The potential for sequestration of carbon dioxide in South Africa

Carbon capture and storage in South Africa

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INTRODUCTION

Carbon dioxide (CO_2) Capture and Storage (CCS) is a process consisting of the separation of CO_2 from industrial and energy-related sources, transport to a storage location and long-term isolation from the atmosphere. Capture of CO_2 can be applied to large point sources. The CO_2 would then be compressed and transported for storage in geological formations, in the ocean, in mineral carbonates, or for use in industrial processes. (IPCC special report 2005)

Internationally and nationally the potential for the sequestration of CO_2 is increasingly receiving attention due to the growing levels of CO_2 and other greenhouses gases in the atmosphere. A South African policy option is to undertake a CCS programme. The Department of Minerals and Energy, therefore, contracted the CSIR to undertake a preliminary study on the potential for CCS in South Africa. This poster summarises the outcomes of the study.

Goals of the study

- To generate a knowledge base of the biological and geological potential for sequestration of CO_2 in South Africa
- To publish such information for general use.

RESULTS

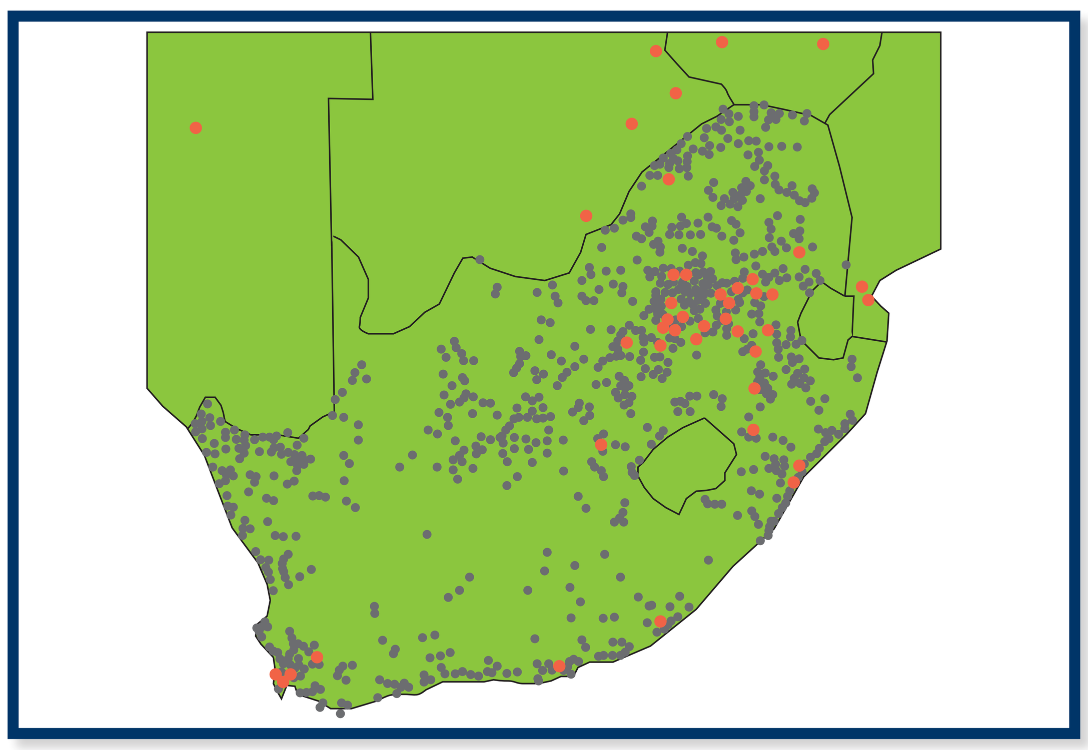

Figure1: Carbon dioxide emissions from mines (grey) and power stations (Orange)

Table 1: Year 2000, CO_2 emissions by industry sector (Scholes, Van der Merwe 1998)

	Mt	%
Sequestrable		
Electricity production	161	65
Industrial processes	28	11
Other energy	30	12
Manufacturing	30	12
Total	249	100
Non sequestrable		
Waste	10	6
Agriculture	48	27
Fugitive	42	24
Transport	40	22
Heat production	37	21
Total	178	100
Combined total	**427**	

Biological sequestration

Biological sequestration is the medium to long-term storage of carbon, derived from the atmosphere (Christie, Scholes, 1995), in living and dead plant parts and soil organic matter. (Du Toit, 1992).

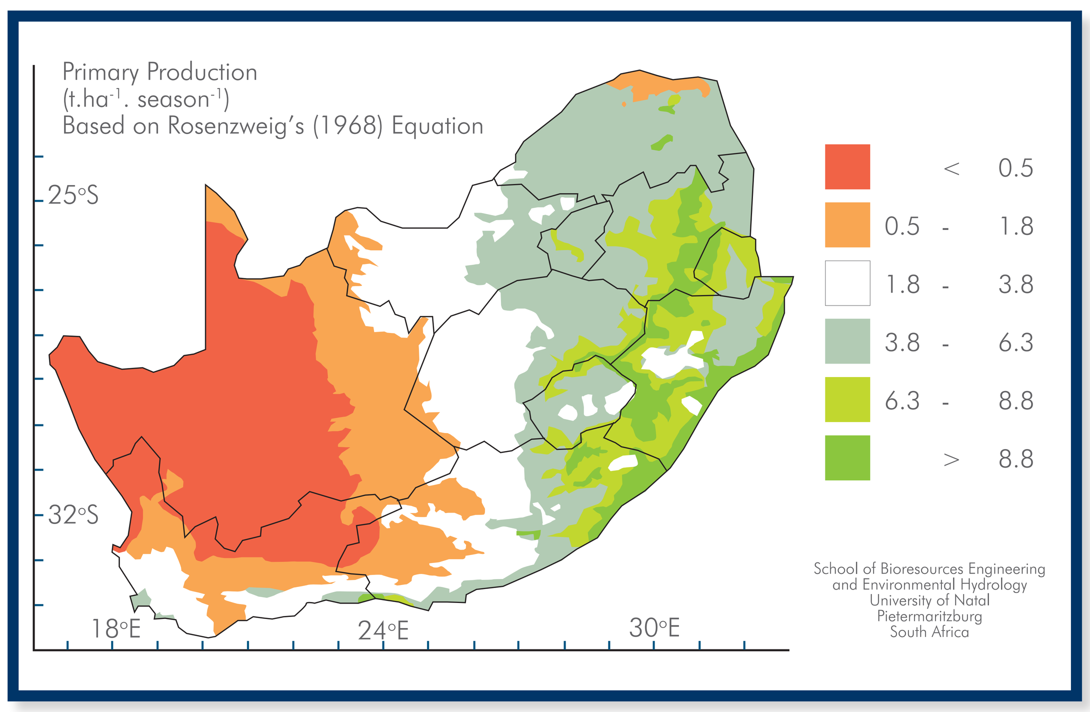

Figure 2: Approximate distribution of net primary productivity in South Africa. (Schulze, 1977)

Table 2: Maximum potential biological sequestration in South Africa

Biome	deltaC gC/m²	Period y	Area Mha	Total MtC	Rate Mt/y
Savannas	7000	30	40	2800	93
Karoo	1000	30	38	380	13
Thicket	8000	30	2.5	200	7
Low tillage farming	2400	30	10.6	254	8
Grassland to plantation forest	8000	30	1.8	144	5
Total				**3778**	**126**

Geological sequestration

Geological sequestration is a form of direct sequestration where CO_2 is stored in underground formations, such as depleted oil and gas reservoirs, non-minable coal seams and saline reservoirs. These formations have the capacity, structure, seals, porosity and other properties (i.e. dissolving of CO_2 in groundwater), that make them amenable to decades or centuries worth of CO_2 storage (Danae, Voormeij and Simandl, 2002). Such methods should be environmentally effective, socially acceptable and economically feasible and will have their own weaknesses and strengths.

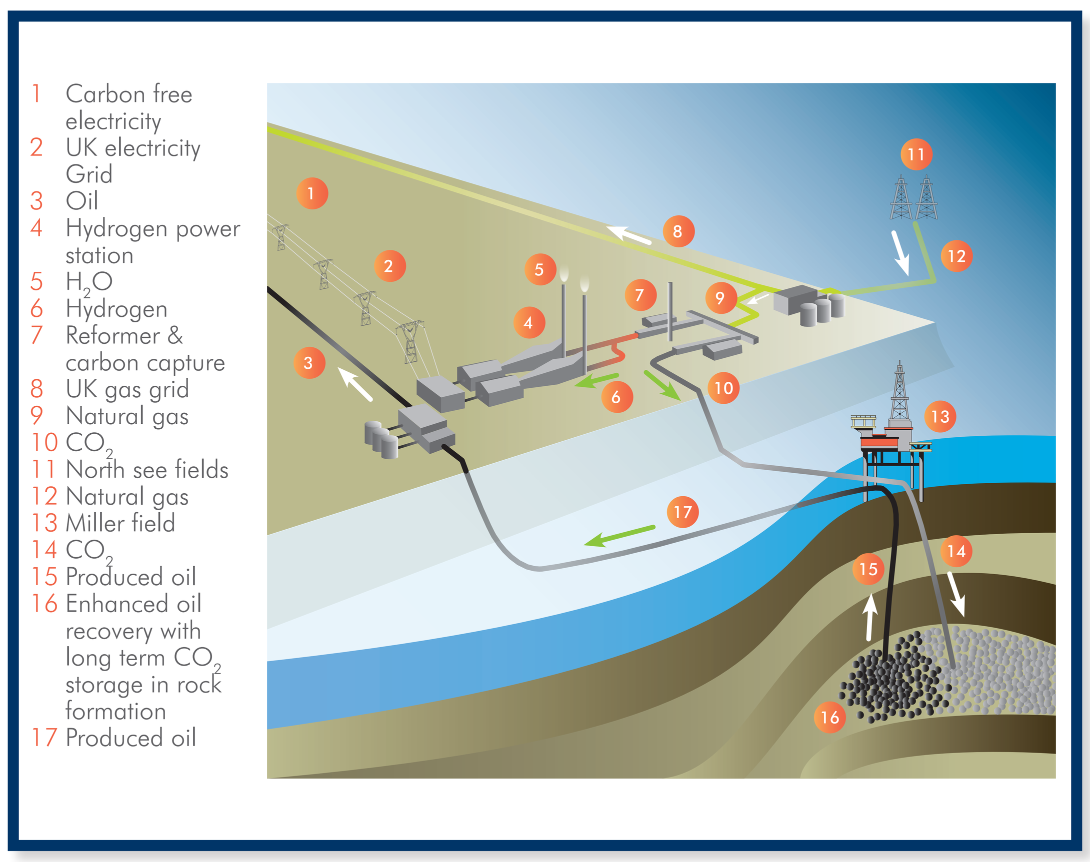

Figure 3: Options for carbon storage in geological formations. Reference www.co2storage.org.uk

Geological sequestration was investigated for oil and gas reservoirs, deep saline formations, and chemical capture within a reasonable distance (about 500 km) from the main generation sited. The capacity for CO_2 storage in deep saline formations (e.g. Vryheid formation) is potentially very large, but little information is available regarding porosity and permeability of these sedimentary formations. The storage capacity for the other options is relatively small.

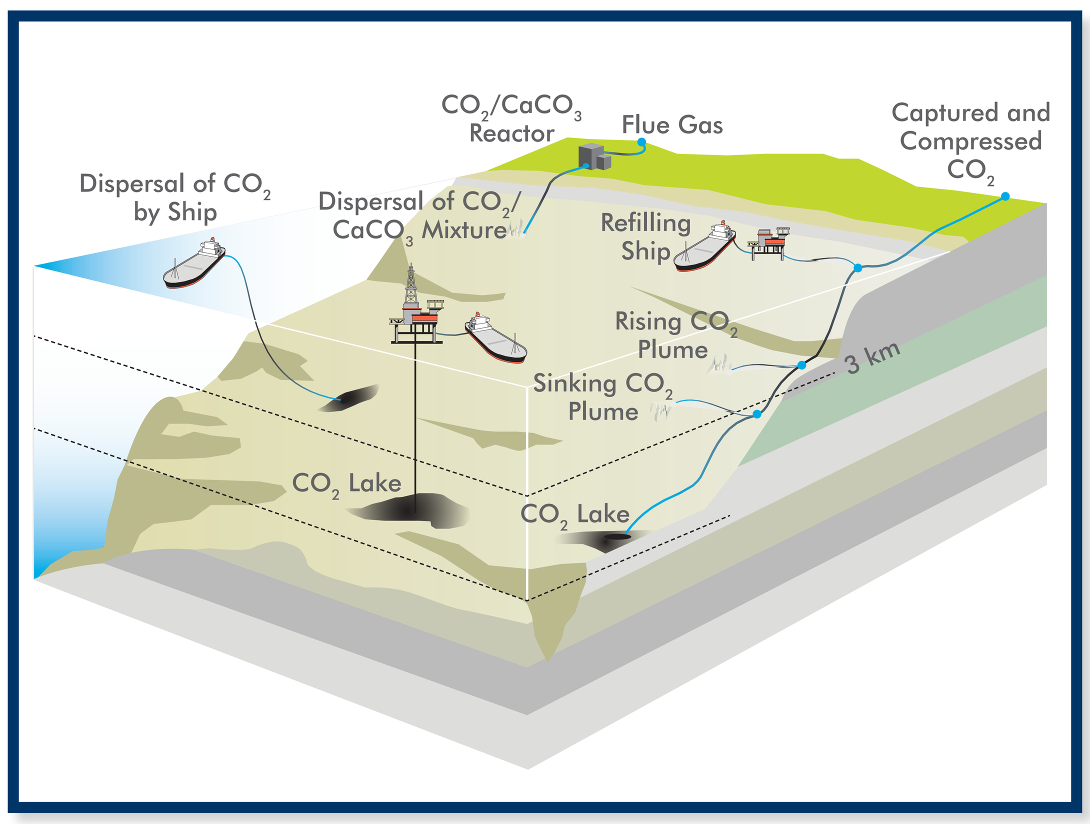

Figure 4: Options for carbon storage in the deep ocean. Reference www.emilylynn.net

Marine sequestration

As the mixing of the different water layers in the oceans is relatively slow, equilibrium between the atmosphere and the different ocean layers is absent. Therefore, it is technically possible to speed up CO_2 transfer to the deeper ocean water layers. All CO_2 contained in fossil fuels could easily be absorbed by these deep ocean water layers assuming perfect mixing, due to the large quantity of deep sea water and the current amount of dissolved CO_2, (38000 Gt C) in these layers.

CSIR researchers investigated the potential of drastically reducing carbon emissions in South African by storing it in deep underground rock formations.

CONCLUSIONS

Potential sink	Tonnage (million ton/ year)	Duration (years)	Comments
Afforestation Reduction tillage Savanna thickening	3.9 0.4 7.9	20 20 20	An effort is required to store CO_2 in 'perpetuity'
Gas reservoirs	1	Very long*	There may be enhanced gas recovery
Mines	10 or more	Site specific	More study is required
Vryheid formation Katberg formation	18,375 million total 1,600 million total	Very long Very long	Relatively poor porosity and permeability, more study is required
Coalbed methane	Small	Long**	It may enhance methane recovery
Chemical capture	1-5	Indefinite	Large volume of 'reactive' material required
Deep ocean	Nearly unlimited	Several hundred years	Deep ocean ecosystems poorly understood
Ocean fertilisation	Not known	Not known	Study required, but not by South Africa

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