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An assessment of different public engagement and communication techniques for diverse audiences in South Africa with recommendations for the Pilot CO_2 Storage Project

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Science in Engineering.

December 2014

DECLARATION

I declare that this research report is my own unaided work.

It is being submitted to the Degree of Master of Science in Engineering to the University of the Witwatersrand, Johannesburg.

It has not been submitted before for any degree or examination to any other University.

_____

(Marisa Fritz)

signed on this **10th** day of **December 2014**.

ABSTRACT

This research report presents an analysis of applicable types of public engagement and communication techniques for demographically diverse, non-technical audiences. It further investigates the simplification of technical topics in order to successfully communicate the topics to these audiences.

The analysis shows that the demographic diversity of the target audience has a significant influence on the public engagement and communication techniques to be used, i.e. specifically the age profile of the target audience, the prominence of traditional authorities in the target area and the language spoken by the communities.

A review of analogous projects concluded that technical topics can be sufficiently simplified for non-technical audiences, given that key messages are framed in a relevant landscape.

The research suggests that the South African Centre for Carbon Capture and Storage (SACCCS) should consider the recommendations summarised in this report for their planned Pilot CO_2 Storage Project (PCSP) in order to enhance their engagement efforts.

Keywords: CCS; PCSP; public engagement; communication techniques; demographic diversity; non-technical audience

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GLOSSARY OF TERMS, ABBREVIATIONS AND ACRONYMNS

TERM	DEFINITION
ADSL	Asymmetric digital subscriber line
BN	Briefing note
CCS	Carbon capture and storage
CDM	Cacadu District Municipality
CO_2	Carbon dioxide
COP	Conference of the Parties
DAERD	Department of Agricultural and Environmental Affairs and Rural Development (KwaZulu-Natal)
DEA	Department of Environmental Affairs
DEDEA	Department of Economic Development and Environmental Affairs (Eastern Cape)
DMR	Department of Mineral Resources
DoE	Department of Energy
DoT	Department of Transport
DST	Department of Science and Technology
DTI	Department of Trade and Industry
DWS	Department of Water and Sanitation
EIA	Environmental impact assessment
EMP	Environmental management plan
EOR	Enhanced oil recovery
FAQs	Frequently asked questions
GHG	Greenhouse gas
IAP2	International Association of Public Participation
ICT	Information and communications technology
IDP	Integrated Development Plan
IFC	International Finance Corporation
IDTT	Inter-departmental task team
IEA GHG	International Energy Association's Greenhouse Gas R&D Programme
IS	Information sheet
IWP	iSimangaliso Wetland Park
LocPlan	Local Plan
MPRDA	Mineral and Petroleum Resources Development Act
MTSF	Medium-term strategic framework
NatPlan	National Plan

TERM	DEFINITION
NDP	National Development Plan
NEMA	National Environmental Management Act
NGO	Non-governmental organisation
NSMTP	National strategic medium-term priorities
NT	National Treasury
PCSP	Pilot CO_2 Storage Project
Q&A	Question and answer
R&D	Research and development
SABC	South African Broadcasting Corporation
SACCCS	South African Centre for Carbon Capture and Storage
UCG	Underground coal gasification
UDM	uMkhanyakude District Municipality
UNESCO	United Nations Educational, Scientific and Cultural Organization
WEF	World Economic Forum
WRI	World Resources Institute

1. INTRODUCTION

1.1. Background

Carbon capture and storage (CCS) is viewed by many governments, businesses and non-governmental organisations (NGOs) as an essential part of the solution to mitigate the worst effects of climate change. It is such an attractive solution because it holds the potential to abate between 15 and 50% of anthropogenic greenhouse gas (GHG) emissions by 2050 (IEA 2009, 1), and it permits the continuation of fossil fuel burning for power, which delivers security of supply and a steady base load without requiring the shift to a radically different energy system. CCS also has its detractors who believe that CCS is expensive, risky and perpetuates fossil fuel dependence [2, 3].

Globally, five industrial scale and more than a dozen smaller scale CCS facilities have deployed, tested, and demonstrated the technology in action. Some of these facilities have demonstrated only limited aspects of the entire chain (e.g. carbon capture), whilst others (mostly oil and gas plants) have demonstrated the entire chain (capture to storage).

As the development of CCS moves into the demonstration phase in South Africa, the public is increasingly coming into contact with large projects. The early large-scale projects, in particular Sleipner, In Salah, Weyburn-Midale and Rangley, went ahead without any public opposition. This may have given rise to a false sense of security amongst developers that there would be no public opposition to future projects. While CCS advocates did mention the importance of public communication from time to time, there was little activity in this area until recently [3]. The acceptance of the early stage projects may have been a consequence of offshore location (Sleipner); the very low population densities in the storage areas (In Salah, Weyburn); and / or of the historical use of enhanced oil recovery (EOR) (Weyburn, Rangley). In these cases, carbon dioxide (CO_2) storage was, in effect, a moderate addition to an existing practice [4].

The IEA CCS Roadmap [1] suggests that 100 large projects will be required by 2020 and 3,400 large projects by 2050 to significantly reduce GHGs to acceptable levels. This proposed scaling-up of CCS activities increasingly recognises the fact that the public is a key stakeholder in this process. A number of proposed facilities have

been cancelled or have gone ahead in a much reduced form due to local public opposition, e.g. Shells' CCS project in Barendrecht (Netherlands), Batelle's proposed project in Greenville, Ohio (USA), and the planned project by WinGas to store CO_2 in the depleted Saltfleetby Gas Field in Lincolnshire (UK) [1, p.21].

Public engagement is the process of having an informed, two-way discussion as to whether a project is appropriate in a particular locality and context [3]. Successful engagement, however, is not a guarantee that every project will go ahead.

1.2. Rationale for CCS in South Africa

Coal fuels contribute over 90% of South Africa's electricity production, making the country a significant emitter of CO_2. Based on this, South Africa is placed amongst the world's top 15 most energy intensive economies, with a significant contribution to GHG emissions at a continental level [5].

Since 2004, a significant amount of work has been done in South Africa to further explore the potential for CCS deployment. Key developments during this time included the release of a South African CCS Roadmap, the launch of the South African Centre for Carbon Capture and Storage (SACCCS), and the release of the Atlas on geological storage of CO_2 in South Africa [5].

At the 15th Conference of the Parties (COP15) in Copenhagen in 2009, President Zuma made commitments that South Africa will undertake mitigation actions which will result in a deviation below the current emissions baseline of 34% by 2020 and 42% by 2025, provided South Africa receives technical and funding support internationally. This level of effort should enable South Africa's emissions to peak between 2020 and 2025, plateau for approximately a decade and decline in absolute terms thereafter.

The purpose of this research study is to critically analyse the effectiveness of different types of public engagement and communication techniques concerning CCS to demographically diverse, non-technical audiences. Specific recommendations will be made for the Pilot CO_2 Storage Project (PCSP) planned by the SACCCS. The SACCCS was established to develop both human capacity and technical know-how pertaining to CCS in South Africa. The work of the SACCCS to date has consisted largely of desktop studies and data analysis. The implementation of the South African CCS roadmap requires the successful delivery of the PCSP to

demonstrate safe and secure CO_2 handling, injection, storage and monitoring in South African conditions, particularly taking into account South African geology.

Core to delivering this project will be the engagement of the South African public at both a national and local level. In a risk assessment [6] conducted by the SACCCS, community and NGO resistance to the project was listed as one of the seven risks that would have the highest impact on the PCSP. CCS public engagement will have some unique challenges in South Africa, given the significant diversity of the population with regard to culture, language, education, and economic situation. Given that South Africa is a developing country, communication about CCS technology also needs to be placed in the context of other national priorities, such as access to energy, poverty alleviation, job creation and education [7].

The 2010 Atlas [5] identifies four possible CO_2 geological storage basins in South Africa (**Figure 1**). Of these four basins, two are being explored as possible storage sites for the PCSP, i.e. onshore areas of the Durban / Zululand (referred to as Zuluand) and Outeniqua (referred to as Algoa) Basins.

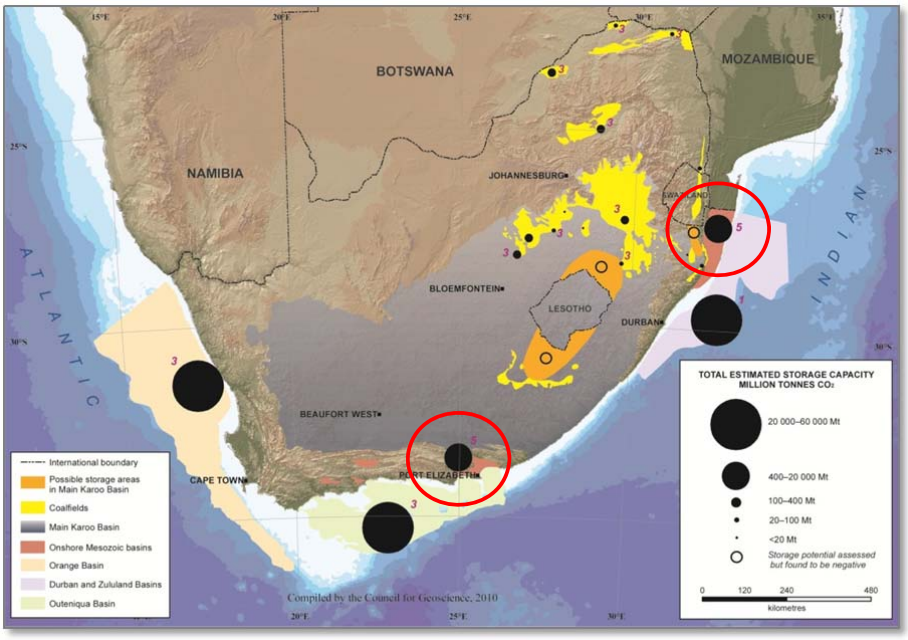


Figure 1: Possible CO_2 geological storage basins in South Africa [5]

With pilot injection for the PCSP planned to commence in 2017 and a demonstration plant for 2020, it is imperative to plan for stakeholder engagement in order to raise the awareness and understanding of CCS and its purpose. In order to be effective

and address potential concerns about CCS proactively, stakeholder engagement needs to take account of national and local socio-political contexts as well as the stakeholder landscape. Given the technical nature of CCS, it is highly likely that there will be limited knowledge and understanding of the CCS process, technology and strategy, especially at the local level [8].

1.3. Aim and research objectives

The overarching aim of this research report is to investigate whether technical topics can be successfully communicated to demographically diverse non-technical audiences using applicable types of public engagement and communication techniques.

A literature review was undertaken to investigate current practice and to capture data with information and recommendations associated with similar projects undertaken elsewhere, locally, nationally and internationally.

In this context, three specific key questions are investigated:

- To what extent does the demographic diversity of the target audience influence the public engagement and communication techniques to be used? The purpose here is to determine the demographic diversity of the target audience for the PCSP project.
- What public engagement and communication techniques are applicable to the PCSP? The objective is to analyse the effectiveness of different types of public engagement and communications techniques for technical topics.
- Can technical topics be sufficiently simplified to make it understandable to non-technical audiences?

1.4. Scope of research

The scope of this research focus on applicable public engagement and communication techniques for SACCCS's planned PCSP project in both the Zululand and Algoa Basins. Emphasis will be placed on the demographic diversity of the target audience and to what extent this will influence the approach to engagement.

This study will recommend different communication techniques and propose messages that will resonate with a diverse, non-technical audience.

2. LITERATURE REVIEW

A crucial element of developing any CCS pilot or demonstration project is the understanding of public perceptions of CCS and effectively communicating the risks and benefits. Each CCS project and potentially impacted community is unique, requiring a tailored, site-specific engagement process. Useful lessons are emerging from CCS case studies and social science research worldwide that project developers and regulators should be aware of when establishing their own public engagement and communication strategies.

In an attempt to measure public understanding and perceptions of CCS, a considerable number of studies have been undertaken [2, 4, 9, 10, & 11]. These studies in general revealed that the public has limited knowledge of CCS and a limited understanding of both climate change and the energy context that supports the need for CCS.

Who is the public? Although the public represents every member of society, it is made up of many different groups. All of these vary according to location, culture, education, income and historical background. It is therefore important to understand that the public is not a single entity and to recognise these differences. Furthermore, people's views and opinions can themselves change over time as the political, economic and social background evolves [11].

According to Hammond and Shackley [4] there are five major questions that the public generally ask in relation to CCS (**Figure 2**).

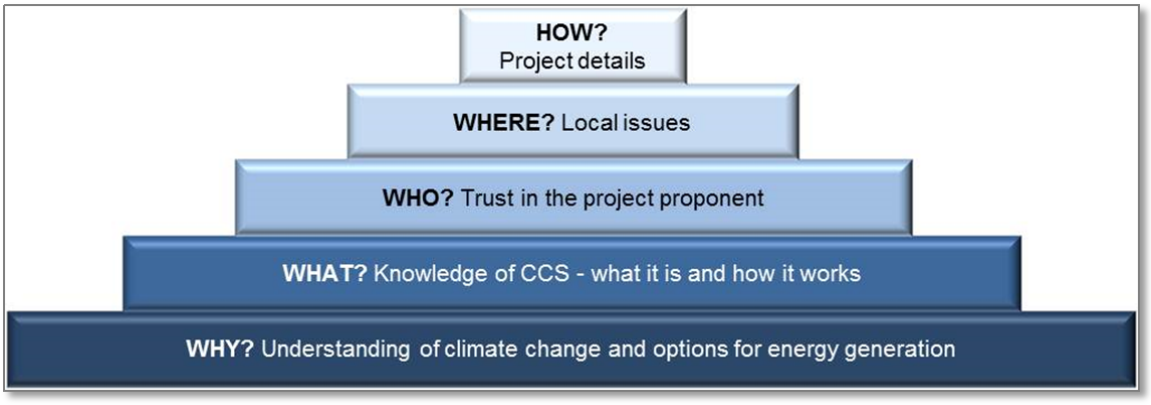


Figure 2: Steps towards public acceptance of CCS projects [4]

Public perceptions of CCS will be informed by an analysis of the perceived risks and benefits of the project. Benefits for the local community are often viewed in economic terms. Should the proposed project bring jobs and investment to the area, then there could be support for CCS. On the other hand, should a community feel that they are shouldering all of the risks associated with the project and not receiving any of the benefits, they are likely to oppose the project.

The risks, as perceived by members of the public, can have a strong influence over project acceptability, hence the need for risk communication. Risk communication aims to establish an effective dialogue through the exchange of information and opinions amongst those responsible for assessing, minimising and regulating risks and those who may be affected by the outcomes of the risks. Leiss [12] identified three distinct approaches to risk communication – the information deficit model, the persuasion model, and the two-way communication model.

The traditional approach has been to educate the general public and laypersons to acknowledge and accept the risk management practices of the respective institutions [13]. This tactic, referred to as the *information deficit model*, assumes that individuals define risk in technical terms and undertakes risk calculations and comparisons in a largely technical sense.

As individuals and communities did not respond to risk as expected, the limitations of the first approach became evident. This resulted in the realisation that non-technical information, like social and institutional context, was highly significant.

Given that most people were unable to engage in the technical dialogue due to lack of time and motivation, a short-cut way of determining the risk is for people to assess the organisations and institutions that are attempting to persuade them of some point-of-view. The *persuasion model* highlights the importance of trust between the public and the organisations promoting a new technology or development. Although this model incorporated the social context, the fact that it was still based on a one-way communication process resulted in shortcomings.

These deficiencies resulted in a third approach – the *two-way communication model*. Through this model, engagement is defined as a two-way flow of information between stakeholders and a developer(s). The goal is that the stakeholders' support for the project is built by asking questions they may have, giving input to decisions,

and improving their sense of empowerment and trust in the project and for the developer(s) to better understand the stakeholders, in order to improve the project and / or engagement strategy [4].

The ultimate goal of risk communication is to assist stakeholders in understanding the rationale of risk assessment results and risk management decisions, and to help them arrive at a balanced judgement that reflects the factual evidence about the matter at hand in relation to their own interests and values. Hence, the objective is to build mutual trust by responding to the concerns of relevant stakeholders.

2.1. Diversity of the target audience

South Africa has a diverse population with a wide variety of cultures and has 11 official languages, as well as others. According to the National Development Plan (NDP) [14] South Africa's population is 51.7 million and is expected to grow to approximately 58.5 million by 2030.

The country is characterised by high rates of unemployment, with a large proportion of out-of-school youth and adults not working. According to the World Economic Forum's (WEF) Global Risk 2014 report [15], South Africa has the third highest unemployment rate in the world for people between the ages of 15 to 24. The report estimates that more than 50% of young South Africans in this age group are unemployed. Only Greece and Spain have higher unemployment in this age range, whilst the other two countries in the top five of most unemployed youth are Portugal and Italy, with unemployment of more than 30%, but less than 40%.

2.1.1. National communication environment

South Africa presents a unique communication environment given rapid changes in its current legal and political context. Disparities are widespread in the country's communication environment, notably access to information and communications technology (ICT) and the linguistic differences. With 11 official languages, information needs to be tailored to reflect the language diversity of a specific region.

Albeit constraints, almost all South Africans have access to some form or medium of information – even those who live in the most rural and remote areas. Examples include radio, television, newspapers, and cell phones.

According to the National Plan (NatPlan) and Local Plan (LocPlan) [8] developed by SRK Consulting, radio is by far the most widely used broadcast medium in the

country. It is estimated that some 94% of South Africans have access to radio in one form or another. There are 16 regional or local radio stations as well as several community radio stations.

The South African Broadcasting Corporation (SABC) offers three free-to-air television channels, together with independent channel eTV. It is estimated that these channels reach approximately 84% of the population. Subscription television services (M-Net and DSTV) reach about 10% of the population [8].

South Africa has a well-established print media comprising a myriad of daily newspapers, mostly serving major urban centres. In line with trends worldwide, the uptake of print media in South Africa is in decline, reaching less than 50% of the population [8]. A number of the larger newspapers have websites where they publish online version of their papers.

Over the past 15 years South Africa has experienced a rapid expansion in cellular phone technology and it is estimated that 96% of the country's population is covered by mobile phones [8]. Further to the fixed line infrastructure and services provided by Telkom and Neotel, these telecommunications companies also provide broadband, which is a key foundation of ICT.

Access to internet in South Africa is available through mobile phones, asymmetric digital subscriber line (ADSL) and fibre-optic cables. Only 17% of the population has access to the internet, which is largely as a result of the persistent high costs of connection [8].

2.1.2. National regulatory environment

Although South Africa does not currently have CCS specific regulations in place, existing national laws can be amended to support CCS. These laws hold strong requirements for development activities that may impact the environment, and stakeholder engagement is conducted as an integral part of environmental authorisation processes and are governed by legislation, including the National Environmental Management Act (NEMA) (Act 107 of 1998), Mineral and Petroleum Resources Development Act (MPRDA) (Act 28 of 2002), and National Water Act (Act 36 of 1998) [8]. For CCS, implementing best practices for engagement in addition to complying with public participation and engagement rules is recommended due to

the new and complex nature of CCS, and the need for stewardship of CCS project sites for many generations

An inter-departmental task team (IDTT) has been established in 2011 to develop a common policy position for South Africa on CCS. The IDTT includes the Department of Energy (DoE), the Department of Environmental Affairs (DEA), the Department of Mineral Resources (DMR), the Department of Trade and Industry (DTI), the Department of Science and Technology (DST), the Department of Transport (DoT), the Department of Water and Sanitation (DWS), and National Treasure (NT).

2.1.3. Regional communication and regulatory environments

Together with community and NGO resistance to the PCSP project, timely an appropriate regulatory certainty was listed as two of the risks identified through a risk assessment conducted by SACCCS [6]. Both these risks will have some unique challenges in South Africa, given the significant diversity of the population with regard to culture, language, education, and economic situation.

Due to the diversity, this research study will focus on the communication and regulatory environments of the PCSP areas of interest, namely the uMkhanyakude District Municipality (UDM) in KwaZulu-Natal and the Cacadu District Municipality (CDM) in the Eastern Cape.

KwaZulu-Natal has 11 districts, of which the UDM is one. The communication environment will be informed by the majority of Zulu speaking people in female-headed households, where more than half of the population is younger than 20 years [16]. Furthermore, traditional authorities, as a decision making body, should be considered an important parameter in analysing the province's regulatory environment.

The CDM is located in the western portion of the Eastern Cape province and is sparsely populated. The two major languages spoken in this province are Xhosa and Afrikaans. This demographic, together with the deficit in the age profile of children aged 5 – 20 (compared to that of the UDM) and the high illiteracy rate will be addressed in an analysis of the communication environment.

As for KwaZulu-Natal, no policy information regarding climate change exists at national level in the Eastern Cape. However, at provincial level, KwaZulu-Natal's Department of Agricultural and Environmental Affairs and Rural Development

(DAERD) compiled a policy for climate change in 2010. Likewise, the Eastern Cape's provincial Department of Economic Development and Environmental Affairs (DEDEA) developed a comprehensive Climate Change Response Strategy, addressing issues like communication, education and public awareness. Both these provincial initiatives will inform an analysis of the regulatory environments.

2.2. Rationale behind different types of public engagement and communication techniques

In assessing different types of public engagement and communication techniques that are relevant to the PCSP, focus studies, case studies, and international standards and guidelines were studied. Methods used to determine the relevance of these techniques include social characterisation of the target audience(s) and stakeholder analysis.

2.2.1. SACCCS and the PCSP

The primary focus of the SACCCS is the delivery of the PCSP, which involves the injection, storage and monitoring of 10,000 – 50,000Mt of CO_2 in South African conditions with the primary aims of:

- Demonstrating safe and secure CO_2 handling, injection, storage and monitoring in South African conditions, in particular South African geology;
- Increasing the South African human and technical capacity for the development and operation of CO_2 handling, injection, storage and monitoring; and
- Raising awareness of the potential importance of CCS to the South African public. [16]

The current sites under investigation for the PCSP are onshore portions of the Zululand Basin in KwaZulu-Natal and the Algoa Basin in the Eastern Cape. While there is more geological storage capacity in the offshore portions of the basins, an onshore pilot will enable industries, government and academics to be involved in the project to inspect and assess the practical elements of CCS and build skills and capacity in the technology.

If successful, the 10,000 – 50,000Mt PCSP may be followed by a larger scale 100,000Mt CO_2 CCS demonstration plant in 2020, which will be the preparation for a full-scale one-million-tonne commercial CCS plant by 2025. Although the site for the

PCSP is onshore, it is expected that the demonstration and full-scale plant will need to store the CO_2 in an offshore geological basin [16].

Current data available on the Zululand and Algoa Basins will be analysed before SACCCS can move forward to basin exploration of the two basins. Basin exploration will initially involve seismic surveys of the two basins, along with additional analysis of existing core available. The aim of basin exploration is to develop the understanding of the two basins such that a site or sites can be identified with the potential for CO_2 storage at a reasonable level of confidence. However, it does not provide detailed understanding of reservoir characteristics, such as permeability.

A request for Section 50(1) approval for a geological investigation (basin exploration and site characterisation) of the Zululand Basin was submitted to the DMR at the end of 2013. The permitting process for the feasibility stage for the Zululand Basin is currently underway and will soon be followed by a similar request for permission for the Algoa Basin. Once permitting for the feasibility stage has been attained, permitting for the PCSP itself will commence.

2.2.2. NatPlan and LocPlan

In April 2012 a consortium of South African and international consulting and research organisations was appointed as part of the World Bank – South African Department of Energy CCS Study. The task of the consortium was to prepare two separate stakeholder engagement plans, a National Plan (NatPlan) and a Local Plan (LocPlan) prior to the commencement of the PCSP [1, 8]. The NatPlan addressed stakeholder engagement at a strategic national level and defined the roles and responsibilities of different national stakeholders. The LocPlan looked at local stakeholder engagement in the two proposed areas to be considered for the PCSP – KwaZulu-Natal and the Eastern Cape. A generic process for stakeholder engagement at local level was presented to be used in any local context [1].

The following objectives apply at national and local level:

- Raise awareness of CCS as a possible climate change mitigation measure;
- Develop an understanding of CCS, key concepts, sub-surface storage and key issues;
- Outline the benefits and potential risks of demonstration and deployment of the CCS technology in South Africa;

- Place CCS in the context of South African climate change mitigation, energy production and use, coal use, resource development, job creation, etc.; and
- Identify roles and responsibilities for implementation of public engagement around CCS deployment in South Africa [8].

National and local stakeholder engagement will be deployed in an action plan comprising of five phases:

- Inception and preparation;
- Introductory engagement;
- General awareness raising;
- Test injection regulatory process; and
- On-going engagement (national and local) [8].

2.2.3. International standards and guidelines

The World Bank, which includes the International Finance Corporation (IFC), has been instrumental in promoting stakeholder engagement and has developed various standards and principles for stakeholder engagement:

- IFC good practice manual for public consultation and disclosure; and
- The Equator Principles [8].

Furthermore, the International Association of Public Participation (IAP2) is an international association that promotes the values and best practices associated with involving the public in government and industry decisions.

The World Resources Institute (WRI) has identified key principles of effective community engagement for CCS, which are intended to serve as international guidelines for regulators, local decision-makers and project developers of CCS projects [8].

2.2.4. Social characterisation

Locations and communities differ greatly, even within a small geographic area, and the ‘social fit’ of a project in its local context can be an important indicator of potential public acceptance or opposition [4]. Social site characterization is the process of investigating and monitoring the local social circumstances in the area, changes therein over time and underlying factors shaping public awareness and public opinion as a parallel activity to technical site characterization [9].

Public views on CCS are generally not based solely upon an understanding of the technology, but are created in reference to a whole host of other knowledge and experiences [8]. Social characterisation can help determine if a project is more or less likely to be locally popular, and can provide useful information for designing an engagement campaign. Relevant factors can be assessed through social characterisation, including local relationships with the energy industries, reactions to other recent infrastructural developments, and the fit with the needs of the local economy.

For CCS in general, the capture element of the process seems to be, so far, perceived as no more than an innovative extension of existing technology. The storage, however, is perceived as something new, unknown and potentially risky. Furthermore, onshore storage is much more contentious than offshore, because of the proximity to people and their livelihoods. Also, the transportation of CO_2 might leave room for public concern.

2.3. Simplification of presenting technical topics

Drake [19] argues that communication strategies that emphasise an abundance of scientific information, laden with technical language have insufficient appeal to non-technical audiences. Also, communication in this regard has been reduced to static, one-way presentations of technical information. Iterative, interactive, and tangible learning processes are underrepresented in technical communication efforts, but can better resonate and engage many non-technical audiences. Furthermore, non-technical audiences can better relate to and understand a technical project through the deliberation of language, relevance and resonant messages framed in a valued landscape. Key messages are used to simplify and control the communication through creating meaning and introducing the issue.

A report issued by the International Energy Association's Greenhouse Gas R&D Programme (IEAGHG) [11] identified the following gaps in their study titled *Key Messages for Communication Needs for Key Stakeholders:*

- Link CCS and day-to-day activities;
- Graphic improvements;
- Creative public engagement; and
- Acknowledge counter views.

The IEAGHG study [11] revealed that there will always be questions asked with regards to alternative projects where funding could be diverted to, for instance energy conservation and renewable energy. Furthermore, a minority of the public are still sceptical about the direct link between human activity and climate change and this need to be continually explained. The recommendation was thus to endeavour to link CCS as a climate change mitigation option to people's everyday lives.

The general feedback on graphics and illustrations were the lack of human elements, the sense of everything occurring in one place and the lack of a sense of scale, with a reference to everyday objects or distances.

The IEAGHG's recommendations included the use of e-based communication methods, including webcams and online question and answer (Q&A) forums. However, due to the focus of this study on the demographically diverse, non-technical audiences, and the lack of available equipment and computers, the use of these types of materials would not be investigated.

Another useful recommendation was to acknowledge counter views, such as the opinion that the technology is unproven or that CCS provides a justification to continue burning fossil fuels without restraint. This might promote a sense of openness and could possibly overcome potential showstoppers before they escalate into major concerns. The overall objective would be to illustrate to stakeholders and the public that a range of opinions and perspectives exist.

A further key deliverable from the IEAGHG study [11] was a series of Briefing Notes (BNs) covering key information needs of key stakeholders. The aim of the BNs was to translate the technical (scientific and engineering) reports published by the IEAGHG into uncomplicated documents that would summarise the key points for the benefit of non-expert stakeholders and interested, reasonably well informed members of the public. The topics covered by the BNs included key issues within CCS which required explanation and / or have previously caused confusion and / or controversy. These topics include:

- Key terms and concepts (including carbon, CO_2, greenhouse gases, fossil fuels and basic geology);
- Briefing Note 1: Setting the scene for CO_2 capture and storage: human-caused climate change;

- Briefing Note 2: Carbon dioxide capture and storage – a brief history and current status;
- Briefing Note 3: From sources to stores – matching carbon dioxide (CO_2) sources with potential geological storage sites for CO_2;
- Briefing Note 4: Capturing carbon dioxide;
- Briefing Note 5: The costs of carbon dioxide capture and storage (CCS);
- Briefing Note 6: Transporting carbon dioxide;
- Briefing Note 7: Naturally occurring carbon dioxide (CO_2) in underground rocks;
- Briefing Note 8: Geological CO_2 storage mechanisms and site selection;
- Briefing Note 9: Possible impacts of carbon dioxide (CO_2) leakage onshore;
- Briefing Note 10: Possible impacts of carbon dioxide (CO_2) leakage off-shore;
- Briefing Note 11: Monitoring for the presence and movement of CO_2 in CO_2 capture and storage (CCS) projects;
- Briefing Note 12: What are the legal issues surrounding carbon dioxide capture and storage?
- Briefing Note 13: What does the public think about carbon dioxide capture and storage?

Although not completed by the time of issuing the study, a further aim was to summarise the BNs into shorter Information Sheets (ISs). The aim of the ISs is to simplify the material into short, quick and easy-to-read information sheets for the interested, but less or non-informed stakeholder or member of the public. The ISs are intended for less engaged stakeholders who might devote just a few minutes to reading and digesting the information and make use of minimal text and mostly illustrations, diagrams and photos to convey key messages, where possible [11].

2.4. Chapter summary

The literature review revealed that public perceptions of CCS will be informed by an analysis of the perceived risks and benefits of a proposed project. Risk communication should be used to assist stakeholders in arriving at a balanced judgement that reflects the factual evidence of the risks at hand, in relation to their own interests and values.

This communication should take cognisance of the diversity of the target audience and all the parameters at play, including language, age profile and gender.

Furthermore, the communication mediums to be used will also depend on the demographics of the target audience and range between radio, newspapers and cell phones, depending on area and accessibility.

SACCCS identified regulatory uncertainty as one of the key risks for the PCSP. The IDTT is currently busy with developing a common policy position for South Africa on CCS and the timely outcome of such a position will be critical to the success of the PCSP. Regional differences exist between the regulatory environments in the two provinces under considerations, due to differences in the provincial governments and the presiding role of traditional authorities in KwaZulu-Natal.

South Africa's diverse population, with a wide variety of cultures and languages necessitates an analysis of the diversity of the target audience. This will be discussed going forward, including a look at the particular communication and regulatory environments.

Different types of techniques that will be investigated include social characterisation and stakeholder analysis. Lastly, three of the BNs developed by the IEAGHG study [11] will be summarized into ISs.

3. METHODOLOGY

Research studies are distinguished in terms of the research methods used and the purpose or underlying rationale of the study. The traditional purpose of academic or basic research is to develop a better understanding through theory development and hypothesis testing. This provides a foundation for applied research which can be used as intelligence gathering for developers preparing to undertake a real engagement campaign. Applied research could also potentially lead to designing a communications and engagement strategy – to be implemented in the realm of practice. These three methods / activities - basic research, applied research and practice – are not strictly demarcated and involve exchange and iteration between one another.

In the current investigation, a literature-based research methodology was chosen with the traditional (narrative or comprehensive) literature review to be more specific [20]. A traditional or narrative literature review critiques and summarises a body of literature and draws conclusions about the topic in question [21]. The body of literature is made up of the relevant studies and knowledge that address the subject area.

The primary purpose of this review is to provide the reader with a comprehensive background for understanding the current knowledge and highlighting the significance of new research. It might inspire research ideas by identifying gaps or inconsistencies in a body of knowledge, thus helping the researcher to determine or define research questions or hypotheses [21].

The literature review process followed included:

- the selection of a review topic;
- searching the literature;
- gathering, reading and analysing the literature;
- writing the report; and
- referencing.

Literature searches were undertaken by using keywords on electronic databases and websites.

In analysing and synthesising the literature, an initial first read of the articles were undertaken to get a sense of what they were about. After completion of the initial review, a more systematic and critical review of the content was done. Once appraisal of the literature was completed, consideration was given on how to present the findings in a clear and consistent manner.

To narrow down the scope, the literature review investigated relevant public engagement and communication techniques for SACCCS's planned PCSP project in South Africa. Focus studies, case studies, and international standards and guidelines were studied. Methods used to determine the application of these techniques included social characterisation and stakeholder analysis.

In framing this study, the investigation focused on the two South African basins identified in the 2010 Atlas [5] as possible CO_2 geological storage sites for the PCSP, i.e. onshore areas of the Zululand and Algoa Basins (**Figure 1**).

4. DISCUSSION

The PCSP area of interest in the Zululand Basin falls within the uMkhanyakude District Municipality (UDM) in KwaZulu-Natal with Durban as metropolitan and the area in the Algoa Basin that holds promise comprise of the Cacadu District Municipality (CDM) in the Eastern Cape, having Port Elizabeth as metropolitan.

In describing the diversity of the target audience, the locality, demographic analysis, local regulation and local communication environments of the UDM and CDM were analysed.

Moreover, social characterisation of the UDM and CDM and a stakeholder analysis attempts to provide a rationale for different types of public engagement and communication techniques. The discussion concludes with a proposal on how to simplify the presentation of technical topics to stakeholders.

4.1. Diversity of the target audience

CCS public engagement will have some unique challenges in South Africa, given the significant diversity of the population with regards to language, culture, education, and economic situation. Communication about CCS technology also needs to be placed in the context of other national priorities, such as access to energy, poverty alleviation, job creation, and education [7].

Communication in the rural areas is challenging, due to limited infrastructure and remoteness. Radio is an important means of reaching communities in these areas and the number of mobile users is increasing as the cellular network coverage is improving. Although rural areas are serviced in terms of reporting by regional and local newspapers, distribution is generally limited to urban areas [8].

Governance at local level takes place through municipal ward and traditional council structures. In terms of legislation, municipalities are tasked with local planning and delivery of services, whereas traditional councils are required to uphold the values and administer the affairs of the traditional community [8]. Public engagement regarding CCS will need to take account of and engage with relevant representatives in all governance structures.

The regulatory public participation process that forms part of an environmental impact assessment (EIA) requires notices about a project or activity in areas with

limited access to communication infrastructure to be displayed in key public places such as municipal offices, police stations and libraries.

A further requirement is to contact community representatives, including ward councillors and traditional leaders. A critical evaluation of "*The role of ward committees in enhancing public participation in Rustenburg municipality*" [22] concluded at the time that no definitive assumptions could be drawn on whether ward committees have managed successfully to promote or enhance participation in totality and that community participation should rather be viewed as a process. Furthermore, municipalities may view ward committees as a challenge to their power and rights as elected representatives. Also, public participation is meaningless if municipalities are not fulfilling their coordinative role and reducing it to consultation alone [22].

4.1.1. uMkhanyakude District Municipality (UDM)

a) Locality

uMkhanyakude is one of the 11 districts of Kwazulu-Natal and lies in the northernmost part of the province (see **Figure 3**), consisting of six (6) local municipalities. uMkhanyakude is named after the yellow-barked fever tree. This district is very rural and contains a large number of wetlands, the greatest being the iSimangaliso Wetland Park (IWP), a UNESCO World Heritage Site. This park presents a wide variety of habitats, such as marshes, peatlands, floodplains, rivers, lakes and coastal areas [8].

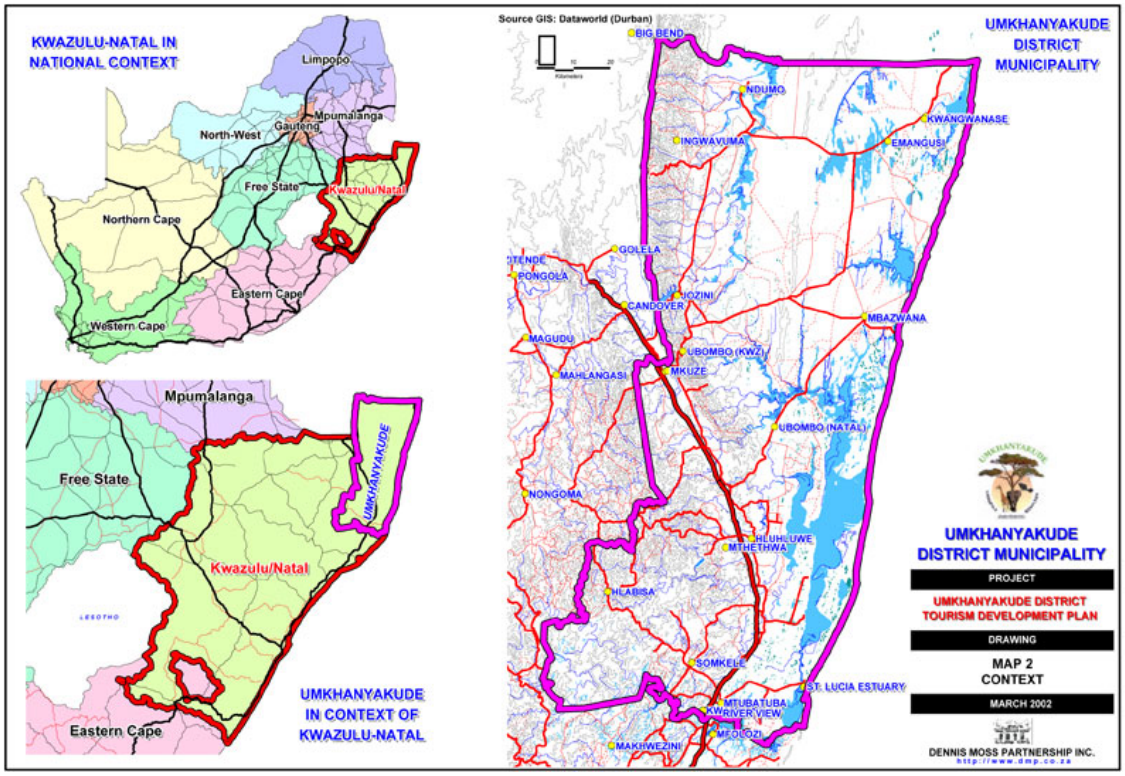


Figure 3: uMkhanyakude District Municipality (UDM) [23]

The land cover in uMkhanyakude district is fifty percent (50%) bushland and thicket and eleven percent (11%) primary grassland. Fourteen percent (14%) of land is allocated for conservation. Fifty one percent (51%) of land is owned by the Ingonyama Trust Board (ITB), followed by nine percent (9%) of land owned by the state and eight percent (8%) by companies. Three percent (3%) of the district land is privately owned [24].

b) Demographic analysis

A demographic analysis that aims to understand the community, the population dynamics, and the living conditions for UDM, is presented in ***Annexure 1***. Gender (**Figure A 2**) and age (**Figure A 3**) are important parameters to understand the level of economic activity that is likely to occur, together with aspects of migration and gender-headed households. With a total population of more than half a million people, more than half of the residents in the UDM are female and almost 60% are younger than 20 years. A possible explanation is the migration of job seeking males to urban areas, leaving female-headed households and a strong dependency on the youth in the area. Due to this dependency, the education levels are low. The

education and participation of women in the work force are key principles that should be embedded in local initiatives. Another key part of designing an engagement strategy should be to utilise the school curriculum as an important communication and learning tool in order to reach the half of the population younger than 20 years. The participation of young people should be encouraged in all local initiatives and schools developed as an important common arena for young people's participation in topics of important local and regional aspects.

The majority of people in this area speak Zulu, which will inform the communications plan for public engagement.

c) Local regulation

Legislation in KwaZulu-Natal is promulgated by the KZN Provincial Legislature. KwaZulu-Natal's Department of Agriculture and Environmental Affairs (DAE) provides the province's environmental management strategy, which draws its mandate from NEMA. The overriding objective of the DAE is to develop and maintain an environmental management strategy that supports sustainable livelihoods in recognition of all relevant stakeholders.

Other provincial legislation that will have a bearing on environmental governance includes:

- KwaZulu-Natal Heritage Act 4 of 2008;
- KwaZulu-Natal Planning and Development Act 6 of 2008;
- KwaZulu-Natal Traditional Leadership and Governance Act 5 of 2005; and
- KwaZulu-Natal Land Administration Act 3 of 2003.

No policy information pertaining to climate change exists at municipal level in KwaZulu-Natal. KwaZulu-Natal's Department of Agricultural and Environmental Affairs and Rural Development (DAERD) compiled a policy for climate change in 2010. This report notes that changes in the climate have been observed in the province and calls for an action plan that aims at reducing the factors that contribute to the change in climate, without compromising the population's social and economic status [8].

Traditional authorities play an important social and economic role in the UDM area. In each local municipality there is a traditional body that communicates with the local ward committees and council forming part of the decision making body in the area.

As land owners, traditional authorities directly shape the economic conditions of the area. There are 296 traditional councils in KwaZulu-Natal of which eighteen (18) traditional authorities reside in the UDM area [24].

The ITB and other traditional authorities own more than half of the land in the UDM, which constitute almost 3 million hectares of land in KwaZulu-Natal. The ITB has a specified process for allowing development on land that is owned by them. After conducting a full EIA and obtaining the land owners' consent for the respective development, the developer will then formally apply to the ITB to develop and build on the land. The Board will then meet to consider whether or not to accept the application. This provides a substantial risk for developers, as the EIA process is time-consuming and costly to complete with little or no guarantee on whether or not the application will be approved. Furthermore, the land belongs to the ITB, thus securing tenure is uncertain and significantly increases the risk of developing on the land.

While recognising the importance of land ownership by traditional authorities, the lack of effective communication poses a big developmental challenge in uMkhanyakude. The fact that land cannot be purchased or developed without traditional authorities' consent is seen to be stunting growth and commercial activity in the area.

d) Local communication environment

Durban has several radio stations – the main radio station being East Coast Radio with an audience of around 2 million people. Community radio stations that cater for a range of listeners include Gagasi, Inanda FM and Lotus FM. Gagasi has an audience of up to a million listeners and provides programmes in English and Zulu. Inanda FM also broadcasts in English and Zulu, with an audience of around 200,000 listeners, whilst Lotus FM caters for the Indian community [8].

The main newspapers in the Durban area include The Daily News, The Independent, The Mercury, The Post, The Sunday Tribune and Isolezwene, which caters for a Zulu readership. The Hilltop, Northern News and Berea Mail are a few of the weekly community newspapers [8].

4.1.2. Cacadu District Municipality (CDM)

a) Locality

The Cacadu District Municipality (CDM) is situated in the western portion of the Eastern Cape province (see **Figure 4**). The name Cacadu is derived from the Khoikhoi word tkakadao, which means “bulrush river”, the earlier name for the Papkuils River near Port Elizabeth. The CDM consists of nine (9) local municipalities and two other portions that are National Parks, namely the Addo Elephant and the Tsitsikamma National Parks.

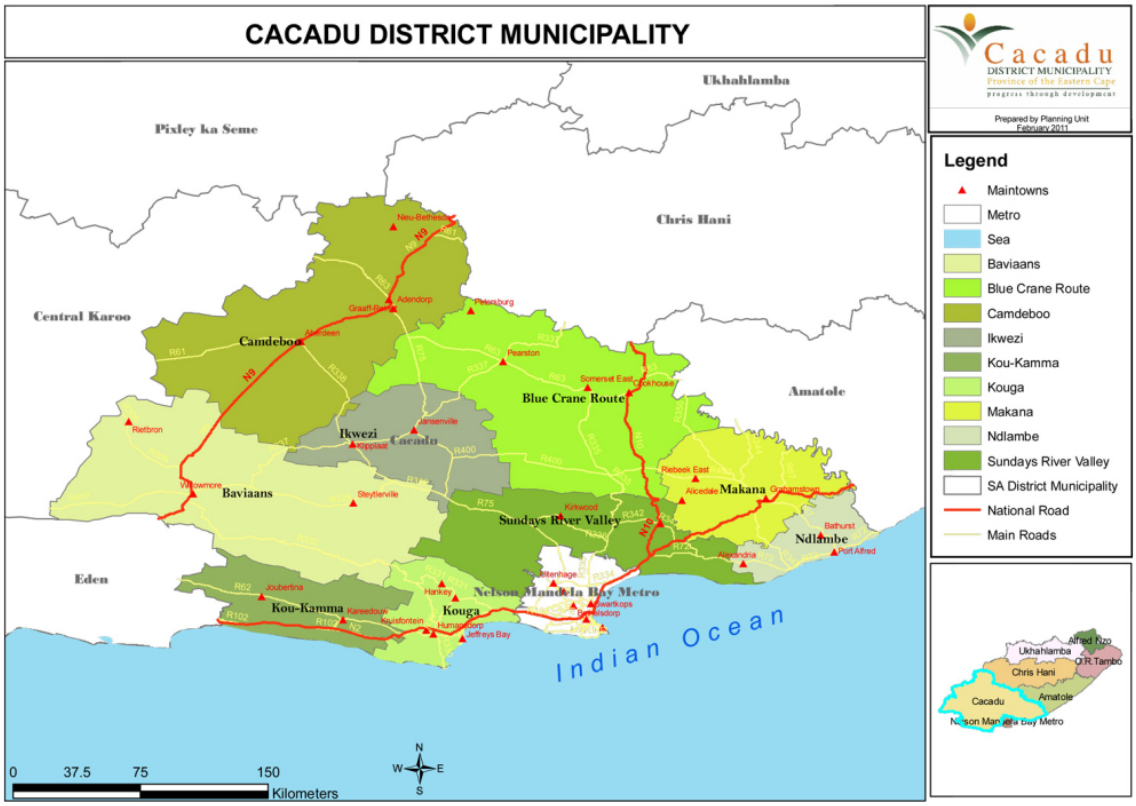


Figure 4: Cacadu District Municipality (CDM) [25]

Although the CDM covers approximately one third of the Eastern Cape’s land area, it only houses 5.4% of the province’s population. Unemployment is very high, with about 57% of the population living below an acceptable income threshold.

b) Demographic analysis

A demographic analysis for Cacadu District Municipality is given in ***Annexure 2***. The majority of people in this area speak Xhosa (~50%), followed by Afrikaans (~45%) – an interesting characteristic that will inform the communications plan.

The population is relatively youthful with notable exceptions of relatively few children aged 5 – 20, possibly indicating that they are being raised and educated in areas with better education opportunities. This then provides a significant difference between the age profiles of the CDM and the UDM (**Figure 5**) and should be addressed in the communications plan and public engagement strategy.

Inland areas in Cacadu are typically characterised by a Karoo landmass, which restricts agricultural production to extensive practices, i.e. sheep and cattle farming. This results in low population densities and scattered small towns as employment opportunities are fewer and the demand for commercial infrastructure less. Coastal areas in Cacadu are characterised by higher population densities, primarily due to the prevalence of intensive agricultural practices, which are encouraged by the higher coastal rainfall, associated fertile soils and the increased tourism potential of seaside-towns [25].

c) Local regulation

At provincial level, legislation in the Eastern Cape is promulgated by the Eastern Cape Provincial Legislature, following drafting by the relevant provincial department with the requisite powers and duties for law making and administration.

The Eastern Cape's Department of Economic Development and Environmental Affairs (DEDEA) oversees environmental management within the province. Environmental governance in the province is further informed by the:

- Eastern Cape Environmental Conservation Act 13 of 2003;
- Eastern Cape Heritage Resources Act 9 of 2003;
- Eastern Cape Provincial Parks Board Act 12 of 2003; and
- Eastern Cape Traditional Leadership and Governance Act 4 of 2005.

The Eastern Cape's DEDEA has developed a comprehensive Climate Change Response Strategy [17], which represents a situational analysis of current and future climate change impacts for the province, technological assessments, action plans as well as communication, education and public awareness strategies. The document also includes a Draft Climate Change Communications Programme for the Eastern Cape [17, Appendix 2, p.21-25]. Although this programme was initiated in 2011, the progress should be assessed to ascertain whether CCS communication can be included or added to this, as the context of climate change was already provided.

d) Local communication environment

The main radio station in Port Elizabeth is Algoa FM with approximately three quarter of a million listeners. Community radio stations that cater to a range of listener groupings include Nqkubela Community Radio and Bay FM, which broadcast in Xhosa, English and Afrikaans [8].

There are a number of English newspapers in the Port Elizabeth area, including The Herald, Port Elizabeth Express and Weekend Post [8].

4.1.3. Comparison between the UDM and the CDM

Age distribution and gender differences were compared between the UDM and the CDM in ***Annexure 3***.

As mentioned, more than half of the population in the UDM is younger than 20 years. Compared to this, a relative deficit of children aged 5 – 20 is noteworthy in the CDM population density (see **Figure 5**).

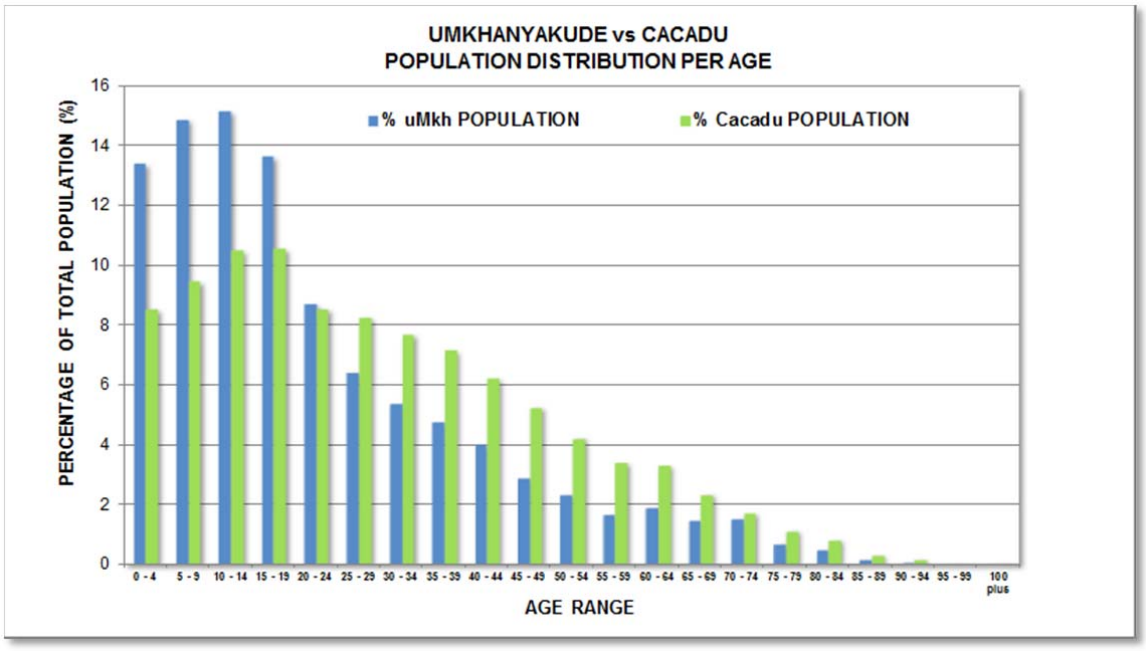


Figure 5: Age group comparison between UDM and CDM as a percentage of total population

The significant difference between the age profiles of the UDM and the CDM should be addressed in the communications plan and engagement strategy. More emphasis should be placed on designing an engagement strategy that utilises the school curriculum in the UDM, for instance.

A gender comparison between the two areas showed no significant differences (**Figure A 10**). The UDM has 10% more females than males, whilst the CDM has approximately 5% more females than males. Both areas have a significant number of female-headed households and the education and participation of women should be a key part of an engagement strategy.

Furthermore, the prominence of traditional authorities in the UDM will require specific attention in terms of an engagement strategy. This should include the correct protocol with regards to engagement, together with a communications plan that fits in with the language and culture.

The language differences between the two district municipalities will require diverse approaches to a communications plan. The majority of the people in the UDM speak Zulu, whilst there is quite an even spread between Xhosa and Afrikaans in the CDM. Due to the technical nature of the topics to be communicated, it is imperative that the communication be done in a language that the majority of the people understand. As discussed before (Drake, 19), non-technical audiences can better relate to and understand a technical project if the communication is tailored to a relevant language and landscape.

4.2. Rationale behind different types of public engagement and communication techniques

As discussed, methods used to determine the relevance of different public engagement and communication techniques to the target audience(s) include social characterisation and stakeholder analysis.

4.2.1. Social characterisation

A social context unlikely to be supportive of CCS can be as detrimental to the viability of a project as the limitations in infrastructure or geology in a particular area. The success of the CCS project therefore necessitates the understanding of the social characteristics of a potential CCS site right at the start of the development, in order to gauge likely support and identify possible areas of concern – a process known as social site characterisation. The areas that social characterisation analyse include:

- The history of fossil fuels and / or extractive industry in the area;
- The economic and employment situation;

- Who the key stakeholders are and what motivates them;
- The demographic and social profile of the communities local to the development;
- What the key social, economic, and environmental issues are in the area; and
- Which individual and / or organisations the public and local communities trust to convey messages to them [11].

Methods that can be used for social characterisation include the reviewing of newspapers, internet sites, community histories, existing studies, and provincial government documents. Factors to be considered include the trust levels in the developer, population density, policy fit in local and national context, local media or opinion forming groups, and the existing perceptions of energy developments and CCS.

A study done in Scotland and Poland [9] show social site characterisation to be a powerful tool to raise public awareness about complex issues such as CCS.

a) UDM

A local economic and social development analysis for the UDM revealed poverty alleviation, water constraints, the lack of a coherent and common view and approach to economic development as some of the major challenges facing the district. The UDM's mission statement [23] focuses, amongst others, on the following:

- Economic and industrial growth strategy and projects;
- Sound social and infrastructural development programme;
- Ninety percent (90%) of the district to be using green energy by 2020;
- Robust district rural development strategy; and
- A human resource development strategy.

The Integrated Development Plan (IDP) for the UDM [23] cites the following competitive advantages:

- Strategic location as a border district. The UDM borders both Swaziland and Mozambique and is an important location in terms of major infrastructure and economic development projects and programmes.
- Lavumisa and Ponta D'Oro border posts – these are the most strategic borders south of Swaziland and Mozambique. These borders handle millions

of tonnes of cargo between the three countries and are linked to South Africa's premier ports – Richards Bay and Durban.

- The Jozini dam is a major source of drinking water for people, irrigation water for agriculture, drinking water for animals, and a catalyst for urban development and economic growth.
- iSimangaliso Wetland Park (IWP) and more than 200 kilometres of pristine coastline. The IWP was declared a World Heritage site by UNESCO in 1999. The total area occupied by IWP is about 3,320km^2 and has Lake St Lucia which is the largest estuary in Africa.
- Good climate – the weather conditions are favourable for good agricultural activity round the year and also provide leverage for tourism development.
- The N2, R22 and R66 national roads are important in terms of infrastructure for public transport and movement of goods between South Africa, Swaziland and Mozambique.
- uMkhanyakude is one of the richest areas in KwaZulu-Natal in terms of cultural heritage.
- The Ubombo mountain ridge and range is an important natural heritage feature of the district.
- The UDM has all the necessary ingredients for diverse agricultural practice, given the climate, soil types and conditions, water availability, and stable weather throughout the year.
- Recently geological maps and oral histories told in many chiefdoms indicate a diverse mineral resource base found across UDM. The selection of sites for resources exploitation and beneficiation in the district will be guided by the balance with sustaining the cultural, natural and human environment.

The integration of environmental conservation and management remains a challenge for the region to be integrated into sustainable development – especially within an impoverished region. Dependence on the natural resources, especially within rural areas of higher population densities, creates serious conservational concerns [23]. One of these concerns is a lack of land use planning, whereby sustainable agricultural practices need to be complimented by the protection and regeneration of the natural environment. More relevant to CCS is the need for

climate change to be considered in project planning initiatives as it might hold future consequences for the tourism and economic base of the UDM.

b) CDM

Cacadu's Integrated Development Plan (IDP) (2012 – 2017) [25] was used as source for this situational analysis from the perspective of the socio-economic conditions as well as institutional arrangements, infrastructure and organizational challenges. One of the sources that informed the IDP is the Medium Term Strategic Framework (MTSF) that was developed to guide government programmes in the electoral mandate period between 2009 and 2014. The MTSF intends on guiding planning and resource allocation across all the spheres of government, through the identification of ten (10) National Strategic Medium Term Priorities (NSMTP). Some of these NSMTPs can be incorporated in a stakeholder engagement strategy for the PCSP, in particular:

- #2. *Massive programme to build economic and social infrastructure.* One of the thirteen (13) key areas identified as part of this strategy holds particular promise:
    - #2.1. *Creatively accessing resources from various sources to continue with the economic and social infrastructure programme in a manner that supports growth and employment creation and the involvement of the private sector in financing projects.*
- #9. *Sustainable resource management and use.* The main objective of government is to encourage sustainable resource management and use by focusing on various interventions including:
    - *Improving air and atmospheric quality for health and well-being of citizens.* The MTSF analysis further goes on to say that *climate change should be considered in project planning initiatives as this holds consequences for the tourism and agricultural economic base of the district*. This key focus area should inform the stakeholder engagement strategy for the PCSP in this area.

The district has economic potential to create employment and has strong tourism attractions and economic development opportunities, such as game reserves and agriculture. Investment in alternative energy, such as wind turbines, nuclear power

and hydro-electrical power are potential projects which will stimulate spin-offs for economic growth. A development agency has been established by the municipality as a strategy in enhancing economic growth in the Cacadu district [25].

4.2.2. Local stakeholder analysis

Local stakeholders (**Figure 6**) are analysed to determine their potential influence and impact on the project. This determines the level of engagement required per stakeholder. Conclusions were drawn from a stakeholder analysis conducted by SRK Consulting as part of the NatPlan and LocPlan [8]. The analysis is given in ***Annexure 4***, **Table A 13** and summarized in **Figure 6** below.

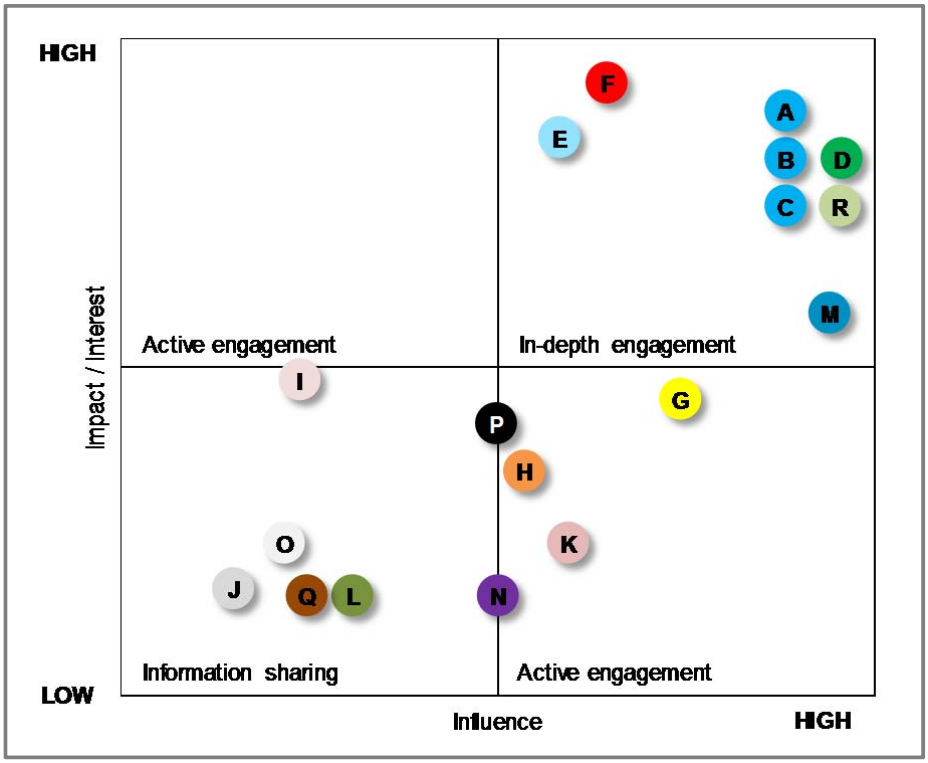


Figure 6: Local stakeholder matrix [8]

LEGEND:

A	Government – National
B	Government – Provincial
C	Government – Local
D	Traditional authorities
E	NGOs & conservation groups
F	Directly affected communities & landowners

G	Researchers & academia
H	Education
I	Business & commercial
J	National & international forums & existing structures
K	SACCCS partners
L	Labour
M	Media (national, regional & local)
N	Tourism & recreation
O	Parastatals
P	Transport sector
Q	Agriculture
R	General public

It is recommended that information dissemination and engagement should take place in a systematic and iterative manner, starting with key national stakeholders, followed by provincial stakeholders and finally involving engagement with key stakeholders at local level [8]. **Figure 6** suggests that initial engagement should focus on the government (national, provincial and local), traditional authorities, NGOs and conservation groups, directly affected communities and landowners, media and the general public. Key methods for in-depth engagement include individual consultation or focus groups – or open house meetings, technical workshops, etc. **Table A 14** (***Annexure 5***) suggests a range of engagement materials that can be utilized for awareness raising and knowledge sharing regarding CCS. In the communication context provided earlier in the discussion, engagement materials that will be functional in these environments include frequently asked questions (FAQs) documents, background information documents (BNs and ISs, more specifically), pamphlets and flyers, poster exhibitions, editorials, cell phone communication, and a CCS information centre. Notices in newspapers and on radio can be used to advertise information sharing meetings, public meetings, open house meetings or other events.

Stakeholder engagement for the PCSP will be integrated into the permitting activities, in particular to the development of the environmental management plan (EMP), which will require a formal stakeholder participation process. It is SACCCS's

intention to engage with all the interested and affected parties before this formal process commences to ensure that the parties fully understand the project and have had an opportunity to engage with SACCCS about it.

Public engagement is listed as primary success criteria of the PCSP, with the following objectives:

- Raise awareness about CCS and its potential importance in the South African context at a national level amongst the South African public.
- Engage with the public in the vicinity of the PCSP (including the capture and transport facilities) to ensure they understand and are comfortable with and supportive of CCS within their community [16].

To date, engagement has been done on a national and provincial government level in both areas and the next focus will be the local communities and traditional authorities.

4.3. Simplification of presenting technical topics

Drake's [19] argument to relate technical communication to resonant messages, framed in a valued landscape was further investigated by evaluating key messages developed through the World Bank study [8]. These key messages are related to key issues expected to be raised by stakeholders regarding CCS and are listed in ***Annexure* 6, Table A 15**. Key messages can be used to contextualise the ISs for the South African environment.

Three of the Briefing Notes (BNs) (BN 1, 2 and 9) developed by the IEAGHG study [11] were summarized into Information Sheets (ISs). These ISs (see ***Annexure 7***, ***8*** and ***9***) resonate well with the stakeholder groups anticipated in the designated areas SACCCS are currently investigating to conduct the PCSP. These BNs cover the key terms and concepts, elaborate on human-caused climate change and highlight possible impacts of CO_2 leakage onshore.

- Briefing Note 1: Setting the scene for CO_2 capture and storage: human-caused climate change;
- Briefing Note 2: Carbon dioxide capture and storage – a brief history and current status; and
- Briefing Note 9: Possible impacts of carbon dioxide (CO_2) leakage onshore.

The following recommendations from the IEAGHG study [11] were incorporated in the development of the ISs:

- There is a need to make a reasonably strong link between CCS and peoples' everyday lives. It was suggested to include people who are involved in testing and developing CCS in communication material. Another suggestion on how to portray CCS as a human-based enterprise was to locate infrastructure within a social setting of settlements, other commercial and industrial enterprises, e.g. links with existing oil and gas extraction and processing.
- Representations of CCS are large bits of equipment in big landscapes, but there needs to be a human angle. A suggestion is to represent CCS facilities as part of an overall power station type complex and associated infrastructure. This might soften the appearance and provide context.
- The terminology and images used in communication are too technical and sometimes misleading, e.g. terms like supercritical, seismic, etc.
- The messages need to be simple and clear. Don't have too much unnecessary detail and too many options.
- Start from the assumption that your audience has zero geological knowledge. Geological layers and formations are not usually understood, especially in the absence of reference points for the layman.
- Scale is also an issue – an innovative way needs to be found to show depth of injection and storage that looks realistic, especially not give the impression that it occurs just below the surface.
- Also, assume a very low level of knowledge of economic evaluation methods and be careful of using graphs and bar charts, as they can be hard to interpret. There is a need for clear and informative info-graphics - graphic representations which are accompanied by call-out boxes presenting clear text descriptions which enhance the information value of the graphic.
- Be careful not to assume that people will be reassured by analogues.
- Work to improve the association of CCS with positive things, i.e. trusted individuals, trusted organisations, respected academics, etc.

The IS topics chosen from the list of BNs concur with the following objectives from the NatPlan and LocPlan [8]:

- Raise awareness of CCS as a possible climate change mitigation measure;

- Develop an understanding of CCS, key concepts, sub-surface storage and key issues; and
- Outline the benefits and potential risks of demonstration and deployment of the CCS technology.

The application of these ISs should consider the delivery methods discussed earlier, taking into the account the constraints in different areas. Most South Africans have access to some form or medium of information – radio, newspapers and cell phones are the most widely used.

The purpose of translating the BNs into ISs was to demonstrate that technical information can be sufficiently simplified, taken into account lessons learnt from previous projects and studies. The ISs presented in ***Annexures 7 – 9*** are not the final product and recommendations are made in the next chapter on how to improve them.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The overarching aim of this research report was to investigate whether technical topics could be successfully communicated to demographically diverse non-technical audiences. The research suggested that this is possible, given that the public engagement strategy is carefully crafted to include the various dynamics at play in a target area.

With respect to the specific research questions set out at the inception of this research work, the following answers have been found, observations made and conclusions drawn.

a) *To what extent does the demographic diversity of the target audience influence the public engagement and communication techniques to be used?*

An analysis of the target audiences in the two different areas, i.e. the Zululand and Algoa Basins revealed the existence of various dynamics. KwaZulu-Natal accounts for 20% of South Africa's population and the Eastern Cape almost 13%. Illiteracy in both these areas, as in the rest of South Africa, is high - an important parameter for the development of a communications plan.

The UDM in the Kwazulu-Natal province is characterised by a large number of wetlands, the greatest being the iSimangaliso Wetland Park, a UNESCO World Heritage Site. The level of unemployment is high and there are a larger percentage of females compared to males within this district. This may be as a result of migrant labour, where men leave to find work in urban areas. The IDP revealed a significant percentage of youth between the ages of 0 to 19.

The socio-economic characteristics of the CDM are that the district is fairly sparsely populated and is relatively youthful. With the exception of the city of Port Elizabeth, the study area is predominantly rural and the majority of employment comes from trade and agriculture. Unemployment figures are high and a large proportion of the local population is dependent on social grants.

The difference in the age profiles between the UDM and the CDM requires specific attention in developing an engagement strategy and communications plan. Utilising techniques that involve the youth in the UDM, which constitute more than half of the

population, should be investigated further. CCS education could be included in the school curriculum, where this type of engagement can result in an effective way whereby school kids communicate the topic of CCS to illiterate parents in a relevant context and language.

Furthermore, the large amount of female-headed households, together with the strong dependency on the youth in the UDM creates a unique situation to be considered in an engagement strategy. As the dependency on the youth results in low education levels, the education and participation of women in the work force are key principles that should be embedded in local initiatives.

Another important dynamic in the UDM is the significant social and economic role that the 18 traditional authorities play in this area. These authorities own more than half of the land in the UDM and there are specified processes for allowing development on land owned by them. This adds significant risk to a proposed project in this area, especially in terms of approval of a development by the authorities and securing tenure for a project. A very specific communications plan should be developed before engaging these authorities, to ensure that correct protocols are followed with regards to engagement. Public engagement regarding CCS will need to take account of and engage with relevant representatives in all governance structures.

A message that responds to the high unemployment rates in both these districts should be carefully crafted, as there will be high expectations for economic development and job creation from both communities. It is imperative that a developer be honest about job creation prospects and not create undue expectations that might jeopardise the trust relationship in future. Important to note is that if the community feel they are shouldering all of the risks associated with the project, but not receiving any of the benefits, they might oppose the project.

The conclusion is therefore drawn that the demographic diversity of the target audience, together with social, economic, and environmental conditions are likely to have a significant influence on the public engagement and communication techniques to be used.

b) *What public engagement and communication techniques are applicable to the PCSP and what is the effectiveness of different types of public engagement and communication techniques for technical topics?*

When communicating technical topics to a non-technical audience, the observation was made that communication should be done in a language that most of the people understand. This requirement will involve different engagement strategies for the UDM and the CDM. A communications plan for the UDM will be need to be undertaken in Zulu, whilst a communications plan for the CDM will have to cater for both Xhosa and Afrikaans. Furthermore, different language groups have different cultures, which should also be included in developing and engagement strategy.

The communication environment varies in urban and rural areas. It is easier to reach the public and stakeholders in urban areas due to the existence of good communication infrastructure, whilst rural areas are constrained by limited infrastructure together with the remoteness of the population. South African cities and towns are well served by radio, newspapers, the internet and telephone and cellular networks. Radio is an important means of reaching communities in rural areas and the number of mobile users is increasing as the cellular network coverage is improving. Although rural areas are serviced in terms of reporting by regional and local newspapers, distribution is generally limited to urban areas.

It is therefore concluded that the most important communication technique applicable to the PCSP is the two-way communication model suggested by Leiss [12]. Through this model, stakeholders should be allowed to ask questions they might wish to pose and to give inputs into decisions. This should improve their sense of empowerment and trust in the project and allow the developer to better understand the stakeholders. Furthermore, risk communication techniques should be included whereby risk assessment results and decisions for the project are communicated to stakeholders in order to help them arrive at a balanced judgement between the factual evidence about the project in relation to their own interests and values. This should enhance the objective of building mutual trust between the developer and the stakeholders.

c) *Can technical topics be sufficiently simplified to make it understandable to non-technical audiences?*

Based upon the literature review and personal investigations, it is concluded that technical topics can be sufficiently simplified to make them understandable to non-technical audiences, on condition that these messages are framed in a relevant landscape that includes language and culture.

Important recommendations from the IEAGHG study [11] suggest that the messages must be simple and clear, without unnecessary detail or too many options. It should also be assumed that the audience has a very low level of knowledge of economic evaluation methods and therefore it is necessary to be careful of using graphs and bar charts as they can be hard to interpret. Messages should work to improve the association of CCS with positive things, i.e. trusted individuals, trusted organisations, respected academics and the like.

Further proposals were to acknowledge counter views, such as the opinion that CCS provides a justification to continue burning fossil fuels without restraint or the technology is unproven. This could possibly overcome potential showstoppers before they escalate into major concerns and might at the same time promote a sense of openness. The overall aim would be to illustrate to stakeholders and the public that a variety of opinions and perspectives exist.

The ISs, summarised from BNs which were developed as part of the IEAGHG study [11], provide some direction with regards to preparing messages for consideration as part of the communications plan as they relate to questions asked by stakeholders on previous projects.

In conclusion, it may be stated that technical topics can be sufficiently simplified to make it understandable to non-technical audiences.

5.2. Recommendations

It is recommended that

- ISs could be further improved by including relevant diagrams and / or pictures to enhance the understanding.
- ISs could be translated into the identified languages of the target areas, i.e. Zulu, Xhosa and Afrikaans.

- Finally, CCS should be placed in the context of South African climate change mitigation, energy production and use, coal use, resource development, and job creation.

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ANNEXURES

Annexure 1: Demographics for uMkhanyakude District Municipality (UDM) [16]

Table A 1: Local municipalities in uMkhanyakude District Municipality (UDM)

LOCAL MUNICIPALITY,	POPULATION	%	DOMINANT LANGUAGE
Jozini	184,093	32.11	Zulu
Hlabisa	176,899	30.85	Zulu
Umhlabuyalingana	140,962	24.59	Zulu
Mtubatuba	35,216	6.14	Zulu
The Big 5 False Bay	31,102	5.42	Zulu
St Lucia Park	5,080	0.89	Zulu

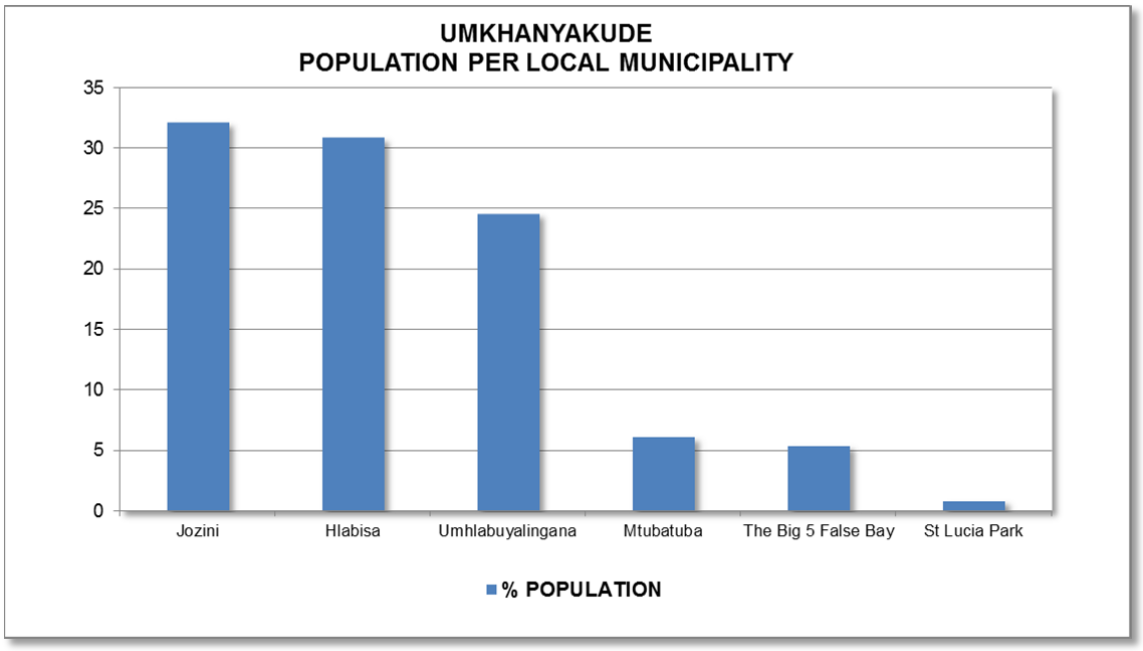


Figure A 1: UDM local municipalities

Table A 2: UDM - population and language

LANGUAGE	POPULATION	%
IsiZulu	559,949	97.66
SiSwati	3,748	0.65
English	3,182	0.55
Afrikaans	2,304	0.40
IsiNdebele	1,378	0.24
Sesotho	903	0.16
Sepedi	582	0.10
IsiXhosa	561	0.10
Setswana	259	0.05
Xitsonga	230	0.04
Other	208	0.04
Tshivenda	48	0.01

Table A 3: UDM - gender

GENDER	POPULATION	%
Female	313,954	54.76
Male	259,399	45.24

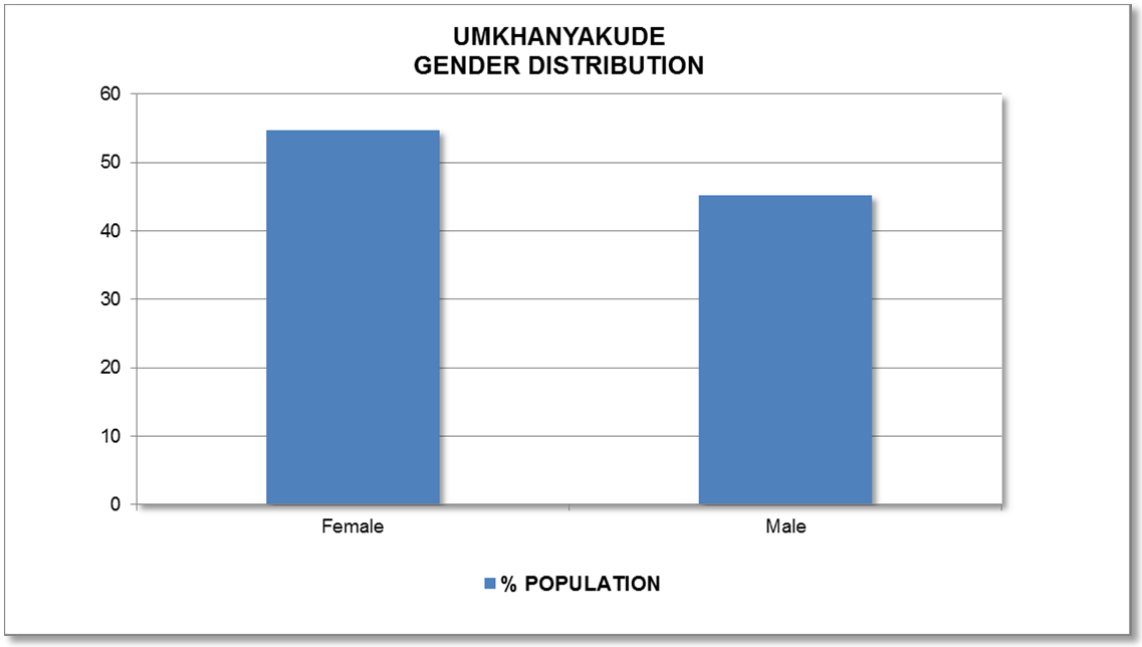


Figure A 2: UDM gender distribution

Table A 4: UDM - ethnic groups

ETHNIC GROUP	POPULATION	%
Black African	568,853	99.22
White	3,235	0.56
Coloured	898	0.16
Indian / Asian	367	0.06

Table A 5: UDM – age groups

AGE	POPULATION	%
000 - 004	76,956	13.42
005 – 009	85,375	14.89
010 – 014	86,948	15.16
015 - 019	78,248	13.65
020 – 024	50,006	8.72
025 – 029	36,983	6.45
030 - 034	30,883	5.39
035 – 039	27,382	4.78
040 – 044	23,084	4.03
045 – 049	16,695	2.91
050 – 054	13,481	2.35
055 – 059	9,654	1.68
060 – 064	11,199	1.95
065 – 069	8,543	1.49
070 – 074	8,869	1.55
075 – 079	4,049	0.71
080 – 084	3,017	0.53
085 – 089	1,004	0.18
090 – 094	579	0.10
095 – 099	292	0.05
100 plus	106	0.02

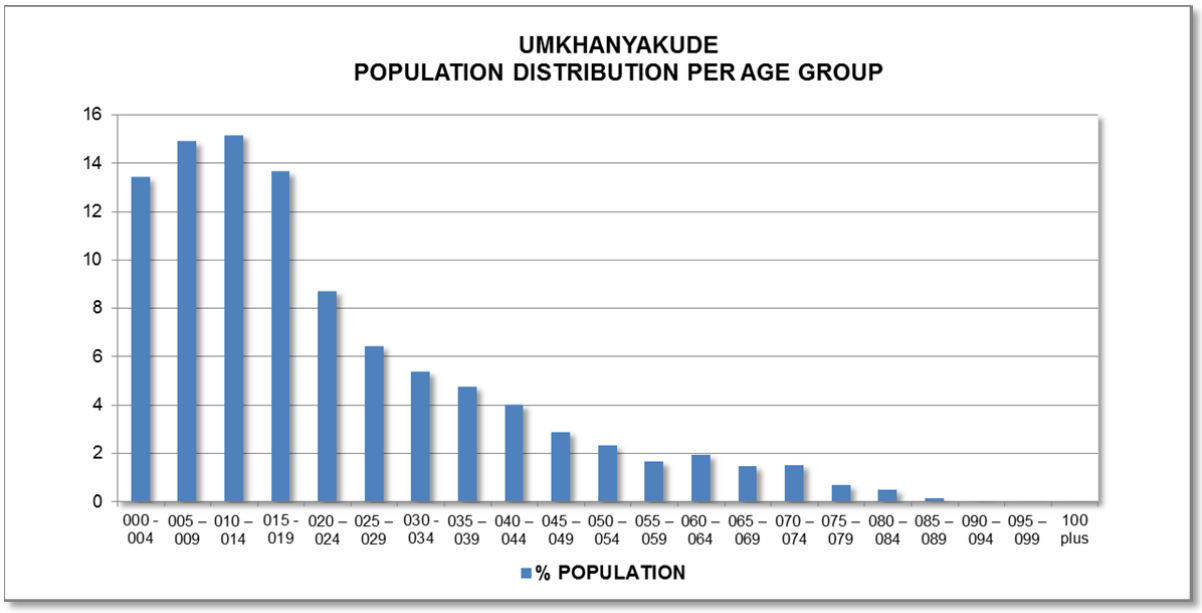


Figure A 3: UDM population distribution per age group

Annexure 2: Demographics for Cacadu District Municipality (CDM) [27]

Table A 6: Local municipalities in Cacadu District Municipality (CDM)

LOCAL MUNICIPALITY,	POPULATION	%
Makana	74,544	19.20
Kouga	70,693	18.21
Ndlambe	55,478	14.29
Camdeboo	44,381	11.43
Sunday's River Valley	41,580	10.71
Blue Crane Rout	35,006	9.02
Kou-Kamma	34,296	8.83
Baviaans	15,341	3.95
Ikwezi	10,371	2.67
District managed area	6,531	1.68

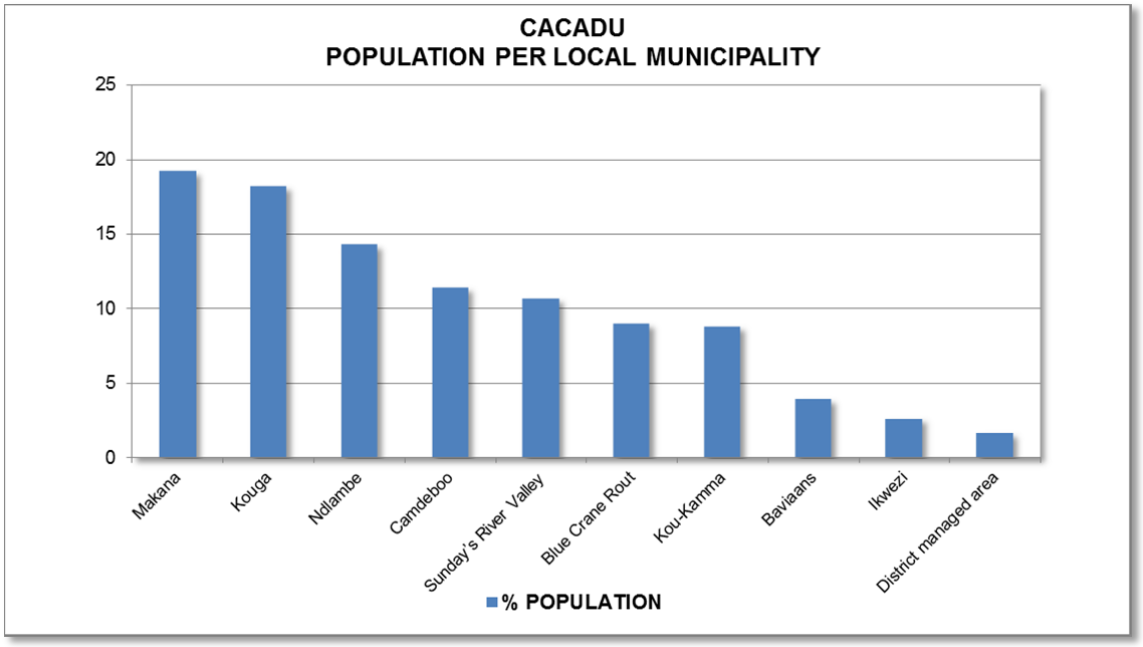


Figure A 4: CDM local municipalities

Table A 7: CDM - population and language

LANGUAGE	POPULATION	%
Xhosa	190,003	48.94
Afrikaans	174,917	45.06
English	20,806	5.36
Sotho	744	0.19
Zulu	596	0.15
Other	451	0.12
Ndbele	192	0.05
Swati	172	0.04
Tswana	127	0.03
Northern Sotho	87	0.02
Tsonga	80	0.02
Venda	46	0.01

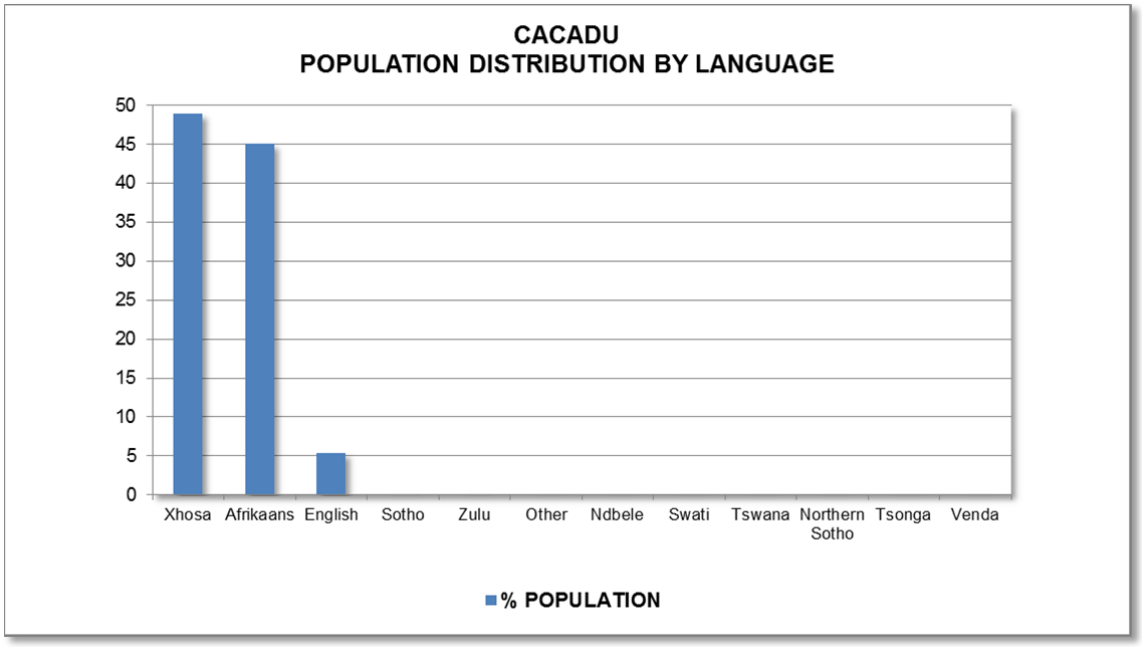


Figure A 5: CDM population distribution by language

Table A 8: CDM - gender

GENDER	POPULATION	%
Female	202,295	52.11
Male	185,906	47.89

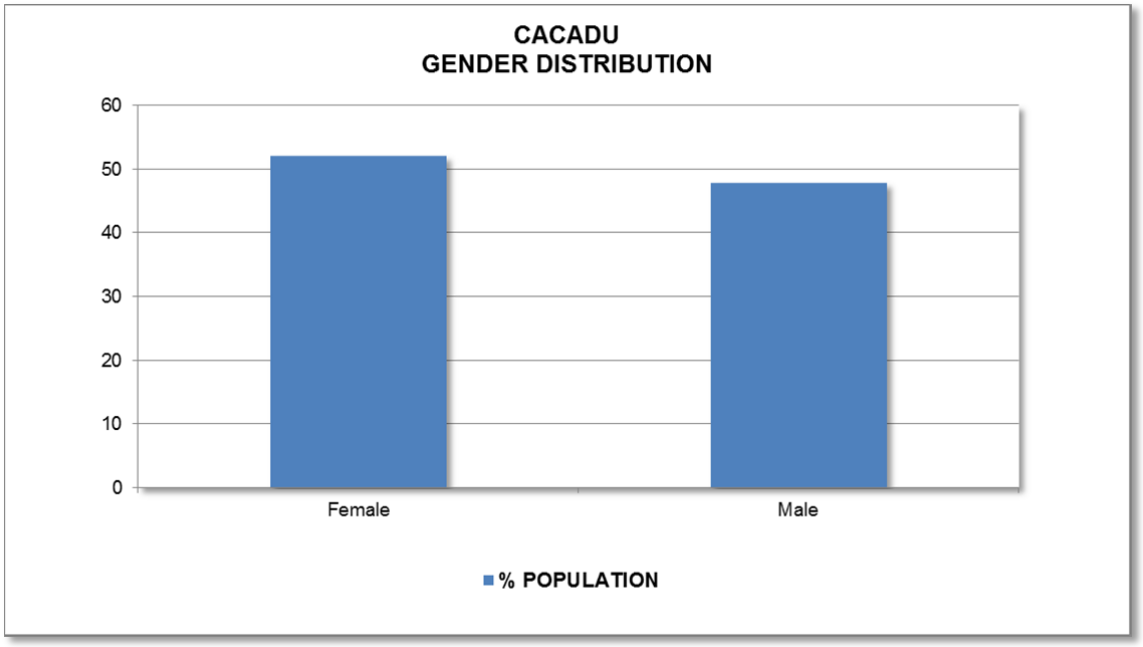


Figure A 6: CDM gender distribution

Table A 9: CDM - ethnic groups

ETHNIC GROUP	POPULATION	%
Black African	202,289	52.11
White	44,110	11.36
Coloured	141,083	36.64
Indian / Asian	719	0.19

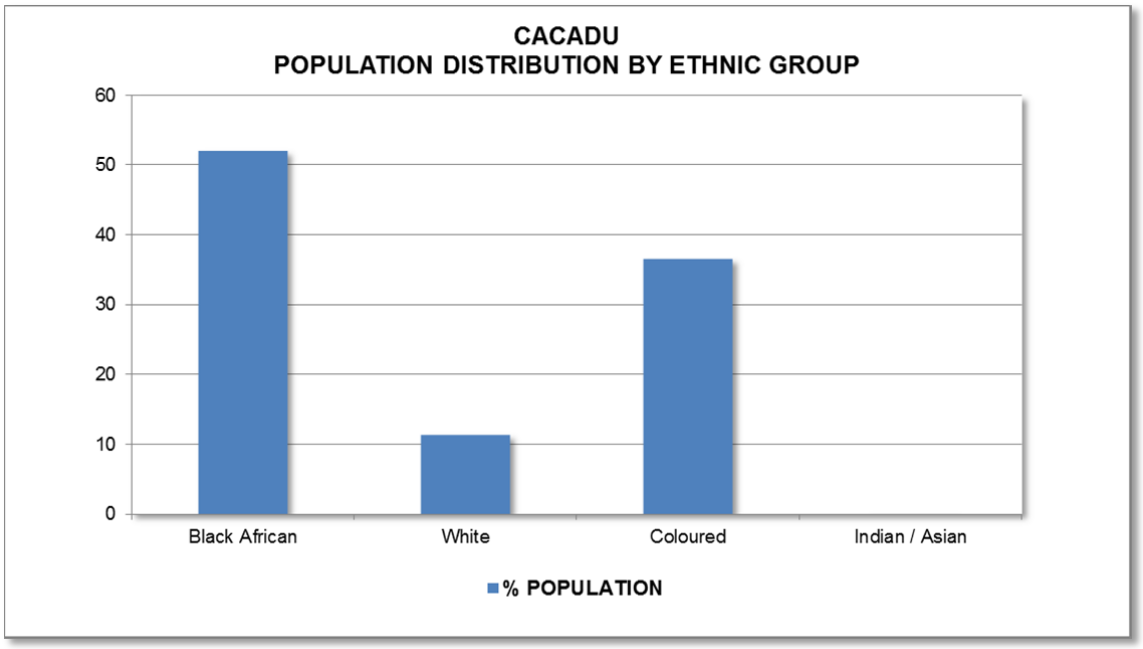


Figure A 7: CDM population distribution by ethnic groups

Table A 10: CDM – age groups

AGE	POPULATION	%
000 - 004	33,178	8.55
005 – 009	36,745	9.47
010 – 014	40,809	10.51
015 - 019	41,052	10.57
020 – 024	33,222	8.56
025 – 029	32,096	8.27
030 - 034	29,929	7.71
035 – 039	27,840	7.17
040 – 044	24,208	6.24
045 – 049	20,483	5.28
050 – 054	16,494	4.25

AGE	POPULATION	%
055 – 059	13,289	3.42
060 – 064	12,928	3.33
065 – 069	9,218	2.37
070 – 074	6,764	1.74
075 – 079	4,447	1.15
080 – 084	3,276	0.84
085 – 089	1,325	0.34
090 – 094	680	0.18
095 – 099	154	0.04
100 plus	64	0.02

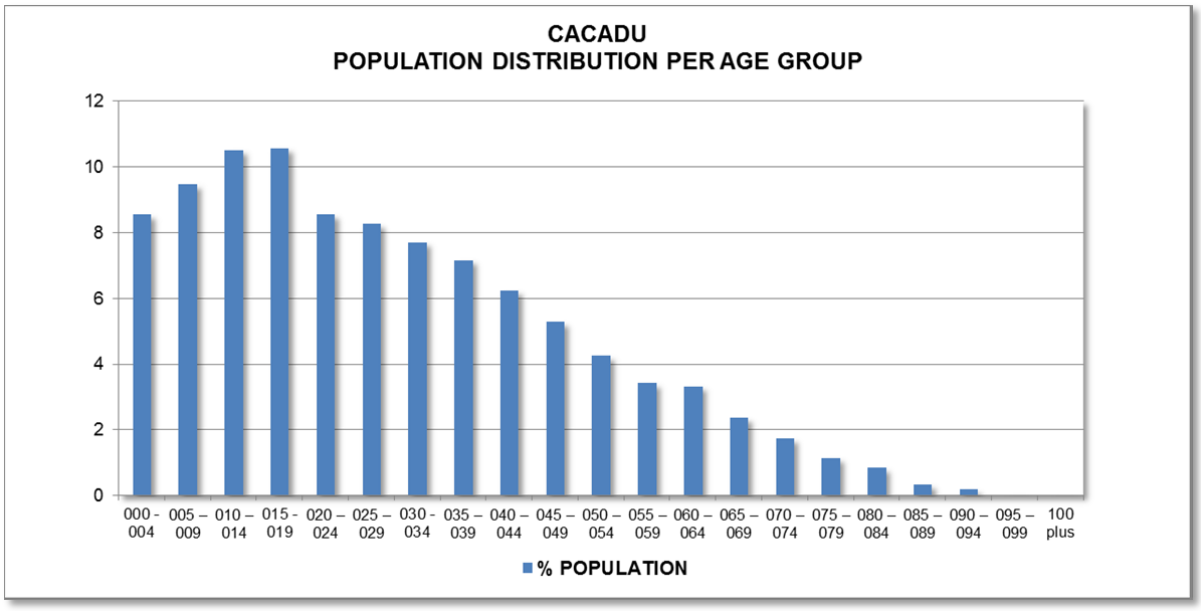


Figure A 8: CDM population distribution per age group

Annexure 3: Demographic comparison between UDM and CDM

Table A 11: Age group comparison between UDM and CDM

AGE	% UMKHANYAKUDE	% CACADU
000 - 004	13.42	8.55
005 – 009	14.89	9.47
010 – 014	15.16	10.51
015 - 019	13.65	10.57
020 – 024	8.72	8.56
025 – 029	6.45	8.27
030 - 034	5.39	7.71
035 – 039	4.78	7.17
040 – 044	4.03	6.24
045 – 049	2.91	5.28
050 – 054	2.35	4.25
055 – 059	1.68	3.42
060 – 064	1.95	3.33
065 – 069	1.49	2.37
070 – 074	1.55	1.74
075 – 079	0.71	1.15
080 – 084	0.53	0.84
085 – 089	0.18	0.34
090 – 094	0.10	0.18
095 – 099	0.05	0.04
100 plus	0.02	0.02

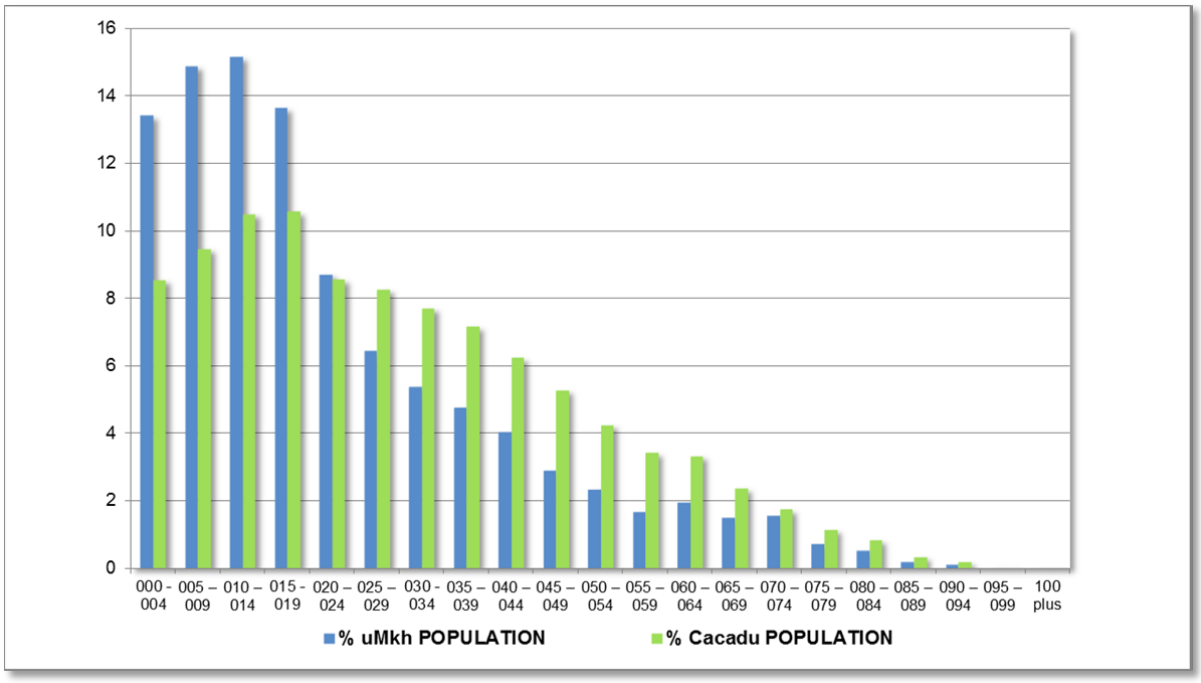


Figure A 9: Age group comparison between UDM and CDM

Table A 12: Gender comparison between UDM and CDM

GENDER	% UMKHANYAKUDE	% CACADU
Female	54.76	52.11
Male	45.24	47.89

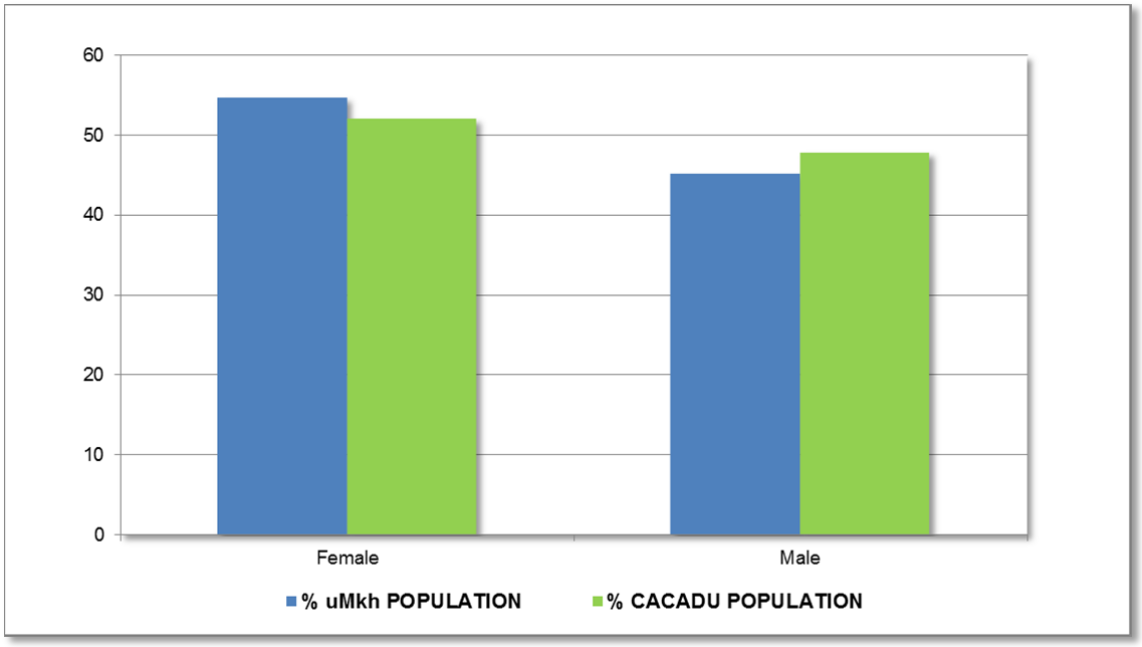


Figure A 10: Gender comparison between UDM and CDM

Annexure 4: Stakeholder analysis from the LocPlan

Table A 13: Local stakeholder analysis for the PCSP [8]

#	CATEGORY	IMPACT / INTEREST	INFLUENCE (+ / -)
A	Government – National	HIGH	HIGH + or – The competent authority in this case, which will ultimately make the decision whether CCS and CO_2 storage will be deployed in South Africa, is the DoE. The DoE commissioned this study in association with the WB and they are expected to have a high positive influence on the project as they are interested to investigate the viability of utilising CCS in South Africa through comprehensive stakeholder engagement. Other national departments may have different views about the deployment of CCS in South Africa.
B	Government – Provincial	HIGH	HIGH + or – It is expected that provincial government will have the responsibility to make decisions regarding permitting and authorisation for the PCSP and they can have a high positive or negative influence over the project, depending on the results of anticipated environmental and social impact studies.
C	Government – Local	HIGH	MEDIUM + or – It is not expected that local government will have decision-making capacity (except in the instances of municipal by-laws) for the PCSP. Local politicians can use their political influence as representatives of the community for or against the project.
D	Traditional authorities	HIGH	HIGH + or – If the PCSP site is situated on tribal land, traditional authorities can have a high influence, especially if they are landowners. Traditional authorities are also representatives of the community and can use their power in the community to influence the project.
E	NGOs & conservation groups	HIGH	HIGH – Organisations such as Earthlife

#	CATEGORY	IMPACT / INTEREST	INFLUENCE (+ / -)
			Africa, the Parks Board, etc. can be very negative about the project, especially if the PCSP site falls within a national heritage sit. The area currently considered for test injection in the Zululand Basin falls within the iSimangaliso Wetland Park. There are also nature reserves such as the Thembe Elephant Park and Ndumo, amongst others. In the Algoa Basin, nature reserves such as the Addo Elephant Park and the Sileza Nature Reserve occur within the proposed area for the test injection site. Although these organisations do not have decision-making authority, they can influence community perspectives and the media.
			MEDIUM + NGO views may differ on the issue of CCS. Some may view CCS as an important mitigation measure for reducing the impact of CO_2 emissions and therefore can be positive about the PCSP. Others may view CCS as part of the problem of prolonging the use of coal instead of moving towards renewable energy.
F	Directly affected communities & landowners	HIGH	HIGH – If any communities are affected negatively in any way, especially on a socio-economic level, their influence can be highly negative.
			MEDIUM / HIGH + If efforts are made to benefit communities with the implementation of the test injection site, such as social upliftment initiatives, capacity building, etc. and communities are involved in a positive manner, their influence can be positive.
G	Researchers & academia	MEDIUM	MEDIUM + or – Researchers and academia who might have insight into the technical details and risks and benefits of the PCSP may view the project positively. Should some of them for example be of the opinion that there are high risks, etc. their influence may be negative. Their opinions are considered independent and they can have substantial influence on community perspectives and the

#	CATEGORY	IMPACT / INTEREST	INFLUENCE (+ / -)
			media, even though they have no decision-making capacity.
H	Education	LOW	LOW + or - / NEUTRAL Universities and schools are expected to have a low influence over the PCSP as the project does not really affect them, unless these institutions are situated in close proximity to a test injection site. Educators may also play a neutral role providing information on how South Africa is addressing the impacts of climate change.
			MEDIUM + If capacity building initiatives are undertaken for raising awareness in schools and universities regarding CCS and the PCSP, this may result in these institutions having a positive influence in terms of understanding and spreading awareness of CCS.
I	Business & commerce	MEDIUM / LOW	MEDIUM + If the PCSP brings social upliftment and job opportunities, the business community could have a positive effect on community and media views.
J	National & international forums and other existing structures	LOW	LOW – These organisations do not have decision-making capacity and their influence on the decision whether to proceed with the PCSP is limited.
		MEDIUM	MEDIUM + Due to the success and relative safety of CCS internationally, these organisations may have a positive view of CCS and my affect local views and perceptions positively.
K	SACCCS partners	HIGH	MEDIUM + The project partners are supportive of the project and if they all send out the message that they are in support of CCS it may have a positive influence over community perceptions and the media.
L	Labour	LOW	LOW + It is not expected that the PCSP will provide a high number of job opportunities, but if job opportunities can be created, it could affect the project in a positive manner. It is

#	CATEGORY	IMPACT / INTEREST	INFLUENCE (+ / -)
			expected that labour organisations will be in favour of the project as a result of potential job opportunities.
M	Media (national, regional & local)	HIGH	HIGH + or – The media can affect the project highly positive or negative depending on their perceived impact of the PCSP and can influence community views.
N	Tourism & recreation	LOW / MEDIUM	MEDIUM – or + It is expected that the impact of the PCSP will have a low impact on tourism in the areas. However, if the test injection sites are used as a means of educating the public with an on-site communication liaison officer, this can have a medium positive impact. Perceptions from media and the fact the one of the sites to be considered for the PCSP is in the iSimangaliso Wetland Park and the proximity of other nature reserves may create the perception that tourism and recreation will be affected negatively.
O	Parastatals	LOW	LOW + or – Parastatals are expected to have a low influence over the project as they do not have any decision-making capacity.
P	Transport sector	MEDIUM	LOW + / MEDIUM + If there is the possibility of job opportunities, especially with the transport of CO2 to the TIP, this sector's interest can be high, however, they don't have any decision-making capacity and their influence over the project is considered low to medium.
Q	Agriculture	LOW	LOW / MEDIUM + / - If the TIP is perceived to affect agricultural land or agricultural activities in the local area, this sector may be more interested in the PCSP and express their views.
R	General public	HIGH	HIGH + / - The general public is expected to take a significant interest in the PCSP, as CCS storage is a new technology and potentially controversial. It is expected that their

#	CATEGORY	IMPACT / INTEREST	INFLUENCE (+ / -)
			views and perceptions will be conveyed to the media and for instance local government and politicians. This can be positive or negative, depending on the impacts and outcome of the impact assessment of the PCSP.

Annexure 5: Engagement materials

Table A 14: Suggested engagement materials / initiatives [8]

ENGAGEMENT MATERIAL	DESCRIPTION
CCS holding statement	It is important that the information regarding CCS communicated to stakeholders is accurate and consistent. A holding statement ensures that all role-players communicate consistent information to stakeholders.
Fact sheets	In-depth information on a range of topics related to CCS.
Frequently asked questions (FAQs) documents	Answers provided to a long list of frequently asked questions that must be updated on a regular basis.
Background information documents	Non-technical, clearly understandable information on CCS and related topics written for the general reader.
Technical reports	For stakeholders and the media who would like a deeper understanding on certain topics.
DVD's	Information DVD's available on websites or internet sites such as You Tube. This can include information on how CCS works, arguments for and against it, international examples, etc.
Interactive presentations	Presentations using Power Point, with animated slide shows and information boxes.
Pamphlets & flyers	Information presented on one page, usually with colour graphics.
Power point presentations	Prepared slide shows for use at general meetings.
Poster exhibitions	Information such as, "it's a new concept", mitigation for climate change, etc., how deep storage takes place, can be visually portrayed to be displayed at information sharing meetings, at a CCS information centre or public places such as shopping malls, libraries, post offices, etc.
Image library	A picture gallery of international storage sites, relevant CCS images and a host of other visual material can be made available on a website.
Drama theatre	Involving local school / college / university drama groups in plays or concerts to enact the key messages and these in a fun, entertaining and informative way.
Press releases	Information made available in the press to announce the project, or to give specific information related to key messages.
Editorials	Leading articles written by senior staff or a publisher or newspaper or magazine.
Newsletters	A written report, usually issued periodically, such as a monthly or quarterly, that can be issued in colour with pictures and graphs to make it more visual.
Panel discussions	A number of experts in the field of CCS can be interviewed and discuss many CCS related topics on TV or radio.
Advertisements	Notices in newspapers and on radio and television to advertise information sharing meetings, public meetings, open house meetings or other events.
Visual materials	Samples of cap rock, storage rock and models showing aspects

ENGAGEMENT MATERIAL	DESCRIPTION
	of capture and storage.
CCS toolkit	An information toolkit has been developed in South Africa to assist with education and capacity building of municipalities with regards to climate change. A similar toolkit can be developed for government and other stakeholder group, or an add-on can be developed to supplement the climate change toolkit.
Social media	Information can be made available on the internet via Twitter, internet blogs, Facebook, etc.
Cell phone communications	Information, such as notification of meetings or events or key milestones can be made available to stakeholders.
Competitions	At schools and local newspapers, around the topics of CCS as part of the curriculum.
Training sessions / workshops	For teachers and university lecturers to incorporate CCS as part of the curriculum.
CCS information centre	The development of a CCS information centre in the area of the PCSP will provide a place where many capacity building and knowledge sharing initiatives can take place and where CCS materials can be displayed.
Transfer of CCS knowledge	Facilitate the transfer of knowledge from international CCS experts to South Africans.
Skills development	Train CCS personnel and tailor South African skills for use on CCS development and operations.
Employment creation	Provide a point of entry for relevant university graduates into CCS employment and help connect educational activities with the needs of industry.

Annexure 6: Key messages for local stakeholders

Table A 15: Key messages to be communicated to local stakeholders [8]

ISSUE	KEY MESSAGE
Project description	A small scale PCSP to understand South African geology and conditions and to build skills and capacity and raise awareness around CCS technology.
Rationale for the project	Significant exploration is required to ensure that the site selected is appropriate for the safe, secure and long term storage of CO_2. The PCSP will be executed to prove that CO_2 storage can be done in South African conditions and geology and build capacity and awareness around CCS.
Experience	There are 5 large scale CCS projects that store a million tonnes per annum since 1996 and there are over 30 smaller projects in operation globally. SACCCS will be drawing from international experiences in the execution of the CCS project.
Location	*The 2010 Atlas on Geologic Storage of CO_2 Storage in South Africa* has identified the Zululand Basin in KwaZulu-Natal and the Algoa Basin in the Eastern Cape as areas with potential sites for safe and secure CO_2 storage.
Schedule	The project is currently in the exploration phase. SACCCS intends to select a site for the PCSP by 2014 and the PCSP may be operational in 2017.
Jobs	A small number of direct jobs will be created for the duration of the PCSP. The project developer will use every opportunity to maximize local job creation and build skills capacity to support the project.
Human safety	CO_2 is a naturally occurring substance and will only negative affect human health in very high concentrations. Extensive monitoring and mitigation measures will be in place to ensure that these high concentrations will not be reached in the implementation of the PCSP.
Water use	The project will have minimal water requirements. All efforts will be made to source water sustainably.
Water table	CO_2 storage occurs significantly lower than the fresh water table. Extensive monitoring and mitigation measures will be in place to ensure minimization of any risks to the water table.
Environment	An Environmental Impact Assessment will be conducted according to environmental regulations, to determine the impact of the PCSP on the environment. Mitigation measures will be put in place to minimize negative impacts and enhance positive impacts.
Energy costs	The PCSP is funded by a consortium of South African and international governments.
Economics	Efforts will be made to employ local businesses and services in the PCSP.
Responsibility / liability	The project developer will be responsible for the development, execution and decommissioning of the PCSP.

Annexure 7: Information Sheet 1

Setting the scene for CO_2 capture and storage: human-caused climate change: Human-caused climate change [11, adapted]

What is climate change?

Climate change is the persistent, long-term variation in climate averages, such as rainfall or temperature, which can result in more extreme weather events.

This Information Sheet aims to provide a foundation about how we are affecting our climate and how it affects us.

We live in a greenhouse

The glass in a greenhouse prevents some of the sun's heat from escaping and help keeps the greenhouse warm. Similarly, some gases in the earth's atmosphere prevent a proportion of solar energy from radiating back into space, thereby keeping the planet warm. These gases are called greenhouse gases of which carbon dioxide is one.

Human impact

The increase in the concentration of greenhouse gases (especially carbon dioxide) is a result of years of industrialisation during which time societies have burnt huge quantities of oil, gas and coal, called fossil fuels. These activities release carbon dioxide and other greenhouse gases into the atmosphere.

What is carbon dioxide?

The major greenhouse gas is carbon dioxide which is a naturally occurring substance made up of two of the most common chemical elements on earth, i.e. carbon and oxygen (CO_2).

Under natural conditions carbon dioxide is a gas, but it can be compressed into a liquid, frozen into a solid (dry ice) or dissolved in water (sparkling water and carbonated beverages). Carbon dioxide occurs naturally in fresh and seawater, in some rock formations and in the soil.

Carbon dioxide is not flammable or toxic nor does it explode. It can, however, cause drowsiness at low concentrations and asphyxiation and death at very high concentrations.

The carbon cycle

Carbon is present in all of the earth's systems (atmosphere, water, soil, rocks, plants and animals). Nature's carbon cycle normally keeps carbon dioxide levels in valance, but human activity, mostly burning of oil, gas and coal, produces more carbon dioxide than nature can absorb. When these fossil fuels contain carbon and when they are burned, the carbon is released and combines with oxygen to form carbon dioxide.

The challenge ahead

Society as a whole must endeavour to stabilise greenhouse gas emissions, because climate change will bring about dangerous short-term and long-lasting social, economic and environmental effects. Examples include the spread of diseases, displaced communities, food shortages, extreme weather events, water shortages and much more.

One way to reduce the amount of carbon being emitted is to change the way in which we use energy. Developing low-carbon forms of energy is therefore essential to stabilising emissions.

Carbon capture and storage (CCS) is one technology, alongside demand reduction, greater energy efficiency and renewable forms of energy, which could be used to help achieve this.

Annexure 8: Information Sheet 2

Carbon dioxide capture and storage – a brief history and current status [11, adapted]

The early days of CCS

Carbon dioxide capture technology was developed in the early 1920s and 1930s for separating carbon dioxide found in natural gas reservoirs from the methane gas. This process is often referred to as carbon dioxide scrubbing as it “cleans” up the natural gas making it pure enough to burn.

In the early 1970s some carbon dioxide captured in this way was piped to an oil field and injected into the field to help recover extra oil. This process, known as enhance oil recovery (EOR) has proven very successful and millions of tonnes of carbon dioxide are now being piped to and injected into oil fields in the USA and elsewhere.

In 1996, following the introduction of the world’s first tax on carbon dioxide emissions by the Norwegian government, the Statoil oil and gas company started the world’s first large carbon dioxide capture and injection project for the purpose of preventing the emission of carbon dioxide into the atmosphere. Located in the North Sea, the Sleipner project separates carbon dioxide found with natural gas in an undersea reservoir and instead of releasing it to the atmosphere, injects it into a rock formation called a saline aquifer deep in the rocks beneath the sea. Around one million tonnes of carbon dioxide per year has been captured and injected at Sleipner and careful monitoring has shown the carbon dioxide to be trapped in the rock as intended.

In the 2000s another two similar projects were also started – at the In Salah gas processing facility in Algeria (2002) and the Snohvit gas processing facility in the Barents Sea offshore Norway (2007).

Types of CCS projects

Carbon dioxide capture and storage (CCS) consists of three basic steps:

1. The capture of the carbon dioxide resulting from the burning of fossil fuels;
2. The compression and transportation of the captured carbon dioxide; and
3. The injection of the carbon dioxide into rock formations hundreds of meters below the earth’s surface where it can be securely stored for hundreds of thousands of years.

CCS is currently the only available option to significantly reduce carbon dioxide emissions while continuing the burning of fossil fuels to produce electricity and manufacture the materials and products from which modern society is powered and built.

The scale of a CCS project is important. In 2011, fossil fuel burning resulted in over 30 billion tonnes of carbon dioxide emissions world-wide. Enhance oil recovery (EOR) operations currently inject around 15 million tonnes of captured carbon dioxide from industrial sources per year and around 4 million tonnes of captured carbon dioxide is injected into saline aquifers. While a good start, this is not enough. A single large coal burning power plant produces around 20-30 million tonnes of carbon dioxide per year.

Status of CCS

For CCS to deliver the expected carbon dioxide emissions reductions, its rate of deployment will have to massively increase from that seen to date. There are around 60-70 large CCS projects proposed around the world in varying degrees of planning and preparation. While there remains a lot of potential for improvement, current CCS technology and experience is sufficiently advanced to allow the first generation of large scale projects to be built and operated.

Annexure 9: Information Sheet 9

Possible impacts of carbon dioxide (CO_2) leakage onshore [11, adapted]

Possible sources of CO_2 leakage from CCS onshore

Carbon capture and storage (CCS) involves three broad stages, i.e. capturing, transporting (usually via pipeline) and injecting the carbon dioxide into appropriate rocks deep underground for long-term storage. All of these stages present a possibility for carbon dioxide leakage. However, all can be managed to minimise both the chance of leakage occurring and the hazards that a leak might pose.

Possible dangers and environmental impacts of CO_2

Carbon dioxide is a very common chemical and is naturally present in air at very low concentrations (around 0.04%). Carbon dioxide is produced by many processes including burning substances containing carbon (including fossil fuels and wood), and respiration by animals, humans and plants.

If there is a source of concentrated carbon dioxide near the ground surface, it usually presents little danger to humans outside enclosed spaces as air movement mixes the carbon dioxide in the air. This mixing quickly reduces the carbon dioxide concentrations to safe levels. However, carbon dioxide is heavier than other gases in air, so if there is little air movement, dangerous levels of carbon dioxide can accumulate around a concentrated carbon dioxide source, especially in landscape features lower than the surrounding area such as pits, troughs and deep valleys. Such circumstances can pose a serious hazard.

However, the actual level of risk to human health from leaking carbon dioxide is very low. The risk posed by engineered carbon dioxide storage should be much less due to careful storage site selection and monitoring.

Another possible concern related to deep underground storage of carbon dioxide is the potential for contamination of underground fresh water aquifers used for drinking and irrigating agriculture. Fresh water aquifers are generally located much closer to the surface (up to around 500m) than the deep rock formations (around 1,000-3,000m depth) considered for carbon dioxide storage, which often contain unusable, very salty and mineral rich water. Many layers of capping rock lie between these fresh and saline aquifers, preventing connection between them.

CO_2 capture and transport – leakage risks and prevention measures

Carbon dioxide capture and transport both occur on or near the land-surface. A carbon dioxide leak would be easy to detect, e.g. there would be an unexpected change in the carbon dioxide pipeline pressure, alerting the operators and enabling a rapid shutdown and immediate repair. Although carbon dioxide at high pressure and high temperature could present a serious hazard, carbon dioxide source facilities are large industrial sites, familiar with the appropriate containment and handling of hazardous substances.

Given the large volumes of carbon dioxide that might be captured from large facilities, pipelines are the most practical method for onshore carbon dioxide transportation. In a pipeline, carbon dioxide is usually compressed under high pressure to be moved as a dense gas or liquid. Leakage of carbon dioxide into the atmosphere from pipelines is a possibility, and might occur due to a material failure of the pipeline.

Release of carbon dioxide from a pipeline poses two hazards. First, as a substance under high pressure, a carbon dioxide leak could explode forcefully (while not flammable), and as it rapidly expands from a leak it can cool to very low temperatures, posing a risk. Second, as carbon dioxide is a heavy gas, if an accidental release were to occur near a low-lying landscape feature and in still weather conditions, a hazardous carbon dioxide layer might form.

However, onshore carbon dioxide pipeline technology is well-established and has been used since the 1970s to supply carbon dioxide for used in enhance oil recovery (EOR) to oilfields in the USA and Canada. Like natural gas pipelines, regulations set standards for the materials and designs used and the operation and inspection procedures applied. Around six thousand kilometres of such pipeline is currently in operation, and no serious carbon dioxide leakage or accidents have occurred.

CO_2 storage – leakage risks and prevention measures

Carbon dioxide storage is undertaken by injecting the carbon dioxide into rocks deep (usually over a kilometre down) underground. Appropriate storage sites consist of a reservoir rock into which the carbon dioxide can be injected to fill the tiny spaces between the individual rock grains, overlain by a layer (or layers) of cap rock (rocks through which carbon dioxide cannot pass, which hold the carbon dioxide in place. Potential storage sites can be depleted oil or gas fields, deep saline aquifers (rocks containing very salty water), or in some cases coal seams that are too deep to be mined. Possible leakage routes could occur in places where the capping rock fails to contain the carbon dioxide. This might be a result of natural features such as gaps where the rock isn't present or cracks in the capping rock. Alternatively, old oil and gas wells that cut through the capping rock might also present a possible leakage route.

To minimise the risk of leakage from a carbon dioxide site, many different measures can be taken – both in selecting the site and in monitoring the injected carbon dioxide once storage operations have begun.

Assessing the environmental risks – Environmental Impact Assessments (EIAs)

An environmental impact assessment (EIA) is required for any CCS project to be granted approval for the capture, transport and underground storage of carbon dioxide. EIAs allow developers, regulators and the public to assess the risks of a project, identify potential problems and establish prevention and repair methods to ensure projects are safely and properly operated.