Trade & Industrial Policy Strategies (TIPS)
is a research organisation that facilitates policy development and dialogue across three focus areas: trade and industrial policy, inequality and economic inclusion,
and sustainable growth

info@tips.org.za
+27 12 433 9340
www.tips.org.za

Small Business Development in the Climate Change Adaptation Space in South Africa

Gaylor Montmasson-Clair
Shakespear Mudombi
Muhammed Patel

March 2019

ACKNOWLEDGEMENT

This research report was authored by Gaylor Montmasson-Clair, Shakespear Mudombi and Muhammed Patel from Trade & Industrial Policy Strategies (TIPS), a not-for-profit economic research organisation based in Pretoria, South Africa. It is complemented by six case studies on South Africa-based entrepreneurs active in the adaptation space: AB Farms, EWEF-SusTech, Isidima, Loo Afrique, MySmartFarm, and Waste Intrique. Case studies can be accessed on TIPS's website. The authors gracefully acknowledge the support and funding received from the Government of Flanders to conduct this research.

The authors would like to thank:

- Bulelwa Ntsendwana (EWEF-SusTech), Chantal Ramcharan-Kotze (Water Research Commission, South Africa), Chris Hopkins (Green Economy Coalition), Christine Meyer (SEED), Jane Reddick (GreenCape), Katrien Vandepladutse (Government of Flanders), Stuart Worsley (Green Economy Coalition) and Tasneem Essop (National Planning Commission, South Africa) for their feedback and comments at various stages of the research lifecycle;
- Delegates at the first regional workshop on "Development Policies for Sustainable Economic Growth in Southern Africa" organised by the UNCTAD and the Department of Trade and Industry of the Republic of South Africa, in Pretoria, South Africa, on 27-28 March 2017;
- Delegates who provided feedback on the preliminary findings presented at the Roundtable on Small Business Development in the Climate Change Adaptation Space, on 20 November 2018 at the Industrial Development Corporation (IDC) in Johannesburg, South Africa;
- Mogale Maleka and Tumelo Pule (AB Farms), Bulelwa Ntsendwana (EWEF-SusTech), Jonny Harris and Sabelo Domo (Isidima), Rori Mpete (Loo Afrique), Wolfgang von Loeper (MySmartFarm), and Tshego Mpete (Waste Intrique) for their warm welcome, availability, insight and comments on their respective case studies;
- Janet Wilhelm for the editing of the report; and
- Natasha du Plessis for the administrative support.

EXECUTIVE SUMMARY

Climate change is increasingly becoming the single most pressing challenge facing society in the 21st century. Climate change will have multiple negative effects on economic development, social progress and environmental sustainability in the next coming years. The degree of societies' resilience depends on the risks (their amplitude and timeframe and the probability that they occur) as well as the degree of vulnerability, i.e. the exposure and susceptibility to the risks, and the ability to withstand and recover from impacts.

South Africa is particularly vulnerable to climate change-related impacts. The country is expected to face serious water insecurity, as it is one of the driest countries. It has 2 798 km of coastline, which makes it vulnerable to sea-level rise. Its economy is heavily carbon- and energy-intensive, which further puts the country at risk of climate change response measures domestically and globally. The presence of these risks raises the urgency for adaptation to expected (and unexpected) impacts and presents an opportunity to improve the resilience of the economy, society and the environment.

Adaptation specifically serves the role of reducing the vulnerability of natural and human systems against actual or expected climate change effects. Indeed, the global and intertwined nature of the climate change challenge requires positioning climate change adaptation within the broader context of sustainable development. Within this paradigm, mitigation, adaptation and resilience are inherently integrated. Mitigating climate change through a reduction in greenhouse gas (GHG) emissions is imperative to limit impacts and contribute to the future need to adapt. Adaptation is a core component of resilience. In many respects, adaptation solutions also contribute to decreasing GHG emissions. Efforts towards building a climate-resilient society and economy drive both mitigation and adaptation actions.

The need for adaptation opens opportunities for innovation, both at the policy and business levels. Despite the challenges, Small, Medium and Micro-Sized Enterprises (SMMEs), and particularly small businesses (i.e. micro, very small and small enterprises), are particularly well-suited to seize such opportunities. However, the potential for adaptation-driven needs, investments and mechanisms to generate socio-economic opportunities for small businesses remains largely unexplored and misunderstood. The focus has been on mitigation-driven prospects, on the premise that mitigation-related interventions and investments are more financially viable and provide more imminent benefits.

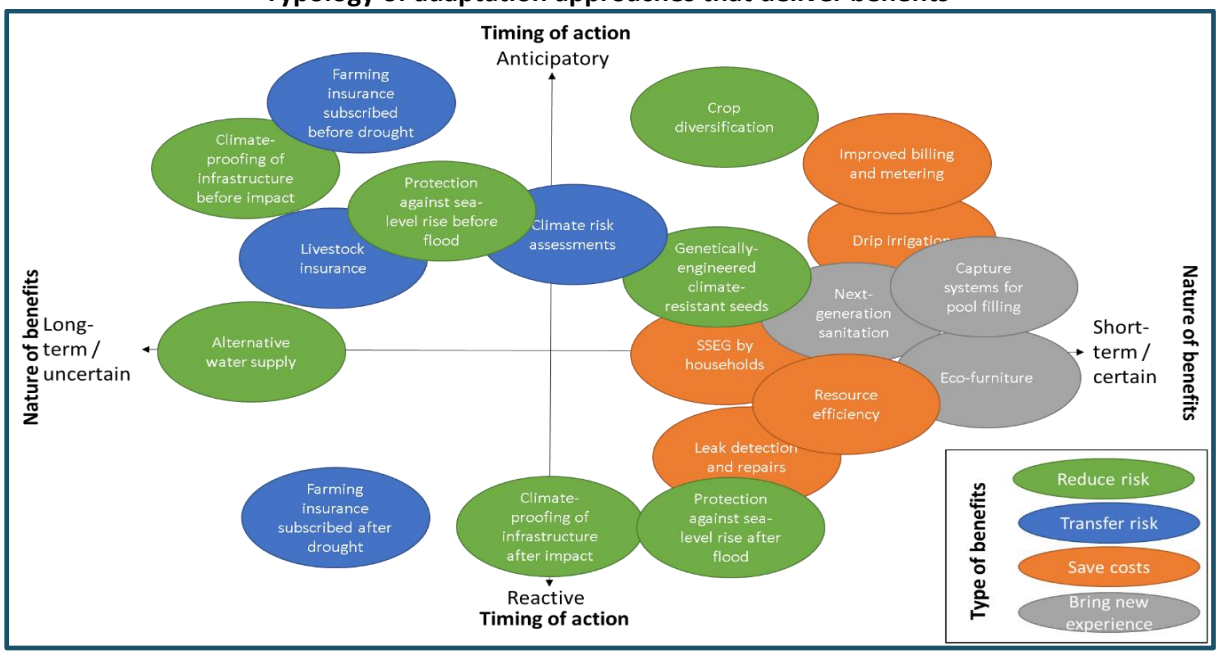
From needs to markets

The impacts of climate change, both climate- and policy-related, are increasingly felt across sectors and groups in society. Adaptation is required when the anticipated risks or experienced impacts of climate change require action so as to enable the safety of people and the security of assets, including ecosystems and their services. Adaptation has generally been categorised according to biophysical and environmental needs; social needs; institutional needs; and information, capacity, and resource needs. Current adaptation actions remain, however, vastly insufficient to ensure resilience. Significant adaptation gaps exist, namely the finance gap, the technology gap, the knowledge gap, and the governance gap.

As a result, while the need for adaptation is evident and the cost to sustainably adapt to climate change impacts are significant, they do not directly equate to markets. Adaptation needs nevertheless do drive a degree of demand for specific products, goods and solutions. Potential markets in the

adaptation space can be illustrated by looking at three interrelated dimensions, as shown in the below Figure below. The first dimension relates to the type of benefits, namely: reducing risk; transferring risk; generating cost savings; or benefiting from an enhanced customer experience. Benefits further depend on the dimension of time (short versus long term), and are also influenced by the timing of implementation, i.e. anticipatory versus reactive action. Importantly, some interventions can generate multiple adaptation-related benefits and/or additional non-adaptation-related benefits (i.e. co-benefits). In order to illustrate possible adaptation-related markets, the water-energy-food (WEF) nexus is used as an entry point.

Typology of adaptation approaches that deliver benefits



Source: Authors

(1) Water and sanitation market

Water security and availability directly impacts all activities, particularly the agricultural sector.

The global water and sanitation market was estimated at US$862 billion in 2016. From 2013 to 2023, the World Bank estimated the water-related markets in developing countries to reach US$3.6 trillion, of which about less than a quarter would be accessible to small businesses. In South Africa, government is expected to drive a large share of the required investment. More than R700 billion is required over the 2017-2027 forecast period to upgrade, rehabilitate and enhance water infrastructure in the country. This jumps to about R900 billion when including sanitation. However, only a portion of this large market addresses adaptation needs. Furthermore, only a subset of that is then accessible by small businesses. Key adaptation-related solutions in the water sector which represent opportunities for (small) businesses range from the provision of water saving technologies and the rollout of smart water systems to the management and restoration of ecological infrastructure through water stewardship.

One key area with significant market potential for small businesses is the drive towards smart (i.e. efficient and inter-connected) irrigation systems. Agriculture is the largest water user globally and in South Africa, and most of the irrigation schemes use relatively inefficient irrigation methods. This inefficiency of irrigation methods opens new avenues in which better working and more efficient

methods can be adopted to enhance water usage in the sector. Another key market is the reduction of non-revenue water (NRW), i.e. the volume of water supplied by the water utility but for which it receives no income, essentially due to system losses. In the 2013/14 municipal financial year, the average NRW for all the metros was 34.5%, giving a total volume of NRW of 924 million m^3 per annum, amounting to an annual loss of about R5.5 billion. The sanitation sector provides another illustration. Sanitation needs are substantial in South Africa and globally. About US$120 billion is required annually to meet the 2030 Sustainable Development Goals sanitation targets in the world. In South Africa alone, about US$1.4 billion (equivalent to about R17.4 billion)[1] is required annually to meet these targets. In this context, next generation sanitation (NGS) technologies, which require no (or minimal) usage of water, do not require conveyance, employ on-site treatment of human waste, and seek resource recovery, are gaining traction. The global opportunity for NGS has been estimated at over US$8 billion a year. However, this could be much more considering its potential to leapfrog and disrupt the market.

(2) Agriculture and agro-processing market

The agriculture and the agro-processing sectors are directly affected by climate change, especially through water availability.

Irrigation consumes between 60% and 65% of available water in South Africa, making agricultural value chains particularly vulnerable to climate change impacts. The water-related component of the global agricultural market stood at US$14 billion in 2016, largely driven by irrigation spending. The market offers opportunities for a variety of businesses. It is both high-tech, with development around drip irrigation, hydroponics and Farming 4.0, and low-tech, with the domination of the market by pumps, pipes and valves. Some key climate adaptation solutions in the sector include crop and animal diversification technologies, efficient irrigation, agricultural extension services, food storage and preservation facilities, soil and water conservation, water conservation measures, climate advisory services, fit-for-purpose water use, among others.

Climate-Smart Agriculture (CSA) presents a new way to meet food and nutrition security needs in the face of the changing climate. It aims at transforming agriculture and adopting practices that are sustainable, i.e. reducing GHGs, adapting to climate change, and reducing vulnerability. CSA in South Africa is based on the following production systems: namely organic farming, agro-ecology and conservation agriculture. For example, the market for no-till planting machinery in South Africa is estimated to be worth about R1.1 billion, with opportunities for local manufacturing as the sector is still dominated by imported machinery that is not well-suited to the country's soil conditions. The market for organically-produced agricultural products has also been growing. South Africa is, however, trailing behind in this, with, organic agriculture accounting for only 0.01% of South Africa's agricultural, compared to 1.2% globally.

(3) Energy market

The energy sector, while traditionally associated with climate change mitigation only, also has a critical role to play in adaptation. Decarbonising the energy sector is notably a key avenue to ensuring the resilience of the economy and society to climate policy shocks. The World Bank estimates the market for clean energy technologies in developing countries from 2013 to 2023 to be in excess to US$2 trillion, of which about a third would be accessible to small businesses. Key adaptation-related

[1] Exchange rate of 15 May 2018 was used. It was US$1 = R12.41.
https://www.resbank.co.za/Research/Rates/Pages/SelectedHistoricalExchangeAndInterestRates.aspx

opportunities encompass the greening of the energy value chains (including energy efficiency), adjusting power plants and electricity grids, building climate compatible energy infrastructure, diversification into alternative energy sources, and incorporating projected climate change effects into the designs of renewable energy.

Improving energy efficiency is an important area with a secured huge market. A conservative estimate of the value of the Energy Service Companies market is between R2.6 billion and R7.8 billion over the 2014-2024 period. For example, climate change is leading to a growing demand for air conditioning. The need to use more energy efficient air conditioning, coupled with the decarbonisation of power generation, can contribute to significant opportunities for small businesses. These new and efficient technologies can be incorporated into new buildings as well as being retrofitted in old ones. The potential market size for solar-powered irrigation systems, estimated at R2.9 billion in South Africa, is another illustration.

There is also a significant market for the production and distribution of clean fuels. Though renewable energy is associated mostly with mitigation, it also has adaptation co-benefits. For instance, participating in the renewable energy value chain can be a form of livelihood and income diversification for small business and small-scale farmers.

From markets to business models

Small businesses can drive forward adaptation efforts in an economy. However, small businesses and entrepreneurs face unique circumstances compared to larger businesses that provide adaptation-related solutions. They have to bring a quality and cost-competitive solution to market, often when markets are new and undeveloped. This is typically accompanied by very limited resources at their disposal and a lack of knowledge and information on markets. Limited demand is also driven by lack of an innovation focus in state procurement. Small businesses in the adaptation space further face additional constraints over small businesses in other markets. The provision of adaptation products and services is constrained by, among other factors, a general lack of awareness by consumers and demand, risk aversion in procurement, and the difficulty in understanding market segments.

The catalyst for adaptation responses can result from a number of sources. Perceptible weather changes, supply constraints and (possibly resultant) changing consumer demand, and national and international climate policy all can drive adaptation responses. For an adaptation business to survive and thrive, however, an essential component that the business needs to ultimately understand is the potential adaptation responses of their consumers. Consumer adaptation responses include doing nothing (no response); directly reducing physical risk; capitalising on new opportunities; and transferring risk. Adaptation solutions can be segmented into four market segments:

1) solutions delivering rapid return on investment;
2) solutions protecting against possible climate change risks;
3) financial risk transfer products; and
4) solutions enhancing consumer experience.

Each segment has a corresponding business model. In line with the Figure above, these distinctions relate to whether solutions are being implemented in an anticipatory (i.e. voluntary) or reactive (i.e. triggered) fashion; and whether solutions generate short-term/certain or long-term/uncertain financial benefits. Some solutions may fall in more than one market segment, depending on the client's motivation or the product's characteristics.

Adaptation solutions which deliver a rapid return on investment (returns that lead to a short and relatively certain payback period)

Such solutions are mostly implemented in an anticipatory fashion as a result of their financial attractiveness. These solutions often have mitigation co-benefits as they lead to resource efficiency and savings. Examples of solutions include water leak detection and repair, increasing the energy efficiency of existing generation plants, and water-efficient crops. Solutions are typically marketed on their affordability, i.e. their ability to generate financial benefits to customers. They bring short-term and a relatively certain payback period, essentially by generating financial savings. Such solutions require an upfront investment which can be substantial. As a result, these solutions are attractive to large businesses and households with relatively high disposable incomes that have the cashflow and investment capacity to afford the upfront capital outlay. These investments are also attractive for more vulnerable groups, such as small businesses and households with low disposable incomes, provided that these groups can receive assistance to fund the capital investments.

Adaptation solutions for this segment are regarded as the "easiest" to sell given that they deliver benefits soon. A number of business models can be employed to leverage this. Using established online platforms for technology and solution dissemination allows new businesses to market their solutions and reach certain consumer markets for a relatively low cost. The setting of a cost-competitive price for the basic products by adding services for an additional cost i.e. value-added services, is another strategy. Additional services could include maintenance, training and other technical services. Modular design can also be employed to keep prices competitive. A basic model can be sold at the lowest price with additional add-ons costing more. Developing a newsletter that connects customers to a business is a way to disseminate new developments in the business, as well as new products and services. Scale-up of the business can occur through franchising to other entrepreneurs (business to business). This can be developed as a business concept including the necessary capital/equipment, training material, and training workshops.

Adaptation solutions protecting against possible climate change risks (solutions that do not necessarily bring short-term financial benefits, but build resilience and provide protection against climate change risks).

Solutions are likely to be triggered (rather than voluntary taken on). Voluntary solutions tend to get picked up when consumers have better predictions of future climate events, or are highly risk-averse. Examples within this market segment include the climate-proofing of infrastructure (such as the raising of dam walls in anticipation of future rainfall and flooding), large-scale alternative water supply options, the design, construction and fortification of electricity generation and transmission and distribution infrastructure; and introducing crop varieties.

Small business can be involved in a number of ways in this segment too. Businesses would be better off focusing on developing fine-tuned and niched expertise in their area of practice. Developing customers within a very narrow untapped sub-segment of a large market may prove to be a superior strategy than trying to target the entire market.

Smaller businesses can also target large-scale projects, by partnering with similarly-sized small businesses. This approach will also allow small businesses to benefit from synergies in combining expertise. Partnerships can also be formed through joining industry associations and by attending industry events.

Risk transfer products (products which transfer risk rather than directly protect against it).

Financial risk mitigation products have been gaining traction in recent years as a means to transfer risk to the financial sector in exchange for a premium. Between 2017 and 2018 alone, there were three major climatic events in South Africa that triggered catastrophe claims. Such products can be voluntary or triggered. They are a pure cost and bring no certain financial benefits. Their uptake depends on the consumer's risk perception and this varies between sectors and clients. Risk transfer products like insurance also provide income security, protecting the vulnerable through smoothing consumption and lessening the financial and economic shocks the adverse climate events bring. Certain consumers are constrained in their ability to purchase insurance, particularly if the activity they are insuring for is high risk. For vulnerable groups like poor households and smallholder farms, affordability is likely to prevent uptake. For these groups, state support can supplement their ability to pay for insurance, and along with well-tailored insurance packages could serve as income-protection and adaptation goals. The state can also drive forward the uptake of transfer mechanisms through legislation and partnering with the insurance industry to increase the resilience of public infrastructure, such as roads, electricity, and water infrastructure.

The services the insurance industry offers have a unique base, and smaller players find it difficult to establish scale and effectively compete. For a small business to enter as an insurer is difficult due to the large capital reserves required and the regulatory hurdles. However, the Insurance Act (No. 18 of 2017), which was passed in 2018, increases the ability of small businesses to enter the industry. Small businesses offering adaptation solutions in this segment can now position themselves in a number of ways. Small businesses should focus on developing competencies in digital and data skills, and innovation, which are currently prized by insurers. The Insurance Act also makes provisions for microinsurance products to be more accessible, affordable and fair for consumers, by introducing standards and a regulatory framework for these. This is an opportunity for small businesses to enter the climate microfinance industry. Other niched offerings can be targeted at large insurers by small businesses. While the accurate prediction of floods is difficult for example, a firm that develops technical expertise in this would have a competitive edge in the market. Brokerage services remain the chief channel through which insurance is sold in South Africa. Small adaptation firms can specialise in offering a basket of climate-related products on which they can advise clients based on their ability to pay and risk profile.

Solutions that enhance the consumer experience and/or provide a new experience.

Solutions in this segment would be primarily sold on providing an aspirational experience. Examples in consumer markets include eco-friendly furniture, foods, and cleaning agents. Demand for such products is essentially voluntary and driven by personal rather than financial motives. Consumers of such products would tend to generally fit a middle-to-upper income demographic and derive utility from luxury, reputational benefits and/or climate friendliness. Demand for such "frontier" solutions still remain limited as this market segment mainly targets early adopters, trendsetters and pioneers. Consumer education is certainly an important intervention that would drive demand for the types of solutions described in this market segment.

Small businesses in this segment can adopt a number of strategies to create demand for their products. Certain types of adaptation goods, such as fast-moving consumer goods (FMCGs), can be leveraged to disseminate widescale public awareness and dissemination of adaptation.

Small businesses targeting a wealthier market should focus on developing specialised products for distribution through specific channels. For example, custom-made eco-furniture, recyclable coffee pods and luxury eco lighting can be distributed only through selected speciality stores at specific locations, allowing the brand to maintain a certain premium. Social media has become a key resource that can certainly be a starting point for entrepreneurs. Partnering with influencers can help generate traction for the adaptation solution and assist to increase customer reach. As an entry point into the broader consumer market, large retailers should be targeted, such as Pick n Pay or Woolworths, and products should aim to bolster both the aspirational nature of the good combined with the climate benefits. Examples of such products include sustainably-made detergents. Negotiations with retailers can include a trial period combined with advertising in-store to promote the product. This could include free give-aways and competitions to entice consumers to purchase the product.

From obstacles to policy recommendations

Though the potential for adaptation-driven needs to generate socio-economic opportunities for small businesses remains largely unexplored and misunderstood, this report endeavours to contribute to closing this gap. The findings show that there are market opportunities in the adaptation space, and room for small businesses to participate. The major categorisation of the adaptation offerings are: products with immediate savings, offerings with future savings, financial risk transfer products, and products that enhance consumer experience. However, the attributes of the required adaptation products and services make it a challenging terrain in which to participate. In each of these categories, small businesses can participate, though this will depend greatly on the support available and the conduciveness of the policy and regulatory framework.

Seizing the emerging opportunities requires stimulating demand for adaptation-related solutions as well as adequately supporting entrepreneurs active in this space. On the supply side, access to finance and market should be supported by dedicated programmes focused on entrepreneurs active in greening the economy. This is crucial to bridge the information asymmetry between entrepreneurs and financiers (who often do not understand the need for a just transition to a low-carbon, climate-resilient and environmentally-sustainable economy). It is also essential to support entrepreneurs to better understand the markets in which the operate. Market segments within the climate change adaptation space are distinct and driven by different factors. Support to access infrastructure should also be provided to enable growth.

On the demand side, significant action is required to stimulate demand for adaptation-related products and services. The finalisation of the country's adaptation strategy and its mainstreaming through the organs of the state would go a long way in bringing adaptation to the fore. Raising awareness in all spheres of government, the private sector and society at large is instrumental in stimulating climate action. In addition, the state, through public procurement, could assist in driving demand. In addition, regulations, enabling policies and, in some cases, tax incentives can be used to drive demand. Adequate support is also required to ensure that vulnerable households and businesses which cannot afford to adapt to climate change are assisted in implementing adequate solutions. Partnerships with the private sector should also be pursued to fast-track the adaptation of vulnerable ecosystems and communities and create implementation pathways.

In the end, adapting to climate change is an urgent necessity. Whether or not it comes with domestic co-benefits for small business development, however, relies on adequate action.

The future depends on what we do in the present, Mahatma Gandhi

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AC	Air Conditioning
APAP	Agricultural Policy Action Plan
CEA	Controlled Environment Agriculture
CSA	Climate-Smart Agriculture
ESCO	Energy Service Company
EWEF-Sustech	Energy Water Environmental Food Sustainable Technologies
FMCGs	Fast-moving Consumer Goods
GHG	Greenhouse Gas
GW	Gigawatts
ICTs	information and communication technologies
IDC	Industrial Development Corporation
IEA	International Energy Agency
NDP	National Development Plan
NGS	Next Generation Sanitation
NRW	Non-Revenue Water
PV	Photovoltaic
R	South African Rand
SAFE	Sanitation Appropriate for Education
SAWS	South African Weather Service
SSEG	Small-Scale Embedded Generation
SEZ	Special Economic Zone
SDG	Sustainable Development Goals
SMME	Small, Medium and Micro-Sized Enterprise
TIPS	Trade & Industrial Policy Strategies
TWh	Terawatt Hours
US$	United States Dollar
WEF	Water-Energy-Food

1 INTRODUCTION

Climate change is increasingly becoming the single most pressing challenge facing society in the 21st century. Despite ramping efforts to mitigate climate change, under the leadership of the Paris Agreement, climate change impacts are becoming evident the world over. In the near future, climate change will have exponential and disastrous effects on economic development, social progress and environmental sustainability. However, not everyone is equally vulnerable to the impact of climate change. The degree of societies' resilience[2] depends on the risks (their amplitude, timeframe and the probability they occur) as well as the degree of vulnerability, i.e. the exposure and susceptibility to the risks, and the ability to withstand and recover from impacts.

The African continent is set to be severely affected by climate change through a combination of high exposure to climate change impacts coupled with a low ability to adapt. South Africa particularly is already one of the driest countries, and is expected to face serious water security issues going forward. With 2 798 km of coastline, South Africa is also vulnerable to sea-level rise. Relying on an economy which is heavily carbon- and energy-intensive further puts the country at risk of climate change response measures domestically and globally.

The effects of climate change are already observed in the country, raising the urgency for adaptation[3] to expected (and unexpected) impacts. This also presents an opportunity to improve the resilience of the economy, society and the environment. Adaptation specifically serves the role of reducing the vulnerability of natural and human systems against actual or expected climate change effects (DEA, 2017; Oxfam, 2012). Indeed, the global and intertwined nature of the climate change challenge requires positioning climate change adaptation within the broader context of sustainable development. Within this paradigm, mitigation, adaptation and resilience are inherently integrated. Mitigating climate change through a reduction in GHG emissions is imperative to limit impacts and contribute to the future need to adapt. Adaptation is a core component of resilience. In many respects, adaptation solutions also contribute to decreasing GHG emissions. Efforts towards building a climate-resilient society and economy drive both mitigation and adaptation actions (Denton et al., 2014; UNFCCC, n.d.).

The economics of climate change, and in particular adaptation, are dynamic and evolving. As shown by the Stern Review on the Economics of Climate Change, the cost of mitigating climate change is much less than the cost of inaction, and many mitigation interventions actually bear socio-economic benefits (Stern, 2007). While adaptation is still considered relatively costly (although estimates vary greatly, from US$4 billion to US$100 billion a year), many adaptation-related interventions also bring positive socio-economic spillovers (Chambwera et al., 2014) .

Responses to climate change open opportunities for innovation, both at the policy and business levels. SMMEs, and especially small businesses (i.e. micro, very small and small enterprises), are well-suited

[2] The Intergovernmental Panel on Climate Change,(IPCC) defines resilience as "[t]he ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions" (Field et al., 2012, p. 563).

[3] The IPCC defines adaptation as follows: "In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities." (Field et al., 2012, p. 556).

to seize such opportunities.[4] Small businesses are generally more versatile, innovative, adaptive and entrepreneurial than large businesses (Groepe, 2015). New and young firms tend to exploit technological or commercial opportunities neglected by more established companies and often bring new business models, such as social enterprises (Marks and Hidden, 2017; Mohamed, 2018; OECD, 2015; World Bank, 2014). However, compared to large businesses, small businesses face challenges that relate to their size, limited resources, and unfavourable policy, industry and market conditions. These challenges limit their ability to grow, attain scale, and take advantage of regional and global value chains (Montmasson-Clair and Mudombi, 2018; OECD, 2018), feeding a socio-economic gap hampering the development of small businesses.

Given this background, the potential for adaptation-driven needs, investments and mechanisms to generate socio-economic opportunities for small businesses remains largely unexplored and misunderstood. The focus to-date has been on mitigation-driven prospects, on the premise than mitigation-related interventions and investments are more financially viable and provide more imminent benefits.

Having set the context, this report aims to fill the gap between the need to adapt to climate change and the potential to bring out socio-economic development benefits in the process. Specifically, it investigates the interplay between climate change adaptation and small business development in the South African context. Section 2 highlights the global and local adaptation needs, as a proxy to understand the future demand of adaptation solutions, and the size of the market. Section 3 considers the parameters required for small businesses to seize business opportunities arising from adaptation. Section 4 formulates policy implications, and Section 5 concludes.

[4] As per the National Small Business Amendment Act (No. 26 of 2003), medium businesses in manufacturing are those with at least 200 full-time employees, R51 million in total turnover, or R19 million in total gross asset value. Small businesses in manufacturing are those with at least 50 full-time employees, R13 million in total turnover, or R5 million in total gross asset value. Very small businesses in manufacturing are those with at least 20 full-time employees, R5 million in total turnover, or R2 million in total gross asset value. Micro businesses in manufacturing are those with at least five full-time employees, R0.2 million in total turnover, or R0.1 million in total gross asset value.

2 FROM NEEDS TO MARKETS

The first step in understanding the potential to drive small business development on the back of climate change adaptation is to grasp the potential markets driven by the need to adapt to climate change.

2.1 Adaptation needs

The impacts of climate change, both climate- and policy-related, are increasingly felt across sectors and groups in society. Climatic impacts in South Africa and the region mostly trickle down via effects on water resources, with significant socio-economic implications on food security, sanitation, energy security and economic activities. South Africa's Long-Term Adaptation Scenarios Flagship Research Programme, the Intended Nationally Determined Contribution, and the National Adaptation Strategy (Second Draft) highlight implications for various sectors and potential adaptation responses (DEA, 2017, 2013). Policy-related impacts are not well understood but will have tremendous implications for most businesses and households. Camco and TIPS (2010) and Altieri et al. (2015)- provide an initial assessment, highlighting the possible deep impacts on carbon-intensive activities.

Such impacts trigger the need for adaptation measures by households, businesses and society at large. Adaptation needs, summarised in Table 1, arise when the anticipated risks or experienced impacts of climate change require action so as to enable the safety of people and the security of assets, including ecosystems and their services (Noble et al., 2014).

Table 1: Summary of adaptation needs

Need	Description
Biophysical and environmental needs	These needs relate to the protection of natural systems upon which human livelihoods, health, welfare, food security, and prosperity are underpinned. This includes the role of ecosystems in providing food, fibre, and potable water supply; regulating services, such as climate regulation, pollination, disease control, and flood control; and supporting services.
Social needs	Increased frequency of extreme weather events related to climate change results in loss and damage of property, and disrupting social and biophysical life support systems through displacement of communities, destruction of homes, and loss of life. Thus, the need for emotional and psychological support, including social safety nets to deal with the negative impacts of climate change.
Institutional and organisational needs	Institutions provide the guides, incentives, or constraints that influence the extent and distribution of climate risks, as well as creating incentive structures that can enhance adaptation.
Information, capacity, and resource needs	Information-related adaptation needs include vulnerability and impact assessments, country-specific down-scaled socio-economic scenarios, and enhanced understanding of costs and benefits of different adaptation measures. All these require shared learning on adaptation.

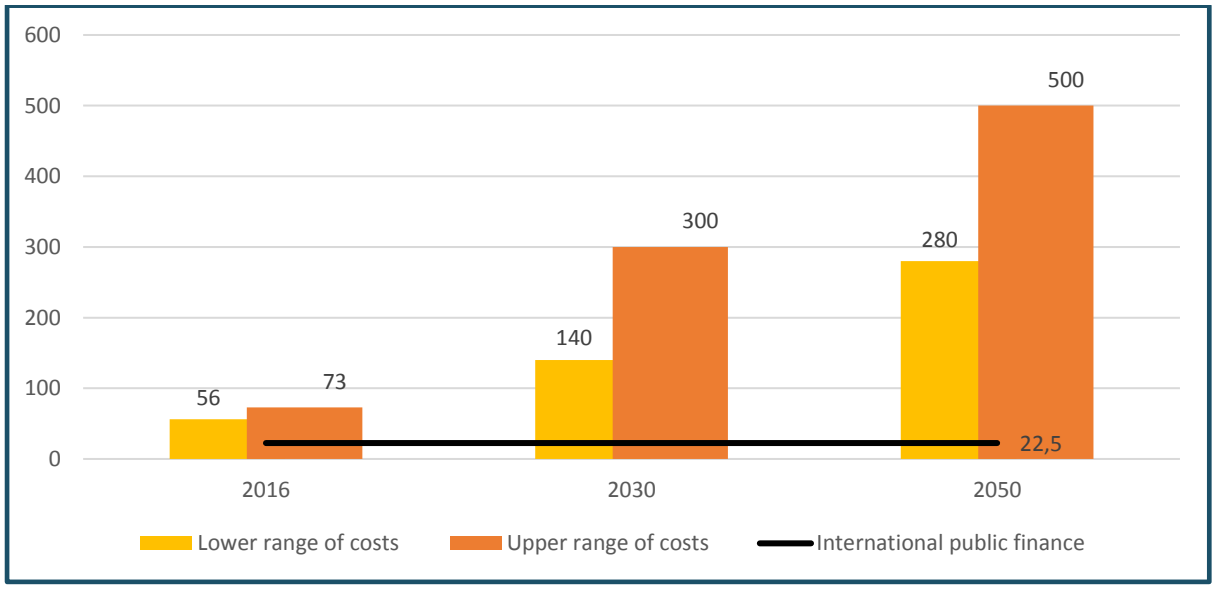
Source: Authors, based on Noble et al. (2014, pp. 840–844)

Current adaptation actions remain, however, vastly insufficient to ensure resilience. Significant adaptation gaps exist, namely:

- a finance gap, i.e. the difference between the costs of meeting a given adaptation target and the amount of finance available to do so;
- a technology gap, i.e. the perceived gaps in available technology and needs, in terms of technological maturity (traditional, modern, high technology) as well as in terms of area of effort (transfer, diffusion, innovation);
- a knowledge gap, encompassing missing or incomplete knowledge (i.e. knowledge production gaps); inadequate linkages between different bodies of knowledge (knowledge integration gaps); and limited diffusion and translation of knowledge to decision makers (knowledge transfer and uptake gaps) (UNEP, 2016a, 2014); and
- a governance gap, which relates to a lack of a proper governance framework to coordinate action. Many innovative adaptation efforts proceed in isolated niches, circumscribed by boundaries of localities, policy domains, or jurisdictional levels (Termeer et al., 2017).

Adaptation financing is forecast to be very costly, and will be even more costly if early action is not taken. For instance, for developing countries this would require expenditure in the range of US$140-US$300 billion a year by 2030, and a range of US$280-US$500 billion a year by 2050 (Figure 1). The adaptation finance gap in 2016 was likely to be at least two to three times higher than international public finance for adaptation (about US$22.5 billion). Assuming no change in the flows of international public adaptation finance, the adaptation finance gap is projected to 12-to-22 times the current flows (UNEP, 2016a).

Figure 1: Conceptualising the adaptation finance gap in developing countries through the years



Source: Authors, adapted from UNEP (2016a, p. 41)

2.2 The markets

While the need for adaptation is evident and the cost to sustainably adapt to climate change impacts are significant, they do not directly equate to markets.

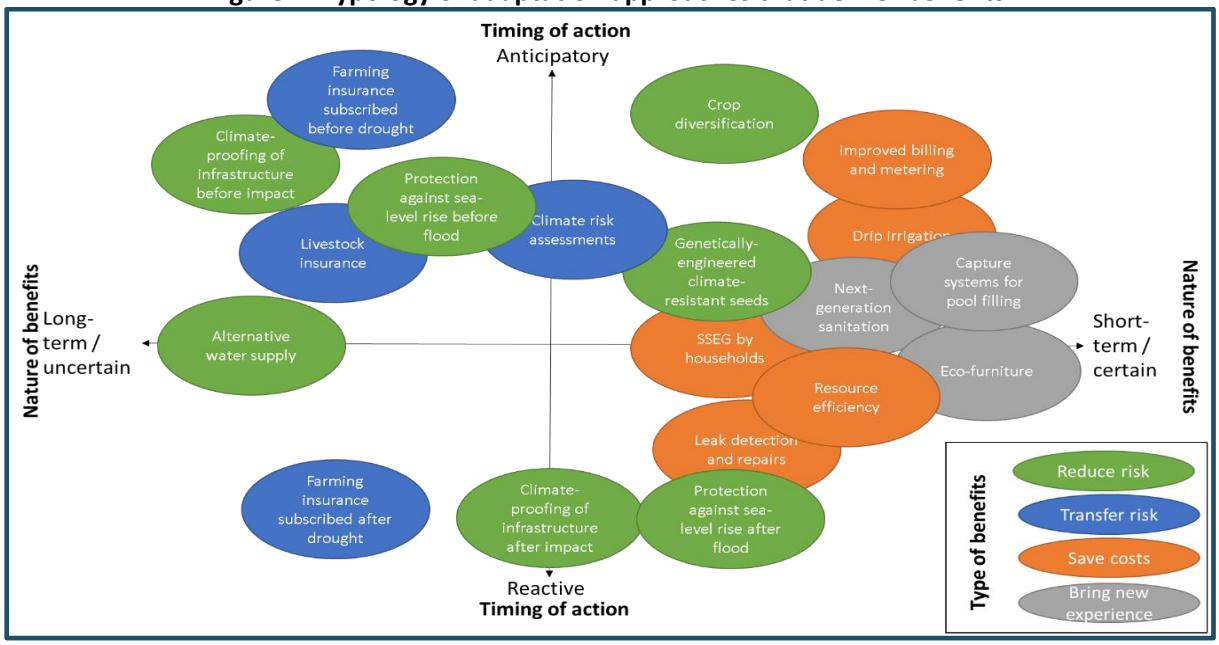
Adaptation needs nevertheless do drive a degree of market demand for specific products, goods and solutions. Potential markets in the adaptation space can be illustrated by looking at three interrelated dimensions. The first dimension relates to the type of benefits: reducing risk; transferring risk;

generating cost savings; or benefiting from an enhanced customer experience. Benefits further depend on the dimension of time (immediate versus future), and are also influenced the timing of implementation, i.e. anticipatory versus reactive action.

First, *anticipatory solutions* are those implemented proactively by consumers (be it a household, firm, government or any other entity), well before impacts are experienced. Customer awareness often plays a key role in this, notably by driving demand and encouraging suppliers to incorporate climate-friendly adaptation practices with a green economy focus in procurement. Retail chain Woolworths, for example, follows an internal climate change policy and bases its procurement of fresh produce through scoring its suppliers on an established rating model (Woolworths, 2016). In contrast, *reactive adaptation* is triggered by external factors, such as regulation, legislation and incentives or the realisation of the actual climate risk. Building regulations, which have made energy efficiency the norm in new construction, have for example driven material improvement in energy consumption in buildings. Although primarily motivated by climate change mitigation objectives, such a dynamic has clear adaptation benefits, particularly for energy security. Importantly, most interventions can be implemented in both an anticipatory and reactive fashion. For example, the drought in the Western Cape triggered many reactive adaptation-related interventions. Then, companies with a national footprint proceeded to roll out interventions in other areas of the country in anticipation.

Second, while all adaptation solutions provide benefits, their nature varies greatly. A key distinction is whether such benefits translate into financial gains and under what timeframe. Some solutions provide relatively certain financial benefits in the short term, thus translating into short payback periods (less than five years) for the investment. This is generally the case of resource efficiency-related solutions, for example the rollout of energy efficient lighting or water-efficient devices, such as low-flow shower heads/tap aerators. Alternatively, other solutions, while providing definite benefits, do not directly generate financial benefits. They may have a long payback period or not be motivated by their return on investment. This is the case of insurance products as well as solutions which provide security of supply and continuity of services.

Figure 2: Typology of adaptation approaches that deliver benefits



Source: Authors

Figure 2 illustrates the typology and Section 3 further expands on its implications. Importantly, some interventions can generate multiple adaptation-related benefits and/or additional non-adaptation-related benefits (i.e. co-benefits). In contrast, some interventions have clear drawbacks, and can lead to maladaptation, i.e. actions that may lead to increased risk of adverse climate-related outcomes, including via increased GHG emissions, increased vulnerability to climate change, or diminished welfare, now or in the future (IPCC, 2018).

The climate change adaptation space is broad. To illustrate possible adaptation-related markets, the WEF nexus is used as an entry point. These dimensions are complex and have inextricable linkages between them, with water being at the centre of the web. For instance, South Africa is already water scarce, and climate change is an additional stressor to the system (DAFF, 2018). At the same time, more energy would be required to purify poor quality water and/or draw water from greater depths or distances. Coupled with rising electricity prices, this trend is putting traditional wastewater treatment mechanisms at risk (Swartz et al., 2013). There might also be increased competition for available water resources between the energy and food sectors, which also affects some renewable energy sources (Carter and Gulati, 2014). Moreover, the uneven distribution of natural resources and the location of economic development nodes in the country exacerbate the management constraints and inequality of access to these resources, e.g. coal deposits are in areas with the country's best agricultural land and water catchments for major inland rivers (Von Bormann and Gulati, 2014).

2.2.1 Water-related markets driven by climate change adaptation

Water availability (both quantity and quality) directly impacts all activities, particularly the agricultural sector (Jarmain et al., 2017). Key adaptation-related solutions in the water sector that represent opportunities for (small) businesses are given in Table 2. These solutions range from the provision of water saving technologies and the rollout of smart water systems to the management and restoration of ecological infrastructure through water stewardship.

The global water and sanitation market was estimated at US$ 862billion in 2016. The utility sector (67%) mainly dominates the market, followed by the industrial (15%) sector and the bottled water segment (14%). Agriculture, while consuming more than two-thirds of water globally, only accounts for a marginal share of the market (Montmasson-Clair, 2018).

From 2013 to 2023, the World Bank estimates the water-related markets in developing countries to reach US$3.6 trillion, of which less than a quarter would be accessible to small businesses (infoDev, 2014). In South Africa, government is expected to drive a large share of the required investment. More than R700 billion is required over the 2017-2027 period to upgrade, rehabilitate and enhanced water infrastructure in the country. This jumps to about R900 billion when including sanitation (DWS, 2017).

Only a portion of this large market is, however, related to adaptation needs. Furthermore, a subset of that is then accessible by small businesses. Deciphering with accuracy the size and segments of the adaptation-related water and sanitation market is a highly speculative exercise. Nevertheless, a look at a few key market segments provide an illustrative picture of the market potential.

Table 2: Key climate change implications for the water sector in South Africa

Impact	Adaptation responses/ options
A higher frequency of flooding and drought extremes is projected. National runoff projected to range from a 20% reduction to a 60% increase, depending on regions, by as early as mid-century. Areas showing highest risks in extreme runoff related events (and flooding conditions) include KwaZulu-Natal, parts of southern Mpumalanga and the Eastern Cape. Increased temperatures in many areas can lead to increased e**vapotranspiration** and loss of water from water reservoirs.	- Provision of water saving technologies. - Water reuse and recycling technologies. - Alternative water supply sources, such as ground, rain, and seawater. - Water regulations and agreements. - Sustainable water resources management, including water demand management and conservation measures. - Non-revenue water reduction measures, such as metering, monitoring, and leak detection. - Contingency planning for extreme events (floods, droughts) and disaster relief measures. - Improved water infrastructure. - Water resources technical and planning capacity and skills development. - Incorporate the climate change dimension into water resources planning tools. - Adaptation response strategies for the water sector at distinct governance levels, namely national, sub-national / system, and sub-catchment / municipal scales. - Restoring and maintaining ecological infrastructure. - Water-related institutions that can build adaptive management capacity at various water governance levels.

Source: Compiled from DEA (2017, 2013) and Noble et al. (2014, p. 845)

One key area with a significant market potential for small businesses is the drive towards smart (i.e. efficient and inter-connected) irrigation systems. Agriculture is the largest water user globally and in South Africa most of the irrigation schemes use relatively inefficient irrigation methods, which creates opportunities to enhance efficiency in the sector. The area under irrigation in South Africa stood at around 1.3-1.4 million ha in 2014 (Schulze, 2016, p. 19; Van der Stoep and Tylcoat, 2014), which is close to 1.5% of the country's agricultural land (DAFF, 2015a), it produces 30% of the country's crops (DWS, 2017). While the potential of additional irrigation is limited in the country, as water extraction for irrigation is already exceeding rates of replenishment, most existing schemes are not operating optimally. According to the National Development Plan (NDP), improved and efficient use of existing water resources could allow the expansion of irrigated land by at least 500 000 hectares (NPC, 2012). There can also be fit-for purpose irrigation solutions, such as the use of non-toxic semi-treated, recycled water for specific crop types.

GreenCape (2017) notes an opportunity to supply water-efficient irrigation technology to farmers, with more than 100 million meters of dripper lines sold each year. Innovative drip irrigation systems suitable for various soils, as well as highly energy and water efficient solutions are particularly suited. For instance, the online tool FruitLook has resulted in notable financial benefits for Western Cape fruit

and grape growers as they access satellite-based information that improves water usage and crop productivity (GreenCape, 2017, p. 49). Another new irrigation system called Tree Hog can reduce an orchard's water consumption by up to 70%, as it combines the advantages of both micro and drip irrigation. The Tree Hog is already being exported to farmers across the continent, as well as to Europe and Australia (De Villiers, 2018).

Rainwater harvesting offers important market opportunities. Such solutions can replace about 30% of domestic consumption catering for irrigation, and washing of clothes and dishes. With a properly designed system, this can include potable water (GreenCape, 2016). Business opportunities include manufacturing, selling and installing household and office rooftop rainwater harvesting systems. The South African government has been rolling out water harvesting technology to resource poor farmers. This has boosted demand for the various components, such as water tanks. About R33.5 million was allocated for rainwater harvesting in the 2016/17 national budget to help less-resourced farmers (Creamer Media, 2016; PAGE, 2017). Water tank manufacturers, such as Eco Tanks and JoJo Tanks, had enormous demand for their products in the middle of the drought. For instance, Mathe (2019) reported that Jojo was selling about 1 000 tanks a day (reported in January 2019).

Another key market is the reduction of non-revenue water, i.e. the volume of water supplied by the water utility but for which it receives no income. Associated with NRW are water leakages, as water is lost through leakages and aging infrastructure, putting strain on South Africa's already scarce water system. In the 2013/14 municipal financial year, the average Infrastructure Leakage Index for all South African metros was 5.4, meaning that the current leakage in the system was 5.4 times the expected performance (DWS, 2015). In the same period, the average NRW for all the metros was 34.5%, giving a total volume of NRW of 924 million m^3 per annum, amounting to an annual loss of about R5.5 billion (DWS, 2015). This is a sizeable share of the R45 billion required annually to upgrade, rehabilitate and enhance South Africa's water transmission and distribution infrastructure.

There are various ways in which NRW and the associated losses can be reduced. This includes employing various water conservation and demand management approaches such as new technologies to detect leaks, replacing aging infrastructure, improving the billing systems, and adopting smart metering. The market in this space is huge. For instance, the equipment spending in South Africa on automation/control, tests and meters, is expected to grow from US$265 million in 2018 to US$324 million in 2022 (GWI, 2017a).

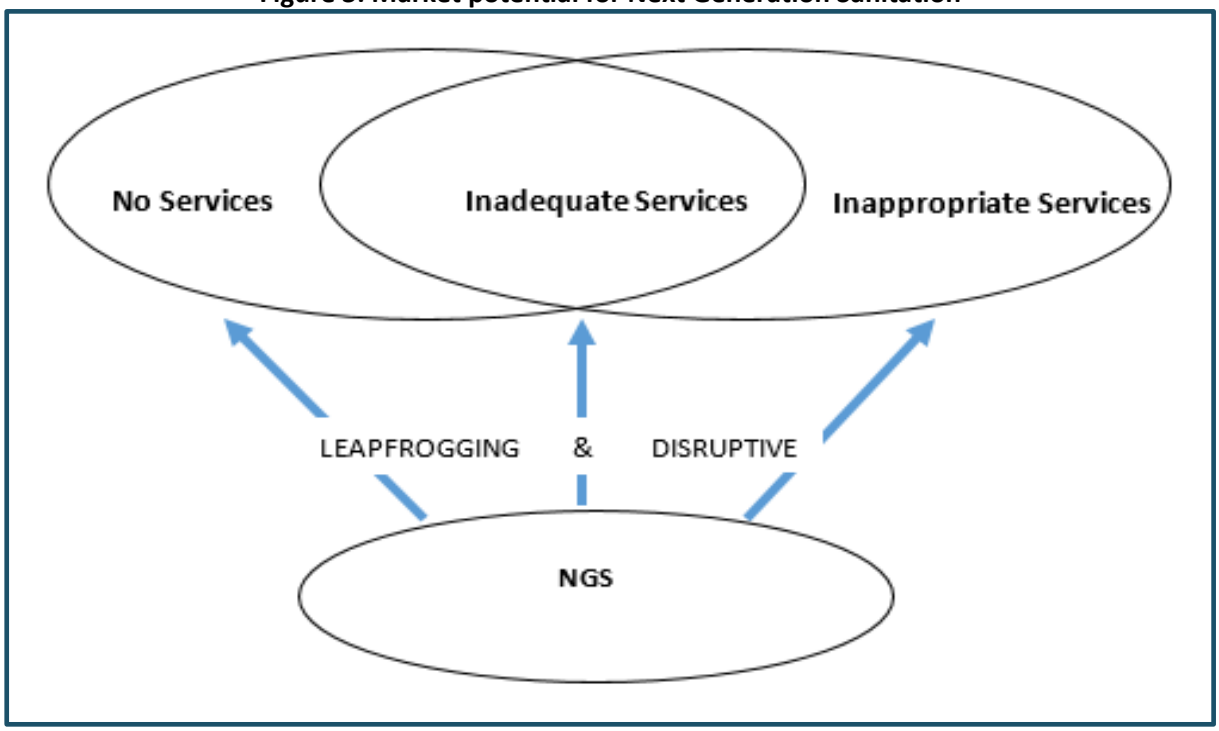
The sanitation sector is another illustration. Needs in the sanitation sector are substantial in South Africa and globally. About US$120 billion is required annually to meet the 2030 Sustainable Development Goals (SDG) sanitation targets in the world. In South Africa alone, about US$1.4 billion (equivalent to about R17.4 billion) is required annually to meet these targets. In addition, about 40% of water consumed by households in South Africa is used just to flush toilets (Burger, 2015). The flush toilet as the most common type of toilet is inappropriate as the country is water scarce (Mudombi, 2018).

There has been increased focus on promoting the wider adoption of water-efficient sanitation systems. In this regard, there are both high-tech systems that are relatively costly and low-tech systems which are more affordable solutions. Small businesses can easily harness opportunities in the provision of low-tech solutions which might require lower capital outlay. Numerous low-tech solutions are emerging. The innovations developed by start-up Loo Afrique propose to optimise the use of water

for sanitation in rural and poor areas by, for example, turning the toilet cap into a basin (see (Mudombi, 2019a) for a case study on Loo Afrique). Another start-up, Isidima, operating in this space, has also developed innovative solutions (such as the Arumloo toilet and the DEWdrop sanitation system) aimed at optimising resource use (see (Mudombi, 2019b) for a case study on Isidima).

The provision of sanitation through government programmes has huge potential to create opportunities for small businesses to participate. For instance, the government launched the Sanitation Appropriate for Education (SAFE) programme, which aims to provide innovative, safe ablution facilities at nearly 4 000 mostly rural and township schools that only have pit latrines or other inappropriate sanitation facilities (The Presidency, 2018). This can be an important entry point to implement appropriate sanitation solutions with multiple benefits (Mudombi, 2018). In this context, NGS is gaining traction.

Figure 3: Market potential for Next Generation Sanitation



Source: Mudombi (2018b, p. 5)

NGS technologies require no (or minimal) water usage, do not require conveyance, employ on-site treatment of human waste, and seek resource recovery. The global opportunity for NGS has been estimated at over US$8 billion a year; however, this could be much more considering its potential to leapfrog and disrupt the market. Indeed, the NGS market is anchored on two broad segments as depicted in Figure 3. First, NGS has the potential to leapfrog those who currently do not have access to sanitation services (no or inadequate services). Second, NGS has the potential to be disruptive in the segment that has inappropriate sanitation services (e.g. waterborne sanitation in water scarce areas). South Africa is working to position itself as a leading manufacturer of NGS technologies with the establishment of an NGS Cluster Development Programme (the dti, 2017).

2.2.2 Food-related markets driven by climate change adaptation

Agriculture and the agro-processing sector are directly affected by climate change and water availability in particular. Irrigation consumes between 60% and 65% of available water in South Africa, making agricultural value chains particularly vulnerable to climate change impacts. Climate change impacts affect the productivity of farming operations, as well as increases the risk of production disruption (Schulze, 2016). The direct effects manifest through changes in productivity, quality of yield, crop failures, loss of livestock, farming costs, and the impacts of changing weather conditions on agricultural practices (Carter and Gulati, 2014).

The water-related component of the global agricultural market stood at US$14 billion in 2016, largely driven by irrigation spending. The market offers opportunities for a variety of businesses. It is both high-tech, with development around drip irrigation, hydroponics and Farming 4.0, and low-tech, with the domination of the market by pumps, pipes and valves (GWI, 2017b). Table 3 lists some key climate adaptation solutions in the sector.

Table 3: Climate change implications for the agricultural/ food sector

Impact	Adaptation responses/ options
Likely to be spatial shift in the optimum growing regions for many key crops and pasture grasses. Increase in climate change-induced changes in plant and animal diseases, and insect distribution which impacts on crop and livestock production. Projected heat stress and a fall in rainfall will reduce herbage yields with negative health impacts for livestock. Increased flooding occurrences will exacerbate the effects of overgrazing, resulting in increased soil erosion. Labour likely to be negatively affected by thermal discomfort during hot days.	- Agricultural extension services. - Crop and animal diversification complimented by new varieties. - Efficient irrigation and water saving technologies including rainwater harvesting. - Food storage and preservation facilities; distribution of food surplus. - Soil and water conservation. - Livelihood diversification. - Changing livestock and aquaculture practices. - Best management practices involving ecosystem and community based adaptation, conservation agriculture, climate-smart agriculture, agro-ecology: and silvicultural options. - Changes in agricultural management practices e.g. crop-switching; changing cropping practices, patterns, and planting dates. - Water conservation measures, such as drip irrigation. - Preventative measures against crop and livestock disease - Adopt an integrated approach that combines indigenous knowledge and scientific insights to address multiple stressors. - National level strategies including capacity building in key research areas, extension, and consideration of water resource allocation. - Enhance climate advisory services to communicate key messages to various stakeholders.

Source: Authors, compiled from DEA (2017, 2013) and Noble et al. (2014, p. 845)

Climate-smart agriculture, as proposed in the 2015-2019 Agricultural Policy Action Plan (APAP), presents a new way to meet food and nutrition security needs in the face of the changing climate (DAFF, 2015b). It aims at transforming agriculture and adopting practices that are sustainable, i.e. reducing GHGs, adapting to climate change, and reducing vulnerability. From a nexus perspective, integrating renewable energy technologies can make the agricultural sector more productive and also climate-smart (Christina et al., 2016). CSA in South Africa is based on the following production systems, namely organic farming,[5] agro-ecology[6] and conservation agriculture[7] (DAFF, 2015b).

As listed in the draft Climate Smart Agriculture Strategic Framework for Agriculture, Forestry and Fisheries (DAFF, 2018), CSA encompasses encouraging adaptive farming practices; disaster risk management; irrigation and water resource management; conservation agriculture; watershed and land management; livestock management; and crop, forestry and fisheries and income loss risk management. AB Farms, located in the Westonaria Agri-Parks in Western Gauteng, is one of the leading start-ups in the country for hydroponics. The company already produces lettuce through hydroponics and is developing a new advanced system to transform South Africa's agricultural landscape (see Patel, 2019a, for a case study of AB Farms).

While GreenCape (2017) reported an increase in the uptake of conservation agriculture in South Africa, primarily among grain farmers, especially wheat in the Western Cape and maize across the country, there is a still significant potential for its uptake. For example, GreenCape (2017) estimated the market for no-till planting machinery in South Africa to be worth about R1.1 billion, with opportunities for local manufacturing as the sector is still dominated by imported machinery that is not well-suited for the country's soil conditions. It also estimated that the market for controlled environment agriculture (CEA)[8] in the Western Cape to be around R600 million, which was predicted to grow by 15% per annum. Increasingly, information and communication technologies (ICTs) are being integrated to promote CSA. For instance, MySmartFarm uses latest software applications, intelligent models, and machine learning to enhance farm management and productivity by availing agricultural information, optimising decision, and better resource use (see Patel, 2019b for a case study on MySmartFarm).

The market for organically-produced agricultural products has also been growing. Globally, organic food and drink sales have increased from less than US$15 billion in 1996 to about US$90 billion in 2016 (Helga and Lernoud, 2018). This high demand has largely been driven by rising standards of living and increased consumer awareness about health benefits and sustainability, and demand for sustainable products (GreenCape, 2017; Mordor Intelligence, 2017).

More farmers across the world are cultivating on certified organic lands, with about 170 countries reporting organic farming activities (Mordor Intelligence, 2017). In 2016, about 57.8 million ha of land were under organic agriculture globally, with Africa having about 3% of this (1.8 million ha). South

[5] Organic agriculture refers to a production system that does not allow the use of synthetic production inputs like fertilisers and pesticides. It advocates the adoption of production practices that simultaneously mitigate climate change, build resilient farming systems, reduce poverty and improve food security.

[6] Agro-ecology is a form of agriculture that when properly implemented provides all the solutions for soil fertility, natural parasites, pest and weed control, and the potential hazards associated with continuous irrigation.

[7] Conservation agriculture is a farming approach that fosters natural processes to increase agricultural yields and sustainability by minimising soil disturbance, maintaining permanent soil cover, and diversifying crop rotations.

[8] CEA includes low-tech protective infrastructure (e.g. netting) to mitigate production losses, and higher-tech integrated systems (e.g. hydroponic systems) to increase yields and resource efficiencies (GreenCape, 2017).

Africa had only about 14 196 ha under organic agriculture in 2016, which has actually decreased by 35 816 ha over a 10-year period. Globally, 1.2% of agricultural land is cultivated organically, however, in South Africa, organic agriculture only account for 0.01% of the country's agricultural land, illustrating the growth potential in the country (Helga and Lernoud, 2018).

2.2.3 Energy-related markets driven by climate change adaptation

The energy sector, while traditionally associated with climate change mitigation only, also has a critical role to play in adaptation. The sector is responsible for the lion's share of global GHG emissions. At the same time, the sector has to adapt to changing circumstances. Decarbonising the energy sector is furthermore a key avenue to ensure the resilience of the economy and society to climate policy shocks. The energy market is large and continues to grow at a fast rate. The World Bank estimates the market for clean energy technologies in developing countries from 2013 to 2023 could be just over US$2 trillion, of which about a third would be accessible to small businesses (infoDev, 2014).

Table 4: Climate change implications for energy sector

Impact	Adaptation responses/ options
The economy is energy intensive and relies on coal-fired power plants, which require significant volumes of water. Hydropower generation is highly dependent on water availability hence vulnerable to changes in water availability. Energy infrastructure at risk from extreme weather events, e.g. in coastal areas risk from rising sea levels and saltwater damage. The increased risks of floods, **water abstraction**, and heat-related damage have impacts on transmission and maintenance costs.	- Greening of the energy value chains including energy efficiency. - Adjusting power plants and electricity grids. - Building climate-compatible energy infrastructure. - Diversification into alternative energy sources such as renewable energy and second-generation biofuels. - Need to understand and incorporate projected climate change effects into the designs of renewable energy.

Source: Authors, compiled from DEA (2017, 2013) and Noble et al. (2014, p. 845)

Improving energy efficiency is an important area with a huge market. A conservative estimate of the value of the Energy Service Companies (ESCOs) market, based on targeted energy savings and assumed market penetration, is between R2.6 billion and R7.8 billion over the 2014-2024 period (IDC, 2013). GreenCape (2017) identified a number of opportunities, such as the growing need for energy audits to provide correct data and information on energy consumption in farming operations.

For instance, climate change is associated with adverse changes in temperatures, which might require more air conditioning (AC). The International Energy Agency (IEA, 2018) noted that the energy demand for space cooling is growing faster than any other end use in buildings, and currently, about a fifth of all the electricity consumed in buildings is used for cooling. Energy consumption for AC in buildings in South Africa, doubled from 4 terawatt hours (TWh) in 1990 to 8 TWh in 2016, while globally it more than tripled from 608 to 2021 TWh over the same period. The demand for AC is growing across the world, creating opportunities along the value chain for small businesses to participate. Between 1990

and 2016, annual sales of ACs globally nearly quadrupled to 135 million units, while in South Africa the annual sales were about 0.3 million (see Table 5). By the end of 2016, about 1.6 billion ACs were in use globally, including about three million in South Africa. Using more energy efficient ACs, coupled with decarbonisation of power generation, can contribute to significant reduction of GHG emissions (IEA, 2018). These new and efficient technologies can be incorporated into new buildings as well as being retrofitted into old ones.

Table 5: Air-conditioning units and cooling capacity in South Africa and the world, 2016

		Million units			GW output capacity		
		Residential	Commercial	Total	Residential	Commercial	Total
South Africa	Installed stock	1	1	3	6	15	22
	Annual sales	0.1	0.1	0.3	0.9	1.1	2.1
World	Installed stock	1 093	529	1 622	6 181	5 491	11 673
	Annual sales	94	40	135	848	359	1207

Source: Authors, extracted from IEA (2018, p. 19)
Note: Gigawatts (GW) of capacity is the cooling output capacity, which refers to the thermal output of air conditioning systems.

In addition, the current market for solar photovoltaic (PV) in agriculture in the Western Cape was estimated at about R150 million and projected to grow. The potential market size for solar-powered irrigation systems is worth R2.9 billion in South Africa.

In addition, there is a significant market for the production and distribution of clean fuels. Though renewable energy is associated mostly with mitigation, it also has adaptation co-benefits. For instance, participating in the renewable energy value chain can be a form of livelihood and income diversification for small business and small-scale farmers. However, an important dimension in the WEF nexus relates to the competition between the production of biofuels and food crop production. In this context, DAFF (2015a) asserts that these consequences can be minimised by targeting under-utilised arable and marginal land as well as waste-based production. The global market for sustainable fuels is forecasted to reach US$185 billion by 2021 (We Mean Business, 2018). There are initiatives at the global level that seek to promote the growth of the market. For instance, *below50*, an initiative of the World Business Council for Sustainable Development, seeks to promote and scale up demand and deployment of low-carbon fuels by encouraging more companies to adopt sustainable alternative fuels. The *RE100*, an initiative of The Climate Group in conjunction with CDP, encourages companies to use 100% renewable sources of energy. The *EP100* (an initiative of The Climate Group, the Alliance to Save Energy, and the World Green Building Council) targets energy-smart companies that want to use energy more productively and lower GHGs.

While this section only highlights climate change adaptation options associated with the water-energy-food nexus, it is important to note that there are many other opportunities in other sectors (such as forestry, health, marine fisheries, biodiversity and ecosystems, human settlements, disaster management, mining and extractives, and transport sectors). However, the various market opportunities are not easily accessible to small businesses. For them to actively participate, there is a need to support them to overcome the myriad of constraints they face. The next section highlights the business models that can be employed to tap into the market opportunities.

3 FROM MARKETS TO BUSINESS MODELS

Markets for adaptation-related solutions are large, diverse and growing, as illustrated in the previous section. Such markets are also complex and heterogeneous, driven by varying dynamics. Tapping into these markets requires tailor-made business models and strategies. This section explores the different market segments and associated business models that small businesses can employ to bring their adaptation-related solutions to market. For the purposes of this study, business models refer to how small businesses create value for their consumers, producing adaptation products and services.

3.1 Typology of market segments

Small businesses are well-poised to drive forward adaptation efforts in an economy. However, small businesses and entrepreneurs face unique circumstances when compared to larger businesses that provide adaptation-related solutions (i.e. goods, technologies, processes and services). They face the daunting task of bringing a quality solution to market, often where markets are new and undeveloped. The limited demand for small business solutions is also explained by the lack of an innovation focus in state procurement, where the state prefers established solutions, which does not favour innovative solutions. Further, small businesses possess limited resources at their disposal and a lack of knowledge and information on markets (Montmasson-Clair and Mudombi, 2018).

Figure 4: Adaptive responses to climate change

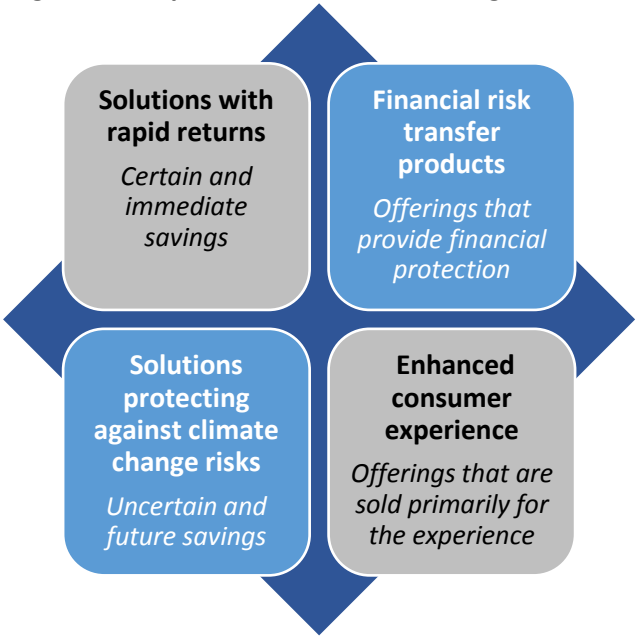
Source: Authors, adapted from BMZ et al. (2016, p. 4)

Small businesses in the adaptation space face additional constraints over small businesses in other markets. The provision of adaptation products and services is difficult for a number of reasons. While adaptation needs are evident, as shown in Section 2, the often long-term and uncertain nature of the risks is not powerful enough to trigger a large demand. Potential consumers may not be fully aware of the available solutions and their associated benefits. Risk aversion and the lack of green economy focus in procurement plans also limit the demand for adaptation offerings in the private and public

sectors (Montmasson-Clair and Mudombi, 2018, pp. 7–8). Therefore, it is often the case that small businesses may provide solutions for which there are no appreciable markets and demand is limited.

The catalyst for adaptation responses can come from a number of sources. Perceptible weather changes, supply constraints, and (possibly resultant) changing consumer demand all can drive adaptation responses. For an adaptation business to survive and thrive, however, an essential component that the business needs to ultimately understand is the potential adaptation responses of their consumers. Understanding adaptation responses that potential consumers take is important for (small) businesses when thinking about their business models. These responses, illustrated in Figure 4, inform the adaptation solutions for which there is appreciable demand.

Figure 5: Adaptation business model segmentation



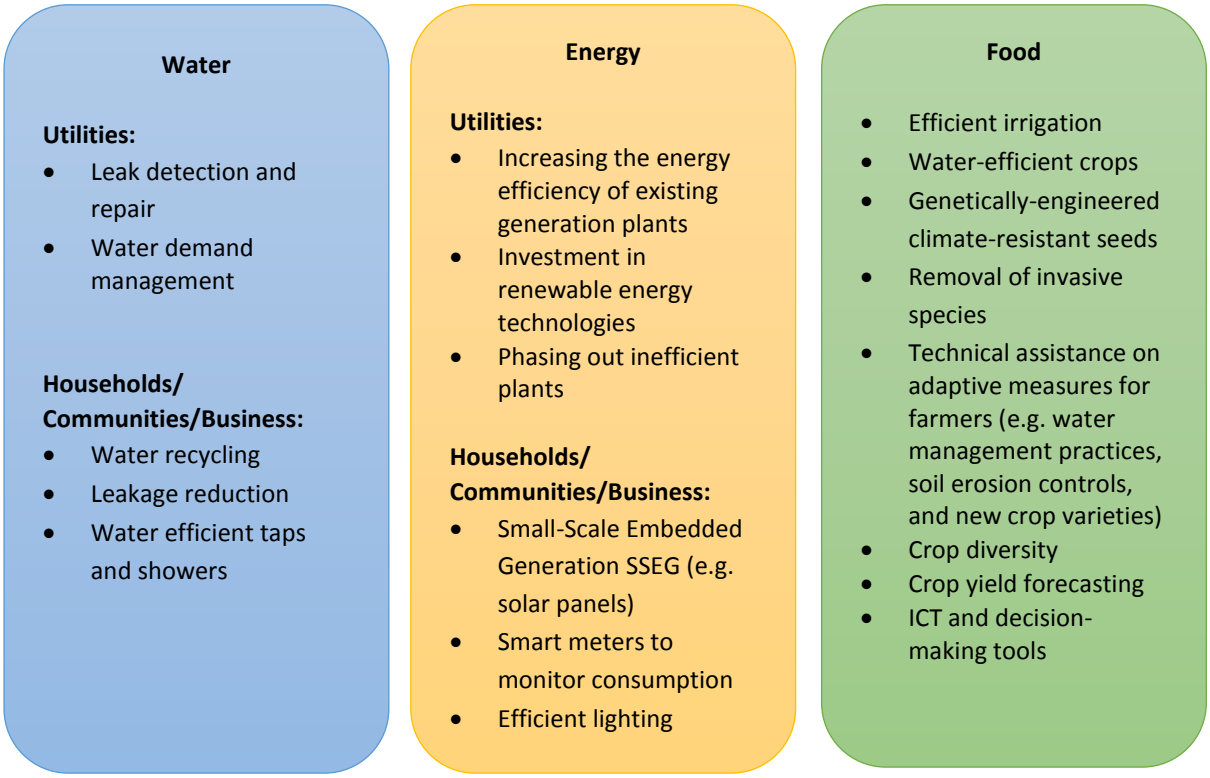
Source: Authors

Adaptation solutions can largely be segmented into four market segments, depicted in Figure 5. Each segment has a corresponding business model. Key distinctions emerge between the market segments and provide greater clarity on consumers' main decision-making criteria. In line with Figure 2 in Section 2, these distinctions relate to whether solutions are being implemented in an anticipatory (i.e. voluntary) or reactive (i.e. triggered) fashion; and whether offerings generate short-term/certain or long-term/uncertain financial benefits. Importantly, some solutions may fall in more than one market segment depending on the client's motivation or the product's characteristics. For example, a water-efficiency device, such as a tap or low-flush toilet can afford the proactive consumer a lower water bill while affording protection during anticipated water scarce times, despite the consumer not facing any water supply issues. In this case, the product offers savings and is of an anticipatory nature. During a period of water stress, a consumer will be forced to purchase the same type of water efficiency devices due to the cost of water and possible supply restrictions. In this scenario, implementation is reactive to a water-scarce scenario and is meant to relieve an immediate need.

3.2 Solutions delivering rapid return on investment

In this market segment, adaptation solutions generate financial returns that lead to a short and relatively certain payback period. Typically, such offerings make financial sense as the immediate financial benefits serve as an attraction. Such solutions are mostly implemented in an anticipatory fashion as a result of their financial attractiveness. There are numerous examples of solutions that can be marketed in this segment, as exemplified in Figure 6. Interestingly, such products often have mitigation co-benefits as they lead to resource efficiency and savings.

Figure 6. Adaptation offerings with immediate benefits



Source: Authors

3.2.1 Techno-economic potential

In this market segment, solutions are typically marketed on their affordability, i.e. their ability to generate financial benefits to customers. These solutions bring short-term and a relatively certain payback period by generating financial savings. It is therefore vital that solutions are viable and competitive on price either (a) compared to their substitutes when existing solutions are available, or (b) compared to other investments that consumers could make given limited resources.

For example, as raised in Section 2, an opportunity viewed as a low-hanging fruit in the water sector is attending to the high rate of NRW, specifically losses due to leakages. Locating and resolving leakages in the water system provides immediate financial benefits through the conservation of a limited and scarce resource, and represents one of the lowest cost interventions to ensure water security. This can happen through investments in water audits and sensors which detect leaks rapidly (WRG, 2009). A similar case can be made for energy efficiency.

Such solutions do require an upfront investment, however, which can be substantial. As a result, these solutions are attractive to large businesses and households with relatively high disposable incomes that have the cashflow and investment capacity to afford the upfront capital outlay. In an environment in which firms and households prioritise investments with the highest returns, such interventions need to demonstrate large and fast benefits to be implemented. Government support programmes can make some solutions even more attractive and enhance market demand. This is particularly important when a large upfront investment is required to implement the solution. For example, while solar home systems provide consumers with electricity security and prices have been declining in recent times (coupled with rising electricity prices, this leads to a short return on investment), such systems remain relatively costly to purchase and install.

In this respect, government interventions are critical to level the playing field (with other technologies) and/or to provide the enabling regulatory framework. For example, the sale of excess electricity by prosumers (i.e. consumers also producing electricity through their own generation systems) equipped with SSEG back to the municipality at a regulated rate allowing consumers to pay off the investment in the technology and limit their electricity consumption. Such a practice is already present in the Western Cape, for example. This creates a derived demand for such technologies if it is linked to a revenue-generating venture.

These investments are also attractive for more vulnerable groups, such as small businesses and household with low disposable incomes, provided that these groups can receive assistance to fund the initial capital investment. Once made, these investments deliver ongoing financial benefits, such as reduced expenses, and are attractive as they increase disposable income. In this case, government support programmes play an even greater role in unlocking the market potential. The subsidisation of water efficient taps and showers for vulnerable households can, for example, drive the market demand for such solutions while offering savings to consumers, after installation.

In the case of untested and new technologies, the financial benefit might not be sufficient to drive demand. In other words, a *laissez-faire* approach may be insufficient to organically generate market activity and some external initiator or catalyst is warranted. The degree of information asymmetry and uncertainty between the supply and demand side increases, the more novel and technically complex an adaptation offering is. This asymmetry serves as a barrier to investment and perceptions, particularly in vulnerable consumer groups which do not have the resources to bridge the gap. In the agricultural sector, for example, adaptation solutions include drought-resistant seeds, efficient irrigation systems and the removal of invasive alien plant species. All of these interventions require the correct pricing as well as the adequate level of awareness for the technologies to diffuse in the market.

Perceptions around genetically-engineered crops, for example, can have an impact on market demand for such crops. While genetically-engineered seeds boast advantages of resistance to insects and herbicides, increased tolerance to heat and cold, and potentially higher crop yields, consumer concerns around allergic reactions, antibiotic resistance, and cancer may cause market resistance (Sullivan, 2016). As a result, farmers may be hesitant to invest in such offerings due to changing end-user preferences. Entrepreneurs in the water treatment segment face similar difficulties and resistance due to perception about the quality of treated wastewater.

Start-up Energy Water Environmental Food Sustainable Technologies (EWEF-Sustech), which has developed a pioneering water cleaning system harnessing the power of chemistry is one example of a firm attempting to break through in this challenging environment (see (Montmasson-Clair, 2019) for a case study on EWEF-Sustech).

3.2.2 How can small businesses get involved?

The adaptation solutions for this segment are regarded as the "easiest" to sell given that they deliver benefits soon, meaning that they are paid off within a relatively short amount of time (below five years generally). A distinction can be drawn between the provision of low-tech solutions and innovative, hi-tech solutions. The former is usually associated with a higher degree of competition, while the latter embraces a new technology for which there is no substantial competition. Taking advantage of the characteristics of this segment, a number of recognised business models for small business can be employed.

- *Using established online platforms for technology and solution dissemination.* Given the relative marketability of products in this market segment, small businesses can take advantage of the multiple existing platforms through which new businesses can market their solutions and reach consumer markets. Online sales channels, such as eBay, allow suppliers to link with consumers globally, principally final consumers. Other platforms, such as Ali Baba/Ali Express, allow businesses to reach other businesses at a wholesale/distribution level. Locally, platforms, such as BidorBuy, also allow retailers to meet consumers. These platforms serve as the marketing ground on which small businesses can effectively reach their target markets, and advertise their products for a relatively low cost. These platforms also feature an auction system, which allows sellers to test the willingness of the market to purchase the solution and determine what price consumers are willing to pay. Online sales platforms have the added benefit of being a forum for free advertising through a feedback system, helping to add credibility to the brand, particularly at the initial stages. New and innovative applications, such as Google My Business, also allow small businesses to list themselves to appear in local searches (of the area they are situated) as well as keep abreast of news in their industry at no cost. This is particularly helpful for businesses, providing a low-tech solution that focuses on a specific geography and appeals to a local demographic. Such applications also assist firms to manage their brand image. Some company, such as Waste Intrique (see (Mudombi, 2019c) for a case study), also develop their own application to enable their business model. Finally, many small businesses have turned to social media to increase accessibility of their products. Applications, such as Facebook and Instagram, can be used to market products for free. Promotions, such as competitions and free giveaways, can also help boost sales and reach. Further strategic partnering with influencers, who are individuals that have a large subscriber base, to market the product can be a useful strategy to employ.
- *Value-added services.* Another type of model for this segment is setting a cost-competitive price for products but adding services for an additional cost. Additional services could include maintenance, training and other technical services which can be purchased for an additional fee. Value-added services also allow small businesses to guarantee stability in cash flows if

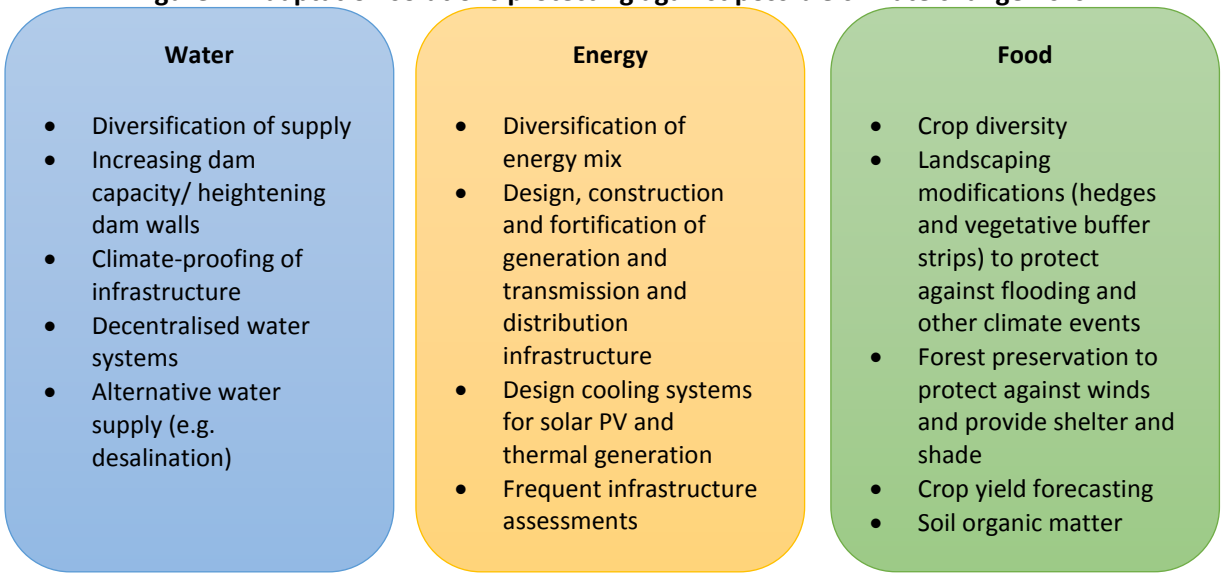
payments are scheduled when the additional services occur, and if these can be distributed strategically across a given year.

- *Modular design.* Another strategy to keep prices competitive is to incorporate modularity into the design of solutions. A basic model consisting of bare necessities for operation can be sold at the lowest price, with additional add-ons that can be incorporated for an additional price. In this way, customers can be catered to, based on ability to pay, and those willing to purchase a premium product can be provided with a greater service.
- *Keeping connected with customers through newsletters.* Developing a feature that connects customers to a business is an ideal way to disseminate new developments in the business, as well as new products and services. In addition, it ties the business with a specific service/product in the eyes of the customer. The entry costs for such an activity are not high as all it involves is an internet connection, and basic formatting and editing skills.
- *Franchising model.* Once a functioning business model is developed, a way to scale up the business is to sell the franchise to other entrepreneurs. This can be developed as a business concept on its own, with providing the franchisee the necessary capital/equipment, training material, training workshops, connecting them to the right suppliers and assisting franchisees to identify target markets. Royalties earned on the franchisees sales can help the business to scale up and also assists in diffusing the new technology.

3.3 Solutions protecting against possible climate change risks

The second market segment concerns adaptation solutions that do not necessarily bring short-term financial benefits, but build resilience for consumers and provide protection against climate change risks. Solutions in this market segment are therefore likely to be triggered (rather than voluntary). Voluntary implementation of such options tend to occur when consumers have better predictions of future climate events, or are highly risk-averse. Examples, shown in Figure 7, within this market segment include the climate proofing of infrastructure, such as the raising of dam walls in anticipation of future rainfall and flooding.

Figure 7: Adaptation solutions protecting against possible climate change risks



Source: FAO (2007, pp. 11–12)

3.3.1 Techno-economic potential

The viability of adaptation solutions in this market segment depends on the type of technology, the risks they are meant to protect against and cost implications for consumers. Typically, such projects generate no (immediate) cash return or one that is limited compared to the risk involved, rendering them less attractive than projects with a short-term return on investment (CAN, 2013, p. 13). The main motivation for such solutions is not the financial benefit they may deliver, but the risk mitigation they provide by preventing economic (and therefore financial) losses as a result of climate change impacts.

Examples of solutions in this type of segment include long-term resilience-building solutions. In the water sector, for example, desalination plants represent a long-term adaptation strategy to increase water supply by diversifying the water mix and placing reduced stress on traditional sources that are threatened. In energy, the diversification away from a singular energy source, such as coal, reduces the vulnerability of the sector to policy and climate risks and builds resilience to future shocks. Diversifying crops represents a long-term strategy to deal with potential drought scenarios in the future, where some crops may be more drought-resistant than others.

The adaptation offerings in this type of business model are accompanied by a degree of uncertainty and tend to not be financially viable on a pure expenditure versus revenue basis. Such investments do not generate direct financial returns, rather they protect against losses which may (or may not) materially arise in the future. Whatever financial benefit they may generate is uncertain, distant in time and immaterial. Investors' time preference for short-term (rather than long-term) and cash-based (rather than immaterial) returns makes such investment harder to sell. The uncertainty arises from an inability to accurately determine whether an adverse climate event will occur in the future and what the impact of that event, if it does occur, will have on the consumer. The difficulty in predicting future climate events (both from a climatic and policy perspective) contributes to this uncertainty. The uncertainty of future returns and the time value of money add to the actual investment cost. The time value of money impacts on investment decisions as the more distant the potential return on investment occurs, the less attractive such an investment becomes, and greater returns could be realised from alternate investments, particularly those which guarantee sooner or more probable returns.

Such adaptation solutions, which are not directly financially-viable and requires exploratory engagements, often require partnerships. These can take the form of a public-private partnership, a public-private collaboration, or a community-based approach. The scale of projects and the target market determine the type of financing used by consumers and the source.

Adaptation solutions in this segment span a number of different sectors. In the water and energy sectors, offerings are unlikely to face technical issues with market uptake unless technologies are entirely new and have not been developed to operate at the scale required. Building resilience in the energy sector relates to generation, transmission and distribution infrastructure. The spatial distribution of generation infrastructure, for example, is an adaptation strategy that builds climate resilience through distributing generation infrastructure across the country, such that an adverse climatic event at one point does not compromise the entire system (EUEI PDF, 2017, p. 30). Such a solution is relevant for South Africa, a country that is highly dependent on a single energy source (coal) that, while in relative abundance in the country, faces increasing policy and climate risk. A shift to greater renewable energy diversity in the energy mix will see greater geographic dispersion of

generation capacity to the Western Cape (wind) and Northern Cape (solar) in the medium to long term, where such generation capacity is ideally placed. In the water sector, building resilience into existing water infrastructure is an adaptation option, where new dam capacity can be built in regions of expected high rainfall, or dam infrastructure can be fortified through the raising of dam walls to protect against future flooding. Such investments are highly capital intensive and require substantial civil works. Offerings in the agricultural sector also face limited technical barriers from an operations point of view at the demonstration/pilot level; however, the viability and success of these offerings would be based on technical criteria and ease of implementation and their ability to be adapted to different operations. Increasing crop diversity is a means of increasing the resilience of agricultural production through genetically increasing the ability of crops to be resilient to changing climates or through planting multiple types of crops.[9] Choosing the correct crops is important, as different varieties of a single crop, such as rice for example, can exhibit varying resilience and may even contribute to climate change (FAO, 2007, pp. 9–10). Analysis of the potential crops has to be carried out to determine the appropriate crops that introduce resilience, do not contribute to maladaptation, and are profitable for the farmers.

In the agricultural sector, direct state support can go far in assisting consumers to build resilience in agricultural systems, most notably the vulnerable smallholder establishments. Vulnerable farmers typically plan for the short term and interventions such as agricultural extension can be a powerful tool for technology diffusion and adaptation for the long term. Direct funding and incentives, such as support for new technologies and new crop varieties, would increase uptake and demand for such products. Other fiscal incentives, like credit schemes, can also be implemented in this respect.

3.3.2 How can small businesses get involved?

The adaptation solutions for this segment generally are of a long-term nature, and build resilience to climate change risks. The features of this segment make solutions typically a costly exercise; however, there are possibilities for projects to be of a smaller nature. In this segment, small business can be involved in the following ways.

- *Establishing niched expertise.* Small businesses in this segment would be better off focusing on developing fine-tuned and niched expertise in their area of practice. Developing customers within a very narrow untapped sub-segment of a large market may prove to be a superior strategy than trying to target the entire market. In this way, the business can build its resources within that sub-market and move onto adjacent sub-markets when attempting to expand. A mistake often pursued by small businesses is to diversify solutions too soon, which may leave such businesses with a lack of focus and unable to build a critical mass of consumers. Further, incremental growth can also provide the entrepreneur with valuable experience before embarking on larger ventures.
- *Large-scale projects and partnerships.* While smaller businesses may not possess the scale to service entire large-scale projects, they can seek out joint-venture opportunities to partner with similarly-sized small businesses, such that solutions can be offered to the scale required by a client. Some state tenders allow for the partnering of firms in bidding for projects, for

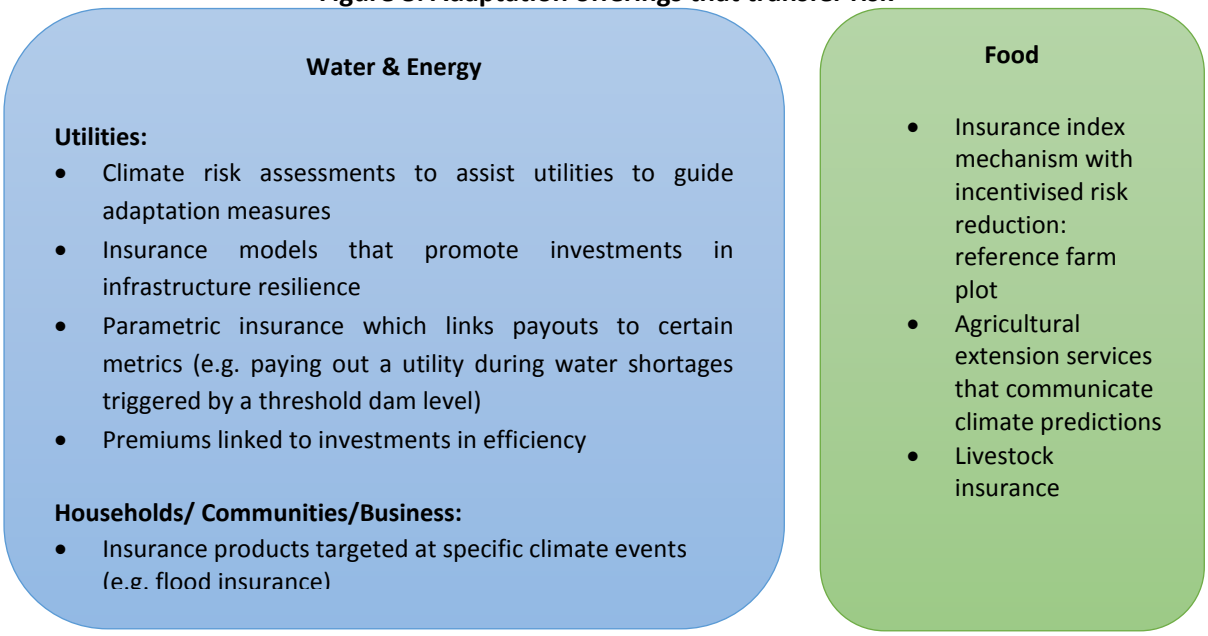
[9] The rationale behind planting diverse crops is that different crops are able to withstand climate events to varying degrees. A diversified plantation is more resilient to adverse climate events compared to one where there are only a single or few crops.

example. If businesses developed niched expertise (as mentioned above), this approach will also allow small businesses to benefit from synergies in combined expertise. Partnerships can also be formed by joining industry associations and attending industry events. Interactions with the market in this way can help small businesses identify new business opportunities and customers. An alternative approach could take the form of high-performance teams which collect competent skills in focused groups that target specific projects.

3.4 Financial risk transfer products

The third market segment proposes to transfer risk, rather than directly protect against it. Financial risk mitigation products have been gaining traction in recent years as a means to transfer risk to the financial sector in exchange for a premium. Between 2017 and 2018 alone, three major climatic events which happened in South Africa triggered catastrophe-related claims, and it has been noted that catastrophe claims have been on the rise since 2012. The country's largest general insurer, Santam, paid out claims for about R2 billion related to fires in Western Cape (including Knysna), and storms in Gauteng and KwaZulu-Natal (The Citizen, 2018, 2017). Products such as climate insurance, can be voluntary or triggered. They are a pure cost and bring no certain financial benefits. The uptake of such products depends on the consumer's risk perception and this varies between sectors and clients.

Figure 8: Adaptation offerings that transfer risk



Source: GWP (2018); UNISDR, n.d.; U.S. Department of Energy (2013)

3.4.1 Techno-economic potential

The loss and damage associated with weather-related events strengthens the need to insure assets, hence insurance is an important component of the response strategies to climate change-related impacts. Climate-related impacts in Southern Africa have been estimated to cost around US$10 billion in damages between 1980 and 2015 (Davis-Reddy and Vincent, 2017). Floods have been the most frequent type of climate-related disaster, while droughts have contributed to the highest economic cost of damages, affected a larger proportion of the region's population, and caused most deaths. Storms have displaced and injured the most people.

In the water and energy sectors, climate risk assessments conducted by the insurance industry can help utilities fortify their infrastructure, such as power stations and dams. Other products, like parametric insurance, trigger payouts based on the value of an established metric. For example, a water utility can receive financial compensation if dam levels fall below a certain established level which serves as the metric. In the agricultural sector, an insurance model that pools consumers of similar risk[10] has found success in Bolivia. The most efficient farm is chosen as the reference plot and used as a metric to monitor whether production levels have been adversely affected by environmental factors. The reference plot determines an insurance payout to all farmers. Peer farmers in the group are incentivised through better premiums to match or beat the yields produced on the reference plot (UNISDR, n.d., p. 6). The design of these climate risk transfer products is based on different dynamics when compared to more traditional insurance products, which offer risk mitigation against the loss of a specific asset.

The lack of credible and reliable data on which to base climate predictions for adaptation-related insurance remains problematic. Predictions are important for the risk assessment performed by an insurer, which then determines the viability of providing insurance. Further, accurate predictions provide insurers with the ability to advise consumers on the expected climate events, which determine the necessary investments that would be required to build resilience into operations. Indeed, beyond playing an income-security role, financial risk mitigation products also can act as risk-mitigation tools and assist in adaptation to climate change (UNISDR, n.d., p. iv). Since insurers are able to identify, analyse and predict risks, they can assist consumers to understand the risks they face and guide them in managing them (U.S. Department of Energy, 2013, p. 5.).

To ensure that adaptation insurance products achieve desired effect, it is vital to create or empower institutions, such as the South African Weather Service (SAWS), that are able to provide accurate forecasting of adverse climate events. Accurate data and predictions are vital for these types of products to work. Collaboration efforts between institutions should be encouraged, such as partnerships between SAWS and the CSIR, combined with representatives of the insurance industry to ascertain the most credible, reliable and accurate forecasting and data on which to make decisions.

Risk transfer products like insurance also provide income security, protecting the vulnerable through smoothing consumption and lessening the financial and economic shocks due to the adverse climate events (UNISDR, n.d., p. iv). Nevertheless, certain consumers are constrained in their ability to purchase insurance, particularly if the activity they are insuring for is high risk, which is reflected in the premium. For vulnerable groups, like poor households and smallholder farms, affordability is likely to be an issue preventing uptake. In developing countries, underinsurance has been identified as a key issue in these vulnerable groups. For these groups, state support can supplement their ability to pay for insurance, and along with well-tailored insurance packages that incentivise the building of resilience into business/household activity, could serve the vital functions of protecting the most vulnerable in society and driving adaptation to climate change. Microinsurance, for example, is a specific type of solutions aimed at low-income consumers to protect them against risk for affordable premiums (UNISDR, n.d., p. 6).

[10] Plots of farmland are chosen in areas which are geographically similar in temperature, precipitation, humidity, and type of soil.

The state can also drive forward the uptake of transfer mechanisms through levers, such as legislation. In high-risk areas, a review of the legislation around mandatory insurance could be conducted in terms of whether investors are fully protected against risk, the types of risks they are exposed to, and the level of insurance they would require when purchasing new property. Such legislation could create demand for climate insurance and draw in insurance firms in supplying these markets. Utility-level water and energy infrastructure could be incentivised to subscribe insurance and build resilience. Climate resilience criteria could be associated with funding allocations by both public and private entities, ensuring that funding for capital investment is accompanied by some form of adaptation and resilience-building.

For the insurance industry to increase its participation in providing climate insurance, however, it need will rely on the state to increase the resilience of public infrastructure, such as roads, electricity, and water infrastructure to name a few. For an insurance firm to be profitable, it has to mitigate as much risk of adverse events as possible and the state can attract insurance into adaptation through investing in fortifying public infrastructure. Projects which have brought together the public sector and the private insurance industry have seen successes in other countries. In the UK, for example, flood schemes take the form of an arrangement in which the public sector invests in building flood-resistant infrastructure while the insurance industry provides cover to affected parties. Vulnerable groups can also be supported by not-for-profit agencies set up where the state and the insurance industry collaborate and provide insurance to consumers who cannot afford it (GWP, 2018, p. 23). Another route of support to the insurance industry is the provision of government guarantees, particularly for high-risk vulnerable groups that can provide the insurance industry with added security in the event of defaulted payment.

3.4.2 How can small businesses get involved?

The insurance industry is uniquely based on the services it offers and has its own set of challenges to entry. The top five non-life insurers hold 56% of the market, and possess deep pockets, diverse product ranges, and large client bases. Smaller players find it difficult to establish scale and compete (PwC, 2018, p. 19). In 2018, The Insurance Act (No. 18 of 2017), which was passed in 2018, introduces measures to increase access to insurance for South Africans, as well as increase the ability of small businesses to enter the industry, the latter being linked to South Africa's Broad-Based Black Economic Empowerment Act (No. 52 or 2003). Provisions have also been made in the Act to increase microinsurance products which cater for lower-income consumers. This is a notable step towards the inclusion of smaller players into an industry that is normally dominated by a handful of larger insurers.

It is difficult for a small business to enter the industry as an insurer due to the large capital reserves required to be an insurer as well as the regulatory hurdles. Taking this into account, small businesses offering adaptation solutions in this segment can position themselves in the following ways.

- *Leveraging technology to provide solutions.* The 2018 PwC Report, *Ready and Willing: African insurance industry poised for growth,* highlights "*digital operations"* as the key skill deficit facing the industry. Competencies in digital and data handling, and innovation are prized by insurers. Small businesses developing a core expertise in climate and adaptation digital operations can leverage these skills to provide such services to large insurers that demand them. A key new trend in the insurance industry is *bancassurance*, which refers to insurance products being sold through banks. This also represents an opportunity for small businesses

to develop software interfaces between banks and insurers which specifically target climate-related insurance. The sale of insurance products through mobile applications is one of the most important growth strategies by insurers currently, and the development of software applications in this space is an alternate entry point for small businesses (PwC, 2018, p. 47).

- *Microfinance.* The Insurance Act passed in 2018 aims to make microinsurance products more accessible, affordable and fair for consumers, introduces standards for microinsurance products, and provides a regulatory framework making it easier for low-income earners to access insurance. This incentivises the roll-out of innovative products, subject to products standards (IOL, 2018). This represents an opportunity for small businesses to enter the climate microfinance industry under certain rules and requirements – an industry previously beyond reach for them. While the capital requirement to enter the microfinance is lower than that of traditional insurance, the reserve requirement is still sizeable, at R3 million of required reserves. Should there be a policy shift to lower this requirement, this type of insurance activity will be within the grasp of a greater proportion of small businesses.
- *Niched focus service offerings to large insurers.* Large insurers can and do outsource certain competencies to firms, when they do not possess these competencies internally (FSB, 2019).
- Small businesses can take advantage of this by developing the skills demanded by large insurers. For example, while the accurate prediction of floods is difficult, a firm that develops technical expertise could use this as a competitive edge to sell this expertise to large insurers.
- *Brokerage services.* While growth in direct sales to the end consumer (without a broker) has been higher than growth in brokerage services recently, brokerage services still remain the chief channel through which insurance is sold in South Africa (PwC, 2018, p. 47). Small adaptation firms can specialise in offering a basket of climate-related products that they can advise clients on, based on their ability to pay and risk profile. Becoming a broker is not specifically arduous and programmes are widely available to enter the space.

3.5 Solutions enhancing consumer experience

A final market segment relates to solutions that enhance the consumer experience, provide a new experience and/or protect a certain lifestyle.

Figure 9: Adaptation solutions that enhance consumer experience

Source: Authors, adapted from (Forbes, 2017; Speier, 2016)

Solutions in this segment, while offering adaptation as well as mitigation benefits, would be primarily sold on providing an aspirational experience. A good representation of such offerings is found in consumer markets, such as eco-friendly furniture, foods, and cleaning agents (see Figure 9). Demand for such products is essentially voluntary and driven by personal rather than financial motives.

3.5.1 Techno-economic potential

Consumers of such products tend to generally fit a middle-to-upper income demographic and derive utility from luxury, status and/or climate friendliness. Though consumers are increasingly placing reliance on green and sustainable products, they still value luxury and experience. Products and services that posit the consumer experience as paramount provide additional utility to consumers in that the solutions are eco-friendly and sustainable. Solutions which would protect a certain (generally high-income) lifestyle, such as capture systems for pool filling, would also fit into this category. This does not preclude the targeting of lower-income households, however, such households are typically constrained in their ability to afford goods and services which are not essential.

Demand for such "frontier" solutions remains limited. In addition, in the case of luxury items, the sustainability angle has to be approached with caution. Introducing a sustainability element to luxury goods can have a negative impact on the perception of a brand as consumers may view certain types of sustainable goods as inferior. For example, the use of recycled material in luxury-branded clothing can lead to negative consumer perceptions (Beckham and Voyer, 2014, p. 245). In this way, producers of sustainable offerings that aim to enhance the consumer experience have to bear in mind consumer perceptions of certain types of sustainability.

From an economic point of view, solutions not viewed as essentials would not be affordable to most of South Africans. Greater inclusion can be fostered through supply-side policies that encourage the development of markets which cannot be reached by lower-income households, with the aim of making these goods and services more affordable. Supporting the development of agro-ecology food products, for example, is one avenue that can be pursued. Support which develops affordable organic produce could serve both adaptation climate change and national health agendas. There is also room for adaptation products in this segment to be marketed at the middle-to-upper income demographic. An important dynamic to consider is the nature of leaders and followers in the respective industries. In fashion and retail for example, large and established luxury houses are often first-movers with other brands imitating and following the designs and trends set by the luxury brands. This positions luxury brands well to set sustainable trends in the industry.

This market segment mainly targets early adopters, trendsetters and pioneers. There is also room for adaptation solutions to be aimed at retail channels. However, these would refer to consumables commonly used by the public, including recyclable carrier bags, organic fresh produce and meat, and recycled clothing.

Consumer education is certainly an important intervention to drive demand for the types of solutions described in this market segment. By encouraging consumers to purchase goods and brands that are sustainable, large retailers and the state can encourage producers to enhance the sustainability of their businesses as well. This is demonstrated by Positive Luxury (a firm in the UK) which provides a service to luxury brands, whereby the firm conducts a detailed sustainability audit of brands wishing to promote sustainable consumption. A successful audit allows firms to display a certification that

provides assurance and comfort to consumers, knowing that the goods are produced in a sustainable manner.

Since solutions in the market segment largely target consumers with a reasonable level of income, it is unlikely that any form of external funding would be required on the demand side. Support on the supply side with the aim of affordability can certainly create access to adaptation goods and services for lower-income households and increase demand for such goods and services. Due to their aspirational nature (particularly those targeted at wealthier demographics), however, offerings in this model possess a high risk of variability in line with economic cycles. Their demand would likely wane during economic downturns. Direct state intervention in markets through mechanisms, such as subsidies or grants can be used when developmental concerns are aligned with adaptation and greater inclusion of lower-income households is desired. Beyond these instances, support would be unnecessary but brand recognition (i.e. certification and labels) would facilitate support market demand.

3.5.2 How can small businesses get involved?

Depending on the type of product, small businesses in this segment can adopt a number of strategies to create demand for their products. It is important to note the distinction between high-end and low-end products which are priced differently. This distinction is noted when applicable in the strategies below. Due to the mass nature of certain goods, particularly FMCGs, solutions in this segment can really assist in creating widescale public awareness and disseminating information about adaptation.

- *Niche/specialised products in speciality stores.* Small businesses targeting a wealthier market can focus on developing specialised products for distribution through only certain channels. For example, custom-made eco-furniture, recyclable coffee pods and luxury eco-lighting can be distributed through only selected speciality store at specific locations. This allows the brand to maintain a certain premium, attract a certain demographic and ensure exclusivity. Maintaining the premium nature of the good can also be achieved through partnering with famous social and public personalities. Tying the brand to a celebrity, for example, can go far in promoting the brand in marketing.
- *Using social media.* Social media has become a key forum through which small businesses can grow, and the use of this resource can be a starting point for entrepreneurs, as mentioned above. Partnering with influencers can help generate traction for the adaptation solution and assist the business to attain customer reach.
- *Target large retailers.* As an entry point into the broader consumer market, large retailers can also be targeted, such as Pick n Pay or Woolworths, and products can aim to bolster both the aspirational nature of the good combined with the climate benefits. This strategy operates on the assumption that the small business is producing a solution for the mass retail market which displays a certain level of price sensitivity. Examples of such products include sustainably-made detergents and other FMCG products. Negotiations with retailers can include a trial period combined with advertising in-store to promote the product. This could include free give-aways and competitions to entice consumers to purchase the product.

4 FROM OBSTACLES TO POLICY RECOMMENDATIONS

While the role and potential of small businesses have been acknowledged by stakeholders including government, small businesses remain largely left behind due to structural obstacles hindering their development. This neglect means that their potential is mainly unharnessed, and that they are prevented from flourishing, increasing growth, enhancing employment, and innovation in the country. From a green economy perspective, this neglect also translates into a missed opportunity in driving forward the adaptation of South Africa to climate change.

Small businesses in general face structural obstacles. These obstacles relate to their size, limited resources, unfavourable policy, industry and market conditions. These obstacles prevent them from growing, scaling up, and taking advantage of regional and global value chains (OECD, 2018). Generally, the entrepreneurial ecosystem has the following gaps: a mismatch between capacity support and funding, fragmented support, early stage funding gap, and missing co-ordination between initiatives (UNEP-WCMC, 2012). In addition, small businesses in the adaptation space face unique challenges beyond the general small business challenges. These adaptation-specific challenges are explored more fully below.

4.1 Stimulating demand

Demand for adaptation-related solutions is nascent. It is also non-linear and somewhat unpredictable. Indeed, climate systems do not act in a linear fashion and there could be points in time when climate impacts are unexpectedly triggered, in turn resulting in increasing demand for certain goods and services. In addition, despite significant adaptation needs, as raised in Section 2, expenditure on adaptation remains low. Many adaptation solutions, such as climate-proofing and insurance, only bring uncertain and distant benefits, which create challenges in stimulating demand. Others, notably interventions which show mitigation co-benefits, such as resource efficiency measures, are more easily marketable but still face significant challenges. The lack of awareness about climate change risks is a paramount obstacle in this respect.

The public sector is a significant driver of demand in the climate change adaptation space. In the water sector, for example, adaptation solutions like water-efficient toilets and greywater recycling systems can be rolled out in new public schools, hospitals, municipal buildings and other public buildings. In the case of energy, adaptation solutions, such as solar PV, can be installed in all government buildings with the public sector leading the small-scale renewable production. A successful procurement strategy for small businesses is naturally contingent on maintaining transparency and other safeguards that prevent abuse of the system. Public procurement, besides initiating demand for adaptation goods, also has the benefit of increasing public awareness of adaptation solutions.

However, small businesses find it difficult to harness the demand arising from the public sector due to a risk-averse procurement system which favours tried-and-tested technologies and solutions. This challenge is evident in the green economy space, which features new thinking, mechanisms and solutions. In addition, climate change adaptation, as a concept, is not yet anchored in policy. This leads to the neglect of critical benefits brought by adaptation-related solutions. South Africa's state procurement policies are biased against the procurement of innovative products and processes. Barriers include a lack of skills to assess innovation by state procurement managers, strict regulations against communication/negotiations between procuring entities and bidders that can drive innovative

solutions, inefficient bureaucracy for unsolicited offers, a lack of innovation incentives in performance conditions, and a lack of innovation focus in the award criteria (Bolton, 2016, pp. 12–26). It is prudent to address these barriers when designing procurement policies for increasing participation by small businesses in the adaptation space, which is an innovation-driven activity. Legislative efforts like the reviewing of the Public Procurement Bill are certainly notable steps in the right direction for greater participation by small businesses and need to be driven forward with urgency by the state.

The state has a vital role to play in setting the context for, and leading, adaptation in South Africa. While a national adaptation strategy has been compiled, this policy is still in draft form and has yet to be finalised (DEA, 2016). It is important for the *adaptation policy to be finalised*, and to institutionalise adaptation throughout the state's operations, including in state-owned enterprises. The adaptation space does not exist in isolation from the rest of the economy. Adaptation is intertwined directly or indirectly with every sector and activity. Thinking about adaptation in environmental circles within state-owned entities, for example, has to be encouraged and actively pursued. Adaptation is a cross-cutting issue requiring the involvement of numerous parties. Personnel in state institutions need to be provided with the correct skills to drive forward adaptation and incorporate adaptation in planning, strategies and future investments. Furthermore, a comprehensive and cohesive strategy would act as a signal to investors and businesses as to where to direct resources in the sector. The policy would also guide the general public concerning adaptation in South Africa.

A dichotomy exists between those who particularly need adaptation solutions (such as poor and/or rural households and communities; and smallholder subsistence farmers) and those who can afford them, but do not perceive an imminent threat. To protect the vulnerable from climate change and to drive forward an adaptation agenda, it is important to *support the most vulnerable* in accessing adaptation goods and services. Support programmes, such as grants and subsidies, for clearly demarcated vulnerable groups and adaptation-related solutions can be a mechanism to drive demand. Support programmes need to be completed by other measures as well as designed carefully, however, as they can place a drain on the fiscus and be difficult to withdraw in the future. Smallholder farmers, for example, could benefit from support to access adaptation-related solutions, such as drip irrigation and drought-resistant seeds. Besides financial support (such as grants, subsidies and concessional loans) when required, awareness raising and technical support through extension services are instrumental in this respect.

Beyond vulnerable groups, other types of consumers ought to be incentivised to increase demand for adaptation solutions. *Awareness raising* plays a key role as most people are not familiar with climate change risks. A vital component of an adaptation strategy is creating awareness of the need to adapt to climate change among the general public. The public sector should use all the tools at its disposal to disseminate information about climate adaptation through multiple channels, such as newspapers, billboards on national highways, and the Internet (including social media). Adaptation should be portrayed as inevitable and an action that requires the entire country to succeed. Furthermore, a process is required to enable existing perspectives on adaptation in the country to engage one another, particularly to bring in existing local and traditional knowledge.

In addition, *stimuli* are often required. This could take the form of regulations (for resource efficiency for example), enabling policies (for small-scale embedded generation) and, in some cases, tax incentives. Notable examples of where legislation would stimulate market demand are:

- In the building industry, laws surrounding the implementation of sanitation infrastructure in the current municipal systems (as well as other state infrastructure, such as schools) can act as a barrier to the adoption of next generation sanitation technologies. Revisions to the legislation, such as building codes and standards, can increase demand for these next generation technologies.
- All new buildings can be legislated to use low flush/water efficient taps and sanitation systems to drive demand for these products. The legislation can also set standards for water metering, efficiency, reuse and alternative supply. Municipal by-laws can also be amended to ensure water users manage municipal water more efficiently.
- New buildings and property acquisitions can be mandated to have insurance against adverse climate events.
- A price signal for large users can be sent by moving towards more cost-reflective tariffs. Low water tariffs in South Africa mean that the business case and savings potential is extremely low for most adaptation measures, particularly in the residential market. This is a challenge for water solutions providers, and is an area where local municipalities could drive the market.

The state can also *work with the private sector* to engage in targeted community upliftment programmes that are oriented towards increasing resilience. AECI for example supports community groups working with various levels of government through its Wise Wayz Water Care project in KwaZulu-Natal. This project is funded through the AECI Community Education and Development Trust Initiative and seeks to build the capacity of the community groups to monitor and enhance river health in the Mbokodweni catchment (Ward and Mudombi, 2018, p. 5). Specifically, the project provides education and awareness to rural communities on water conservation and provides potable water to these communities (AECI, n.d.).

Furthermore, a holistic approach to adaptation requires steps to *consider disincentives to adaptation*. Incentives that promote maladaptation need careful review. For example, heavily subsidised water prices to agricultural users incentivises excessive consumption and limits the demand for water-efficient technologies. In combination with incentives to promote the use of efficient technologies, in this example, disincentives for excessive consumption should be put in place. A move towards less subsidisation of maladaptive practices would involve more cost-reflective pricing of scarce resources, such as water.

While it is always important to design fit-for-purpose solutions, which are acceptable, convenient, and desirable to consumers, it is even more critical in the climate change adaptation space. Indeed, the need for adaptation is generally not enough to stimulate demand. Solutions therefore require multiple other benefits to generate market demand. In the case of next-generation sanitation products, for example, the technology has to take into account factors such as odour emissions, the disposal of waste, and the aspirational nature of flush toilets. While designed to increase rural sanitation access and increase water efficiency in urban households, systems that run on no water may require the disposal of waste periodically, which impacts on the convenience of using such systems. Further, such systems can generate unpleasant odours, reducing their attractiveness. Toilets which flush with water are also of an aspirational nature and this is another negative stereotype which water-saving sanitation systems have to overcome.

4.2 Supporting entrepreneurs

Entrepreneurs and small businesses face significant *challenges in accessing finance*, particularly for commercialising new, innovative products and services. This challenge is even more acute in the green economy space, notably for climate change adaptation-related solutions. New solutions in the adaptation space are often pioneering and unproven (SEED, 2014; UNEP, 2016b; UNEP-WCMC, 2012). The lack of understanding by financial institutions of the green economy space and particularly climate change adaptation further complicates funding access, which tend to focus on markets they are comfortable with and thoroughly understand. Only a handful of institutions, such the Innovation Hub, have dedicated green economy programmes supported by experts who have a deeper understanding of the markets.

The difficulty in accessing funding is compounded by the difficult in *understanding demand* in this space, i.e. identifying the market segments which are relevant for a specific solution remains a challenge. Climate change adaptation is not a defined market in and of itself. As conceptualised in Section 3, several market segments can be found in the space with products possibly overlapping several segments. This makes it more complicated to bridge the information asymmetry between entrepreneurs and funders, as entrepreneurs experience greater difficulty in conveying the technology, concepts and intuition behind their products and services.

While market dynamics depend on the market segment and are highly product-specific, in most cases demand for adaptation solutions remains nascent and uncertain. Assessing the size of a market is challenging as a market may not exist, especially if the product is particularly novel or innovative. There is *uncertain demand* for most adaptation-related solutions. As highlighted in Section 2, adaptation needs do not necessarily translate into demand for adaptation-related products and services. High-risk factors make it difficult and expensive (i.e. high interest rates) for small businesses to attract funding.

One part of the solution is to develop *dedicated green economy funding*. Financial institutions, both private and public, need adequate skills, knowledge and funding to finance entrepreneurs in the green economy space. This is unlikely to happen unless specific funding vehicles are established to target entrepreneurs in this space. In addition, adaptation-related solutions should be considered with a different lens. A longer-term view encompassing all benefits to the economy (from economic, social and environmental perspectives) should be adopted. Modular and proactive financial products which are suited for uncertain demand would also help manage risk and cater for business growth.

Like many other entrepreneurs, small businesses in the adaptation space face challenges developing adequate business models and business plans appealing to funders. This is particular true in the novel and uncharted adaptation space. More *dedicated support programmes and incubators* with expertise in the green economy, such as Fetola, the South African Renewable Energy Business Incubator (SAREBI) and SEED, are necessary to assist entrepreneurs navigating their specific space. Understanding the market segments, what drives them as well as what creates value for consumers is crucial for sustainable growth. This should ideally be in the form of a dedicated institution that provides climate-related small business support and addresses the following: basic business management, formulating business models, how to think about target markets, and who and how to approach for funding.

Support programmes can also provide a conducive and stimulating environment by providing *access to infrastructure*, such as office and manufacturing space, preferential rental rates, and cost-sharing arrangements for basic activities like security and cleaning services. The Agri-Park model which involves the Department of Rural Development and Land Reform in collaboration with other departments and stakeholders, for example, is an intervention which performs such a function providing agro-production, processing, logistics, marketing, training and extension services to beneficiary farmers. Special Economic Zones (SEZs), such as the Atlantis SEZ in the Western Cape, offer a similar platform, with additional support and tax incentive to green manufacturing businesses. This model can be scaled to other adaptation small businesses to provide spaces for them to develop and link into markets.

5 CONCLUSION

Climate change, particularly in South Africa has been realised as the most pressing challenge. The country is vulnerable to climate change impacts from both climatic and policy perspectives. The inadequacy of adaptation to these impacts can lead to significant detrimental effects. It is vital to put measures in place to address the current and expected impacts. This then raises the urgency for adaptation to climate change impacts to improve the resilience of the economy, society and the environment. The adaptation process offers the opportunity to harness local business opportunities to ensure that the country adapts effectively to climate change through local solutions. The inclusion of small businesses becomes an integral part of the adaptation process as it assures holistic approaches to development. Small businesses are well-suited to seize such opportunities, however, the potential for adaptation-driven needs and investments to generate socio-economic opportunities for small businesses remains largely unexplored and misunderstood. While small businesses are known to have particular characteristics that enable them to use such opportunities, they face challenges relating to their size, limited resources, and unfavourable policy, and industry and market conditions. Small businesses in the adaptation space also face additional constraints that are specific to the novel and unchartered territory they operate in.

Though the potential for adaptation-driven needs to generate socio-economic opportunities for small businesses remains largely unexplored and misunderstood, this report has endeavoured to contribute to closing this gap. The market opportunities in the adaptation space, where small businesses can participate are: products with immediate savings, offerings with future savings, financial risk transfer products, and products that enhance consumer experience. However, for these small businesses to operate fully and effectively, requires intensive support and conduciveness of the policy and regulatory framework.

While the need for adaptation is evident, this does not directly equate to markets. This is illustrated clearly in the WEF nexus. Key adaptation-related solutions in the water sector range from the provision of water saving technologies and the rollout of smart water systems to the management and restoration of ecological infrastructure through to water stewardship. One key area with a significant market potential for small businesses is the drive towards smart irrigation systems. NGS technologies are also gaining traction, as an emerging and disruptive technology. In agriculture, key adaptation solutions include crop and animal diversification technologies, efficient irrigation, and agricultural extension services. CSA and organic produce are further emerging markets in South Africa. In the energy sector, adaptation opportunities include the greening of the energy value chains (including energy efficiency), building climate-compatible energy infrastructure, and the diversification into alternative energy sources. There is also a significant market for clean fuels. Despite these opportunities being available and accessible, strategic navigation throughout the adaptation terrain is imperative for the small businesses in order to overcome the challenges they face.

This necessitates identifying the appropriate business segment(s) which they fit in and the selection of suitable business model(s) to pursue. These business segments include: solutions delivering rapid return on investment; solutions protecting against possible climate change risks; financial risk transfer products; and solutions enhancing consumer experience. Each segment has a corresponding business model.

Solutions that deliver a rapid return on investment generate financial returns that lead to a short and relatively certain payback period. In this case, small business can become involved through using established online platforms; providing value-added services; modular design; and using newsletters and franchising. The second market segment concerns solutions that are resilience-building without short-term financial benefits. Small business can participate through developing fine-tuned and niched expertise; and targeting large-scale projects through partnering.

The third market segment proposes to transfer risk, rather than directly protect against it. Small businesses have opportunities in developing competencies in digital and data skills, and innovation; climate microinsurance products; niched service offerings; and brokerage services.

A final market segment relates to solutions that enhance the consumer experience and/or provide a new experience. Small businesses in this case can develop specialised products for distribution through specific channels; leverage social media; and target large retailers for FMCGs.

Adequate policy has also been identified as the appropriate tool to seize the emerging opportunities. This requires both a stimulation of demand for adaptation-related solutions as well as adequate support to entrepreneurs active in this space. On the supply side, access to finance and markets should be supported by dedicated programmes focused on entrepreneurs active in greening the economy. This is critical to bridge the information asymmetry between entrepreneurs and financiers (who often do not consider the need for a just transition to a low-carbon, climate-resilient and environmentally-sustainable economy). It is also essential to support entrepreneurs to better understand the market in which the operate. Market segments within the climate change adaptation space are distinct and driven by different factors. Support to access infrastructure should be provided to enable growth.

On the demand side, significant action is required to stimulate demand for adaptation-related products and services. The finalisation of the country's adaptation strategy and its mainstreaming through the organs of the state would go a long way in bring adaptation to the fore. Raising awareness in all spheres of government, the private sector and society at large will be instrumental in stimulating climate action. The state, through public procurement, could assist in driving demand. In addition, regulations, enabling policies and, in some cases, tax incentives can be used to drive demand. Adequate support is also required to ensure that vulnerable households and businesses which cannot afford to adapt to climate change are assisted in implementing adequate solutions. Partnership with the private sector should also be pursued to fast-track adaptation in vulnerable ecosystems and communities.

In the end, adapting to climate change is an urgent necessity. Whether or not it comes with domestic co-benefits for small business development, however, relies on adequate action.

The future depends on what we do in the present, Mahatma Gandhi

REFERENCES

AECI, n.d. AECI Community Education and Development Trust [WWW Document]. URL https://www.aeci.co.za/sustainability-community-education-development-trust.php (accessed 5.12.18).

Altieri, K., Trollip, H., Caetano, T., Hughes, A., Merven, B., Winkler, H., 2015. Pathways to deep decarbonization in South Africa. SDSN - IDDRI.

Beckham, D., Voyer, B.G., 2014. Can Sustainability be Luxurious? A Mixed Method Investigation of Implicit and Explicit Attitudes towards Sustainable Luxury Consumption [WWW Document]. URL http://www.acrwebsite.org/volumes/v42/acr_v42_17922.pdf (accessed 11.28.18).

BMZ, UNEP, GIZ, 2016. Demystifying Adaptation Finance For the Private Sector - November 2016 [WWW Document]. URL http://www.unepfi.org/wordpress/wp-content/uploads/2016/11/DEMYSITIFYING-ADAPTATION-FINANCE-FOR-THE-PRIVATE-SECTOR-AW-FULL-REPORT.pdf (accessed 4.10.18).

Bolton, P., 2016. Public Procurement as a Tool to Drive Innovation in South Africa [WWW Document]. URL http://www.scielo.org.za/pdf/pelj/v19n1/46.pdf (accessed 4.12.18).

Burger, S., 2015. South Africa probing socially acceptable low- and no-water sanitation alternatives. Creamer Media's Eng. News.

Camco, TIPS, 2010. Case Study – Renewable Energy and t he Draft IRP2010: "The Winds of Change." Camco.

CAN, 2013. Creating effective tools for private sector engagement - Climate change adaptation and the role of the private sector April [WWW Document]. URL https://europa.eu/capacity4dev/file/14313/download?token=1waP-Q5z (accessed 12.11.18).

Carter, S., Gulati, M., 2014. Climate change, the Food Energy Water Nexus and food security in South Africa, Understanding the Food Energy Water Nexus. WWF-SA, South Africa.

Chambwera, M., Heal, G., Dubeux, C., Hallegatte, S., Leclerc, L., Markandya, A., McCarl, B.A., Mechler, R., Neumann, J.E., 2014. Economics of adaptation, in: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 945–977.

Christina, T.G., Pirzer, C., Heuër, A., Liebl, J., Meyer, C., Robertshaw, A., 2016. Scaling Innovation at the Energy-Agriculture Nexus in East Africa. A Sectoral Business Condition Brief (Sectoral Business Condition Brief). SEED, Berlin, Germany.

Creamer Media, 2016. A review of South Africa's water sector. Creamer Media's Research Channel Africa.

DAFF, 2018. Draft climate smart agriculture strategic framework for agriculture, forestry and fisheries (Government Gazette (3 August 2018) No. Notice 428 of 2018). Department of Agriculture, Forestry and Fisheries.

DAFF, 2015a. The irrigation strategy for South Africa. Department of Agriculture, Forestry and Fisheries.

DAFF, 2015b. Agricultural Policy Action Plan (APAP) 2015 - 2019. Department of Agriculture, Forestry and Fisheries.

Davis-Reddy, C.L., Vincent, K., 2017. Climate Risk and Vulnerability: A Handbook for Southern Africa, 2nd ed. CSIR, Pretoria, South Africa.

De Villiers, J., 2018. This SA-created irrigation system cuts water usage by up to 70% – and is revolutionising orchards. Bus. Insid. South Afr.

DEA, 2017. South Africa National Adaptation Strategy (Second Draft). Department of Environmental Affairs, Republic of South Africa.

DEA, 2016. South Africa National Adaptation Strategy Draft for Comments [WWW Document]. URL https://www.environment.gov.za/sites/default/files/docs/nas2016.pdf

DEA, 2013. Long-Term Adaptation Scenarios Flagship Research Programme (LTAS) for South Africa. Summary for policy makers. Department of Environmental Affairs, Republic of South Africa, Pretoria.

Denton, F., Wilbanks, T.J., Abeysinghe, A.C., Burton, I., Gao, Q., Lemos, M.C., Masui, T., O'Brien, K.L., Warner, K., 2014. Climate-resilient pathways: adaptation, mitigation, and sustainable development, in: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R., White, L.L. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1101–1131.

DWS, 2017. Strategic overview of the water sector in South Africa. Department of Water and Sanitation, Republic of South Africa.

DWS, 2015. No Drop Report: the status of water losses & water use efficiency in metropolitan municipalities. Department of Water and Sanitation, Republic of South Africa.

EUEI PDF, 2017. Energy and Climate Change Adaptation in Developing Countries [WWW Document]. URL http://www.euei-pdf.org/sites/default/files/field_publication_file/euei_pdf_2017_energy_and_climate_change_adaptation_in_developing_countries.pdf (accessed 6.10.18).

FAO, 2007. Adaptation to climate change in agriculture, forestry and fisheries: Perspective, framework and priorities [WWW Document]. URL http://www.fao.org/nr/climpag/pub/adaptation_to_climate_change_2007.pdf (accessed 7.10.18).

Field, C.B., Barros, V.R., Stocker, T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., Mach, K.J., Plattner, G.-K., Allen, S.K., Tignor, M., Midgley, P.M. (Eds.), 2012. Glossary of terms, in: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 555–564.

Forbes, 2017. 10 Hottest Products For A Luxury Green Home [WWW Document]. URL https://www.forbes.com/sites/eustaciahuen/2017/01/31/10-hottest-products-for-a-luxury-green-home/#6d35eaed4f71 (accessed 9.11.18).

FSB, 2019. Interview with Insurance Department at the Financial Services Board.

GreenCape, 2017. Agriculture – 2017: Market Intelligence Report.

GreenCape, 2016. Water: Market Intelligence Report 2016. GreenCape, Cape Town.

Groepe, F., 2015. The role of small business in the economy.

GWI, 2017a. Global Water Market 2017 (data). Global Water Intelligence, Oxford.

GWI, 2017b. Global Water Market 2017 - Volume 1: Companies and Markets. Global Water Intelligence, Oxford.

GWP, 2018. Climate insurance and water-related disaster risk management – Unlikely partners in promoting development? [WWW Document]. URL https://www.gwp.org/globalassets/global/toolbox/publications/perspective-papers/11_climate_insurance_perspectives_paper.pdf (accessed 9.11.18).

Helga, W., Lernoud, J., 2018. The World of Organic Agriculture. Statistics and Emerging Trends 2018. Research Institute of Organic Agriculture (FiBL), Frick, and IFOAM - Organics International, Bonn.

IEA, 2018. The Future of Cooling: Opportunities for energyefficient air conditioning. International Energy Agency.

infoDev, 2014. Building Competitive Green Industries: The Climate and Clean Technology Opportunity for Developing Countries. World Bank, Washington, D.C.

IOL, 2018. New insurance laws allow for micro-products [WWW Document]. URL https://www.iol.co.za/personal-finance/new-insurance-laws-allow-for-micro-products-16012217 (accessed 1.22.19).

IPCC, 2018. Annex I: Glossary, in: Matthews, J.B.R. (Ed.), Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty. Intergovernmental Panel on Climate Change, Bonn.

Jarmain, C., Van Niekerk, A., Muller, J., Goudriaan, R., 2017. Extent of irrigated agriculture in South Africa: the new status quo? SABI.

Marks, J., Hidden, K., 2017. SMMEs and the Green Economy: Muddy Waters and Murky Futures. An investigation into the sustainable practices of small medium and micro manufacturing enterprises in South Africa's Gauteng Province. J.P. Morgan and Gordon Institute of Business Science, Johannesburg.

Mohamed, N., 2018. Inclusive sustainability transitions, in: Mohamed, N. (Ed.), Sustainability Transitions in South Africa. Routledge, Oxon and New York, pp. 58–79.

Montmasson-Clair, G., 2019. Bulelwa Ntsendwana: Harnessing chemistry for sustainable development and women empowerment. Trade & Industrial Policy Strategies & Government of Flanders, Pretoria.

Montmasson-Clair, G., 2018. Global water and sanitation market dynamics: Implications from South Africa's industrial development (forthcoming).

Montmasson-Clair, G., Mudombi, S., 2018. Concept Note to inform the 2018 Partnership for Action on the Green Economy (PAGE) Ministerial Conference on Inclusivity within the Green Economy. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and Department of Environmental Affairs, Pretoria.

Mordor Intelligence, 2017. Market Entry - Organic Food Market in South Africa: Analysis of Growth, Trends and Progress (2017 - 2022).

Mudombi, S., 2019a. Rori Mpete: Thinking outside the box, retrofitting water saving in conventional waterborne sanitation systems. Trade & Industrial Policy Strategies & Government of Flanders, Pretoria.

Mudombi, S., 2019b. Jonny Harris: Learning from nature to solve sanitation challenges. Trade & Industrial Policy Strategies & Government of Flanders, Pretoria.

Mudombi, S., 2019c. Tshego Mpete: Embracing green opportunities in the water sector. Trade & Industrial Policy Strategies & Government of Flanders, Pretoria.

Mudombi, S., 2018. Forward-looking approach to next generation sanitation and industrial development in South Africa – a briefing (Policy Brief No. 4/2018). Trade & Industrial Policy Strategies (TIPS).

Noble, I.R., Huq, S., Anokhin, Y.A., Carmin, J., Goudou, D., Lansigan, F.P., Osman-Elasha, B., Villamizar, A., 2014. Adaptation needs and options, in: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Billir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCraken, S., Mastrandrea, P.R., White, L.L. (Eds.), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 833–868.

NPC, 2012. National Development Plan 2030: Our Future-make it work. National Planning Commission, Republic of South Africa.

OECD, 2018. Declaration on strengthening SMEs and entrepreneurship for productivity and inclusive growth, OECD Ministerial Conference on SMEs. Organisation for Economic Co-operation and Development, Mexico City.

OECD, 2015. Environmental Policy Toolkit for Greening SMEs in EU Eastern Partnership countries, Greening Economies in the European Union's Eastern Neighbourhood" (EaP GREEN) programme. Organisation for Economic Co-operation and Development.

PAGE, 2017. A Green Economy Industry and Trade Analysis: Assessing South Africa's Potential. Partnership for Action on Green Economy (PAGE).

Patel, M., 2019a. Mogale Maleka and Tumelo Pule: Using hydroponics to enhance food security. Trade & Industrial Policy Strategies & Government of Flanders, Pretoria.

Patel, M., 2019b. Wolfgang von Loeper: Sustainable farming ensuring food security while preserving the planet. Trade & Industrial Policy Strategies & Government of Flanders, Pretoria.

PREP, n.d. Value chain climate resilience: a guide to managing climate impacts in companies and communities. Partnership for Resilience and Environmental Preparedness (PREP).

PwC, 2018. Ready and Willing African insurance industry poised for growth [WWW Document]. URL https://www.pwc.co.za/en/assets/pdf/south-african-insurance-2018.pdf (accessed 1.22.19).

Schulze, R.E., 2016. Irrigation in South Africa and Climate Change: Setting the Scene, in: Handbook for Farmers, Officials and Other Stakeholders on Adaptation to Climate Change in the Agriculture Sector within South Africa, Section H: Irrigation in South Africa and Climate Change, Chapter H1.

SEED, 2014. SEED South Africa Symposium 2014 Summary Report. SEED Initiative.

Speier, K., 2016. 6 Eco-friendly Brands That Will Inspire You to Go Green [WWW Document]. URL https://www.mainstreethost.com/blog/eco-friendly-brands/

Stern, N., 2007. The Economics of Climate Change: The Stern Review. Cambridge University Press, Cambridge.

Sullivan, D., 2016. GMOs: Pros and Cons [WWW Document]. URL https://www.healthline.com/health/gmos-pros-and-cons

Swartz, C.D., van der Merwe-Botha, M., Freese, S.D., 2013. Energy Efficiency in the South African Water Industry: A Compendium of Best Practices and Case Studies. Water Research Commission, Pretoria.

Termeer, C.J.A.M., Dewulf, A., Diesbroek, G., 2017. Transformational change: governance interventions for climate change adaptation from acontinuous change perspective. J. Environ. Plan. Manag. 60, 558–576.

The Citizen, 2018. Storm Brewing in Insurance Sector [WWW Document]. URL https://www.pressreader.com/ (accessed 1.22.19).

The Citizen, 2017. R1bn claim storm hits SA insurers [WWW Document]. URL https://citizen.co.za/news/south-africa/1700454/r1bn-claim-storm-hits-sa-insurers/ (accessed 1.22.19).

the dti, 2017. Industrial Policy Action Plan: IPAP 2017/18 – 19/20 (Part 2). Department of Trade and Industry, Republic of South Africa.

The Presidency, 2018. President Cyril Ramaphosa launches safe sanitation for schools. Republic of South Africa.

UNEP, 2016a. The Adaptation Finance Gap Report 2016. United Nations Environment Programme (UNEP), Nairobi.

UNEP, 2016b. Green finance for developing countries: Needs, Concerns and Innovations. United Nations Environment Programme.

UNEP, 2014. The Adaptation Gap Report 2014. United Nations Environment Programme (UNEP), Nairobi.

UNEP-WCMC, 2012. A Three Year Investigation into the Triple Bottom Line Performance of Small and Micro Social and Environmental Enterprises in Developing Countries: Part 1: Survey Results for 1337 SMMEs. SEED Initiative and the International Institute for Sustainable Development.

UNFCCC, n.d. Mitigation, Adaptation and Resilience: The Three Pillars of the Response to Global Warming [WWW Document]. COP23 Fiji UN Clim. Change Conf. Bonn 2017-18. URL https://cop23.com.fj/mitigation-adaptation-resilience/

UNISDR, n.d. Adaptation to Climate Change: Linking Disaster Risk Reduction and Insurance [WWW Document]. URL https://www.unisdr.org/files/9654_linkingdrrinsurance.pdf (accessed 9.11.18).

U.S. Department of Energy, 2013. Insurance as a Risk Management Instrument for Energy Infrastructure Security and Resilience [WWW Document]. URL https://www.energy.gov/sites/prod/files/2013/03/f0/03282013_Final_Insurance_EnergyInfrastructure.pdf (accessed 9.11.18).

Van der Stoep, I., Tylcoat, C., 2014. South African Irrigation Statistics – An Analysis of the 2014 Water Registration Management System (WARMS) Data.

Von Bormann, T., Gulati, M., 2014. The Food Energy Water Nexus: Understanding South Africa's most urgent sustainability challenge. WWF-SA.

Ward, M., Mudombi, S., 2018. Protecting and Unlocking Jobs through Water Stewardship: A Case Study Linked to the Umbogintwini Industrial Complex, eThekwini [WWW Document]. URL http://www.tips.org.za/research-archive/sustainable-growth/green-economy/item/download/1587_5976eb52789ee9e4c50d5fce6ebc0cd0 (accessed 1.24.19).

We Mean Business (n.d.) Take action. [WWW Document]. URL https://www.wemeanbusinesscoalition.org/take-action/ (accessed 25.3.18).

Woolworths, 2016. Woolworths Climate Change and Energy Position Statement [WWW Document]. URL https://www.woolworths.co.za/images/elasticera/New_Site/Corporate/Woolworths_Climate_Change_Position_Statement.pdf (accessed 1.11.18).

World Bank, 2014. Building Competitive Green Industries: The Climate and Clean Technology Opportunity for Developing Countries. International Bank for Reconstruction and Development andThe World Bank, Washington, D.C.

WRG, 2009. Charting Our Water Future Economic frameworks to inform decision-making.