South African nuclear industry overview

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South African Energy Challenges

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Key challenges in SA energy sector

Changing the energy mix and ensuring continuity of supply.

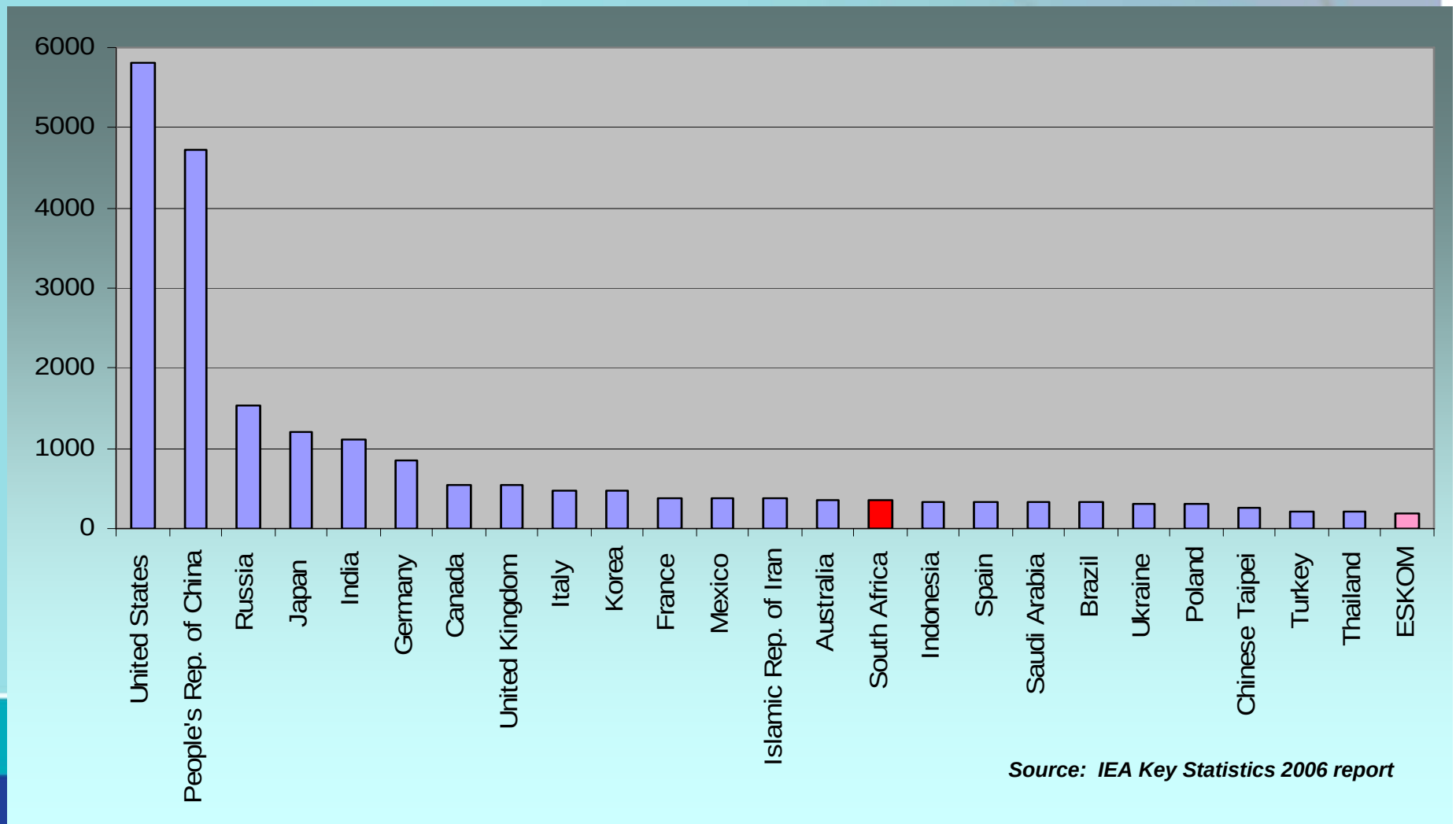
Successful execution of capacity expansion programmes.

Maintaining financial sustainability of energy supply.

Extending the grid to disadvantaged communities.

Responding to climate change.

CO_2 emissions (million tpa) - 2004



Source: IEA Key Statistics 2006 report

Drivers for investment in nuclear infrastructure in SA

- Power station full life cycle costing over 60 year lifetime introduces large cost uncertainties into fossil fuel generation.
- Long term price trajectories shows attractiveness of nuclear energy and fuel cycle investment; may also be needed to underpin security of supply.
- Geographic factors in Western Cape & Eastern Cape rule out other base load generation sources.
- Intended diversification to far lower reliance on coal leads to decision to set nuclear contribution to new build at 50%.
- Comprehensive nuclear energy policy adopted by South African government in June 2008.

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R&D in SA in 2006

- Steady increase in gross expenditure on R&D as a percentage of GDP from 0.60% in 1997 to 0.95% in 2006. Latter figure represents spending of R16.5 billion.
- The business sector was the largest **performer** of R&D (55.9% of total), then government (22.8%) and higher education sector (20.0%).
- The bulk of total R&D expenditure is **funded** from business sector sources (51.3%), followed by government (including science councils) (33.9%) and foreign sources (10.6%).

Eskom’s Plans

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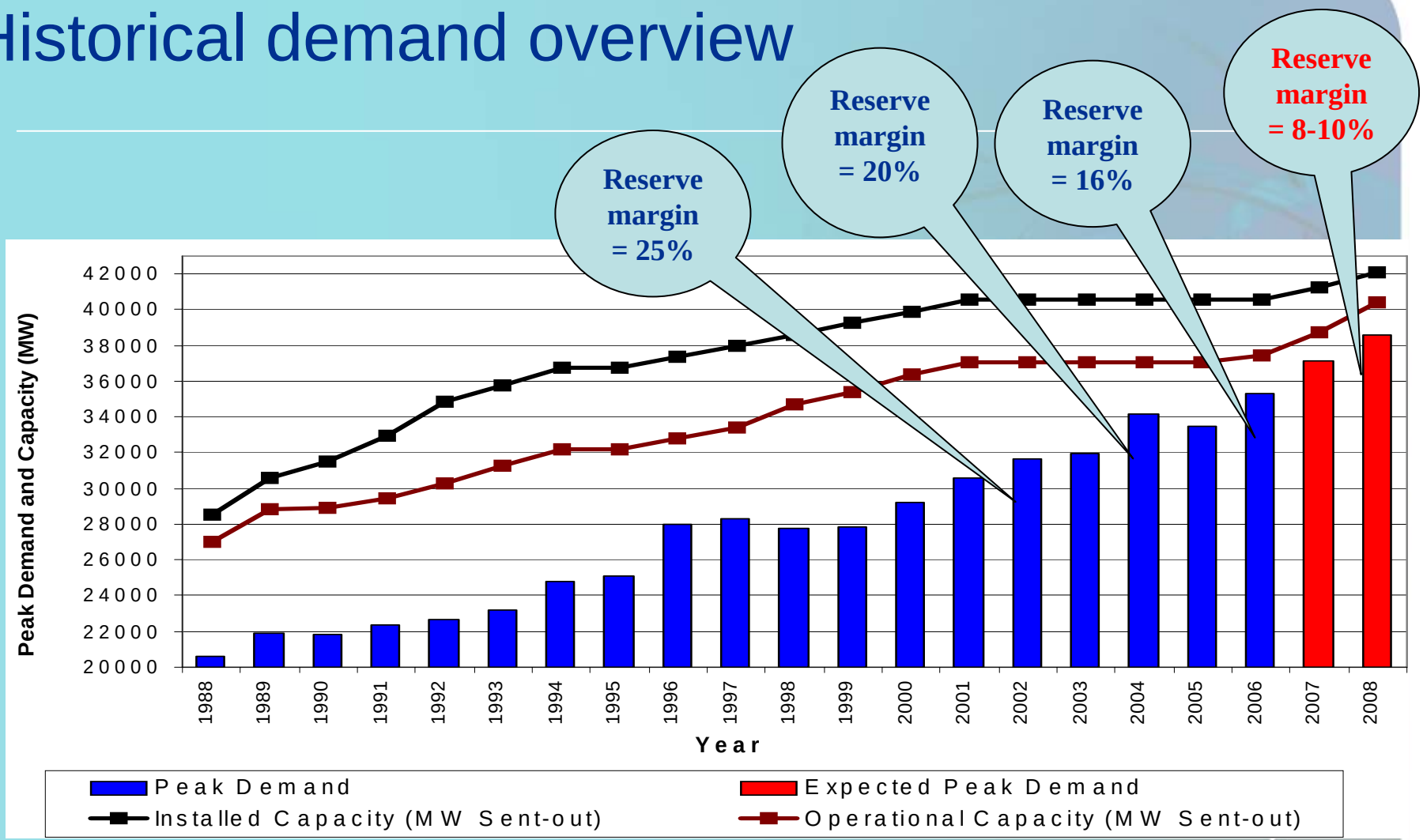
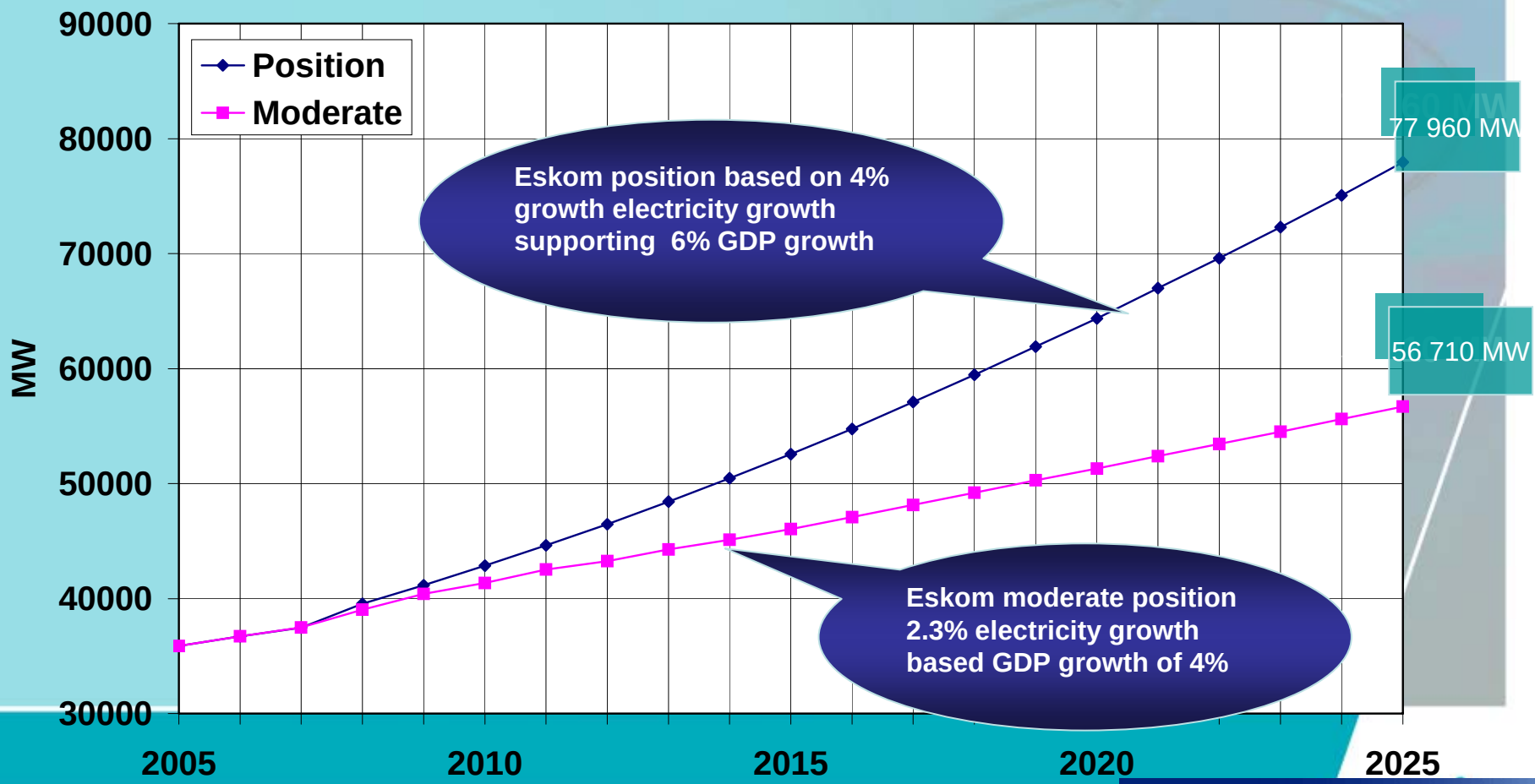
Historical demand overview



Reserve margin aspiration = 15%

Long term demand forecast

Additional 40 000 MW to be added to current capacity



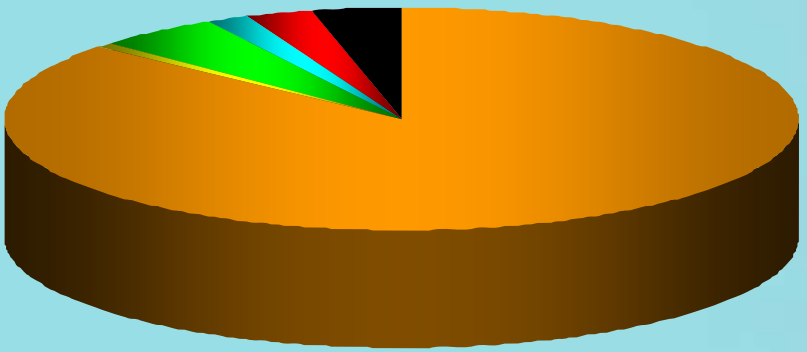
Eskom's expansion plans

By 2030 Eskom aspires to the following portfolio of generation assets with capacity > 80 000 MW:

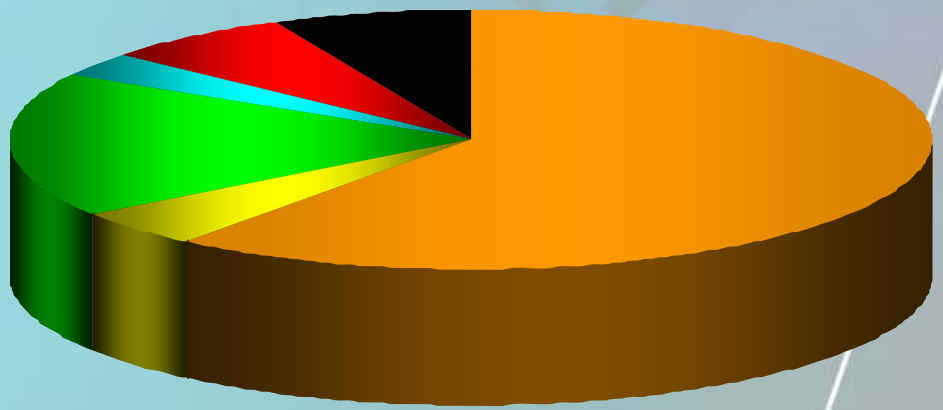
- Additional nuclear capacity of up to 20 000 MW
- Additional renewable energy capacity of at least 1 600 MW
- Additional pumped storage as required
- Additional 4000 MW of OCGT
- Additional imports to a maximum of the prevailing reserve margin (15%)
- Additional cleaner coal capacity (providing for carbon capture and storage)

Diversification of the primary energy mix

Existing



Mix by 2025



Coal
OCGT
Nuclear
Renewable Energy
Imports
Pumped Storage

SA Nuclear Energy Policy and Strategy

Nuclear Energy Policy and Strategy for South Africa

Vision:

Industrial and technological leadership to secure alternative energy resources for the future through the development of a globally competitive infrastructure and skills for the peaceful utilisation of nuclear energy and technology.

Nuclear energy policy **objectives**

Promotion of NE as important electricity supply option.

Promoting energy security.

Contribution to South Africa's social and economic growth.

Attainment of global leadership and self-sufficiency in the long term.

Building the uranium value chain.

Creation of framework for safe utilisation of NE.

Reduction of greenhouse gas emissions.

…….

Nuclear energy policy **principles**

NE part of diversification and security of energy supply

Economic growth and technol devel through investment

Use of uranium resources in sustainable manner

Development of industrial support base

Support for research, development and innovation

Development of human resources

&

Regulatory framework, safety, mitigate climate change, low environmental impact, intellectual property, international obligations

Institutional arrangements

Necsa as the anchor for nuclear energy research, development and innovation

Eskom the main operator of nuclear power plants

The National Nuclear Regulator

A National Radioactive Waste Management Agency

A national nuclear architectural capability for design, manufacture and construction of nuclear energy systems

Existing SA Nuclear Infrastructure

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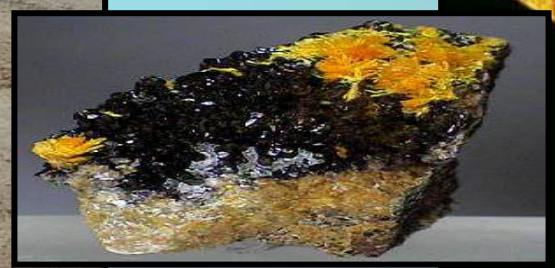
Uranium
Necsa
PBMR
NNR
Uranium
Vaalputs
Koeberg
Uranium
iThemba
Universities
Medical centres
Industry
NAMIBIA
BOTSWANA
ZIMBABWE
LESOTHO
SWAZILAN
SOUTH AFRICA
MOZAMB
WINDHOEK
GABORONE
POLOKWANE
MAPUTO
JOHANNESBURG
BLOEMFONTEIN
CAPE TOWN
Port Elizabeth
Durban
Port Edward
INDIAN OCEAN
Etosha NP
Skeleton Coast Park
Central Kalahari Game Reserve
Kgalagadi Transfrontier Park
Namib-Naukluft Park
Kruger NP
Hluhluwe-Umfolozi GR
Addo Elephant NP
Cape Agulhas

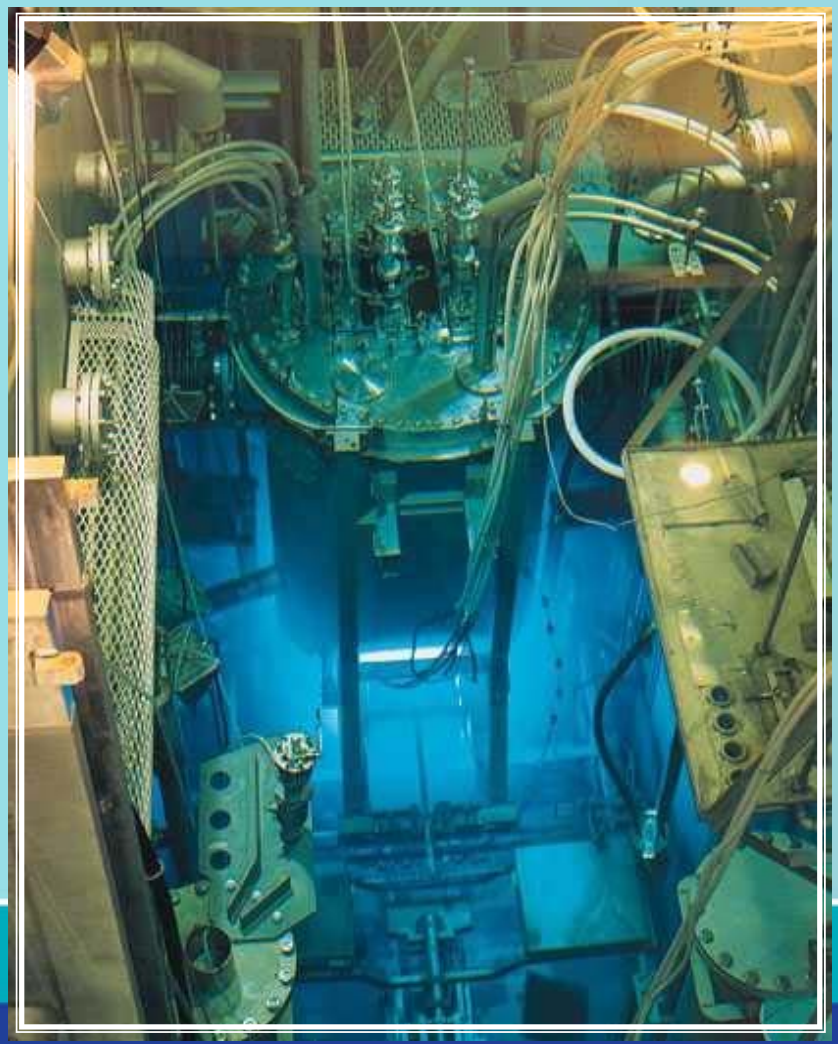
SA has the 4th largest uranium reserves in the world



Two PWRs at Koeberg (1800 MW)

Pebble Bed Modular Reactor

SAFARI-1 Research Reactor



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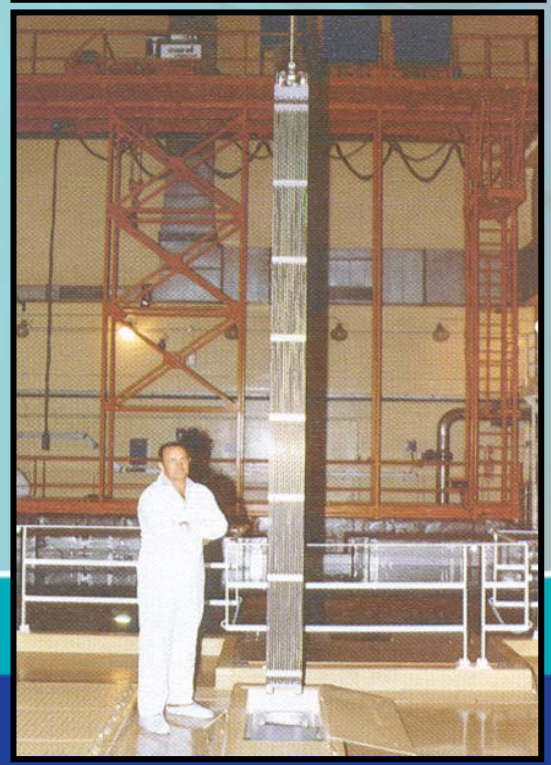
Historic strategic programmes

Uranium Enrichment

Weapons programme



Fuel fabrication

LLW and ILW disposal activities at Vaalputs

Radioisotopes .... 3rd in the world!

Radioisotope Transport Containers

Sales to 55 countries…

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Fabrication and machining at Necsa

Pressure vessels, heat exchangers, tanks, containers, valves, etc.

Manufacturing and Quality Control at the National Nuclear Manufacturing Centre, Necsa

Establishment of a national centre of competence in nuclear manufacturing codes and standards.

Current status:

- ASME VIII accreditation with ASME U-Stamp certification and ISO 9001 certification for manufacturing and QC.
- NQA-1(1994) Quality Management System.
- Design and draughting ISO 9001 certification.
- NDE level I and II (level III external) in ultrasonic, radiography, magnetic particle and liquid penetrant testing.
- Audit for ASME III accreditation and the ASME nuclear NPT-Stamp certification in Nov. 2008.
- ISO 17025 dimensional calibration accreditation assessment by mid 2009.

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Accelerator-based sciences

iThemba LABS 200 MeV cyclotron:

- *Nuclear physics research*
- *Proton and neutron therapy*
- *Isotope production*

Development of a nuclear cluster in SA

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Pre-requisites for the nuclear cluster

A technology strategy

A skills strategy

A funding strategy

An industrial strategy

Coordination

A technology strategy

- Government adoption of National Nuclear Energy Policy and Strategy.
- Necsa will drive nuclear energy research, development and innovation, as well as the conversion, enrichment and fuel manufacturing programmes that will ideally be linked to Eskom’s reactor suppliers.
- The key principle driving the technology strategy will be progressive localization of the value chain.

A skills strategy

4000 technical university graduates and 5000 – 8000 new qualified artisans will be required per annum.

- Marketing the cluster vision, particularly to young South Africans.
- The leveraging of supplier relationships.
- Bilateral relationships with supplier host countries (e.g. France, USA, Japan) as well as key ‘South’ countries, such as Brazil.
- Identification and proper funding of training and educational institutions, directly linked to the nuclear build and operating programme.
- Aggressive recruitment of engineers and scientists from abroad.

A funding strategy

- Of the approx. R40 billion state funding required for localization over duration of new build period, 60 % would be invested in advanced manufacturing industries, 20% in technology development and 20% in skills development.
- Private sector would lead from beginning in shallow localization areas; state funding deployed to develop capacity in advanced (deep localization) areas.
- Coordinated approach required, using the expertise in organizations such as the IDC.
- Note: cost estimate to stimulate localization is only about 2.5% of the cost of the new build.

An industrial strategy

- Competitive Supplier Development Programme (CSDP) - a programme to direct major procurement by State Owned Enterprises towards local investment.
- CSDP requires a local subcontractor component to be present in any large tender involving a South African SOE.
- Already exemplified in coal part of new build, where local supply of priority components will rise from 69% to 91% by 2013, and have a R16 billion positive impact on South Africa's balance of payments.
- CSDP will also be applied to the nuclear new build.

Coordination

- The allocation of responsibilities within core institutions involved in nuclear programme (Necsa, Eskom, NNR, Waste Agency, etc) defined in NEPS.
- Coordination of industrial effort will be ‘reality tested’ by industry itself.
- Several government departments are key role-players: Minerals and Energy (regulation); Public Enterprises (governance of SOEs); Trade and Industry (industrial strategy) and Science and Technology (research and innovation).

Areas of localisation

Shallow:

- Earthworks, foundations, concrete, roads, auxiliary buildings, intake and outfall infrastructure, etc.

Medium:

- Pumps, pipes, valves, filters, motors, vessels, transformers, switchgear, etc.

Areas of localisation (cont.)

Deep:

- Steel works, forges, manufacture reactor pressure vessels, steam generator and turbines, etc.
- Uranium conversion, U enrichment, fuel fabrication, spent fuel reprocessing, high level waste storage

Conclusions

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Nuclear power, as an important component of global baseload capacity, enjoys growing support in both developed countries and developing economies for reasons of security of supply, climate change, etc.

This will have a considerable effect on uranium mining, fuel cycle activities and nuclear manufacturing globally.

South Africa will significantly increase its nuclear power capacity over the next 20 years.

The local mining, manufacturing and electricity industries are ready to partner with local and foreign players to create a local nuclear industry.

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Thank You!

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