believe that they are in control of their lives (Steg *et al.*, 2015).

There is great concern about the effects of climate change on weather, as was also indicated earlier where 54.72% of the respondents raised weather related issues such as floods, droughts, extreme weather events and heat waves, as their main issue with climate change. This is supported by 72.73% of respondents who strongly agree and 19.19% of respondents who agree that 'climate change will seriously affect our weather'. Such an understanding of the impacts of climate change will facilitate effective learning interventions as the Norm Activation Model and the Value-Belief-Norm Theory of Environmentalism indicate that attention and beliefs are critical for action. This is underscored by all key informants who also expressed concerns about the effect of climate change on weather and the onset of extreme weather events.

In this study, respondents' climate change behaviour is not dependent on what others do, as 43.3% of respondents strongly disagreed and 20.62% of respondents disagreed that 'I would only do my bit to reduce climate change if everyone else did as well'. Only 13.4% strongly agreed and 11.34% agreed that their climate change actions were dependent on the actions of others. These findings do not support Clayton *et al.* (2015a), who suggest that individuals' climate change actions are based on what others do or do not do. Hence providing suggestions to respondents in this study of the various actions they can take, is likely to be more acceptable and implemented.

People perceive that they do not have control in undertaking pro-environment actions, as people consider climate change as bad news such as the rising sea level, the increasing numbers of hurricanes and loss of a beach (Gifford, 2015) and people can become less involved due to the spread of the fear and gloom about climate change (Andrews *et al.*,

2016). Respondents in this study also agree (31.96%) to strongly agree (27.84%) that ‘climate change is something that frightens me’. Additionally respondents seem to know that climate change is real and happening as 50% strongly disagreed and 27.08% disagreed with the statement ‘I’m unclear whether climate change is really happening’. Only 4.17% strongly agreed that they are unclear whether climate change is really happening. This finding does not support Brügger *et al.* (2015) and Capstick *et al.* (2015) who indicated that many people consider that climate change is not a crisis presently, as most laypeople perceive it as a threat and a potential danger to future generations. Such views by respondents in this study will enhance the effectiveness of any climate change learning intervention, as respondents are already sensitised to the present impacts of climate change and having climate change knowledge promotes public engagement on climate change (Geiger *et al.*, 2017a).

It is not practically feasible and politically acceptable to radically revise current lifestyles to address climate (Capstick *et al.*, 2015). However, 50% of respondents in this study strongly agree and 30.21% agree that ‘radical changes in society are needed to tackle climate change’. This view will facilitate strong climate change actions by respondents, although it is inconsistent with the earlier reluctance of respondents to pay more for cleaner energy. Citizens are more concerned about the negative impact pro-climate change behaviour will have on their current lifestyles, and hence are reluctant to act (Lorenzoni *et al.*, 2007). This self-centred attitude is underscored by respondents in this study, as 30.21% agree and 26.04% strongly agree that ‘people are too selfish to do anything about climate change’.

The Chi-square test reveals that there is a significant relationship between respondents’ view that people are too selfish to do anything about climate change and level of education ($p=0.039$), age ($p=0.000$) and gender ($p=0.022$). Respondents’ view that people are too selfish to do anything about climate change is therefore influenced by their level of education, age and gender. The majority that share this view are males, those between 60-65 years, those with a secondary school qualification, employees at the T04-T08 grade, those who work in the GM’s office and those located in the Distribution Division Head Office. It is interesting that lower qualified (secondary school education) and lower grade employees (T04-T08) also have this perception.

Respondents in this study believe that the evidence for climate change can be trusted as 33.67% disagreed and 30.61% strongly disagreed with the statement ‘the evidence for climate

change is untrustworthy'. It is therefore likely that respondents will engage in pro-climate change actions easier, as Clayton *et al.* (2015a) suggest that regular pro-environmental behaviour is enhanced when there is certainty or lack of doubt about climate change. Respondents in this study tend to accept the assertions of the IPCC (2014) which reported that human influence on the climate system is clear, as 31.25% strongly disagreed and 29.17% disagreed with the statement that 'claims that human activities are changing the climate are exaggerated'. This is an important finding as it suggests that the majority of respondents understand the role of humans in contributing to climate change.

Seven of the key informants underscored this finding by stating that the main drivers of climate change included unsustainable habits, human behaviour, more consumption and energy use, social upheaval, industrialisation and population growth that requires more resources due to lifestyle and aspirational goals. The Chi-square test reveals that place of work, department, grade, level of education, age and gender of respondents does not influence respondents' view that human activities are changing the climate. The majority of respondents who had this view are females, those between 31-40 years, employees with an undergraduate degree, those within the P14-P16 grade, respondents who work in the GM's office and those located at the Distribution Division Head Office.

Some people are of the view that industry, scientists and individuals are responsible for addressing climate change (Zwick and Renn, 2002), while others in a recent South African study indicated that government environmental departments are responsible for dealing with climate change (Pasquini *et al.*, 2013). Respondents in this study, were to consider and indicate who they trusted to take actions on climate change which included business and industry, environmental organisations, Eskom, family or friends, individuals or citizens, local government, respondents, national government, provincial government, UN and NGOs or Civil Society Organisations. In determining who respondents trust in making any changes needed to lessen the impacts of climate change, respondents were required to indicate their views on the scale from 1 (Trust) to 3 (Don't Trust) or Don't Know. Hence there were multiple responses. Only the responses to 1 (Trust) were used in the analysis. According to Table 5.13, 16.17% of respondents would trust themselves to make changes needed to lessen the impacts of climate change, followed by environmental organisations (14.68%) and Eskom (11.06%). The majority of respondents (18.38%) indicated that they don't trust (3) local government.

The Chi-square test reveals that there are no significant relationship between respondents' view that they trusted themselves most to make changes needed to lessen the impacts of climate change and place of work, department, grade, level of education, age and gender of respondents. Respondents who trusted themselves most are those who work in the Distribution Division's Head Office and the MOU, of all departments, those in the GM's office, employees at the M17-M18 grade, those with the highest level of education being primary school, respondents between 60-65 and more females than males.

Table 5.13: Trust in making any changes needed to lessen the impacts of climate change (n=470, multiple responses)

Trust in making any changes needed to lessen the impacts of climate change	Frequency (Trust)	Percentage	Rank
Business and industry	42	8.94	5
Environmental organisations	69	14.68	2
Eskom	52	11.06	3
Family or friends	35	7.45	7
Individuals or citizens	28	5.96	9
Local government	25	5.32	11
Myself	76	16.17	1
National government	29	6.17	8
Provincial government	27	5.74	10
United Nations	39	8.30	6
NGOs or Civil Society Organisations	43	9.15	4
Other (specify)	5	1.06	12

National, provincial and local government were considered at the bottom of the list to be trusted to make any changes needed to lessen the impacts of climate change. According to most of the focus group participants, the high rating of Eskom could be the employee bias of the respondents who are employed by the organisation.

From Figure 5.17, it is clear that while respondents were of the view that local, provincial and national government were responsible for taking actions on climate change, respondents did not trust these levels of government to undertake the necessary climate change actions. Interestingly, respondents trusted themselves the most although they did not see it as their responsibility to take actions on climate change. There was a close correlation with responsibility and trust for climate actions for family or friends and individuals or citizens.

The Chi-square test reveals that there is a significant relationship between respondents' distrust of national government in undertaking climate change actions and OU ($P=0.002$), level of education ($p=0.039$) and age ($p=0.000$). Respondents' view that national government cannot be trusted to undertake climate change actions is therefore influenced by their OU in which they work, level of education and age. The majority that share this view are females, those between 21-30 years, those with an undergraduate degree, employees at the P11-P13 grade, those whose work in the Distribution Division's Executive's office and those who are located at the Distribution Division Head Office. This implies that younger employees, those with a degree and the engineers, professionals and advisors in the Distribution Division are more critical of government's actions on climate change, and could be reflective of the changing political mood and of those in this group and in South Africa broadly.

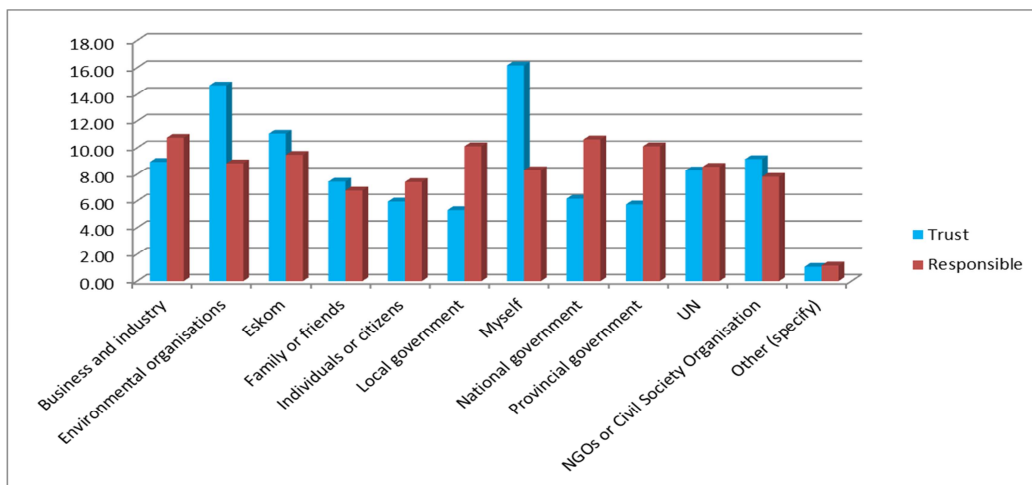


Figure 5.17: Comparison of who respondents consider are responsible for climate change actions and who they trust in undertaking climate change actions

In response to the issue of whether government policy-makers (informed by scientific experts) should decide which measures to adopt against climate change, an overwhelming 82.85% of respondents were of the view that government policy-makers (informed by scientific experts) should decide which measures to adopt against climate change, as opposed to only 11% who disagreed. On the question of whether the public should be actively involved in deciding what should be done about climate change, respondents indicated a desire to be actively involved in deciding what should be done about climate change, as 96.3% of respondents were of the view that the public should be consulted and actively

involved, whereas only 2.87% of respondents thought that public should be consulted only, and not actively involved in climate change initiatives.

In view of the aforementioned findings, the need for climate change learning for employees is further substantiated and necessary as respondents consider themselves as most trustworthy in taking action on climate change and that the public must be actively involved in deciding what should be done about climate change. Such learning will therefore also support more climate change actions, enable the public to provide meaningful input when consulted and be actively involved.

One of the barriers that may prevent pro-climate change actions is the lack of reliable information about climate change (Shackleton *et al.*, 2015). Respondents in this study were required to indicate which of the following sources they considered reliable sources of climate change information by indicating trust (1), may trust (2), do not trust (3) or do not know (4) for reliable climate change information: business and industry reports, Eskom, family or friends, government reports, the media, scientific reports, the UN, work colleagues and NGOs or Civil Society Organisations. Hence there were multiple responses on the scale. From all the different sources listed, Figure 5.18 indicates those that 22.54% of respondents trust scientific reports to give them reliable information on climate change, 13.02% would trust Eskom and 11.11% would trust NGOs or Civil Society Organisations. Tellingly, 23,6% of respondents did not trust (3) government reports.

According to the Chi-square test, place of work, department, grade, level of education, age and gender of respondents did not play a role in the first choice of respondents for reliable information on climate change, namely, scientific reports or their last choice, namely, work colleagues. The majority of those who chose scientific reports were from MOU, those who worked in the BIPM department, employees in the M14-M16 grade, those with a post graduate degree, respondents between the ages of 31-40 years and more males than females. Respondents with a secondary school level of education and those who were 18-20 years were the minority who chose scientific reports as a source of reliable information on climate change of all the different levels of education and age groups of respondents in this study.

In this study, work colleagues were not considered a trustworthy source of information with only 5.1% of respondents selecting this option with more females than males considering

work colleagues a source of reliable information. Furthermore, business and industry reports were ranked 6th and government reports ranked 7th as trustworthy sources. This is underscored by Poortinga and Pidgeon (2003) who suggest that the public tend to mistrust governments, businesses and industry. In view of this, climate change learning in organisation cannot rely on the information employees receive from government or business. It is imperative that this distrust of organisations for climate change information be addressed in climate change learning interventions.

People’s willingness to adapt to climate change is determined by their knowledge and understanding (Brügger *et al.*, 2015; Shi *et al.*, 2015). This is underscored by Clayton *et al.* (2015a) who claimed that changing people's attitudes and beliefs by educating and providing them with information is sufficient to change their actual behaviour. The public also needs

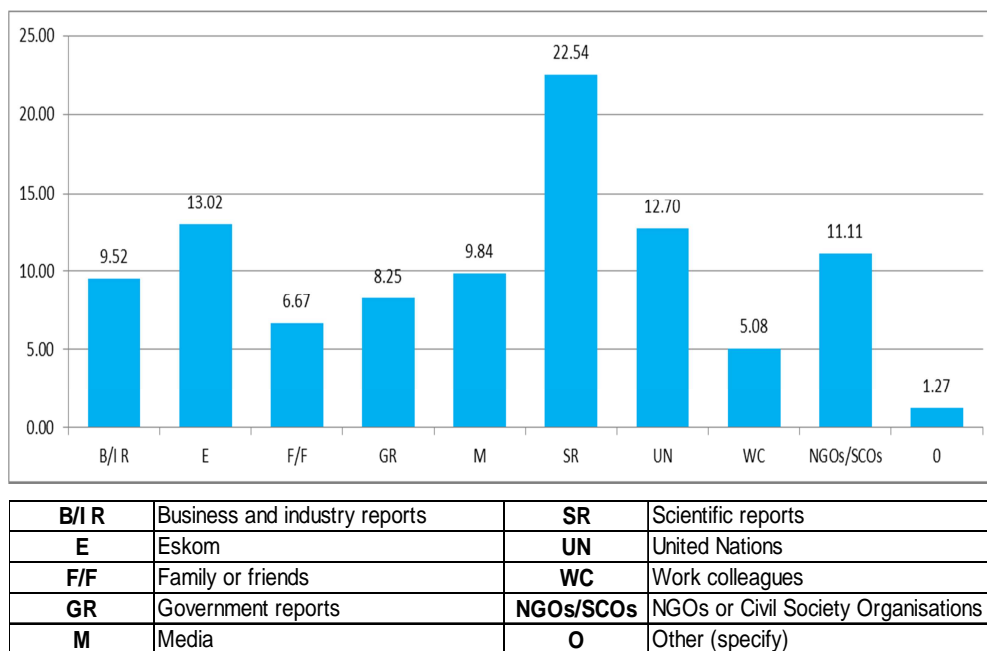


Figure 5.18: Source of reliable information on climate change (n=545, multiple responses, in %)

access to information on climate change to support global initiatives (Campos *et al.*, 2017) and Klenk *et al.* (2015) recommend that to improve the climate change response, it is necessary to engage stakeholders and share scientific information.

However, people increasingly trust other people, even those they have not met more than governments, businesses and other institutions (Yoseph-Paulus and Hindmarsh, 2016). Additionally, climate change communications from authority sources and information that continue to instruct or are forced upon people are likely to be less successful (Bliuc *et al.*, 2015) while Kennel *et al.* (2016) suggest that the sciences should be the source of climate change information. In this study respondents were asked to identify their sources of information on climate change such as environmental groups, for example, the WESSA, Eskom's Environmental Department, friends or family, government departments, the Internet, newspapers and magazines, public libraries, radio, school or university, specialist publications or academic journals, television programmes, National Geographic, and NGOs or Civil Society Organisations. According to Table 5.14, 15.32% of respondents obtained climate change information from environmental groups, for example, WESSA, 13.99% from television programmes, for example, National Geographic, 13.85% from the Internet, 13.65% from Eskom and 12.93% of respondents obtained climate change information from newspapers and magazines.

The Chi-square test reveals that there are no significant relationship between respondents' choice of environmental groups, for example, WESSA as their main source of information on climate change and place of work, department, grade, level of education, age and gender of respondents. The majority of respondents who selected environmental groups, for example, WESSA as their main source of information on climate change are from the M&O department, employees at the T11-T13 grade, those having a diploma or certificate as their highest level of education, respondents between 31-40 years and more males than females.

According to the focus group discussions, Eskom's Environmental Department was ranked as the 4th most common source of current information on climate change, due to the regular environmental communiques which the Distribution Division employees receive without any effort on their part, as they are involuntary recipients of such business communiques. It is important for organisations to initiate information seeking, as this influences the organisation's learning policies and structures (Marsden *et al.*, 2011). People's trust is lost when there is misquoted climate information or over-optimistic claims about future outcomes and the mistrust of the source or credibility of the climate change proposed actions, lessens the likelihood of adopting climate mitigation actions (Carlton *et al.*, 2015).

The low ranking of specialist publications or academic journals (8) as a source of current information on climate change, although respondents consider this a reliable source of information, could be linked to the limited access of the public to such publications (van der Linden *et al.*, 2017). Additionally, government departments as a current source was also ranked low (10) in this study and substantiates Brügger *et al.* (2015) and Capstick *et al.* (2015) who claim that governments are perceived as not credible in diffusing information. Additionally, since the source of climate change information for the majority in this study is from environmental groups, for example, WESSA, such organisations will be instrumental in bolstering the climate change learning programme in organisations rather than relying on presentations or training from government or the scientific community only.

Table 5.14: Sources of current information on climate change (n=618, multiple responses)

Source of current information on climate change	Frequency	Percentage	Rank
Environmental groups, for example, WESSA	449	15.32	1
Eskom's Environmental Department	400	13.65	4
Friends or family	134	4.57	7
Government departments	87	2.97	10
Internet	406	13.85	3
Newspapers and magazines	379	12.93	5
Public libraries	42	1.43	12
Radio	339	11.57	6
School or university	76	2.59	11
Specialist publications or academic journals	109	3.72	8
Television programmes, for example, National Geographic	410	13.99	2
NGOs or Civil Society Organisations	90	3.07	9
Other (specify)	10	0.34	13

For most people, the use of pictures and photographs that depicts climate change issues equally helps to make climate change actions more attractive and persuasive, and will facilitate better participation (Karahan and Roehrig, 2015). It is also important to use more subtle techniques of engagement (Andrews *et al.*, 2016). Some of the mediums and methods used for such climate change campaigns in various countries include websites, radio and television programmes, newsletters, direct mail, publications, social media, web blogs, movies, video games, online games, advertisements, posters, exhibitions, conferences, seminars, lectures, environmental awards, theatre, and special days, weeks or months of action (Jones *et al.*, 2015; UNFCCC, 2016), for example, World Environment Day (Pang and Law, 2017). In this study, respondents were asked to identify their preference for climate change information from the following list: graphs of future trends, interactive computer

displays, Internet pages (for example, an OU webpage showing different future outcomes), more media coverage (for example, articles in newspapers, television and pictures of what an area could look like in the future), posters and leaflets, regular e-mails, scientific reports, seminars and workshops, long courses (more than one day), short courses (one day or less), talks by experts or to suggest any other suitable format. According to Figure 5.19, 16.98% of respondents preferred climate change information in the form of graphs of future trends, 10.49% favoured talks by experts, 9.74% preferred pictures of what an area could look like in the future, 9.57% desired Internet pages, for example, an OU webpage, showing different future outcomes and 8.95% preferred regular e-mails. There was very little interest in long (1.71%) or short (5.38%) climate change courses by respondents.

A key informant was of the view that climate change learning in the Distribution Division was not effective, as the 'volume and style of climate change communication was inappropriate for most employees', while another was of the view that training on climate change needs to take into consideration the different languages in the Distribution Division and address different perspectives. Furthermore, one of the key informants was very supportive of the short climate change course and emphasised that 'there needs to be more climate change communiques and short courses with regular refreshers'.

The Chi-square test reveals that there is a significant relationship between respondents' preference for climate change information in the form of graphs of future trends and age ($p=0.005$). Place of work, department, grade, level of education and gender of respondents did not play a role in this preference. The majority of respondents who selected this preference for climate change information are employees at the T11-T13 grade, employees in the M&O department, those having a diploma or certificate as their highest level of education, respondents between 31-40 years and more males than females.

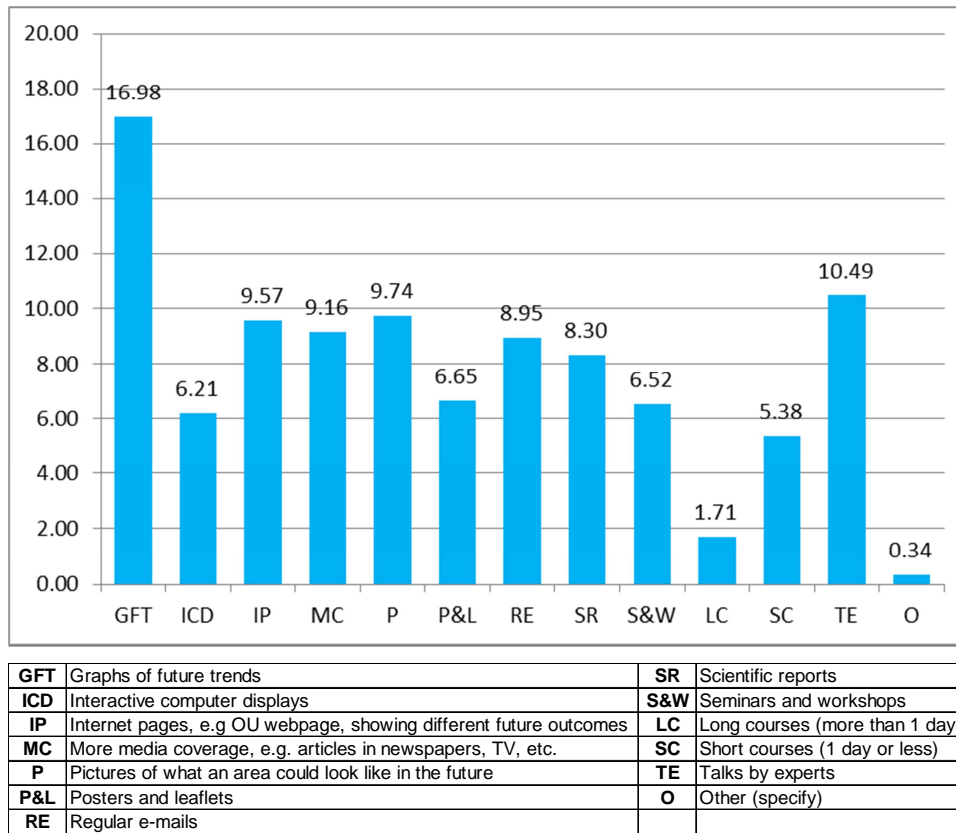


Figure 5.19: Climate change information preference (n=618, multiple responses, in %)

The pairwise ranking exercise undertaken with the focus group discussions indicated that the top three choices of format for information on climate change were: ‘talks by experts’, ‘short courses (one day or less)’ and ‘pictures of what an area could look like in future’ (Table 5.15).

Table 5.15: Combined focus group discussions pairwise ranking of climate change information preferences

Format for information on climate change	Frequency	Rank
Graphs of future trends	7	9
Interactive computer displays	13	7
Internet pages, for example, OU webpage, showing different future outcomes	12	8
More media coverage, for example, articles in newspapers or television	21	6
Pictures of what an area could look like in the future	26	3
Posters and leaflets	22	5
Regular e-mails	6	10
Scientific reports	2	11
Seminars and workshops	24	4
Long courses (more than 1 day)	1	12
Short courses (1 day or less)	28	2
Talks by experts	31	1

There is some significant alignment of the focus group discussions' recommendations with responses from the survey as 'talks by experts' and 'pictures of what an area could look like in future' were highly rated by both groups.

The need for talks by experts expressed in this study is contrary to Kettle and Dow (2016) and Newell *et al.* (2015) who were of the view that the public tends to sometimes mistrust communication of environmental issues and risks from experts. Of greater significance, is that talks by experts and short courses (1 day or less) could address the individual barriers to pro-climate change action identified by Clayton *et al.* (2015a) and Lorenzoni *et al.* (2007), namely, uncertainty and lack of knowledge about climate change. The institutional barriers such as of a lack of capacity, and the limited understanding of and expertise in tackling climate-related issues (Ziervogel *et al.*, 2014) can also be addressed from having climate change experts address employees or climate change courses which are not more than a day and that do not impact significantly on work time and other duties. Perhaps short courses presented by experts will likely be most effective. This is underscored by Gifford (2011) and Kabisch *et al.* (2016) who suggest that working with technical experts will help citizens overcome the barriers to pro-climate change behaviours.

The preference of 'pictures of what an area could look like in future' for climate change learning by the respondents and the participants in the three focus group discussions, is underscored by Carrico *et al.* (2015) who suggest that visual communication methods that portray the future of climate change impacts could be a powerful tool for motivating behaviour change in the present. People are also more willing to undertake pro-climate change actions in their local community, if made aware of the future impacts of sea level rise and climate change adaptation measures (Evans *et al.*, 2014). It is also important to work within the cultural norms, value systems and communication contexts that are meaningful to the majority of people (Fernandez *et al.*, 2016).

It must also be noted that from the focus group discussions, it emerged that some of the above-mentioned means or methods such as Internet pages, regular e-mails, scientific reports, and long courses (more than 1 day) have been tried in certain organisations to improve climate change learning, but without much success. This is underscored by Ziervogel *et al.* (2014) who suggest that to reach a broad audience effectively and credibly, it is essential that the methods for communicating climate science and impacts are significantly improved from

past practices. Triangulation of the qualitative and quantitative data indicates that for this study, ‘talks by experts’ are the most suitable preference for climate change learning by Distribution employees.

Additionally, the focus group discussions were of the view that the format of climate change information indicated in the survey is likely due to the TASK and educational level of employees in the Distribution Division. As indicated earlier (Figure 5.4), at least 19.2% of the respondents are at primary and secondary school level of education and therefore are more likely to prefer climate change information in simple and easy formats. Staff perceptions and attitudes towards climate change emanating from this study indicate that there are varying levels of climate change awareness and a low appetite for pro-climate change action by the Distribution Division employees.

Since there is a strong link between climate change awareness and pro-climate change actions (Brügger *et al.*, 2015; Capstick *et al.*, 2015; Hoffman, 2006; Mobley, 2015; Steg *et al.*, 2015; Stevenson, 2017), the findings in this study indicate that the lack of commitment to pro-climate change actions is indicative of a low level of climate change learning in the Distribution Division. It is therefore imperative to help employees make the connections, through robust climate change learning interventions, using the key findings from this study. People are likely to engage in positive environmental actions, when they are aware of the connection between their actions and climate change (Hickman and Riemer, 2016). Furthermore, individuals are more likely to engage in environmental behaviour when they believe that they have the capability to help solve environmental problems through their own behaviour, as there is a connection between moral thinking and concern about environmental problems (Clayton *et al.*, 2015a). In designing climate change learning interventions, it is also important to note that a person’s own habits deeply affect the choices a person makes and behaviour is influenced more by structural factors above or external to the individual than by individual-level influences (Jagers *et al.*, 2016). Additionally, it will be important to address the importance of gender, traditional and cultural issues, and the diversity of audiences and languages in climate change awareness in the Distribution Division and industry in general, as these issues have traditionally been ignored in climate change awareness programmes (UNFCCC, 2016). In this study, demographic issues have influenced the responses to the climate change questionnaire.

5.6 The Distribution Division’s climate change programme and environmental strategies

Some of the environmental impacts of the distribution of electricity include the loss of indigenous and protected trees and plants, pollution and damage to wetlands, streams, rivers, and heritage sites or artefacts, and the injury or mortality of birds from collisions or electrocutions on overhead powerlines (Eskom, 2013a). In this study, respondents were asked to indicate their level of agreement with the statement that ‘Distribution Division activities have no to little environmental impact’. From Figure 5.20, it is evident that respondents understand that the Distribution Division activities do have an impact on the environment as 31.80% strongly disagreed and 33.60% disagreed with the statement that the Distribution Division activities have no to little environmental impact. Of the 618 respondents, 2.3% did not rate this issue.

Respondents’ understanding of the Distribution Division’s impact on the environment bodes well for climate change learning, as people’s willingness to adapt to climate change is determined by their knowledge, understanding, beliefs and attitudes regarding climate change and the environment, both at an individual or cognitive level (Brügger *et al.*, 2015; Masud *et al.*, 2016; Shi *et al.*, 2015).

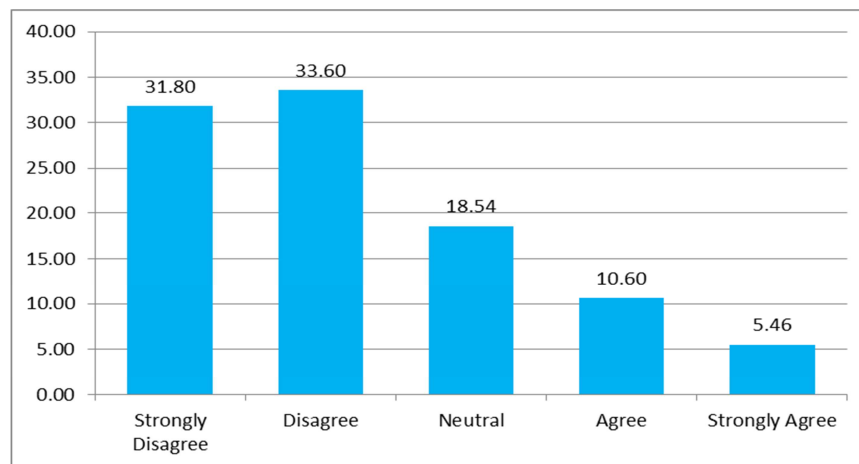


Figure 5.20: Respondents’ view that the Distribution Division activities have no to little environmental impact (n=604, in %)

The Chi-square test reveals that there is a significant relationship between respondents’ view that Distribution Division activities have no to little environmental impact and the department

in which they work ($p=0.020$), grade ($p=0.007$) and gender ($p=0.001$). Location (OU) and level of education of respondents did not play a role in this view. The majority of respondents who strongly disagreed with the statement that Distribution Division activities have no to little environmental impact are males, employees at the M17-M18 grade, employees in the GM's office, those having a primary school level of education, respondents between 18-20 years and those working in the LOU.

Temperature, rainfall and wind speeds affects power infrastructure and the performance of powerlines and climate change-related weather events are expected to worsen such conditions (Ryan *et al.*, 2016). In the electricity distribution industry, the risks of climate change-related events include direct physical impacts and vulnerabilities such as damage to infrastructure, equipment and networks (Makhele, 2009), while the increasing intensity of storm events increases the risk of damage to electric distribution lines (Wang *et al.*, 2016). In this study, respondents were required to indicate their level of agreement with the statement that climate change has no impact (effect, damage) on the Distribution Division. According to Figure 5.21, 45.15% of respondents strongly disagreed that climate change has no impact (effect or damage) on the Distribution Division and 35.79% disagreed with the statement. In other words, the majority of respondents are of the view that the Distribution Division will be impacted by the effects of climate change. A small percentage of respondents agreed (4.18%) and strongly agreed (4.01%) that climate change has no impact on the Distribution Division. Of the 618 respondents, 3.2% did not rate this issue.

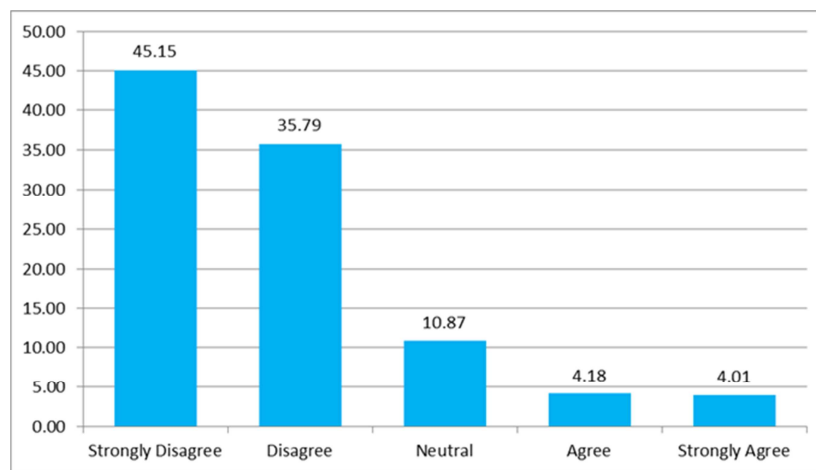


Figure 5.21: Respondents' view that climate change has no impact on the Distribution Division (n=598, in %)

The Chi-square test reveals that there is a significant relationship between respondents' view that climate change has no impact (effect, damage) on the Distribution Division and gender ($p = 0.000$) only. The department in which respondents work, grade, age, location (OU) or level of education did not play a role on this issue. The majority of respondents who strongly disagreed with the statement that climate change has no impact (effect or damage) on the Distribution Division are males, employees at the M14-M16 grade, those in the BIPM department, those having an undergraduate degree, respondents between 18-20 years and those working in the NWOU. More females than males, those between 51-60 years and respondents located in the NWOU strongly agreed that climate change has no impact on the Distribution Division. However, key informants were of the view that it is Eskom's Generation Division that will be most affected by climate change and not the Distribution Division, as the Generation Division will have to consider alternate cleaner ways of electricity generation, while reducing the reliance on fossil fuels.

Key informant interviewees indicated that climate change will impact on the Distribution Division in the following ways: regulatory requirements will impose financial and legal risks, travel will be affected, and the financial implications include increases in insurance cover for weather-related losses, damage to infrastructure, capital costs will be affected and extreme events such as heavy rains or droughts could lead to disruption of business or impact the economy. Since respondents are aware that the Distribution Division will be affected by climate change, it is likely that climate change learning interventions will be more readily acceptable and assimilated by employees.

The Distribution Division dispenses electricity in all nine provinces in South Africa, by building, operating and maintaining distribution assets such as powerlines, substations and related infrastructure (Eskom, 2015e). The Distribution Division employs 15 765 people to manage, support and carry out all these activities (Eskom, 2015a). However, there is a dearth of research on the contribution of the Distribution Division activities to climate change. In this study, respondents were required to indicate their level of agreement with the statement that the Distribution Division activities do not contribute to the climate change problem.

Respondents indicated that the Distribution Division activities do contribute to the climate change problem, as from Figure 5.22, 35.5% strongly disagreed and 35% disagreed that the Distribution Division activities do not contribute to the climate change problem. At least 11%

of respondents were of the view (agreed and strongly agreed) that the Distribution Division activities do not contribute to the climate change problem. Of the 618 respondents, 2.9% did not rate this issue.

The Chi-square test reveals that there is a significant relationship between respondents' view on the Distribution Division's contribution to climate change and grade ($p=0.001$) and gender ($p=0.049$) only. The department in which respondents work, age, location (OU) or level of education did not play a role on this issue. The majority of respondents who strongly disagreed with the statement that Distribution Division activities do not contribute to the climate change problem are from the LOU, work in the GM's office, are at the M17-M18 grade, those with an undergraduate degree, respondents that are 31-40 years and males.

These responses are a cause for concern, as there are no known documented studies or evidence that the Distribution Division activities contribute to the climate change problem. The Distribution Division has no direct GHG emissions (Scope 1). Emissions in the Distribution Division are mainly Scope 2, namely, indirect emissions from the use of purchased electricity in all its buildings and the emissions from the Distribution Division's fleet of vehicles and Scope 3 emissions which consists of emissions from business travel and from purchased goods and services (Depoers *et al.*, 2016; Eskom, 2010b). Respondents' view that the Distribution Division contributes to climate change indicates a gap in climate change learning and is an issue that must be addressed in any climate change learning interventions in the organisation.

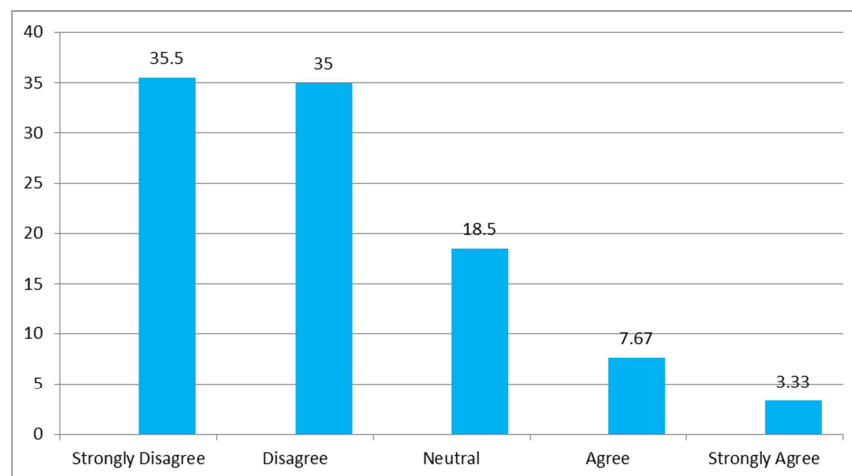


Figure 5.22: Respondents' view that the Distribution Division activities do not contribute to the climate change problem (n=600, in %)

One of the six values adopted in the Distribution Division is zero harm which implies that the Distribution Division will strive to ensure that no harm befalls the natural environment and includes the protection of the environment, reducing the organisation’s environmental and carbon footprint through monitoring and reducing particulate emissions, ensuring efficient water consumption and integrating biodiversity considerations into the business (Eskom, 2015e). The focus in the Distribution Division is to prevent environmental legal contraventions through environmental training, environmental awareness, regular communication and the effective use of trained personnel so as to reduce the business compliance risk (Eskom, 2013a).

In this study, respondents were required to indicate their level of agreement with the statement that the Distribution Division has good environmental management strategies that look after our environment. According to Figure 5.23, 42.12% of respondents agreed and 16.58% strongly agreed that the Distribution Division has good environmental management strategies that look after the environment, although a significant 31.67% were not sure (neutral). At least 9.62% (strongly disagree and disagree) of respondents did not support the view that the Distribution Division has good environmental management strategies that look after the environment. Of the 618 respondents, 2.4% did not rate this issue.

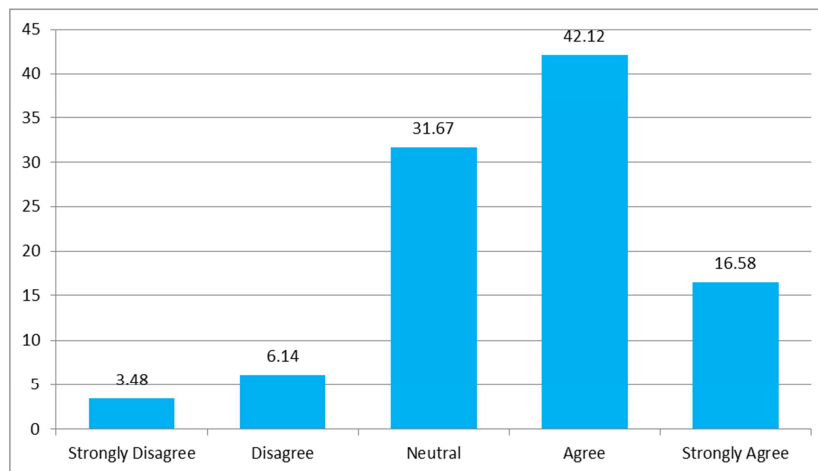


Figure 5.23: Respondents’ view on the Distribution Division has good environmental management strategies that look after our environment (n=603, in %)

The Chi-square test reveals that age, grade, gender, the department in which respondents work, location (OU) or level of education did not play a role on respondents’ view that the Distribution Division has good environmental management strategies that look after the

environment. The majority of respondents who agreed with the statement that Distribution Division has good environmental management strategies that look after the environment are from the WCOU, work in the GM's office, are P14-P16 grade employees, those with a postgraduate degree, respondents between 51-60 years and females. It is noteworthy that those between 18-20 years and those with a primary school level of education as well as senior employees (SSE/EEE and above and those in the Distribution Division's Executive's office) strongly disagreed with the statement that the Distribution Division has good environmental management strategies that look after the environment. This implies that the leadership and the recent employees are not confident or are unaware of the Distribution Division's environmental management strategies. Focus group discussions were also of the view that the leadership in the organisation must lead by example and that there must be buy-in from senior managers. The lack of confidence or awareness of the Distribution Division's environmental management strategies by senior employees poses a particular challenge for the Distribution Division, as Andrews *et al.* (2016) and Hoffman (2006) emphasise the important role of leaders and managers in promoting pro-climate change actions. However, this will be difficult due to the lack of commitment or awareness of senior managers.

The key informants were of the view that environmental management in the Distribution Division is not of a high standard, is visible in only a few specific departments, such as Environmental Management, and that some of the reasons for the poor environmental strategies in the organisation include other priorities in the business such as finance, safety and energy efficiency, which is in line with the views of Beck *et al.* (2011) concerning the key priorities of Eskom currently. There is a need to re-align priorities given the scale of the climate change challenges (Klenk *et al.*, 2015) in line with the recommendations of Begum and Pereira (2015) and Lee *et al.* (2015b) who emphasise climate change learning.

The contrasting views of the survey respondents with that of the key informants indicate that there is a disconnect between employees, and those who work in the environmental management space. Respondents' views could be as a result of employee bias or ignorance of real environmental issues, whereas key informants, who are primarily the environmental practitioners in the Distribution Division, are more aware due to their knowledge and experience.

Climate change is not covered in the Distribution Division Business Plan and hence there are no initiatives or programmes to address climate change in the Distribution Division (Eskom, 2013a). In this study, respondents were required to indicate their level of agreement with the statement ‘I am aware of the work the Distribution Division is doing to address climate change’. According to Figure 5.24, 38.45% agreed and 14.03% strongly agreed that they are aware of the work the Distribution Division is doing to address climate change but 15.52% of respondents strongly disagreed and disagreed with this statement. Of the 618 respondents, 1.9% did not rate this issue. The Chi-square test reveals that there is no relationship between awareness of the work the Distribution Division is doing to address climate change and respondents’ age, grade, gender, the department in which respondents work, location (OU) or level of education. The majority of respondents who agreed with the statement that they are aware of the work the Distribution Division is doing to address climate change are from the MOU, work in the Distribution Executive's Office, are P11-P13 grade employees, those with a secondary school qualification, respondents between 18-20 years and males, while females strongly disagreed.

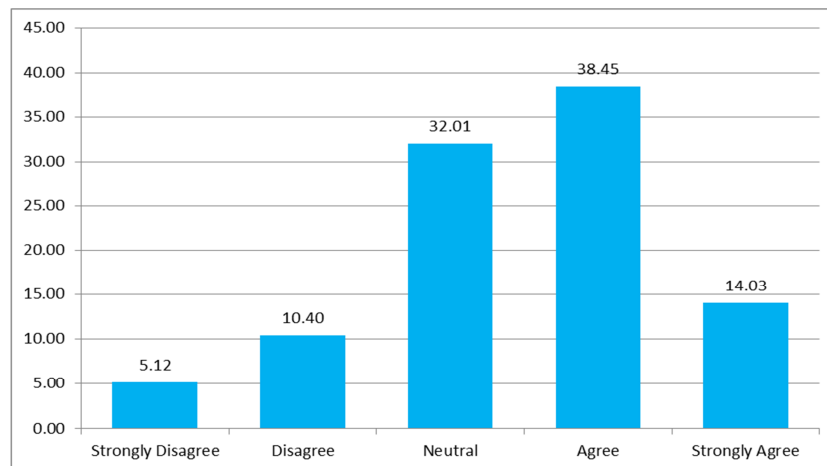


Figure 5.24: Respondents’ view on being aware of the work the Distribution Division is doing to address climate change (n=606, in %)

Most key respondents interviewed indicate that they were not aware of the Distribution Division’s climate change initiatives, although some were vaguely aware of the Eskom Climate Change Six Point Plan but not sure how this was integrated into the Distribution Division. Furthermore, some key respondents and focus group participants were of the view that Eskom's Climate Change Department concentrated its efforts externally, for example,

with government, with minimal to no internal (employee) initiatives. Additionally, key informants suggested that climate change is not an issue that employees can easily identify with, especially as it appears to be an area of specialisation for particular people only, for example, environmental staff in the organisation. This is underscored by Ziervogel *et al.* (2014) who suggest that climate change has tended to be viewed as an environmental issue and in Eskom and the Distribution Division climate change is managed by environmental professionals and not considered a development issue. This vastly different view of the respondents is likely due to employee bias or misunderstanding between environmental management issues and climate change. This is indicative of the lag in the Distribution Division employees' climate change awareness and knowledge which provides further motivation for the dire need of climate change learning.

To address the reliability of electricity supply, Eskom has proposed reducing its environmental carbon footprint, pursuing low carbon growth opportunities and embarking on a proactive approach to identify and manage the inevitable impacts of climate change to its business operations (Eskom, 2012a). There have been challenges in Eskom to implement the aforementioned strategies, and execution has been problematic and non-existent in the Distribution Division (Eskom, 2013a). The organisation has, however, acknowledged that it is imperative to address climate change issues through integrated reporting to inform all stakeholders and via internal engagements and forums (Eskom, 2015e), which implies climate change learning.

There are no climate change goals in the Distribution Division presently (Eskom, 2013a) and there is a paucity of detailed information of employee's response to climate change in industry (Knight, 2016). It is important, however, to have employee buy-in for the success of any climate-related strategy (Depoers *et al.*, 2016; Weinhofer and Busch, 2013). In this study, respondents were required to indicate their level of agreement with the statement, 'I contribute to achieving the Distribution Division's climate change goals in my work'. The majority of the respondents indicated that they contribute to achieving the Distribution Division's climate change goals, as from Figure 5.25, 43.43% agreed with the statement and 19.3% strongly agreed, while 27.79% were undecided. At least 9.48% of respondents disagreed or strongly disagreed that they contribute to the Distribution Division's climate change goals in their work. However, the majority of the respondents (62.73%) indicated that they are making a contribution to climate change at the workplace. Of the 618 respondents,

2.8% did not rate this issue. The Chi-square test reveals that respondents' age, grade, gender, the department in which respondents work, location (OU) or level of education did not influence the view that employees contribute to achieving the Distribution Division's climate change goals in their work.

Of all the different grades in the Distribution Division, interestingly the Group Executive, GMs and Corporate Specialists (SSE/EEE and above grades) indicated that they do not contribute to achieving Distribution's climate change goals as they strongly disagreed with the statement that they contribute to the Distribution Division's climate change goals in their work. According to the five age categories involved in this survey, the youngest, namely, those 18-20 years indicated that they did not contribute to the Distribution Division's climate change goals in their work.

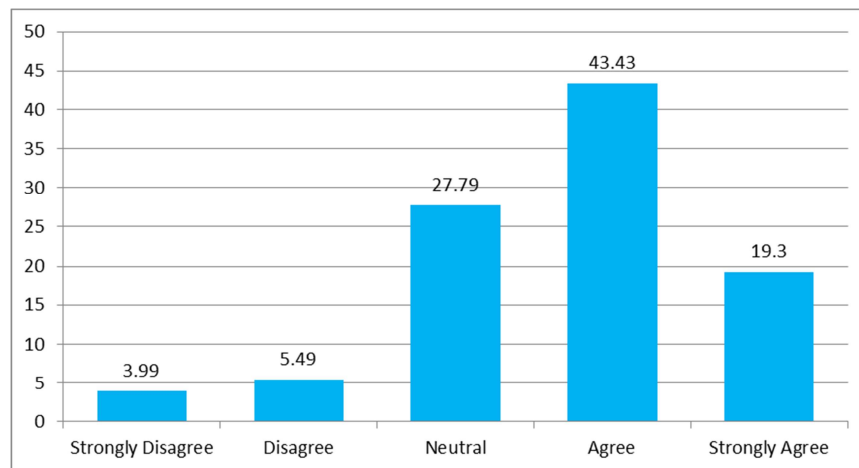


Figure 5.25: Respondents' view on 'I contribute to achieving the Distribution Division's climate change goals in my work' (n=601, in %)

Key informant interviewees and focus group participants were of the view that there is minimal to no initiatives in the Distribution Division to engage employees in climate change issues, as the focus in Eskom has been on technical and energy efficiency due to energy generation constraints, and not specifically on climate change. Once again, the focus group suggested that respondent's view on this issue is strongly influenced by their fear of being considered unsupportive of the organisation's initiatives due to employee bias. It is also likely that respondents are unable to distinguish between environmental management issues and

climate change initiatives and provides more evidence of the need for climate change learning.

It is not easy to get employees involved in climate change initiatives, due to the long-term and complex nature of climate change, and the resources (time and effort) required to get employees engaged in pro-climate change behaviours (Meadow *et al.*, 2015). Instead of forcing employees to be dutiful or obedient regarding pro-climate change behaviour, it is more important for organisations to adopt different and interesting ways, to make pro-climate change behaviour more desirable (Moser, 2016). Additionally, to achieve climate-friendly actions in the workplace, such initiatives must be attractive, convincing, relevant, must make sense to people and contextualised within people's cultural norms, value systems and communication contexts (Fernandez *et al.*, 2016). It is also possible for climate change to be implemented by a wide range of employees in an organisation (Hoffman, 2006), so climate change learning in the Distribution Division can be designed for all employees from grade T4 to SEE/EEE, as well as those with primary school education to those with a postgraduate qualification.

In this study, respondents were required to indicate their level of agreement with the statement, 'The Distribution Division is doing enough to address climate change'. According to Figure 5.26, a significant number of respondents (41.76%) were undecided as to whether the Distribution Division is doing enough, while 24.63% agreed that the Distribution Division is doing enough to address climate change, and 18.8% disagreed with this statement. It implies that a minority (23.96%) were of the view that the Distribution Division is doing enough to address climate change. Of the 618 respondents, 2.8% did not rate this issue. The Chi-square test reveals that there is no relationship between respondents' view that the Distribution Division is doing enough to address climate change and age, grade, gender, the department in which respondents work, location (OU) or level of education. Employees in the GM's office, and interestingly those in grades SSE/EEE and above and females were of the view that Distribution Division is not doing enough to address climate change.

Furthermore, the key informants and focus group discussions indicated that the initiatives in Eskom to reduce fossil fuel use, was due to the energy crisis in South Africa, and not a climate change intervention. However, some good climate change practices emanated from this energy efficiency drive, which contributed to pro-climate change behaviours of some

employees in the Distribution Division. The key informants and some of focus group participants highlighted the following issues of concern: much of the climate change work in Eskom has focused on the Generation Division; climate change issues are coordinated by a single department at the corporate headquarters; there have been few climate change seminars or workshops due to financial constraints at Eskom currently; there is little or no communication and commitment to climate change from senior managers in the Distribution Division and this is underscored by the findings in this study, as these leaders in the SEE/EEE admitted to not contributing to achieving Distribution Division's climate change goals; climate change communication across all the divisions in Eskom has been problematic and there has been no climate change learning interventions undertaken in the Distribution Division. All these factors contribute to a low understanding of what the Distribution Division is doing to address climate change or confusion with environmental issues by the Distribution Division employees. The Distribution Division employees need better information in appropriate mediums to improve their understanding of climate change issues that are relevant to the organisation. Additionally, the findings in this study indicate the need for organisation-wide climate change learning.

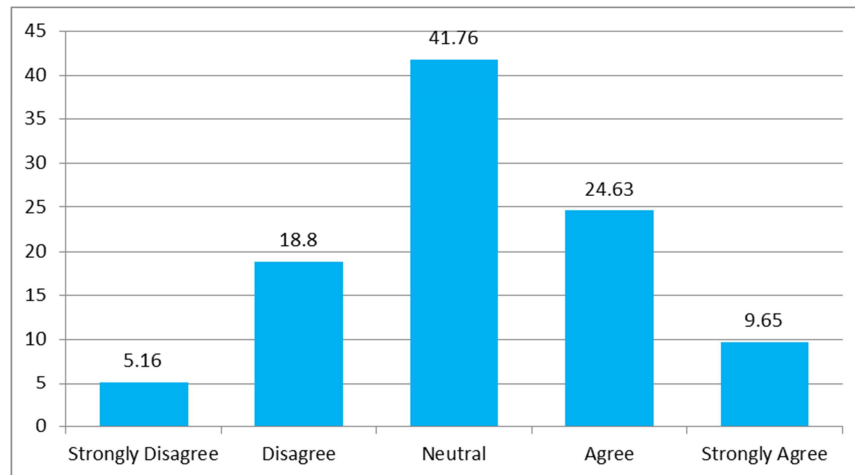


Figure 5.26: Respondents' view on 'the Distribution Division is doing enough to address climate change' (n=601, in %)

It is not unrealistic for the Distribution Division to respond to climate change, as Allen and Craig (2016) are of the view that the structure and operation of modern businesses have many values and features that can be used to address climate change problems. Additionally, the Distribution Division can contribute to a broader climate change response in the country, as

Sabel and Victor (2015) suggest that business can also play a vital facilitative and capacity building role in society. The Distribution Division can also support local governments, as Pasquini *et al.* (2013) maintain that business have the capacity to develop the regulatory infrastructures that encourage innovation and creativity at the local level. It is also important for climate change to be integrated into the core of a business as a strategic issue (Engert *et al.*, 2016). Climate change initiatives cannot be optional or merely for public relations purposes only, as it has recently emerged that most companies now understand that climate change is one of the key drivers for a significant change in the way business operates, primarily due to the influence on market competitiveness and stakeholder concerns (Backman *et al.*, 2015). This is supported by Pattberg and Widerberg (2016) who indicate that the new ethic in business such as good corporate values and the reduction of risk are good drivers to encourage business to assume greater responsibilities for climate change.

The main climate change challenges for businesses include the need to reduce GHG emissions from their own activities and to also understand and respond to the impacts of climate change on their operations (Pan *et al.*, 2016). Hence it is important for businesses to evaluate its vulnerability to climate-related effects (Gasbarro and Pinkse, 2015), as climate change can either be positive or negative for the operation of any business (Demertzidis *et al.*, 2015). Business can focus on profits and still contribute to climate change adaptation and mitigation initiatives (Kolieb and Harrould-Kolieb, 2011). Employee buy-in is fundamental to the success of any climate-related strategy (Depoers *et al.*, 2016; Weinhofer and Busch, 2013). It is also been argued that the mobilisation of employees to understand and respond to climate change, may yield more significant results to the climate change challenges and may be more cost-effective in the long run (Begum and Pereira, 2015; Lee *et al.*, 2015b).

In this study, respondents were required to indicate their level of agreement with the statement, 'most employees are involved in the Distribution Division's environmental management programmes or activities'. The important issue of employee involvement in the environmental management programmes and activities of the Distribution Division revealed that respondents were ambivalent, as 34.51% were neutral on this issue, 20.60% disagreed and 10.21% strongly disagreed that most employees are involved in the Distribution Division's environmental management programmes or activities (Figure 5.27). This indicates that a large percentage of respondents (65.32%) are of the view that employees are not involved in the Distribution Division's environmental management programmes or activities.

More females than males and those between 41-50 years were also of this similar view. Of the 618 respondents, 3.4% did not rate this issue.

According to the key informants and some focus group participants, the erosion of values which are taught in the home from customs and cultures, has contributed to employees not embracing environmental and climate change issues fully, the time and resource pressures in the workplace does not permit environmental issues and climate change to be a high priority and that other KPIs tend to trump climate change issues, for example, in the Distribution Division, technical and safety training for employees, not climate change-related training, is a priority.

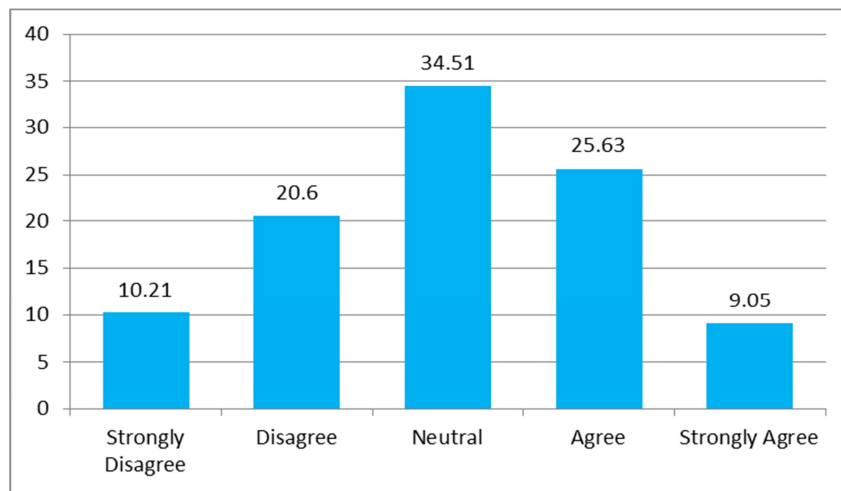


Figure 5.27: Respondents' view that 'most employees are involved in the Distribution Division's Environmental Management Programmes or Activities' (n=597, in %)

Additionally, the general findings of this study indicate that:

- the inequality in climate change actions by people (Gifford, 2015), for example, the highest paid Distribution Division employees such as the Group Executive, GM and Corporate Specialist were the majority that chose paying higher prices for energy from wind and solar, while the lowest paid respondents, namely, those in the T04-T08 grades, were the minority who opted for this pro-climate change action.
- the differing objectives of individuals and groups (Kazemi and Eek, 2008), for example, respondents' priorities for society were diverse and no distinct trend could be observed for any particular priority which influences the objectives of

individuals, namely, 14.88% identified career or job or employment, while 14.19% identified education and 12.09% identified safety and crime as the most important issues for society presently.

- climate change actions are not considered a high priority (Lee *et al.*, 2015a), as opposed to other concerns such as career and finance; Distribution Division employees rated career or job or employment and education as a high priority for society, whereas environmental issues were only ranked 6th.
- there is a lack of effective and meaningful climate change learning interventions in the Distribution Division.

Changing attitudes, knowledge and skills of employees will ensure innovative solutions to problems, and greater involvement of employees (Elnaga and Imran, 2013). Respondents' non-involvement in the environmental management programmes and activities of the Distribution Division provides further motivation for the dire need of climate change learning interventions in the Distribution Division.

5.7 Conclusion

This chapter presented the analysis and discussion of the results collected from the online survey questionnaire, the key informant interviews and the focus group discussions that were conducted. The discussion integrated the relevant literature and incorporated spatial data. There were some parallels and variances between the survey results, the key informant interviewees, the focus group participants and the literature reviewed. The findings were also considered against the theoretical frameworks of sustainability, stakeholder engagement, organisational learning such as the Theory of Planned Behaviour, the Norm Activation Model and the Value-Belief-Norm Theory of Environmentalism and Climate Change Adaptation Theory, as it is clear that attitudes, values, beliefs, motivation and the ability to adapt to climate change are key ingredients for pro-climate change actions.

The demographic profile of this study reflects a very technical and male-dominated electricity utility in the South African business landscape. The findings clearly reveal that education and safety or crime is priority for society presently; most people believe that every individual can take pro-climate change actions such as reducing waste and planting trees to reduce their

contributions to climate change; while local, provincial and national government were responsible for taking actions on climate change, these organs of state are not trusted; scientific reports are trusted as a reliable source of information on climate change, but most obtain climate change information currently from environmental groups, for example, WESSA; talks by experts and pictures of what an area could look like in future is the preferred format for climate change information; the Distribution Division does have an impact on the environment, contributes to climate change but that climate change will also impact on the Distribution Division; the Distribution Division is not doing enough to address climate change and employees are not involved in the Distribution Division's environmental management programmes or activities. Chapter Six provides the summary and the recommendations emanating from this research endeavour.

CHAPTER SIX

SUMMARY OF RESULTS, RECOMMENDATIONS AND CONCLUSION

6.1 Introduction

There are some initiatives in the Distribution Division to address environmental challenges and climate change at the employee level (Eskom, 2015g). However, the relevance, appropriateness or effectiveness of such initiatives in changing behaviour patterns, especially relating to climate change learning, has not, from the review of the Eskom literature, been determined. According to Lotz-Sisitka and Olvitt (2010), workplace-based environmental education and training in South Africa has been keenly reviewed since the promulgation of the NEMA, especially as this area of environmental training has been largely overlooked in the past. Additionally, emerging issues in society, such as increased environmental degradation, increased health risks and new social and economic challenges which are all related to climate change, are being addressed via the South African National Qualifications Framework which has initiated innovative programmes to address these issues. Lotz-Sisitka *et al.* (2016) contend that in order for effective sustainability learning and to ensure compliance to the range of environmental laws and standards, abilities, knowledge and skills are required in areas such as environmental issues, planning and administration, environmental legislation, communications, social justice or ethics, education and training as well as monitoring, evaluation and research. As this study has shown the Distribution Division has responded with many general environmental capacity building (training and awareness) programmes to meet minimum legal requirements to the range of environmental legislation in South Africa. The lack of climate change learning initiatives is exacerbated by the general lack of understanding of climate change and its impacts by the majority of employees and the lack of trained and competent climate change internal training service providers, as revealed in this study.

This particular research involved a critique of the Distribution Division's response as well as the internal capacity building around climate change and environmental management towards responsible environmental behaviour of employees. The overall aim critically examined the Distribution Division's CSI programme with a specific focus on climate change and the programmes to modify internal behaviour. The intention was also to develop a framework

and programme to address electricity utility-specific climate change and environmental challenges systematically.

Given the aforementioned background and the dearth of studies that critically examined climate change learning and pro-climate change behaviour in electricity distribution utilities, this study undertook an incisive examination of employees' behaviour and responses to the climate and environmental challenges in Africa's foremost electricity distributor, the Distribution Division of Eskom Holdings Company.

Chapter Two of this research provided the relevant theoretical contexts drawing from sustainability science, stakeholder engagement, organisational learning and climate change adaptation theories. The chapter also reflected on some of the barriers to climate change learning and behaviour. Consequently, the Distribution Division is constrained in its climate change learning initiatives, which has far reaching implications for addressing climate change within the organisation and broadly in society.

In Chapter Three, a review of the existing literature was undertaken that covered such issues as climate change, climate change instruments and institutions, climate change in South Africa, industry and climate change, electricity and climate change, the Distribution Division and climate change, and climate change and learning. From the literature reviewed, it was clearly evident that humans play a significant role to the contribution of global GHGs and therefore humans are also pivotal in addressing climate change.

Chapter Four described the research methodologies and approaches used in this study which included both quantitative and qualitative techniques. The key quantitative technique employed in this research is the use of the online survey questionnaire that was undertaken in all nine Distribution Division OUs to collect the primary data. Qualitative approaches such as the focus group discussions and key informant interviews were also utilised to triangulate findings.

Chapter Five details the methodology used to analyse and interpret the data collected. Statistical analysis using SPSS was used to identify correlations and reliability of the data, while graphs and tables were generated to identify key results and learnings from the research. The outcomes of the research were also integrated with relevant literature to support

or challenge the findings of existing and available literature on climate change learning in business. This chapter concludes the study with a restatement of the hypothesis, a summary of the main points and findings of this research, explanations for the findings; the limitations of the study, implications of the findings for the broader knowledge base and recommendations for future research and practical applications.

6.2 Summary of the key research findings

The main findings of the research are summarised in relation to the objectives presented in Chapter One. The summary clearly indicates that the objectives were achieved and the research questions that emanated from the objectives (presented in Chapter Four) were addressed.

6.2.1 Demographic profile of the respondents

The majority of the respondents were from the NWOU. Employees in the M&O department responded the most to this survey and most respondents had a diploma or certificate as their highest level of education. In this study, the majority of respondents were between 31-40 years old. This indicates that the survey results are from an educated and mature sample of employees. The response from this age group can also be seen to align with Morrison and Beer (2016) who claimed that middle-aged consumers are most environmentally conscious.

Male respondents were the majority that participated in this survey, although the number of female responses was a higher percentage of the total female population in the Distribution Division than for male employees (Eskom, 2016a). The larger percentage of responses from females is broadly in line with Ortega-Egea *et al.* (2014) who maintained that women are significantly more environmentally concerned than men.

6.2.2 Employees attitudes to life and environmental issues

The findings clearly revealed that what employees thought was important for society, such as a career or job, education, safety or crime and health is indicative of current concerns personally experienced by all citizens in a transforming country with many historical challenges. Besides identifying the financial situation (which is likely due to the current global financial recession), employees also indicated similar priorities for industry or

business such as career or job, safety or crime and education. There was also some alignment with what employees considered important for both society and for business.

The environmental issues employees are most concerned about are water pollution (contamination of rivers and sea), followed by extreme weather conditions, for example, floods, droughts and land pollution (waste and litter). Given that there is a current water shortage and restrictions in the country, it is not unusual for employees to rate water pollution as the environmental issue that they are most concerned about. Moreover, these concerns are mirrored in what respondents thought was also important for the well-being of global society, namely, water pollution and land pollution. Employees' level of climate change understanding was fair, although not sufficient to promote widespread pro-climate change behaviour as required in the Norm Activation Model to trigger appropriate behavioural response. Employees are also much to very much concerned about climate change. The concern expressed is further strengthened by the indication that employees understood the main causes of climate change such as emissions from industry or factories, deforestation (cutting of trees or forests), energy generation from fossil fuels (coal, oil and gas), emissions from vehicles and waste disposal. Most employees have noticed changes in their local environment that indicate that the climate is changing such as hotter summers and water shortages. Employees also understood that Asia and North America contributed the most to climate change, although the majority did not know which continent was most responsible for climate change. The majority of respondents were also aware that Africa and Antarctica will be most affected by the impacts of climate change. Furthermore, employees also acknowledged that climate change is a current issue affecting South Africa.

6.2.3 Employees choices for responding to climate change

Interestingly the majority of employees chose the planting of trees as the main option to reduce climate change. Second and third behavioural choices for pro-climate change behaviour was recycling waste (paper or glass) and using more energy efficient appliances. These issues have not been a focus of the Distribution Division's environmental programmes in the past and therefore represent a new and interesting approach to climate change learning in the Distribution Division. Furthermore, most employees believed that South Africa is not doing enough to reduce climate change and most suggested that more needs to be done concerning education and awareness of climate change at school, government and business level.

One of the key recommendations of Eskom's Climate Change Strategy Review (Eskom, 2010a), was that the organisation needed to undertake internal awareness raising sessions initially for managers and committees as well as staff involved in project approvals and more broadly in the organisation. This study has revealed that those proposed internal awareness sessions have not been done nor are there plans in place to implement the aforementioned recommendation of the strategy review.

6.2.4 Responsibility for climate change actions

There was no clear indication of whom employees thought was responsible for making any changes to lessen the impacts of climate change as they regarded business and all levels of government to be more or less equally responsible. Employees in this study also believed that individuals had a big role to play in addressing climate change. Grave concerns were also expressed about weather-related issues such as floods, droughts, extreme weather events and heat waves. Although employees were not sure who is responsible for making changes, they clearly did not trust government to make such changes, but indicated that themselves, an environmental organisation, and even Eskom were more trustworthy to make the changes needed to lessen the impacts of climate change. Employees also considered scientific reports, Eskom and the UN as the sources of reliable climate change information. However, most employees currently receive such information from environmental groups, such as WESSA, television programmes, for example, National Geographic, and the internet.

The Distribution Division has tried various approaches to environmental learning over the years, through many short courses (Eskom, 2012b). However, the majority of employees in this study provided some radical and unusual options of how they preferred to learn more about climate change, such as graphs of future trends, talks by experts and pictures of what an area could look like in the future. 'talks by experts' and 'pictures of what an area could look like in the future' are the format of climate change information for the Distribution Division employees. However, these formats for environmental learning in the Distribution Division have not been considered or used. These choices identified by employees will require novel, radical and innovative thinking from the Distribution Division to incorporate such new approaches to climate change learning.

6.2.5 The Distribution Division's climate change programme and environmental strategies

Employees acknowledge that the Distribution Division activities have an impact on the environment and also understand that climate change will affect the organisation. Of concern though is that employees indicated that the Distribution Division activities contribute to climate change, although the Distribution Division core activities do not emit GHGs and there is no documented evidence that the distribution of electricity and the associated activities contribute to climate change. Employees were also of the view that the Distribution Division had good environmental management strategies that look after the environment. Employees' indication of being aware of the work the Distribution Division was doing to address climate change and claimed they supported the climate change goals in the organisation was also flawed, as there are no such initiatives in the Distribution Division currently. The majority of employees were not sure if the organisation was doing enough to address climate change but are of the view that employees were involved in the Distribution Division's environmental management programmes and activities.

According to Eskom (2012a), the organisation recognises the need to align its CSI activities to that of its business strategies and the communities where the Distribution Division operates. This study attempted to contribute to make the CSI programme in the Distribution Division more relevant and meaningful in the context of climate change learning and environmental management within the organisation, but to also in the hope that such learning would be carried over to society at large by the great number of employees in the Distribution Division.

6.3 Recommendations emanating from the study

This section highlights and expands on some of the more important recommendations emanating from this research. Again, the discussion is guided by the research objectives of the study, the survey questionnaire, the key informant interviews and the focus group discussions.

6.3.1 The level of the Distribution Division's climate change programme

While most employees claimed to be aware of the various climate change initiatives in the Distribution Division, this is problematic as this study has demonstrated that there are no

climate change programmes in the Distribution Division currently (Eskom 2012b; Eskom, 2013a). The response is indicative of employee bias or a case of what Moser (2016) terms the response of dutiful or obedient employees. It is, however, important that employees understand and respond to climate change for a more positive outcome (Begum and Pereira, 2015; Lee *et al.*, 2015b).

Consequently, there is a need to:

- Make climate change communiques simpler using images as well as more balanced approaches (Karahan and Roehrig, 2015); it is imperative that the preferences of the majority, namely, ‘talks by experts’, ‘short courses (1 day or less)’ and ‘pictures of what an area could look like in future’ be implemented, to ensure that the climate change communication is embraced and accepted better by the majority. This is underscored by Carrico *et al.* (2015) who suggest that visual communication methods that portray the future of climate change impacts could be a powerful tool for motivating behaviour change. Additionally, the source of climate change information for employees must come from scientific reports, Eskom, the UN and NGOs or civil society as these were identified as the most reliable sources of climate change information. There is therefore a great responsibility on the Distribution Division to ensure that its leaders and the climate change learning trainers have a good understanding of climate change to be able to provide employees with credible and useful information.
- Make climate change initiatives more practical and, according to Aune *et al.* (2016) and Fernandez *et al.* (2016), attractive, convincing, relevant and part of the normal routine or habit of daily life. Programmes to plant trees, recycle waste (paper and glass) and provision of energy efficient appliances must be implemented, as these were the best options selected by the majority of respondents in this study to reduce their contributions to climate change.

Sustaining climate change learning initiatives over a longer period of time and not for a limited period, for example, by issuing short e-mails at regular intervals throughout the year, was one of the top five preferences for climate change information by respondents in this study and supports Scheele (2015) who recommended that climate-change communications be approached in the same way as brand communications. Furthermore, it is understood that

most people tend to rely on smart phones, tablets, the internet or other ICT for information, learning and entertainment (Colbert *et al.*, 2016).

6.3.2 The Distribution Division's environmental strategies and practices

More than 60% of the respondents indicated that the Distribution Division activities have an impact on the environment. Some of the Distribution Division impacts include the loss of indigenous and protected trees and plants, pollution and damage to wetlands, streams, rivers, and heritage sites or artefacts, and the injury or mortality of birds from collisions or electrocutions from the construction, operations and maintenance of the Distribution Division powerlines. This awareness and knowledge of respondents is a good start, as Masud *et al.* (2016) are of the view that knowledge and understanding, regarding climate change and the environment are fundamental to individuals' willingness to respond to climate change.

6.3.3 Staff perceptions and attitudes towards climate change

This study indicated that the extent and levels of climate change awareness and involvement of employees varies across the Distribution Division. Most understood the basics of climate change and the need to respond to the climate change challenge, while there were isolated responses that indicated an ignorance of some of the key climate change issues. Of greater concern though was the employee bias or misunderstanding between environmental management issues and climate change in the Distribution Division as well as that the majority of respondents indicated that they are aware and contribute to a climate change programme in the Distribution Division, which is non-existent. It is therefore necessary for all employees to understand why certain activities have detrimental effects on the climate and how it will affect their lives and the business. The responses from employees provides the basis for the need of climate change learning interventions in the Distribution Division and that takes into consideration the following:

- climate change experts be invited to address employees, as this was the main preference of format for climate change information by the majority of respondents and, according to Ziervogel *et al.* (2014), the lack of expertise is one of the major barriers that hinders effective climate change action.
- interesting and vibrant climate change seminars and workshops be arranged for employees.

- an interactive computer display, such as an e-learning programme for climate change learning be developed and rolled out to employees at the appropriate level.
- an intranet page specifically with pertinent climate change information for employees to access and learn more about climate change at their own pace.
- employee values, habits, emotions and beliefs.
- appropriate and relevant climate change posters and leaflets be made available to employees at various offices or sites.
- leadership to undertake and showcase pro-climate change actions, similar to the recent energy efficiency initiatives in their own homes.
- employees be consulted and involved when internal climate change programmes are developed so that their views are incorporated in developing climate change learning interventions.

Furthermore, it recommended that graphs of future trends, pictures of what an area could look like in the future, relevant, recent and interesting videos, and local and personal examples of climate change impacts experienced by employees be made part of talks by experts, the seminars and workshops and the interactive computer displays.

6.3.4 The challenges and opportunities presented by the environmental and climate change crisis for business in South Africa and for electricity utilities in Africa

Some of the challenges emanating from this study are that:

- Most employees are resilient to change due to existing habits, beliefs and practices. Additionally, current employee values, beliefs and habits are not aligned to climate change learning and hence many employees are unable to internalise pro-climate change actions and respond appropriately.
- Increasing the profile of climate change learning in large organisations such as the Distribution Division is difficult due to other more pressing business priorities such as technical and financial drivers.
- Financial resources for climate change programmes may not be readily available, due to the current economic climate and the existing financial constraints in the Distribution Division.
- there are huge logistical challenges in rolling out an effective climate change programme across large, organisations such the Distribution Division, which has

widely dispersed offices, for example, CNCs including in remote areas and the different levels of internet access and capacity that exist in such an organisation.

Recommendations to address the above-mentioned challenges include:

- pro-climate change behaviours should be made normal and routine, as suggested by Gifford (2015);
- incorporate employees' values and habits into climate change learning interventions;
- consider climate change learning in different and new ways, as Allen (2016) and Elnaga and Imran (2013) assert that changing attitudes, knowledge and skills of employees requires innovative solutions to problems;
- climate change issues must be integrated into business strategy and planning due to the risks to infrastructure, customer services and reputation, as the impacts of climate change has financial and technical implications;
- Undertake a carbon footprint of the Distribution Division to better understand the contribution of the Distribution Division to climate change;
- Undertake further research to compare the climate change behaviour of affluent employees across Eskom's Generation and Transmission Divisions, as well as the different sectors of South African economic landscape such as in the water, transportation, telecommunication and mining sectors; and
- use social media platforms and ICT, such as climate change e-learning, to reach employees spread across the Distribution Division.

6.3.5 Framework for internal climate change capacity building programmes for electricity utilities

Eskom's climate change initiatives are relatively recent and unique which has focused primarily on applications and markets for energy efficiency and renewable energy technologies (Eskom, 2015c). Additionally, the only climate change indicator used in Eskom is the annual emissions (in million tons) of CO₂ which, as reported earlier in this study, is worryingly increasing with each year. Arnott *et al.* (2016) are of the view that while efficiency and renewable energy projects do a reasonable job of specifying project-specific performance indicators during the project design and approval process, these indicators tend to measure separate project activities or their direct outputs rather than the outcomes and the attainment of broader objectives. Furthermore, such performance indicators are sometimes

not readily measurable or, if measurable, are lacking documentation as to when, how, or indeed whether the indicators have been measured.

According to Arnott *et al.* (2016) and Kabisch *et al.* (2016), performance indicators are qualitative or quantitative measures, used to reflect progress toward achievement of objectives, whereas Liu *et al.* (2016) are of the view that sustainability indicators measure broad physical, economic, energy and environmental factors at a macro-level. From this study, it emerged that there is a need for a framework for internal climate change capacity building programmes with relevant indicators (Table 6.1) for the Distribution Division and similar utilities. There is a need to go beyond the results from individual projects and look at overall climate change and environmental performance, particularly at the employee awareness level. A robust climate change capacity building framework will enable the Distribution Division to effectively implement Eskom's Global Climate Change Policy (Eskom, 2011a), support the UN SDGs and improve overall environmental and climate change ethic and behaviour of its employees and ultimately reduce the contribution of the Distribution Division to climate change.

As demonstrated in this study, climate change has far reaching implications for human populations, ecosystem services, business and infrastructure. Additionally, it is evident that climate change learning, particularly for business will play a significant role in addressing this global crisis. Ika and Donnelly (2017) indicate that capacity building is defined as a process that improves the ability of a person, group, organisation or system to meet its objectives or to perform better, and is a multi-dimensional and dynamic process that should lead to an improvement in performance at each level and contribute to sustainability. Additionally, external environments also influence capacity building. However, climate change learning is relatively non-existent in business. It is therefore crucial to develop a suite of indicators of climate change learning, to monitor and quantify the effectiveness of such interventions, and to ensure a meaningful contribution to pro-climate change actions on the part of business and its employees. An effective framework to facilitate the development of suitable indicators is by using the SMART principles (Dawson, *et al.* 2016b).

These indicators will cover the two key objectives emanating from this study, namely,

- Build the climate change capacity of employees; and

- Minimise business and individual GHG emissions.

It is important to also demonstrate progress on some of the above-mentioned indicators, for example, a site specific climate change dashboard that tracks progress of the indicators. Additionally, achievement of targets needs to be linked to financial incentives, for example, integrated into employee performance management system and incentive scheme or through establishment of an annual climate change award that recognises achievement of the agreed targets.

To realise any objectives of a programme, policy or project, Ika and Donnelly (2017) assert that resources and adequate capacity to use those resources effectively is required. Moreover, capacity building is considered vital for sustaining behaviour and reducing reliance on external assistance. Based on the responses from the survey questionnaire, the feedback from the key informant interviews and the focus group discussions, the following framework for internal climate change capacity building programmes for electricity utility companies is proposed:

(a) Purpose

The purpose of a climate change capacity building framework is to enhance the capacity and ability of employees to take effective climate change action, including the implementation of adaptation and mitigation actions, and to enable employees to provide meaningful input to climate change proposals at the organisational and country level. In developing these indicators (Table 6.1), it must be ensured that the indicators cover all the key issues in this research, make a meaningful impact to the findings, is sustainable and can be replicated.

(b) Guiding principles for the climate change capacity building programme

- (i) Management needs to commit resources such as financial, staff and time to the programme to ensure commitment to its success as Jabbour *et al.* (2015) point out that the support and involvement of senior management is crucial.
- (ii) All stakeholders must be involved in the planning and implementation phases, as listening to stakeholder needs and perspectives, according to Klenk *et al.* (2015), improves the response to climate change. Additionally, Brügger *et al.* (2015) and Shi *et al.* (2015) suggested that at the individual or cognitive level, people's willingness to

adapt to climate change is determined by their knowledge, understanding, beliefs and attitudes regarding climate change and the environment.

- (iii) Practical and cost-effective climate change action which can be realistically implemented by employees or those within employees' sphere of influence must be proposed, in support of Meadow *et al.* (2015) who indicated that climate change initiatives that are linked to more familiar issues tend to work best.
- (iv) Climate change learning goals must be measureable, reported on, independently verified, and evaluated through the established of a set of KPIs for monthly or quarterly performance monitoring.
- (vi) The outcomes and results of this study should be used and expanded up for the development of such a climate change learning programme.

(c) Objective

After the climate change learning programme, employees should:

- (i) understand the science of climate change better;
- (ii) appreciate their (and the human) contribution to climate change;
- (iii) be able to undertake simple pro-climate change actions in their work and home activities routinely;
- (iv) be able to meaningfully influence company and country climate change policies and initiatives; and
- (v) take actions to reduce their individual contributions to climate change.

(d) Scope

The climate change capacity building programme should be for all employees across the organisation, from senior managers to lower level employees, and tailored (in terms of duration and content) for these specific internal stakeholders as Ziervogel and Taylor (2008) were of the view that stakeholders respond to climate change according to their particular experiences and priorities, due to their different views on climate change.

(e) Implementation of the climate change capacity building programme

(i) Responsibilities

There needs to be mutual commitment by the business and employees to this programme. Facilitators of the climate change capacity building programmes must

become content experts as well as gain a good understanding of the business and its operations.

(ii) Finance and operation

Business leaders must ensure that critical resources, such as a budget, staff, time and appropriate material are available for roll out of the programme.

(iii) Timeframe

The programme should be run over a twenty four month period with periodic reviews, as well quarterly monitoring for progress on targets. Refresher interventions should be introduced when and if required.

(iv) Indicators (Table 6.1)

KPIs have been developed for the twin of objectives of building the climate change capacity of employees and minimising business and individual GHG emissions, which includes recommended targets and the expected outcomes.

(f) Review

At the end of the two year period, the programme should be evaluated for its suitability, adequacy and effectiveness and to identify areas for improvement for future climate change learning programmes in the organisation. There is a dearth of evidence or literature on which elements of capacity are critical to climate change learning. Hence, the indicators (Table 6.1) suggested in this study to assess climate change capacity building requires further study and research.

6.3.6 Policy and programme recommendations

The current climate change research, notably the findings of the IPCC, indicate that it is very likely that the planet will experience a climate or resource shock in the coming years, where natural disasters will cause massive environmental and economic damage. Responding appropriately to climate change, especially in the area of climate change learning and awareness, is pivotal although fraught with challenges. This study has provided some definitive guidelines on how best to enhance climate change learning in the Distribution Division. Business needs to elevate climate change as a business priority and accelerate business-wide discourse and action by increasing employee understanding, acceptance and support.

Table 6.1: Illustrative indicators of climate change capacity building (adapted from Brown *et al.*, 2001: 28)

Objective 1: Build the climate change capacity of employees			
Action	KPI	Target Per Year	Output
Develop and roll out climate change learning interventions	Number of climate change talks by experts	Two	Aware and trained employees; Learnings used to promote pro-climate change actions
	Number of climate change short courses	Three	
	Number of climate change communiques issued in the business	Four	
	Number of sites with climate change-related posters	50% of all sites	
Objective 2: Minimise business and individual GHG emissions			
Action	KPI	Target Per Year	Outcome
Pro-climate change actions	Number of employees who have planted a tree (privately or through the business)	20% of employees	Reduction in GHG emissions from business activities and individuals
	Number of recycle centres established in the business	80% of all offices	
	Energy efficiency requirement for the purchase of appliances or equipment	100% of all contracts or goods purchased outside contracts	
	Reduction in electricity consumption at main offices	5% reduction of previous year's electricity consumption	

Some key policy and programme recommendations emanating from this study are for business to:

- Prioritise actions to enhance climate change learning and strengthen training systems within the organisation;
- Ensure that climate change learning is linked to and helps to achieve organisational objectives including climate change mitigation and adaptation;

- Identify gaps and help mobilise resources for climate change learning interventions from organisation budget;
 - Support the creation of a sustainable human resource base to address climate change learning;
 - Integrate environmental and climate change issues into all activities in the business to ensure sustainable outcomes;
 - Build the capacity of managers with regular climate change interventions or refresher courses, especially from experts in the field, to enhance their commitment and ability to ensure meaningful leadership on climate change;
 - Identify climate change champions at each OU and support their capacity development, to act as role models for driving the climate change agenda, given that climate change is only now being embraced as a relatively new risk for business and there is still widespread apathy and lack of understanding about the problem amongst most managers and employees;
 - Promote networking, cooperation and coordination among all internal and external climate change stakeholders of relevance to the business;
 - Build the climate change capacity of employees through appropriate climate change learning interventions;
 - Develop a comprehensive and focused climate change training plan that caters for all levels of employees taking into consideration grade, level of education and departments in which employees work;
 - Make the links between climate change and energy use, waste management, poverty, gender and health in the climate change learning interventions;
 - Consider an alternative term to climate change, as using climate change tends to often be equated with environmental issues and hence erroneously considered not applicable to everyone; there is a need to breakdown climate change in terms of locally-relevant terminology, even using indigenous words;
 - Promote pro-climate change behaviour at the workplace and at home;
 - Establish a partnership with an external organisation, for example, Trees for Africa, to work with employees to plant a substantial number of trees throughout the business;
- and

- Establish partnerships with local stakeholders such as WESSA, scientific bodies and tertiary institutions to ensure that climate change programmes are based on science and credible information.

Climate change will impact negatively on environmental, social and economic sustainability (Coleman *et al.*, 2017) which will consequently affect the achievement of the SDGs. Climate change learning, as proposed in this study, will create a greater awareness and also motivate the necessary response to limit climate change. It is also imperative that businesses implement stakeholder engagement theory with all relevant internal and external stakeholders to understand the various barriers to climate change learning and to also ensure that climate change learning initiatives are accepted and relevant. Key organisational learning theories such as the Theory of Planned Behaviour, the Norm Activation Model and the Value-Belief-Norm Theory of Environmentalism must be the conceptual frameworks on which any climate change learning initiative must be based to ensure the effectiveness of the initiatives. Another important factor to be considered for climate change learning is the varying degree of adaptive capacity of people. Additionally, adaptation to the impacts of climate cannot be ignored, while simultaneously attempting to mitigate the increasing amount of GHGs emitted into the atmosphere through a mass behavioural change as proposed in this study.

6.4 Limitations

Despite the best efforts of the researcher in this study, the following were identified as some of the limitations of this research:

- Due to time constraints, and financial and access challenges, it was not possible for the researcher to make comparisons with other Divisions in Eskom or with similar utilities in Africa or in the world.
- Of the 15 765 employees in the Distribution Division it is likely that less than 6 000 were actually exposed to the survey, due to computer literacy and access challenges, especially for lower level employees in the Distribution Division.
- Employees could have completed the survey incorrectly or did not fill in some sections adequately due to the varied interpretation or understanding of the respondents and no assistance was provided to any of the respondents in the completion of the questionnaire.

- Learning about climate change is multifaceted and not only occurs in the office environment (Ballantyne, 2016). School education, lifelong learning and community learning were not considered explicitly in this research. This issue is especially relevant in the South African context, as different employees were exposed to different systems and quality of education due to historical reasons, particularly in the environmental education space.
- Environmental and climate change training is not regarded as statutory and core critical training currently in the Distribution Division as compared to technical and safety training. Hence, the climate change awareness and knowledge of the employees differs vastly, which likely affected the responses to the survey questionnaire.
- Attendance at the focus group discussions discussions was entirely voluntary and no compensation offered for time and travel costs of participants which contributed to a low level of attendance of participants from outside the Distribution Division.

The recommendations emanating from this research may not be implemented or tested within a short time, due to time and cost implications. This, therefore, provides the basis for additional research in this area.

6.5 Concluding remarks

Climate change is likely to have a strategic impact on growth, survival and performance of businesses across a wide range of organisations and is more likely to affect activities that form the core business such as the electricity distribution industry. The impact of climate change is multi-faceted for business as it involves responding to the impacts of climate change on business infrastructure, services, products and customers, as well as complying with a range of climate change-related regulations.

This study focused specifically on climate change learning in the Distribution Division of the Eskom Holdings Company. It is important that further studies be conducted to compare the climate change learning in the Distribution Division or Eskom wide with the climate change learning of employees in other industry or with other business or with distribution electricity utilities in other parts of the world, as all these constituencies have a vital role to play in responding to climate change.

According to Bagozzi (2015), although the IPCC reports are a collection of scientific consensus, much of this scientific evidence contained therein is watered down during the various political negotiations, as sensitive climate change challenges for governments often gets taken off or diluted by country representatives. This therefore has a negative impact on the climate change response required from governments, as evidenced by the very slow progress in reducing GHGs since the Kyoto Protocol of 1997 (UN, 2015). Since most governments are lagging in their actions, it therefore becomes imperative to mobilise citizens to respond to climate change for two main reasons, namely:

- Citizens, as consumers, have a significant role to play in reducing global warming (Clarke, *et al.* 2007; Spaargaren and Mol, 2008; Giddens, 1991); and
- Citizens, as key stakeholders play an important role in influencing governments (Barr, *et al.*, 2011a).

However, citizen actions can only be done through improved and innovative climate change learning.

The conceptual framework used in this study contributes substantially to a greater understanding of climate change learning particularly in the electricity distribution industry. This research supports the findings of other scholars who indicated that climate change learning and response is generally poor amongst most people, including workers and that there are some specific interventions that are required to enhance climate change learning in the work environment. A range of innovative options must be considered with the involvement of all relevant stakeholders to find practical and meaningful options for climate change learning and response. This thesis has indicated that there are numerous challenges for mobilising citizens, especially employees in large businesses, to respond to the climate change challenges. However, this research has also provided some direction on what and how climate change learning must take place in order to ensure an effective and sustainable response to the global climate change crisis.

Technology, global agreements or government policies on climate change are not likely to be the panacea to the climate change crisis. Such approaches are fraught with problems and challenges, as indicative of the continued rise in GHGs in spite of all of the global initiatives over the past twenty-five years. There is a need to develop appropriate climate change learning programmes for business and ensure that these are fully implemented to respond to

the climate change crisis. Employee access to relevant and reliable information, scientific reports and technical and managerial competence is vital for an effective climate change learning programme across the organisation. Depending on the different level of employees and departments, specific strategic actions can be taken to improve learning on the issues of climate change, aligned to the theories of organisational learning, while at the same time strengthening the capacity of business. Climate change is manifested in environmental degradation, floods, droughts, dwindling forests and dying animals and this is how most people view climate change. However, climate change contributes to increasing poverty, affects human health and has serious implications for businesses, infrastructural developments, the economy and national security. Climate change must therefore not be viewed as an environmental issue but as human rights, developmental, safety and health issues. Rebranding climate change will contribute to gaining traction of this serious issue especially with employees in large organisations who have generally not been aware or involved in climate change issues. A better term perhaps is human survival.

In order to ensure a robust response to human survival adaptation and mitigation, the need for training and capacity building of employees must be pursued with a new zeal and paradigm shift from the business as usual scenario. Failure to do so, will lead to irreversible damage to the planet that will compromise the long-term sustainability of a business, as well as severely threaten the survival of humans on planet Earth.

We may not be able to solve the problems of human survival soon, or reach all the sectors that must respond to the human survival challenge, but this study aims to contribute towards minimising the impacts of employees in a large organisation and guiding employees to make pro-human survival decisions under their sphere of influence, through an increased awareness and behaviour modifications. To do this, we need a shift in consumer behaviour and that means more and better human survival learning for this important sector of society, namely employees in business, such as an electricity utility, for example, the Distribution Division.

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APPENDICES

Appendix 1: Climate Change Learning Survey Questionnaire

Section A: Demographic profile of respondents

A1. Please indicate where you work:

- Western Cape Operating Unit
- Eastern Cape Operating Unit
- Free State Operating Unit
- Northern Cape Operating Unit
- North West Operating Unit
- KwaZulu-Natal Operating Unit
- Gauteng Operating Unit
- Mpumalanga Operating Unit
- Limpopo Operating Unit
- Distribution Head Office

A2. Please indicate your department:

- Asset Creation
- Operations & Maintenance
- Safety, Health, Environment, Quality and Security (SHEQS)
- Business Integration & Performance Management (BIPM)
- Industry Support
- General Manager's Office
- Distribution Executive's Office
- Business Partner (Human Resources, Finance, Commercial, Communications)

A3. Please indicate your band:

- SSE/EEE and above
- M17-M18
- P17-P18
- S17-S18
- M14-M16
- P14-P16
- G14-G16
- P11-13
- T11-T13
- T9-T10
- T4-T8A3
- Other

A4. Please indicate your highest level of education completed:

- Primary School
- Secondary School
- Diploma/Certificate
- Undergraduate degree
- Postgraduate degree
- Other

(specify):.....

A5. What is your age group (in years)?

- 18 - 20
- 20 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 65

A6. What is your gender?

- Female
- Male

Section B: Attitudes to life and environmental issues

- B1. (a) Which are the most important issues (top 5) for society at present?
 (b) Which do you think are the most important issues (top 5) for industry/business in general at the moment?

Please TICK the most important ones from the list below.

ISSUES	MOST IMPORTANT FOR SOCIETY	MOST IMPORTANT FOR INDUSTRY/BUSINESS
Career/job/employment		
Conflict and war		
Corruption		
Education		
Environmental issues		
Famine and hunger (food security)		
Financial situation		
Health		
Population growth		
Poverty		
Quality of life		
Safety and crime		
Other (specify)		

B2. Which are the most important environmental issues that you experience or impacts on your life at present?

Please TICK your answer on a scale ranging from 1 (not important at all) to 5 (very important) or Don't Know (DK)

ISSUES	1	2	3	4	5	DK
Air pollution (from factories and cars)						
Chopping down of trees/forests						
Extreme weather conditions, e.g. floods, droughts						
Fossil fuel use						
Genetically modified crops						
Hazardous waste (chemicals, radioactive, medical)						
Land pollution (waste, litter)						
Loss of wildlife (animals)						
Nuclear power						
Ozone depletion						
Pesticides and herbicides						
Poor farming practices						

Population explosion						
Poverty						
Traffic congestion						
Water pollution (contamination of rivers, sea)						
Other (specify)						

B3. **How important do you think the following environmental issues are for the well-being of global society in general?**

Please TICK your answer on a scale ranging from 1 (not important at all) to 5 (very important) or Don't Know (DK)

ISSUES	1	2	3	4	5	DK
Air pollution (from factories and cars)						
Chopping down of trees/forests						
Extreme weather conditions, e.g. floods, droughts						
Fossil fuel use						
Genetically modified crops						
Hazardous waste (chemicals, radioactive, medical)						
Land pollution (waste, litter)						
Loss of wildlife, e.g. rhinos						
Nuclear power						
Ozone depletion						
Pesticides and herbicides						
Poor farming practices						
Population explosion						
Poverty						
Traffic congestion						
Water pollution (contamination of rivers, sea)						
Other (specify)						

B4. **Please rate your level of understanding of climate change.**

Please TICK your answer on a scale ranging from 1 (nothing at all) to 5 (a lot) or Don't Know (DK)

1	2	3	4	5	DK
---	---	---	---	---	----

B5. **What do you think climate change is?** Please describe this in your own words.

.....

.....

B6. **Are you concerned about climate change at present?**

Please TICK your answer on a scale ranging from 1 (not much at all) to 5 (very much) or Don't Know (DK)

1	2	3	4	5	DK
---	---	---	---	---	----

B7. **If you are concerned about Climate Change, what are the main issues for you?**

.....

.....

B8. Which of the following do you believe are the main causes of climate change?

ISSUES	NO IMPACT	LITTLE IMPACT	SIGNIFICANT IMPACT
Changes in land-use			
Deforestation (cutting of trees/forests)			
Emissions from industry/factories			
Emissions from vehicles (cars, trucks, buses)			
Energy generation from fossil fuels (coal, oil, gas)			
Natural changes in climate			
Nuclear testing			
Ozone layer depletion from CFCs			
Volcanic eruptions			
Waste disposal			
Human consumption patterns			
Other (specify)			

B9. Have you noticed any changes in your area/community during the time that you have lived there, which may suggest that the climate is changing?

YES	NO	DON'T KNOW

B10. Which continent is likely to be most affected by Climate Change?

- Africa
- Antarctica
- Asia
- Australia
- Europe
- North America
- South America
- Don't know

B11. Which continent contributes the most to Climate Change?

- Antarctica
- Asia
- Australia
- Europe
- North America
- South America
- Don't know

B12. Which, if any, of the following have you noticed (relating to where you have lived) which may suggest that the climate is changing?

CHANGES	YES	NO	DON'T KNOW
Colder winters			
Cooler summers			
Hotter summers			
Milder winters			
More erosion			

More frequent violent weather			
More storms and floods			
Pattern of seasons			
Water shortages			
Other (specify)			

B13. **Do you believe that climate change will affect South Africa?**

YES	NO	DON'T KNOW

B14. **Climate change will affect South Africa.....**

NOW	IN THE FUTURE	DON'T KNOW

Section C. Options for managing climate change

C1. **Would you be prepared to change your behaviour to reduce your contribution to climate change in any of the following ways?**

ISSUES	YES	NO	SOMETIMES	ALWAYS	NOT APPLICABLE
Using renewable energy sources such as solar and wind					
Paying higher prices for energy from wind and solar					
Planting trees					
Recycling waste (paper, glass)					
Reducing air travel					
Reducing car travel					
Reducing waste disposal					
Using more energy efficient appliances					
Consuming less					
Changing eating/dietary patterns, e.g. less meat consumption					
Other (specify)					

C2. **Are you satisfied that our country is doing enough to reduce climate change?**

YES	NO	DON'T KNOW

C3. **If not, what more should be done?**

.....

Section D. Responsibility and trust

D1. Whom do you think should be responsible for making any changes to lessen the impacts of climate change?

Please TICK your answer on the scale from 1 (high responsibility) to 3 (no responsibility) or Don't Know (DK) below.

RESPONSIBILITY	HIGH RESPONSIBILITY (1)	SOME RESPONSIBILITY (2)	NO RESPONSIBILITY (3)	DON'T KNOW
Business and industry				
Environmental organisations				
Eskom				
Family/friends				
Individuals/citizens				
Local government				
Myself				
National government				
Provincial government				
United Nations				
NGOs/Civil Society Organisation				
Other (specify)				

D2. Please indicate how much you agree or disagree with the following statements about climate change by ticking one box on each row:

1: Strongly disagree 2: Disagree 3: Neutral 4: Agree 5: Strongly agree

NO.	RESPONSIBILITY	Strongly disagree	Disagree	Neutral	Agree	Strongly disagree
1.	We can all do our bit to reduce the effects of climate change					
2.	Climate change will seriously affect our weather					
3.	I would only do my bit to reduce climate change if everyone else did as well					
4.	The government should provide incentives for people to look after the environment					
5.	It is already too late to do anything about climate change					
6.	Climate change is something that frightens me					
7.	I'm unclear whether climate change is really happening					
8.	Radical changes in society are needed to tackle climate change					
9.	People are too selfish to do anything about climate change					
10.	The evidence for climate change is untrustworthy					
11.	Claims that human activities are changing the climate are exaggerated					

D3. Whom would you trust in making any changes needed to lessen the impacts of climate change?

Please TICK your answer on the scale from 1 (Trust) to 3 (Don't Trust) or Don't Know.

RESPONSIBILITY	TRUST (1)	MAY TRUST (2)	DON'T TRUST (3)	DON'T KNOW
Business and industry				
Environmental organisations				
Eskom				
Family/friends				
Individuals/citizens				
Local government				
Myself				
National government				
Provincial government				
United Nations				
NGOs/Civil Society Organisations				
Other (specify)				

D4. Do you think that government policy-makers (informed by scientific experts) should decide which measures to adopt against climate change?

YES	NO	DON'T KNOW

D5. Do you think the public should be actively involved in deciding what should be done about climate change?

Please TICK the answer that best reflects your opinion.

Public should be consulted and actively involved	
Public should be consulted only	
Public should <u>not</u> be consulted	

D6. Whom would you trust most to give you reliable information on climate change?

Please TICK your answer on the scale from 1 (Trust) to 3 (Don't trust) or Don't Know below.

SOURCE OF INFORMATION	TRUST (1)	MAY TRUST (2)	DON'T TRUST (3)	DON'T KNOW
Business and industry reports				
Eskom				
Family/friends				
Government reports				
Media				
Scientific reports				
United Nations				
Work colleagues				
NGOs/Civil Society Organisations				
Other (specify)				

- D7. **Where do you get most of your current information on climate change from?**
Please TICK any that apply from the list below.

SOURCE OF INFORMATION	TICK
Environmental groups, e.g WESSA	
Eskom's Environmental Department	
Friends/family	
Government departments	
Internet	
Newspapers and magazines	
Public Libraries	
Radio	
School/university	
Specialist publications/academic journals	
Television programmes, e.g. National Geographic	
NGOs/Civil Society Organisations	
Other (specify)	

- D8. **In what format, if any, would you prefer to be provided with information on climate change from Eskom, to help you decide what you should do about it?**
Please TICK any that apply from the list below.

FORMAT OF INFORMATION	TICK
Graphs of future trends	
Interactive computer displays	
Internet pages, e.g OU webpage, showing different future outcomes	
More media coverage, e.g. articles in newspapers, TV.	
Pictures of what an area could look like in the future	
Posters and leaflets	
Regular e-mails	
Scientific reports	
Seminars and workshops	
Long courses (more than 1 day)	
Short courses (1 day or less)	
Talks by experts	
Other (specify)	

Section E: Eskom, Distribution's climate change programme and environmental strategies

Please rate your level of agreement with the following statements with regard to climate change in Distribution:
1: Strongly disagree 2: Disagree 3: Neutral 4: Agree 5: Strongly agree

NO.	RESPONSIBILITY	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	Distribution activities have no to little environmental impact					
2.	Climate Change has no impact (effect, damage) on Distribution					
3.	Distribution activities do not contribute to the climate change problem					
4.	Distribution has good environmental management strategies that looks after					

	our environment					
5.	I am aware of the work Distribution is doing to address climate change					
6.	I contribute to achieving Distribution's Climate Change goals in my work					
7.	Distribution is doing enough to address climate change					
8.	Most employees are involved in Distribution's environmental management programmes/activities					

Appendix 2: Key Informant Interview Guide

NAME:

POSITION:

DEPARTMENT:

ORGANISATION:

TEL.: CELL:

E-mail:

1. What is your understanding of climate change and its impacts?

.....

.....

What are the main causes/ drivers of climate change?

.....

.....

2. What are the most important issues facing society currently?

.....

.....

How does climate change and environmental considerations more generally relate to these issues?

.....

.....

3. What are the most important issues facing industry/ business currently

.....

.....

How does climate change and environmental considerations more generally relate to these issues?

.....

.....

4. How does climate change impact on industry/ business?
.....
.....

Specifically, what are the key aspects pertinent to Eskom?
.....
.....

5. Do you think that industry/ business generally and Eskom in particularly is responding to climate change challenges?
.....
.....

How can they improve their responses and what are they doing well?
.....
.....

6. In particular, how is Eskom attempting to change practices and behaviour in the workplace to respond to climate change?
.....
.....

Please can you provide details of specific plans, strategies, training interventions, etc. Also, please refer to the communication and information dissemination strategies that Eskom is embarking on to provide more information on climate change to the staff and general public.
.....
.....

7. What is the environmental ethic in a large company such as Eskom, Distribution?
.....
.....

8. Are you aware of Eskom's climate change programme and environmental strategies? If so, which are you aware of and can you comment on their effectiveness?
.....
.....

9. What are the challenges to changing workplace behaviour to reduce industry contribution to climate change?
.....
.....

10. What recommendations can you make to improve Eskom’s response, particularly to change staff behaviour?

.....
.....

What indicators can be developed to improve climate change capacity building in Electricity Distribution Utilities?

.....
.....

What recommendations can be made to Electricity Distribution Utilities to be more responsive to climate change and environmental management?

.....
.....

11. Who do you think should be responsible in Eskom for driving these changes?

.....
.....

12. Is South Africa’s electricity distribution industry responding appropriately to the looming climate change crisis?

.....

Appendix 3: Focus Group Interview Schedule

A. Background Information

1. Number of participants:
2. Date of interview:
3. Interviewer:
4. Note taker:
5. Interview start time:
6. Interview end time:

B. Knowledge about employees in Distribution

1. What is the total number of employees in Distribution and what is the approximate number of employees per OU?
2. Why did some OUs have better response rates to the climate change survey than others?
3. What are the possible reasons for some departments and task grades responding better than others?
4. What factors influenced the gender and age group of majority of the respondents?

C. Attitudes to life and environmental issues

1. Which are the most important issues (top 5) for society at present?
2. Which are the most important issues (top 5) for industry/business in general at the moment?
3. Which are the most important environmental issues that employees experience or impacts on their life at present?
4. What is employee's level of understanding of climate change and what is their own view of climate change?
5. Are employees concerned about climate change and what are their specific concerns?

D. Options for managing climate change

1. What would you be prepared to do personally to reduce your contribution to climate change?
2. What are employees' views on SA's climate change response?

E. Responsibility and trust

1. Who do employees think should be responsible for making any changes to lessen the impacts of climate change?
2. What are employee's views on a range of climate change actions?
3. Who do employees trust in making any changes needed to lessen the impacts of climate change?
4. What are employee's views on government policy-makers' (informed by scientific experts) decisions on which measures to adopt against climate change?
5. What is employee's view on public involvement decisions about climate change?
6. Who do employees trust most to give them reliable information on climate change?
7. Where do employees get most of their current climate change information from?
8. What are some good methods/ways that Eskom could use teach employees about climate change?

F. Eskom (Distribution's) climate change programme and environmental strategies

1. What are employees' levels of agreement on the climate change actions in Distribution?

G. Challenges facing Distribution

1. What are some of the challenges facing Distribution in initiating a climate change programme
2. What other issues are important for Distribution to consider regarding climate change?

THANK YOU FOR YOUR PARTICIPATION AND CONTRIBUTIONS

Appendix 4: Focus Group Discussions Participant Information and Consent

NAME (optional):

ORGANISATION/OU:

DEPARTMENT:

POSITION:

TASK LEVEL:

AGE:

GENDER:

You have been asked to participate in a focus group discussion relating to Climate Change Learning in Distribution, Eskom. The purpose of the group is to try and understand why there is a poor response to climate change by industry employees (and by extension, citizens) in spite of the evidence of climate change and to consider how climate change response in Distribution can be enhanced.

The information learned in the focus group discussions will be used to design a practical climate change programme for Distribution to ensure that the organisation makes meaningful contributions to pro-climate change behaviour.

You can choose whether or not to participate in the focus group and stop at any time. Although the focus group will be tape recorded, your responses will remain anonymous and no names will be mentioned in the final report. There are no right or wrong answers to the focus group questions. We want to hear many different viewpoints and would like to hear from everyone. We hope you can be honest and frank even when your responses may not be in agreement with the rest of the group. In respect for each other, we ask that only one individual speak at a time in the group and that responses made by all participants be kept confidential.

Thank you for your involvement and contributions to this important issue for industry, and in particular for a distribution electricity utility.

I understand and agree to participate fully under the conditions stated above:

Signed: _____ Date: _____

Appendix 5: Sample of TASK grade and related job titles in the Distribution Division

TASK Grades in Distribution	Typical Job Titles
SSE/EEE	Group Executive, General Manager, Corporate Specialist
M17 - M18	Zone Manager, Industry Support Manager
	Portfolio Programme Manager, Maintenance Support Manager
	Network Engineering Manager, Network Planning Manager
	Land Development Manager, Network Maintenance Manager
	SHEQS Manager
P17 - P18	Chief Engineer, Senior Professional, Chief Advisor
S17 - S18	Senior Specialist, Senior Consultant, Consultant
M14-M16	Senior Advisor Projects, Power Systems Manager,
	Occupational Health Manager, Security & Safety Manager
	Major Engineering Works (Construction) Manager,
	Project Manager, Senior Advisor Electrical, Network Maintenance
	Manager, Electrification Manager, Power Plant Maintenance
	Manager, Plant Sector Manager, Environmental Management
	Manager, Senior Advisor Technical Auditing, Network Sector
	Manager, Contracts Manager, Senior Advisor Business Strategy,
	Design Engineering Manager, Project Support Manager, Resource
	Management Manager, Technical Support Manager, Network
	Protection Manager, Senior Advisor Business Improvement,
	Land & Rights Manager, Control Plant Maintenance Manager;
Network Controlling Manager, Live Line Manager,	
P14 - P16 / G14 - 15	Senior Engineer, Senior Technologist, Senior Advisor
P11 - P13	Engineer, Professional, Advisor
T11 - T13	Engineer, CNC Senior Supervisors, Senior Technicians, Officer,
	Project Co-ordinator, Land Surveyor, Advisor
T9 - T10	Junior Technicians, Clerk of Works, Principal Technical Official
	Assistant Officer, Works Co-ordinator
T4 - T8	Administrative Support, Secretaries, Storekeeper
	Construction Official, Assistants to Technical Officials,
	Security Inspector