



# **Nuclear power as a cost effective baseload option for South Africa**

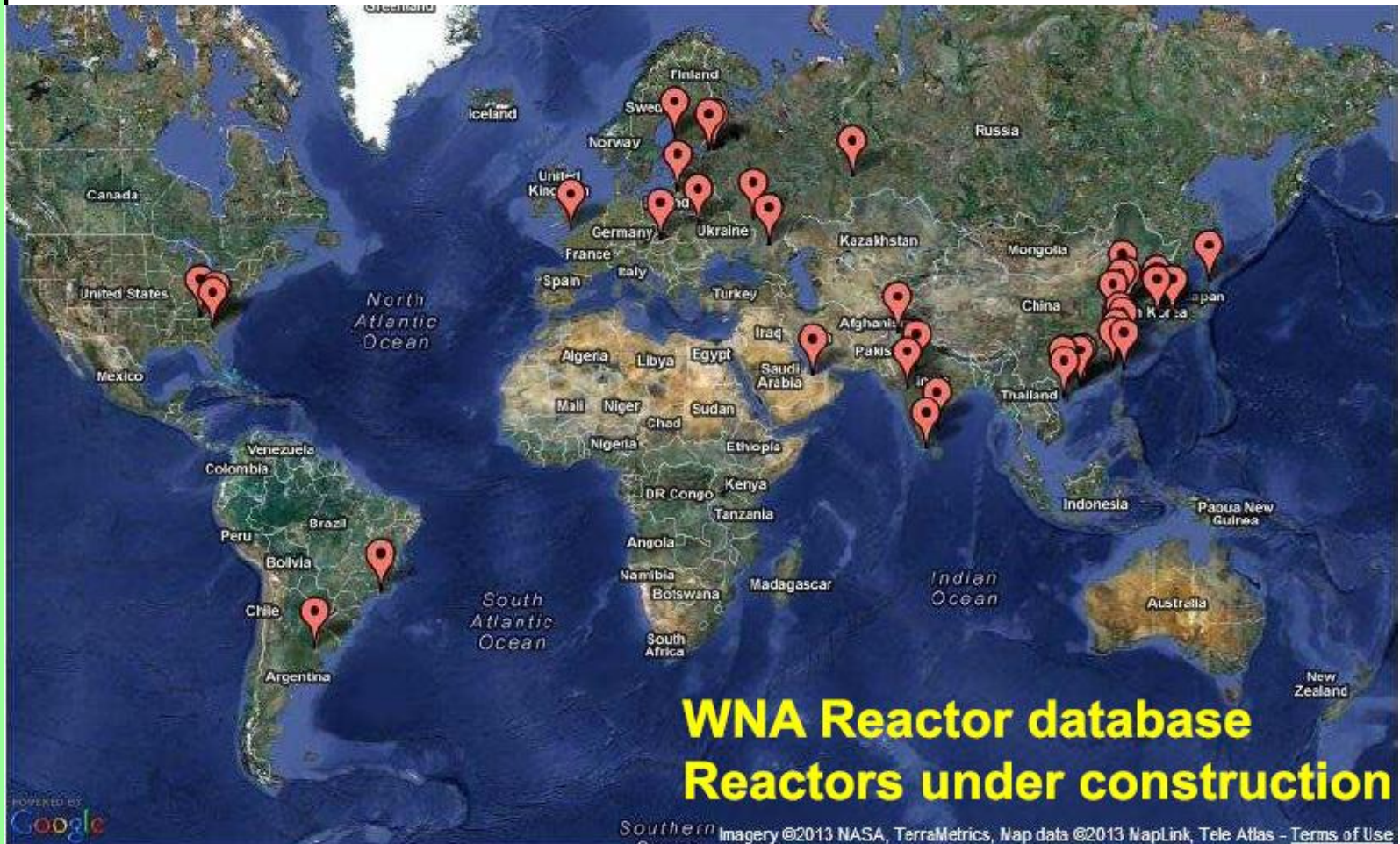
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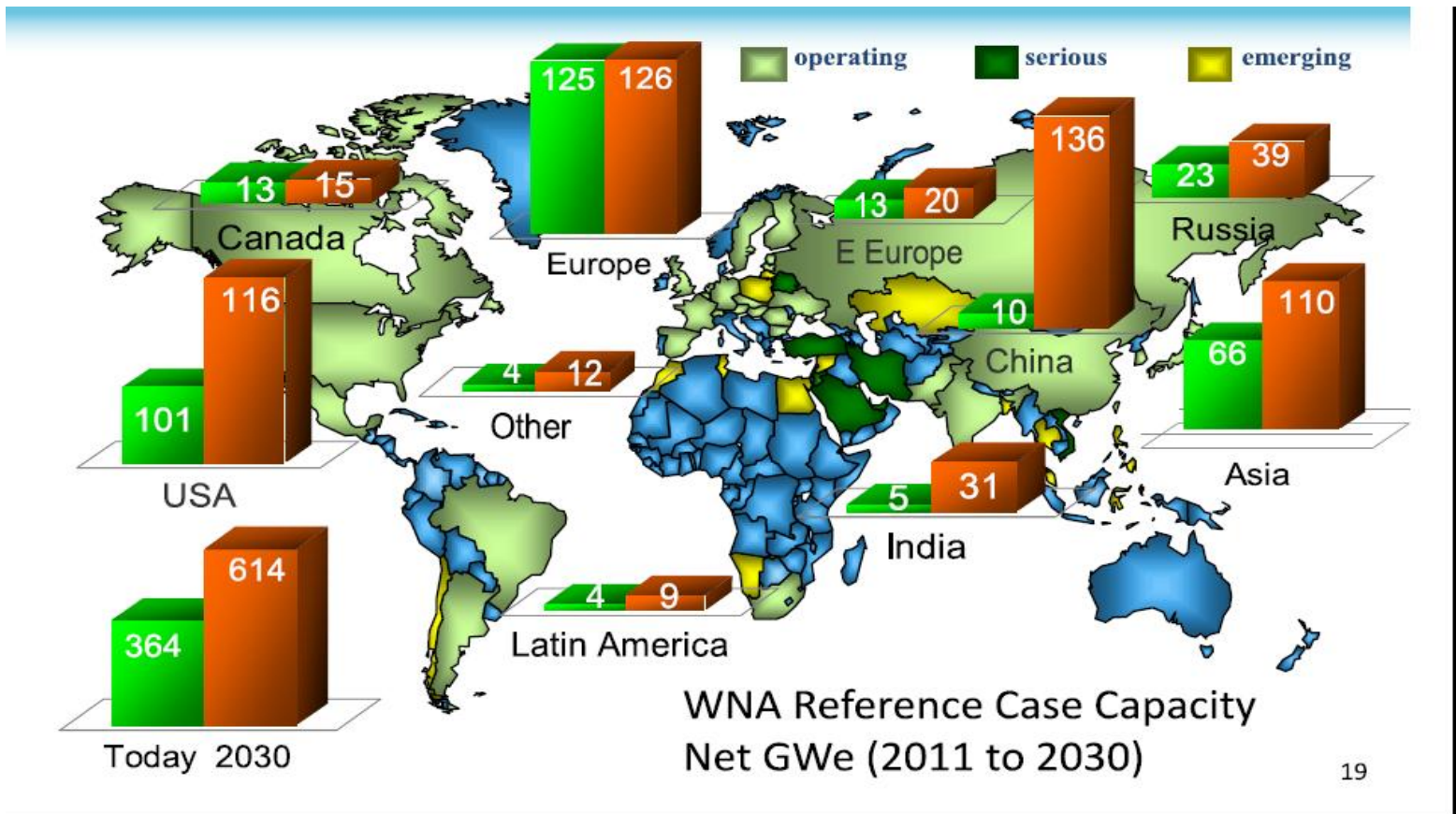
# Global situation

# New build map



Source: WNA (2013)

# Future plans



Source: WNA (2013)

# Local developments

# Factors to consider

- New Minister of Energy
- BRICS dynamic
- Mozambican offshore gas
- Karoo shale gas

# New Minister of Energy

- Will energy policy retain 9600 MW of nuclear in the mix?
- What will the procurement model for nuclear be?.
- What will the timing be?

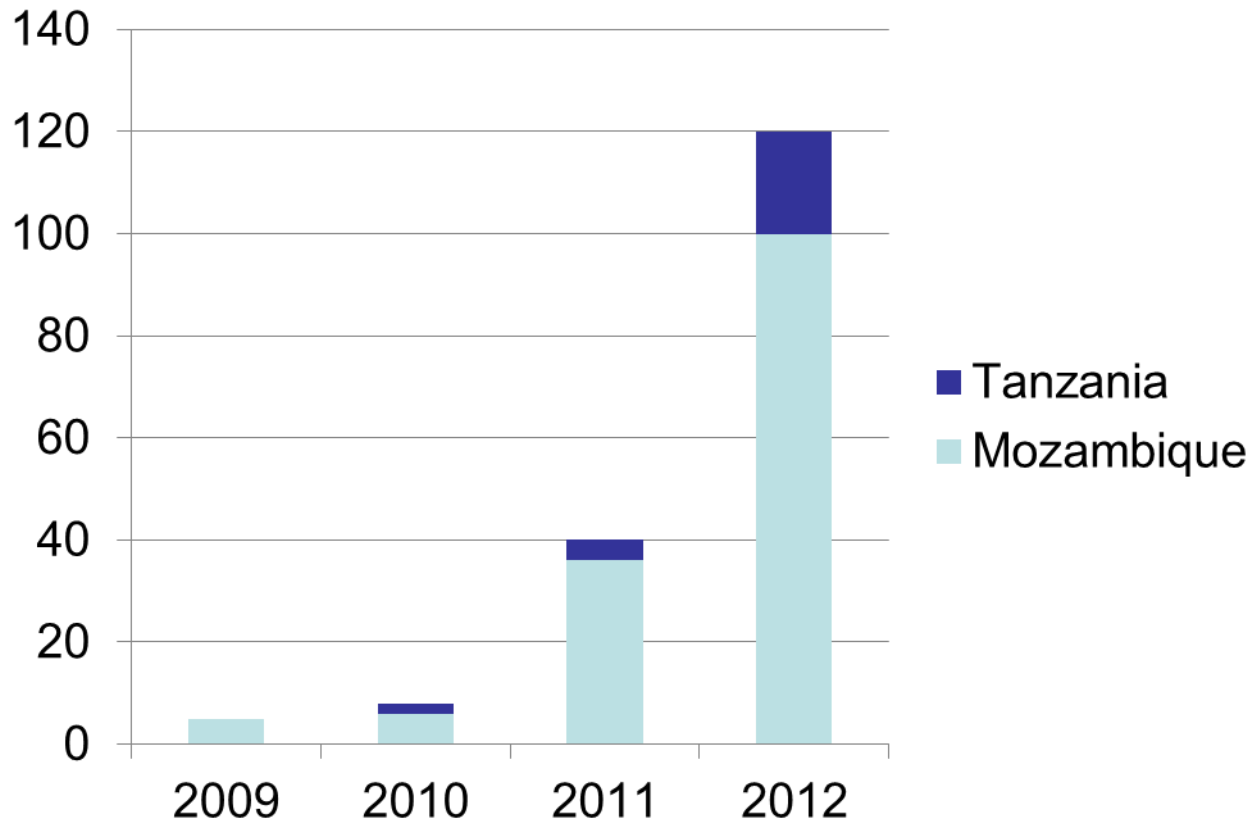


# BRICS dynamics

- SA is an enthusiastic new member
- All other BRICS countries have nuclear (and space!) programmes.
- Shifts in relations with Western countries as a result of African geopolitics.
- SA – Russia trade levels currently low
- China has several nuclear offerings

# Recoverable East African gas reserves

Trillion cubic feet



Source: D. Ledesma, "East Africa Gas – Potential for Export", 2013.

# Is East African gas a baseload option?

No problem really.  
 Much longer pipelines reliably deliver gas to much larger markets.



nuclear industry association of south africa

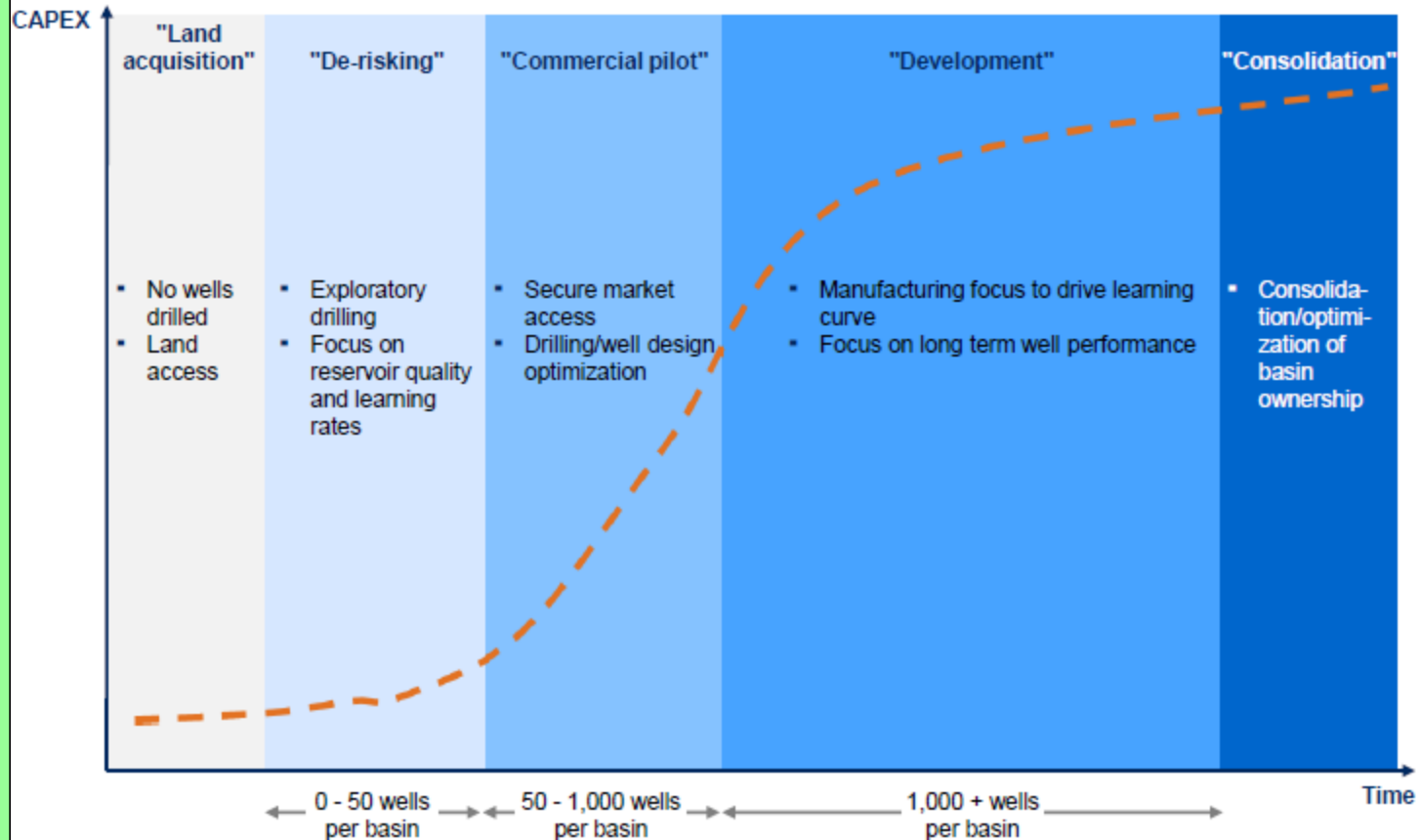
# Who will own the value chain?

- In 2009 Sasol was a major player but has been overtaken by Anadarko (USA) and ENI (Italy).
- Cost of development of LNG train is \$US 12 – 20 bn.
- Australian offshore platform will cost \$US 50 – 60 bn.
- Mozambique GDP = \$US14 bn, Tanzania GDP = \$US 28 bn. Pressure will therefore be put on these governments to trade equity for operational contributions.
- The conclusion is that these resources will not be controlled by Africa.

# Energy security? Conflict returns to Mozambique after 21 years



# Shale gas development typically follows five phases.



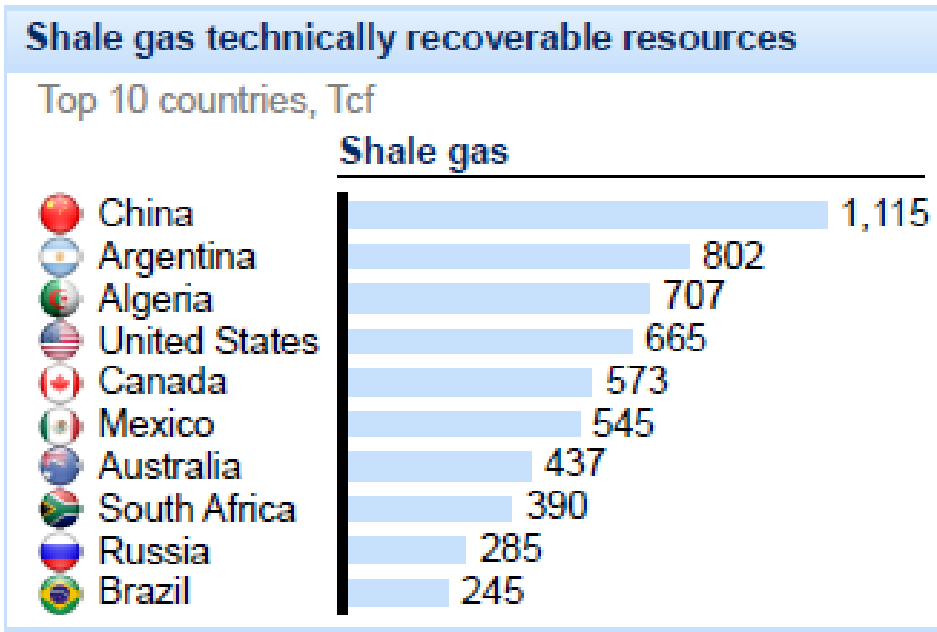
SOURCE: Expert interviews; McKinsey Oil and Gas Practice

McKinsey & Company | 15

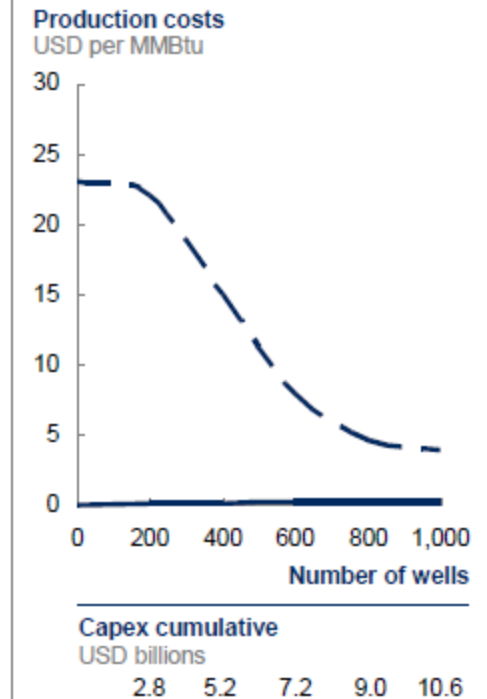


Source: McKinsey (2013)

# South African has significant resources



## High initial production costs

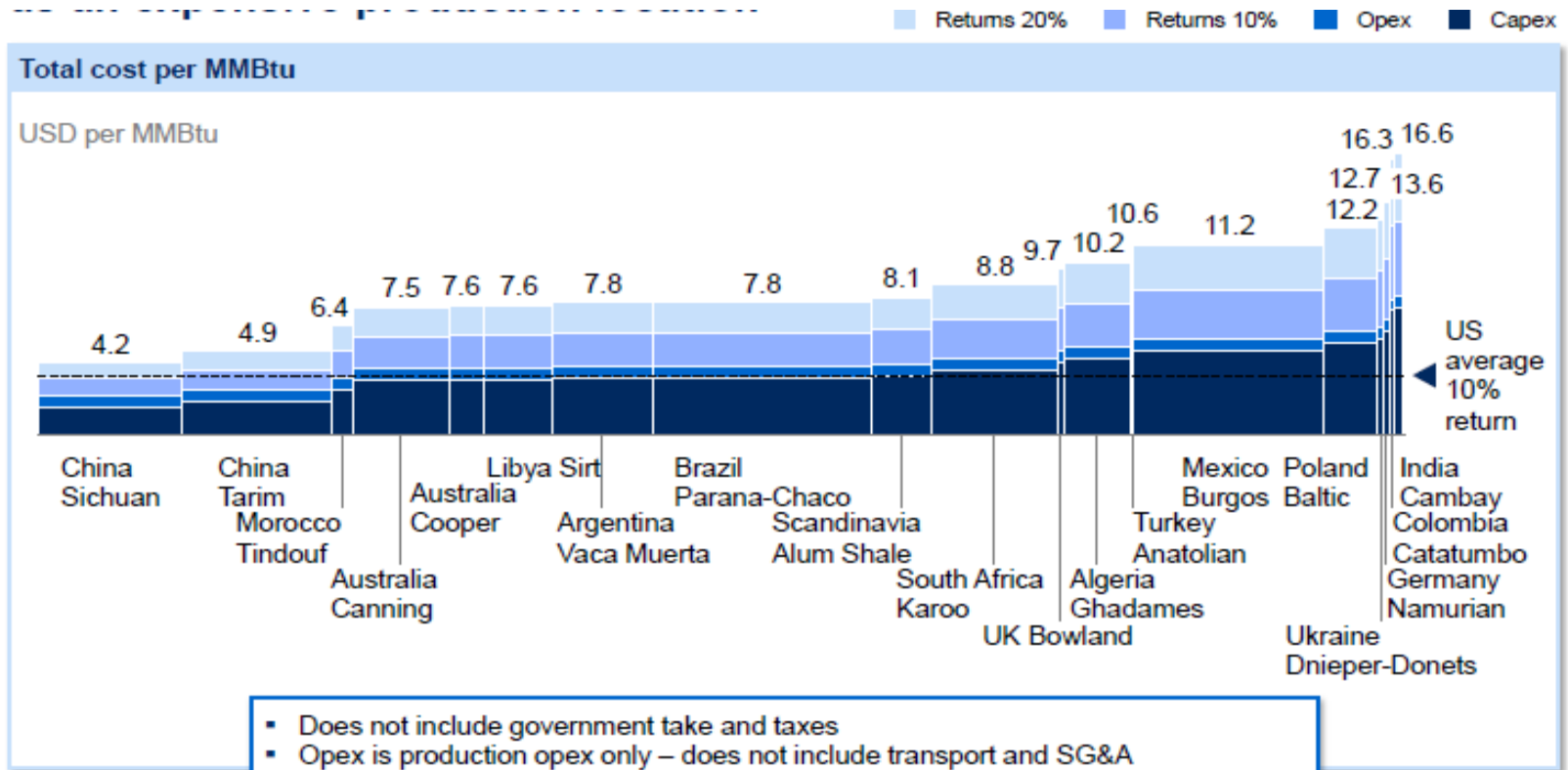


But it takes 1000 – 1500 wells for a basin to be proven.

Source: McKinsey (2013)

# Cost of extraction

(\$US6 per MMBtu is the ceiling)



- Does not include government take and taxes
- Opex is production opex only – does not include transport and SG&A
- Assumes 20 years economic life for well
- Production profile based on Barnett basin; individual basin mapping yet to be done



# Localization

# Aims of localization

- Saving foreign currency.
- Instilling a quality management culture in local suppliers.
- Increase in local high technology capacity.
- International collaboration (safeguards, quality, supply chain...).
- Human resource development

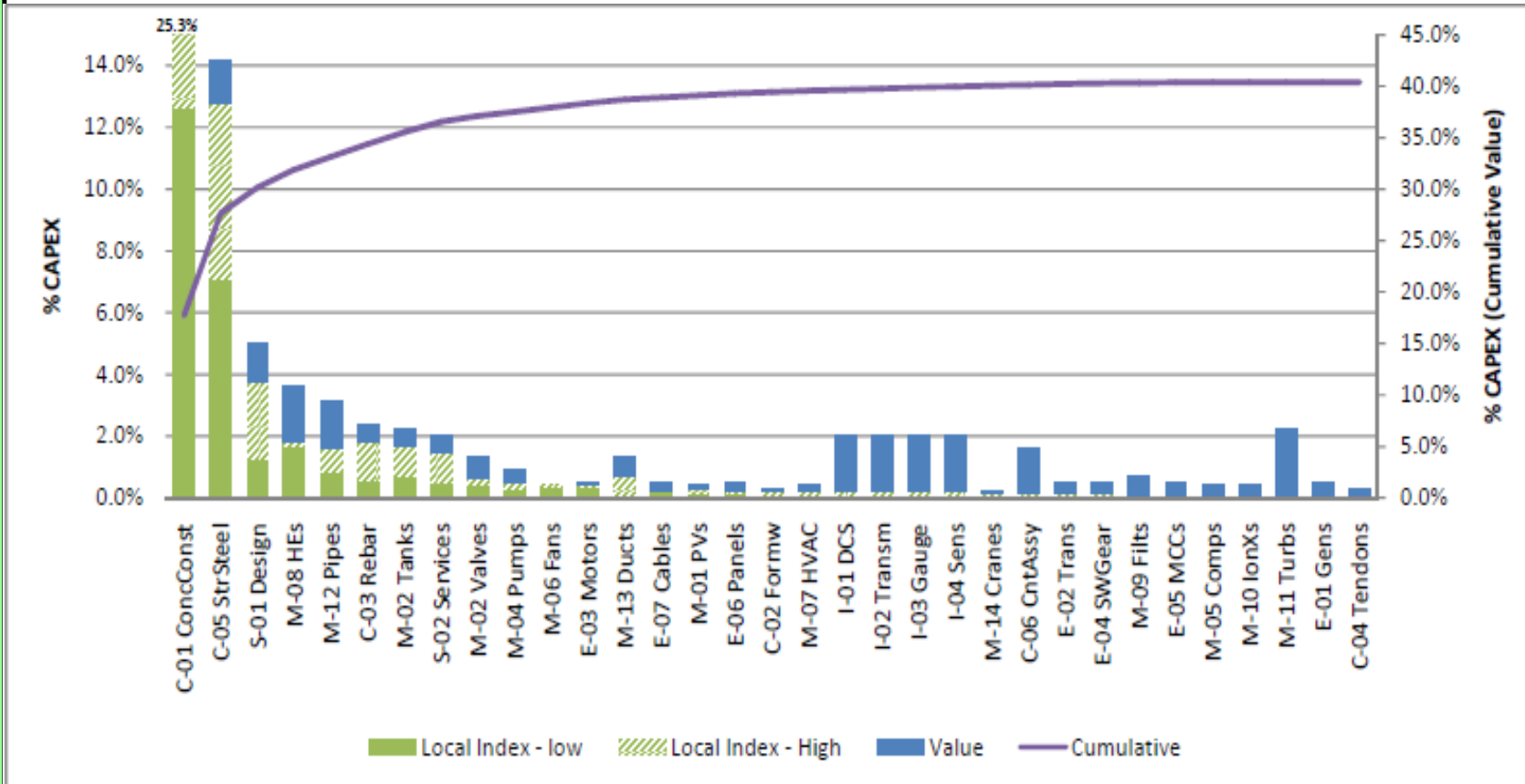
# South Africa's localization base

- South African has extensive experience in large-scale construction projects. Any localization drive will be rooted in this existing capacity.
- Other industrial capacity has a mining and metallurgy base developed over many decades.
- Some high tech industrial development has taken place in the defence and nuclear sectors. South Africa designed and built its own attack helicopter. Uranium conversion, enrichment and fuel fabrication facilities have also been developed locally.

# Manufacturing

- Although South Africa has the basic construction capabilities and many of the manufacturing capabilities, it does not hold international nuclear quality certification on a widespread basis yet.
- Smaller components for nuclear power plants, such as valves, doors, couplers, tanks, smaller forged components etc. can be manufactured in South Africa by applying nuclear quality standards to existing industrial capability.
- South Africa does not have the technology or expertise currently to manufacture heavy components such as turbines and pressure vessels.

# WP analysis



# HR requirements to build 9600MW

- At the height of the construction programme we will need:
  - 1620 engineers
  - 1770 technicians
  - 180 scientists
  - 220 project managers
  - 30 planners
  - 200 instructors
  - 440 security staff
  - 22650 artisans
  - 750 other skilled staff

# Guarantees and bonds

- In order to bid for new build contracts, companies will need to put financial guarantees in place:
  - Parent company guarantees are typically 30% of the project value
  - Performance bonds are typically 10%
- On a R150 billion project, with 40% localization, this amounts to R24 billion.
- The market capitalization of the entire South African construction industry is less than R50 billion.
- Government will set a high bar for localization. Will it incentivize by instructing Eskom to reduce the bond requirements for local components of bids?

# Comparative Economics



# NIASA modelling results

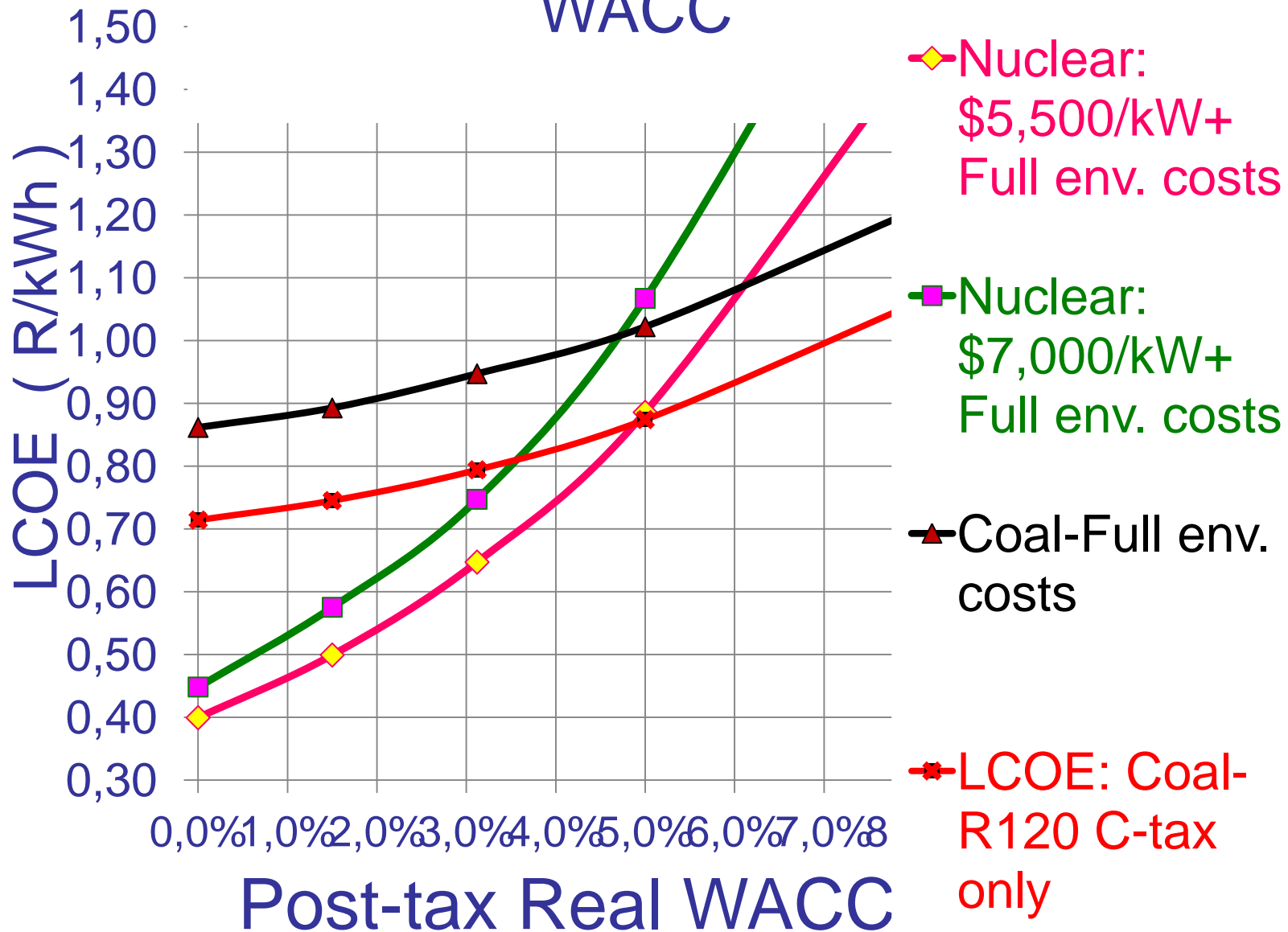
## Business case for nuclear:

- Nuclear plants twice as expensive as coal, but:
- Last for 60 years, vs. 25-50 years for coal.
- Much lower fuel cost than coal.
- Load factor = 92%, vs. 20 - 30% for PV solar and wind.
- Cost of capital is deciding factor.

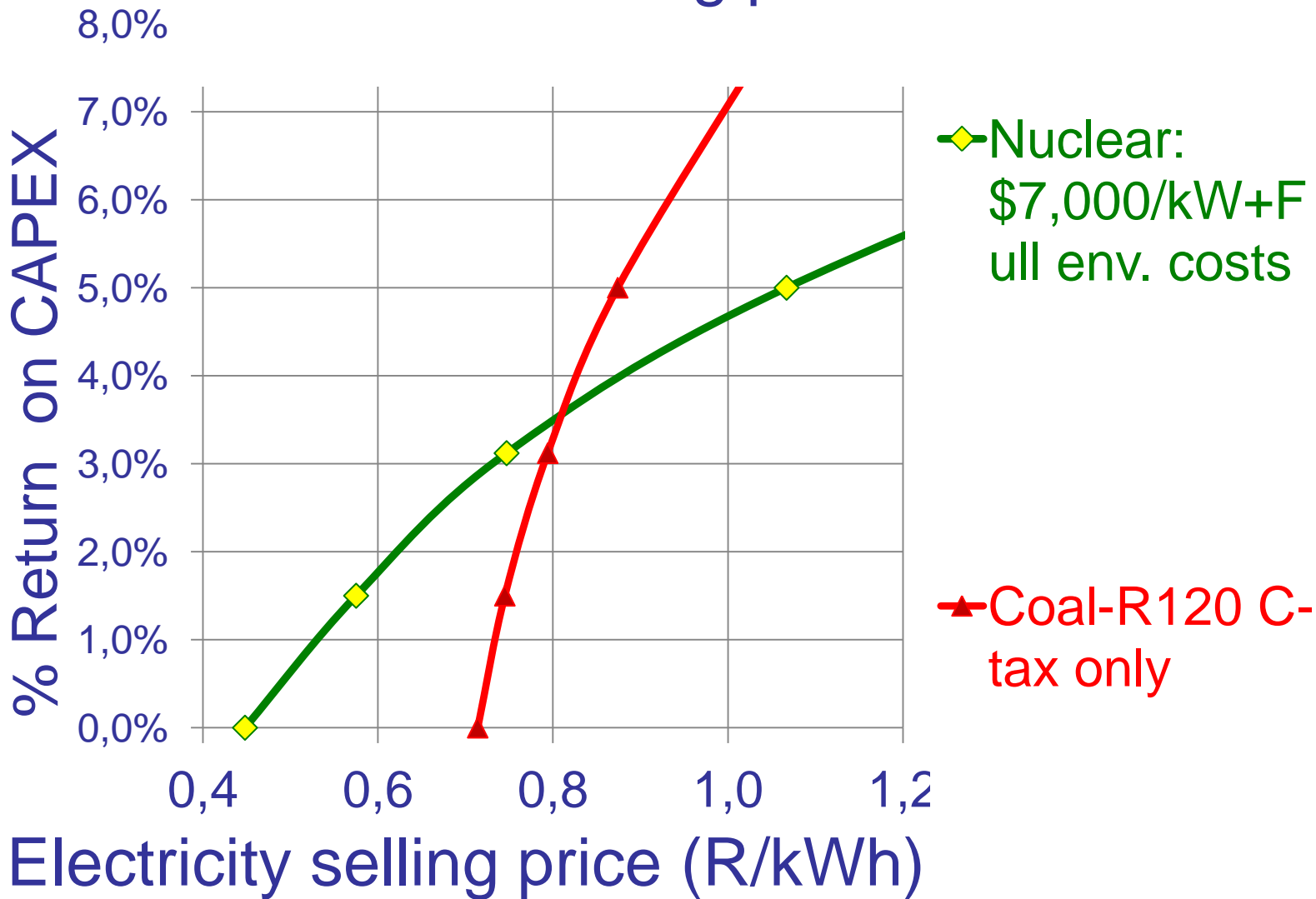
# NIASA modelling results ctd

- Calculate: **LCOE** (WACC).  
Government invests 100% of the capital.  
Simulate full plant lives.
- **Nuclear:** (Conservative: Full external costs)
  - Expected case : Overnight cost = \$5,5/W
  - Pessimistic case: Overnight cost = \$7/W
- **Coal:**
  - Expected Case: External cost = R120/ton CO<sub>2</sub> tax only
  - Pessimistic case: Full external costs (ExternE).

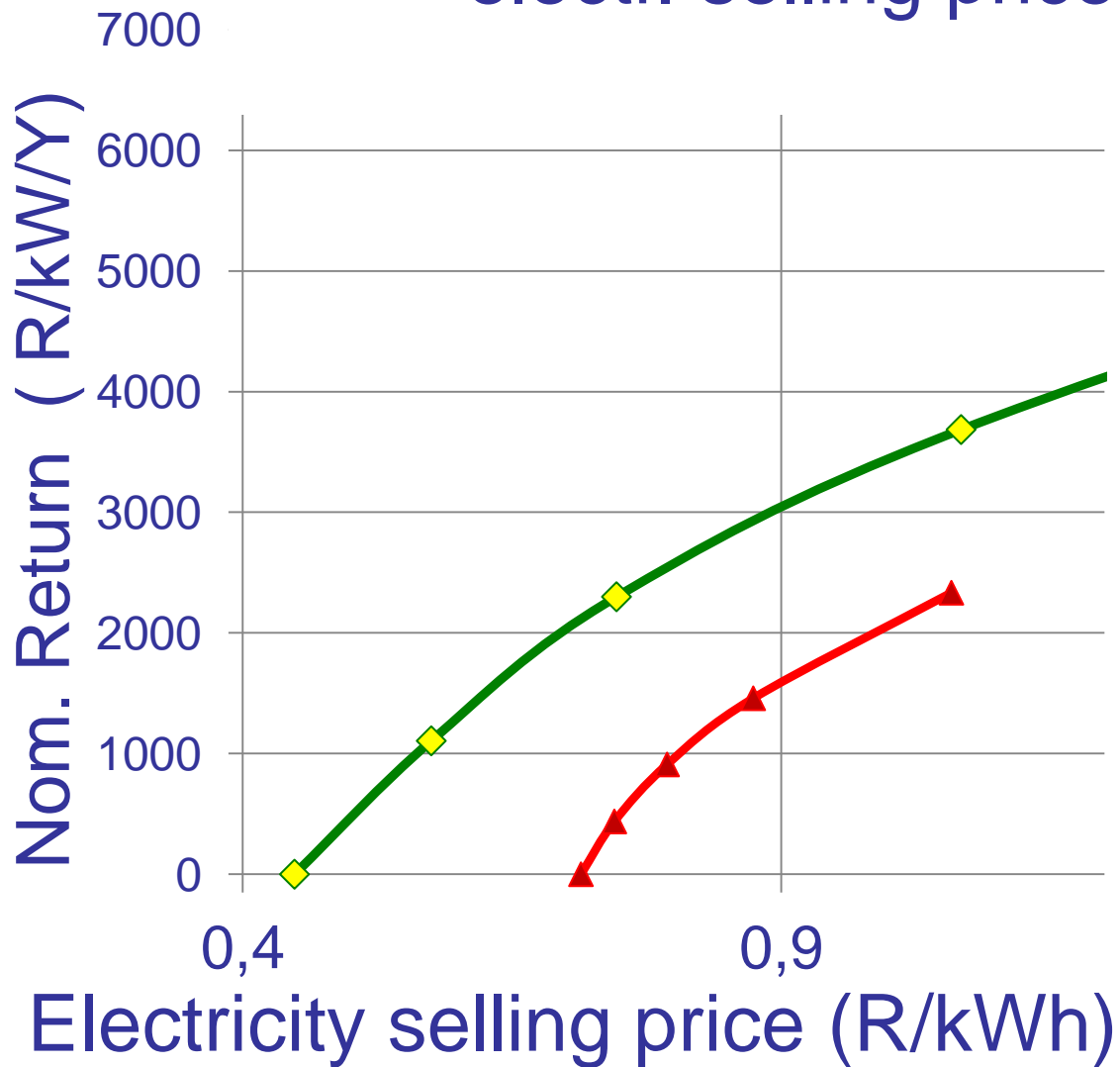
# LCOE as a function of Post-tax WACC



# % Return as a function of electricity selling price



# Nominal Return as a function of electr. selling price



◆ Nuclear:  
\$7,000/kW+  
Full env.  
costs

▲ Coal-R120  
C-tax only

# Conclusions

- New Nuclear will produce electricity more profitably than coal, if funded with equity or low cost capital.
- External cost of New nuclear (R0.005/kWh) is about 50 times lower than that of coal (R0.26/kWh)!
- SA should thus deploy nuclear as its long lead-time cheap base-load technology: Target minimum expected baseload demand.
- Add peaking technologies.
- Add quickly deployable technologies when shortages loom.

# Thank You

