

# Rules-based approaches to industrial innovation: Case study on South Africa's Liquefied Natural Gas (LNG) development

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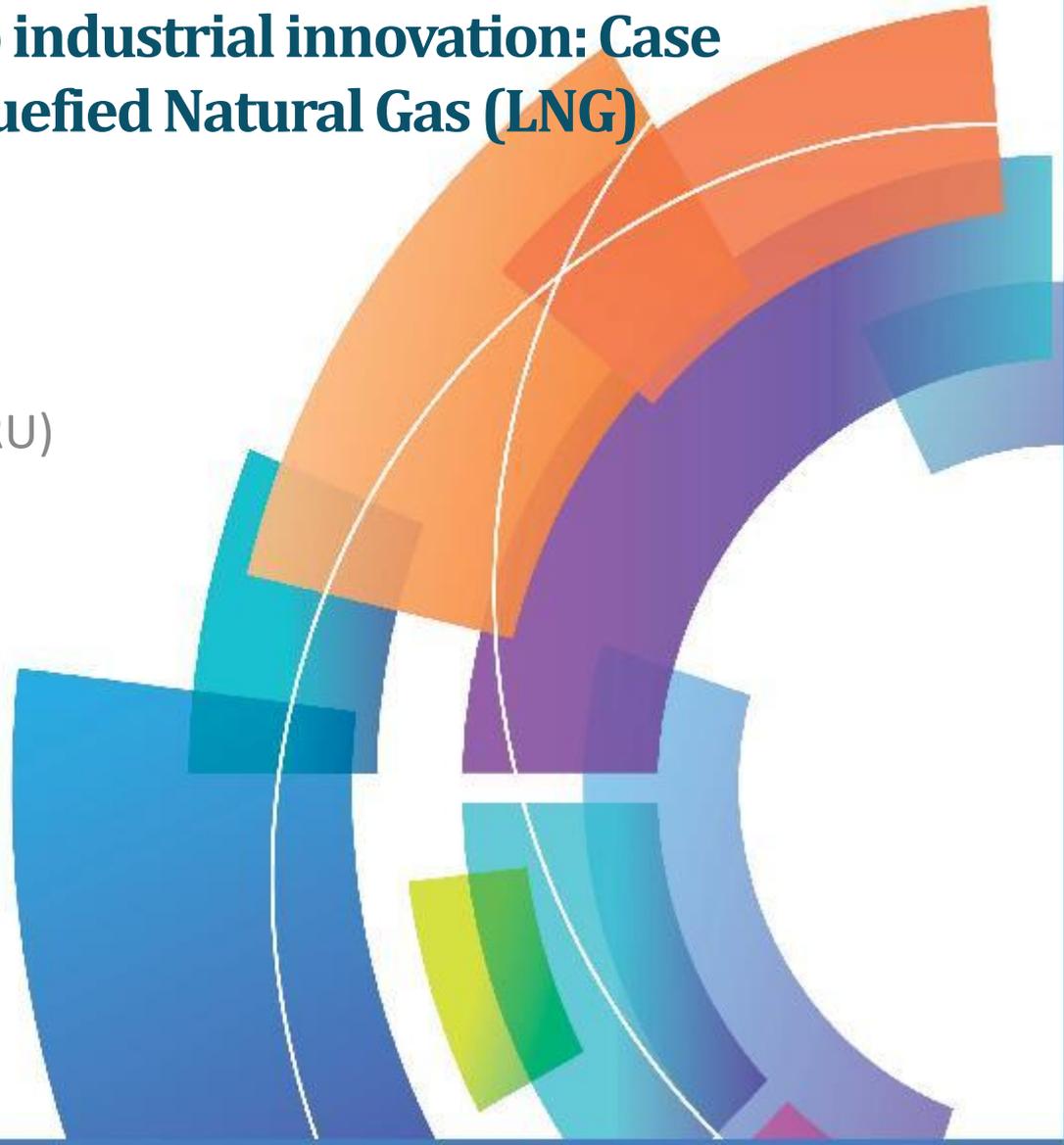
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# Outline

- Introduction
- Theoretical frames
  
- Case study -3 timelines (co-evolution of emerging interaction between liquid fuels and electricity-LNG development)
  
- Discussion
- Conclusion



# PhD Research-South Africa's energy transition

## 1 Mineral Energy Complex (MEC)

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- Electricity is embedded in the MEC (tight configuration of industries) associated with mining.

## 2 Eskom and renewable energy

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- Incumbent resistance, new entrants

## 3 LNG Development

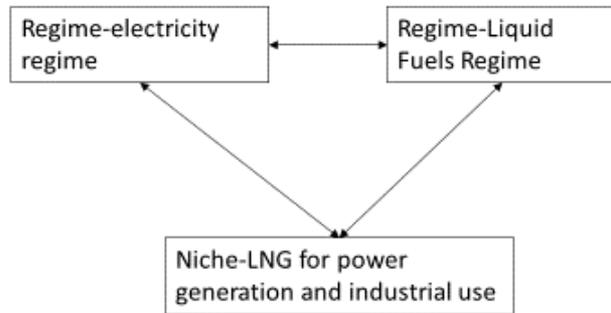
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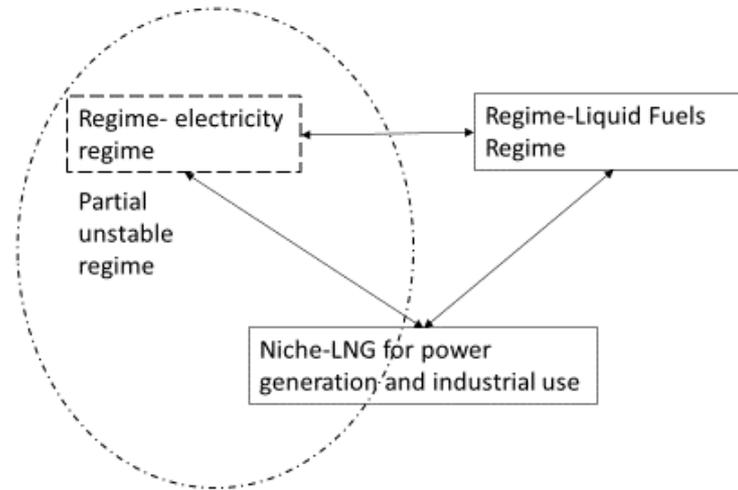
# Introduction

- In 2015, South Africa introduced a gas independent power producers programme, to procure 3.7 GW of LNG to power and later LNG for industrial use (DOE, 2016).
- While much research has been carried out on South Africa's coal industry (Steyn, 2017) and its electricity sector (Eberhard, 2014, Trollip, 2014), far less consideration has been given to gas, both as a feedstock for industry and as an electricity generation source.





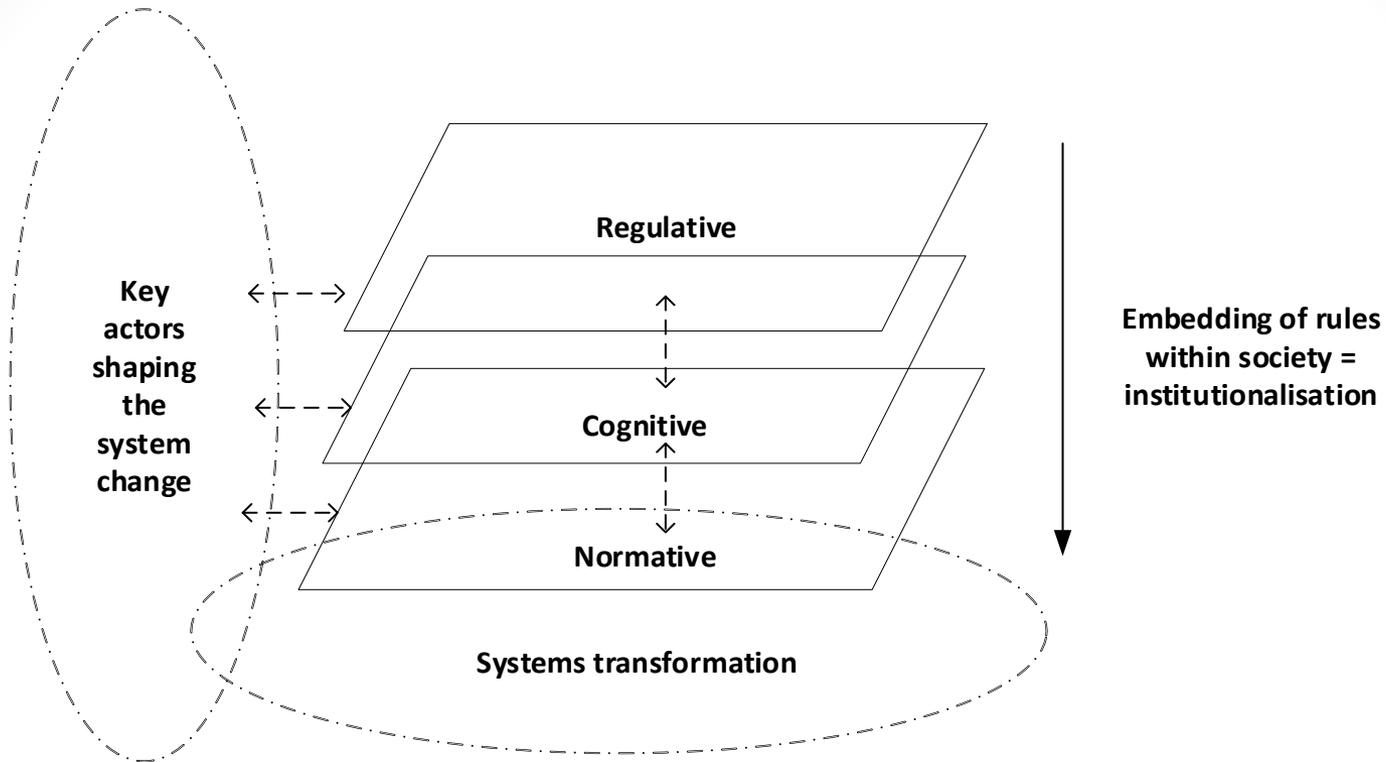
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This research analysed South Africa's Liquefied Natural Gas (LNG) development, which is argued to emerge by drawing on existing systems of coal-fired electricity as well as liquid fuels.

Theoretical frames using rules based approaches derived from **institutions and transitions literature**.



Regulative= regulations, laws and standards, which are imposed on industries

Cognitive= industrial mind-sets and cognitive frames, which influence interpretations, strategic choices, preferences and decisions

*Normative rules* refer to industry identity, values and mission

Alignment of rules is what creates a **regime**, which guide actors activities towards a societal function (Geels and Schot, 2010).

# Transitions theory

- Existing systems are built on both social and technology foundations
- Technology is not neutral-changing the technology does not necessarily change the social. (we have to recognise interests behind the adaptation of technologies). (directionality)
- So when we look at technology adoption we need to understand the set of embedded rules within a system.
- For transitions to take place, there is a need for all three rules to change (systems transformation).
- This case study-existing rules can be 'repurposed' in a way that redirects them for new purposes, goals or interests

# Socio-technical regime-electricity

## **Lock in, path dependent energy system-**

South Africa's 'rules of the game' in the electricity system is coal base generation.

South African government ensured cheap coal, cheap electricity, government incentives, tax subsidies, import substitution to foster mining and energy intensive industries (Makhaya and Roberts, 2013, Roberts and Black, 2009)

Cognitive lock in-e.g. baseload, centralised, energy intensive

Normative- mining-key socio-economic development

# Case study

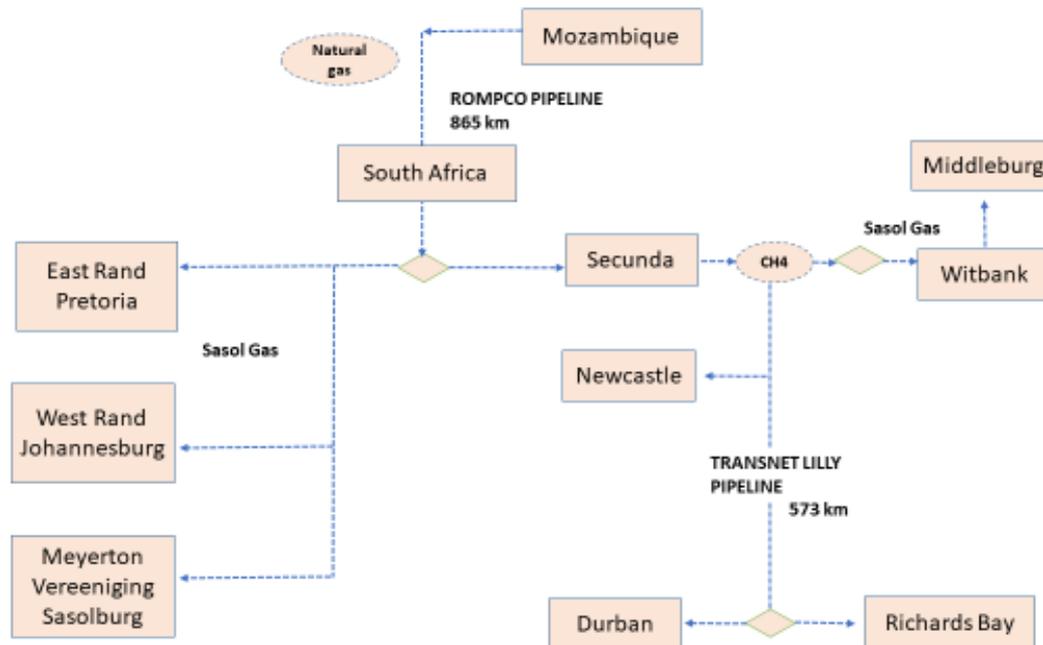
- Three Period discussing the co-evolution between liquid fuels and electricity which was important for LNG development. This research demonstrates that the LNG development shows signs that all three types of existing rules were ‘repurposed’

## Timeline

- 1998-2005 (energy sector reforms)
- 2006-2012 (global and regional trends, electricity crisis)
- 2013-2018 (emerging LNG development)

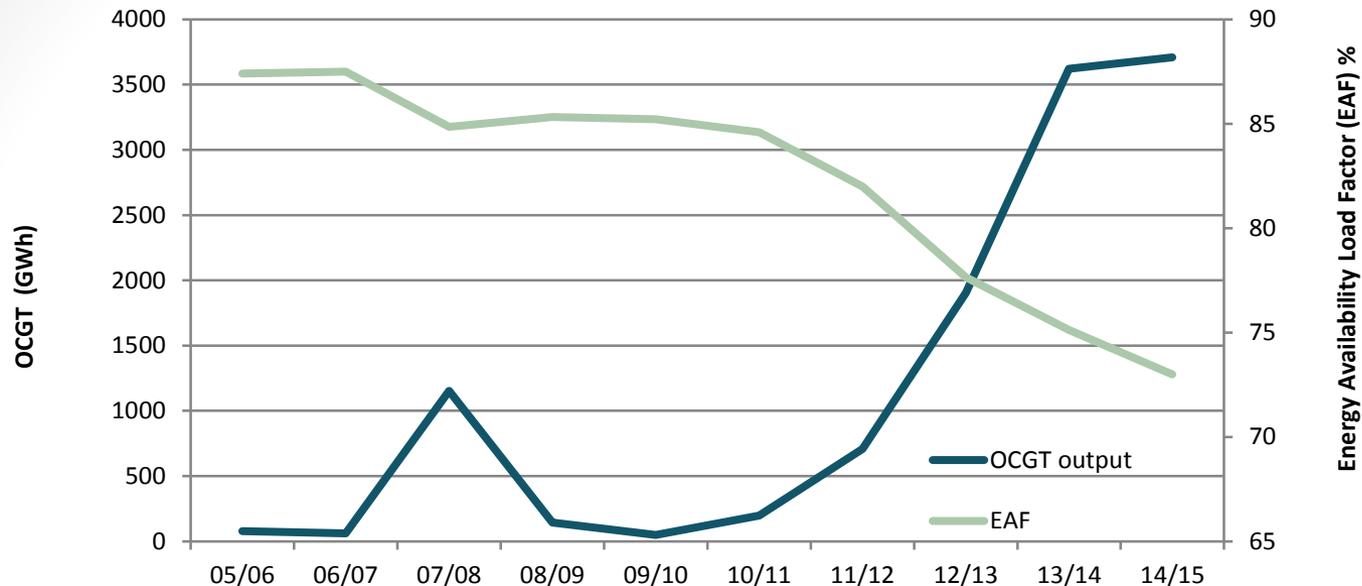


# 1998-2005 (Energy sector reforms)



# 2006-2012 (global and regional trends, electricity crisis

- Gas started to feature more strongly into South Africa's energy system.
- In 2008, South Africa was cited to have one of the top ten technically recoverable **shale gas resource** in the world, with estimates at 390 trillion cubic feet (tcf) (EIA, 2013).
- Although shale gas is not yet proven, the report by the EIA had catalysed significant interest, particularly with the government often articulating it as a **game changer** (DOE, 2016b, p. 24).
- **2008-major electricity crisis**
- Mozambique and Tanzania. from 2009 onwards, regional discoveries of gas near South Africa- Mozambique (Rovuma Basin) and Tanzania.

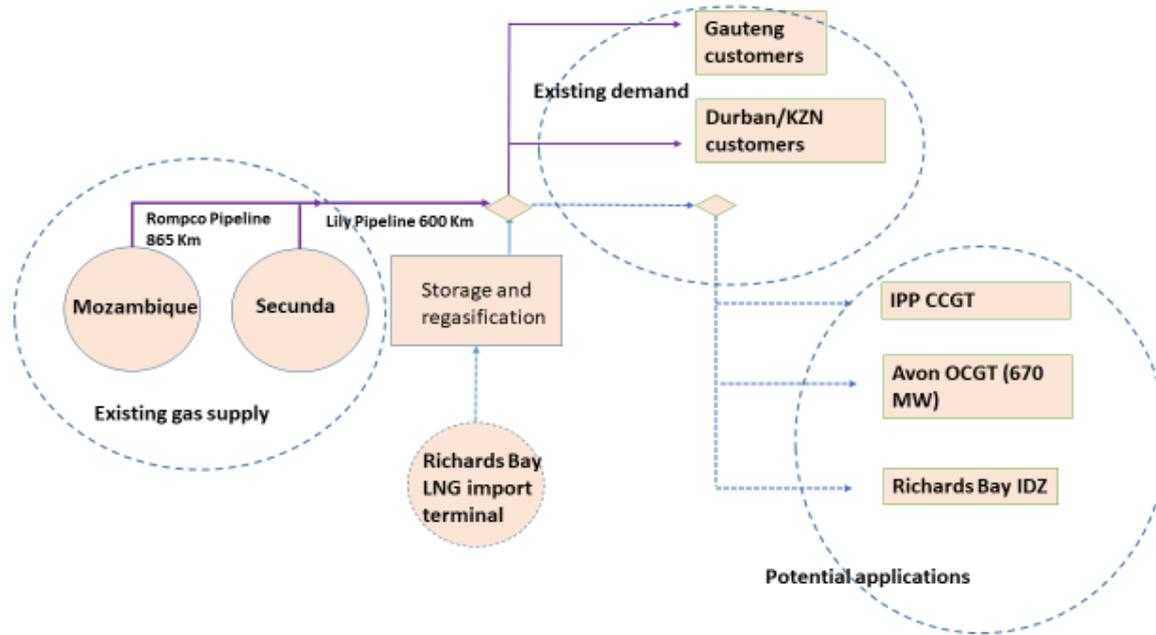


- Eskom reportedly operated the OCGT's at a load factor from 0.3% in 2009/10 to 19% in 2013/14, instead of a typical peak load of up to 5% (Eskom, 2015b).
- A study indicated that running a peaker gas fired Close Cycle Gas Turbine (CCGT) on imported LNG as opposed to diesel at a load factor of 20% had less impact on the country's trade balance (DEDT, 2013, p. 50).
- 2011-2012-Renewable energy-IPP policy instrument

# 2013-2018 (emerging LNG development)

- From 2013 to 2018, gas development started to gain momentum
- Global trends-liquefaction of gas (bypassing the need for pipelines), gas prices (short term contracts), new LNG trade patterns (constantly iterated during interviews)
- By 2015, success of the RE IPPP, the DOE **repurposed the IPP for gas (regulative rule)**

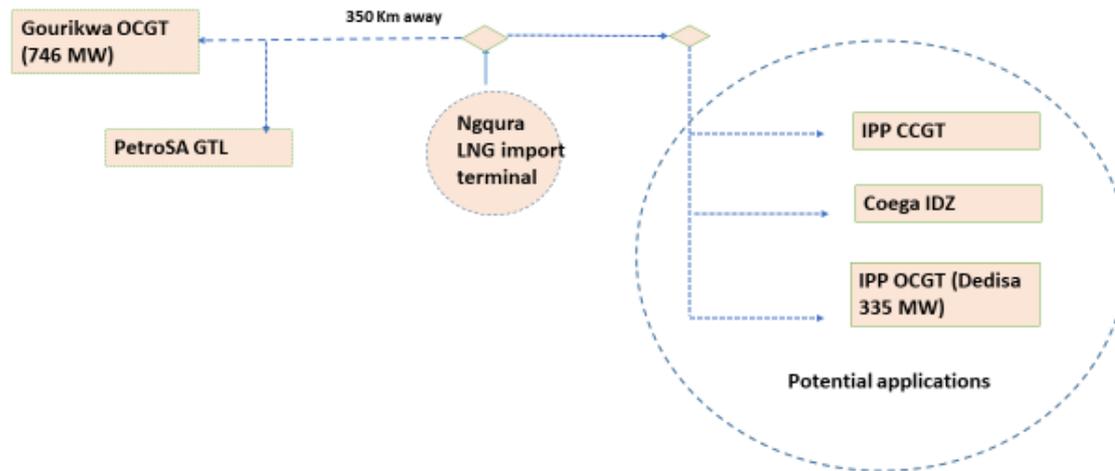




Kwa-Zulu Natal (KZN) potential LNG infrastructure development, adapted from Transnet (2015)

there are established industries of an aluminium smelter, two titanium smelters, a paper mill and chromium smelter, as well as existing industrial demand for gas due to the Lilly Pipeline (DOE, 2016).

Diesel fired power plant called Avon, of which DOE plans to convert into gas with an installed capacity of 670 MW

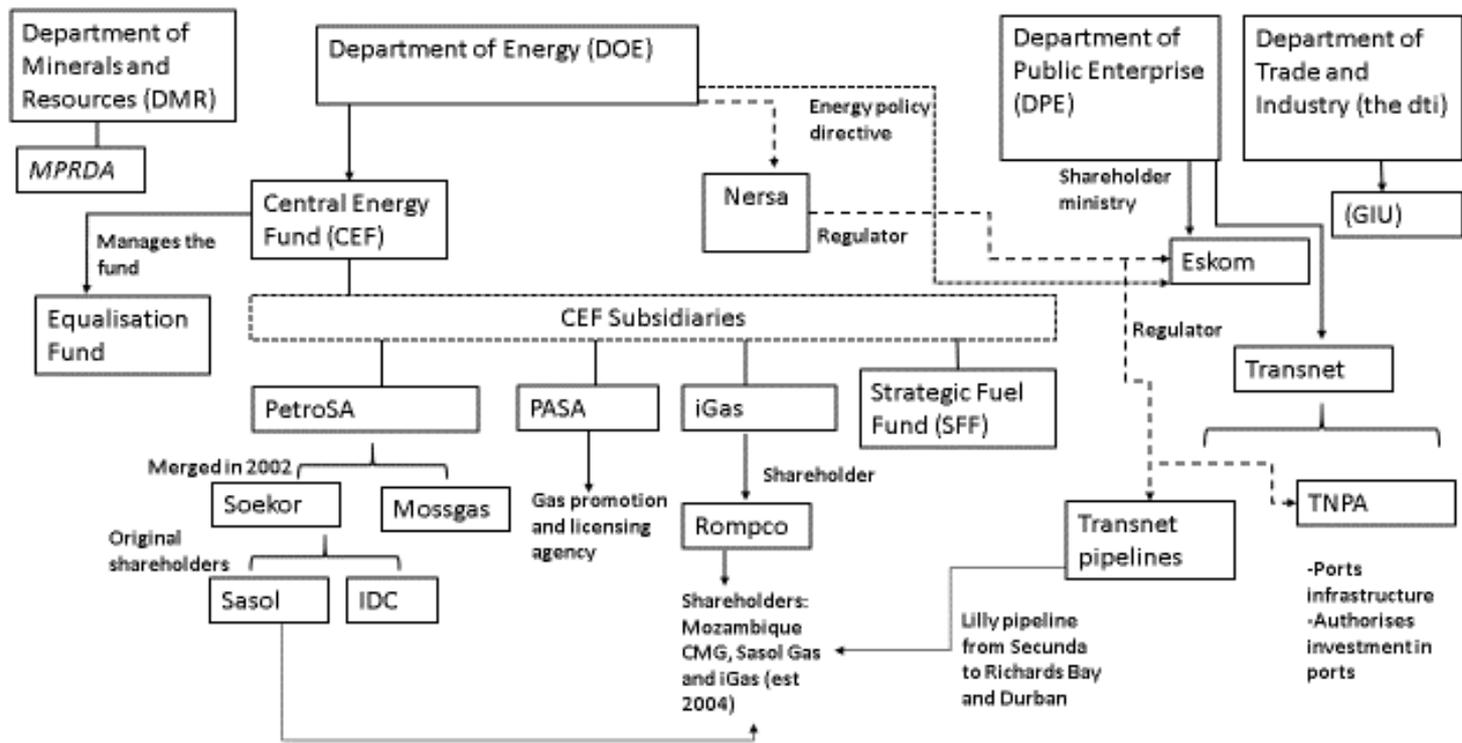


Por Ngqura, located in the Eastern Cape Province of the country and is adjacent to a well-established Coega Industrial Development Zone (IDZ).

Coega is also home to considerable investment in renewable energy developments, especially wind farms (DOE, 2016).

In this location, there is an operational OCGT plant called Dedisa with a capacity of 335 MW, and a further 350 km is Gourikwa (746 MW) in Mossel Bay.

The plans here are to convert Dedisa peaking plant from diesel to gas firing, and the longer term is to establish either a GTL or a minerals beneficiation plant (DOE, 2016, p. 21).



# 2013-2013 (cont..)

- Cognitive elements maturing drawing in more actors aligning interests- questions were being asked about the type of LNG plant to be established, provincial support, funding models, meteorological conditions and port configuration needed (Transnet, 2016).
- “gas, in essence, covers two things, commodity and energy security” (interview)
- DOE planned to convert existing OCGTs into **dual fuel services** that will enable it to use diesel and gas (strategic choices, decisions).
- **Gas-load follower** to renewable energy (flexibility)
- LNG was amenable to modular and flexible implementation, provided **fewer risks of stranded assets**,
- 2016- Gas Industrialisation Unit (**GIU**)-existing capabilities such as those found in liquid fuels and associated industries, could benefit from the expansion of economic activities using gas

# 2013-2013 (cont..)

- 2016- Gas Industrialisation Unit (GIU)-existing capabilities such as those found in liquid fuels and associated industries, could benefit from the expansion of economic activities using gas
- “gas could be the country’s next commodity resource, as the country’s mining future was uncertain” (interview)
- skills required for drilling and exploring gas fields are deemed similar to those found in mining. These views are considered as examples of re-interpretation of industrial mind-sets.



# Discussion



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# Regulative rules

- Regulative IPP policy instrument
- Redefinition of the Mineral and Petroleum Resources Development Act (MPRDA) (upstream exploration).
- Split between oil and gas from the mining industry would be necessary. This meant a separate Upstream Gas Bill tabled
- Gas Act, 2001 (downstream)- a redefinition of gas to include unconventional gas (such as shale gas), LNG and compressed natural gas (CNG).

# Cognitive changes

- Some actors started to articulate a change in beliefs in the extractive industries, whereby the country should be exploiting gas as the new commodity.
- Suggestion that the established mining skills in the country could be **re-directed towards exploring shale gas fields** as those found in the Karoo region. (re-interpretation of industrial mindsets)
- Cognitive- **decentralisation- flexible, modular systems, less stranded assets** (dual service conversion), gas load follower to RE. suggestion that the established mining skills in the country could be re-directed towards exploring shale gas fields as those found in the Karoo region.

# Normative rules (societal legitimacy)

- normative elements featuring- socio-economic benefits due to lower GHG emission (climate change), energy security, diversity, industrialisation (scale-provincial, national, regional).

Diversity of drivers for pursuing gas including energy diversification and security

- reduce the country's dependence on coal for electricity; reduce GHG emissions from electricity generation;
- potential to provide flexibility renewable generation
- provincial industrial hubs
- regional trade within the Southern African Development Community (SADC) (DOE, 2016).

# Conclusion

- LNG initiative involves more than the introduction of laws, standards or policies, but also a deeper form of changes which attends to beliefs, norms, and societal expectations.
- All of which demonstrate a form increasing ‘institutionalisation’ in such a way that embedding of rules within society through diffusion in scale, scope, and social fitness is being realised.
- enduring connection and greater configurational transformation.
- and advocates for new forms of frames, perspectives in innovation and industrialisation.

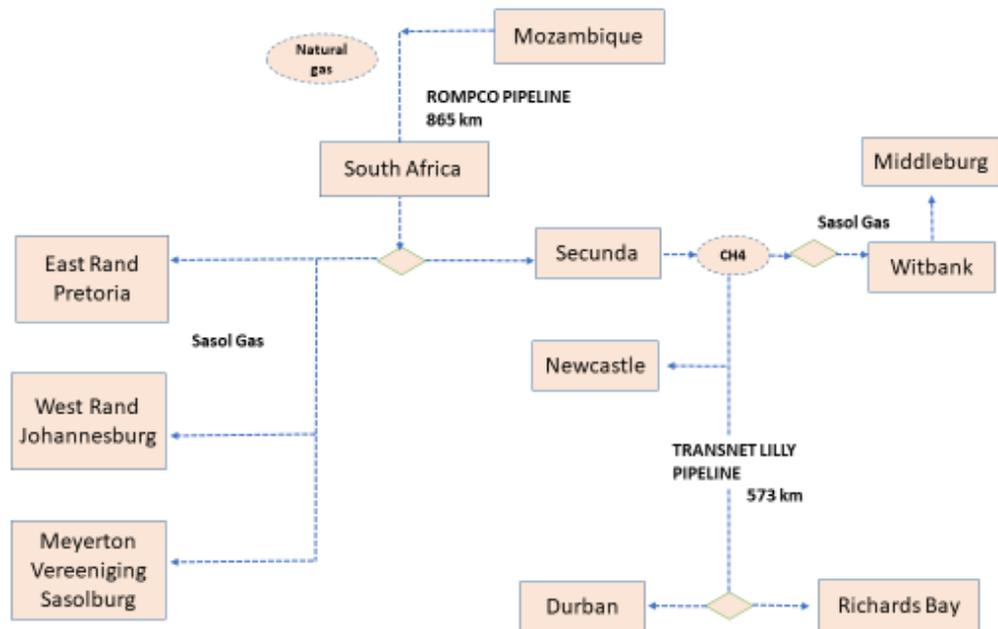
Thank you

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