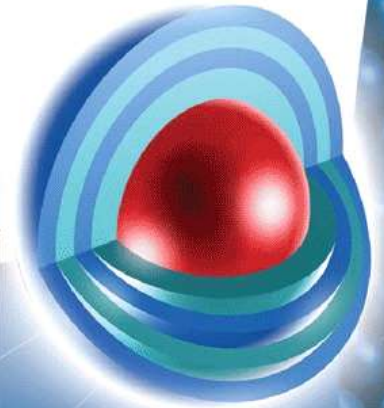




P B M R

Is Nuclear Power an Option for Africa?



PIESA Mombasa 2009

World Energy Needs

The provision of energy has become one of the most critical:

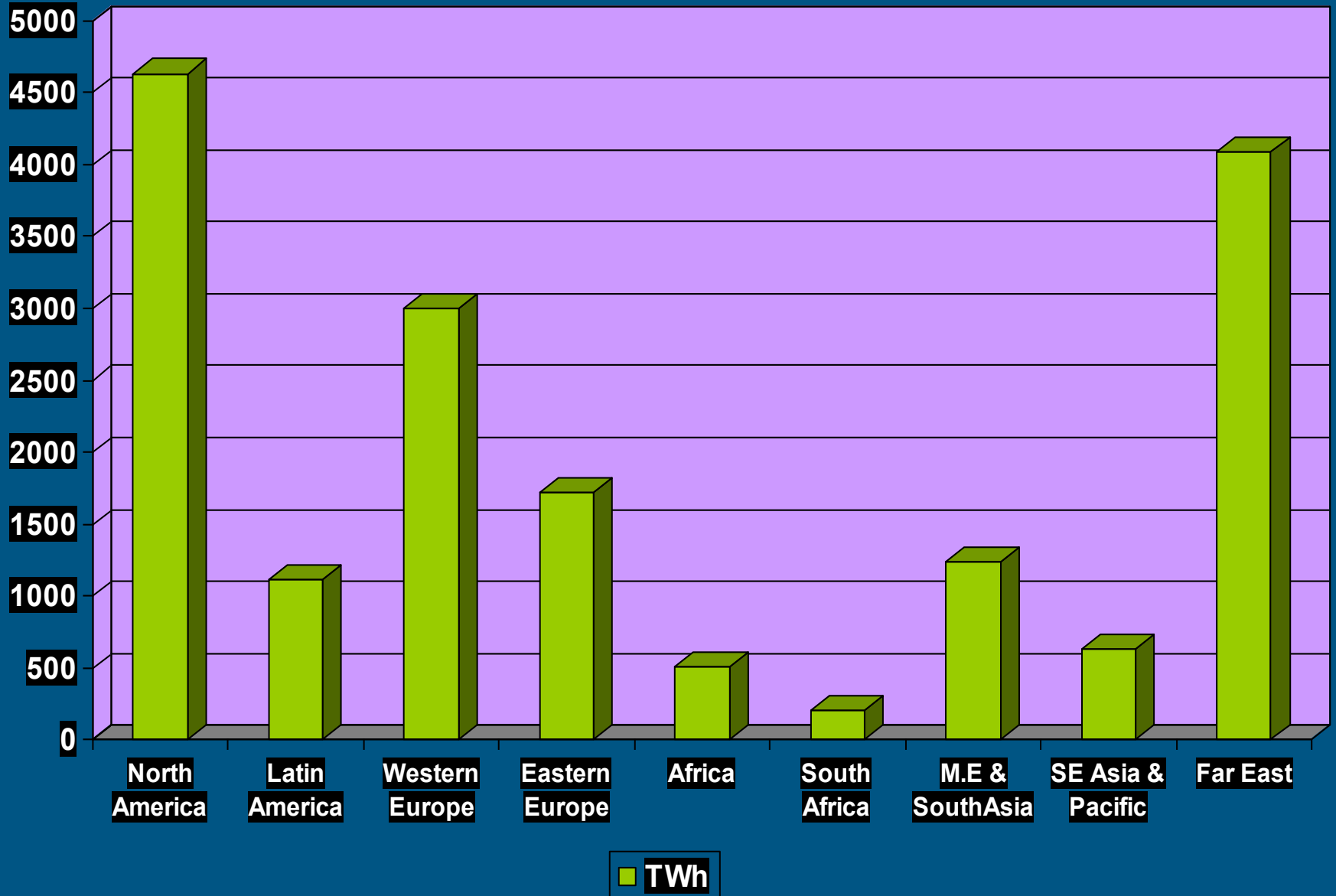
- Political
- Economic
- Environmental
- Developmental and
- Survival issues in the world.

Africa's development is dependent upon access to a future supply of secure, affordable, safe and clean energy.

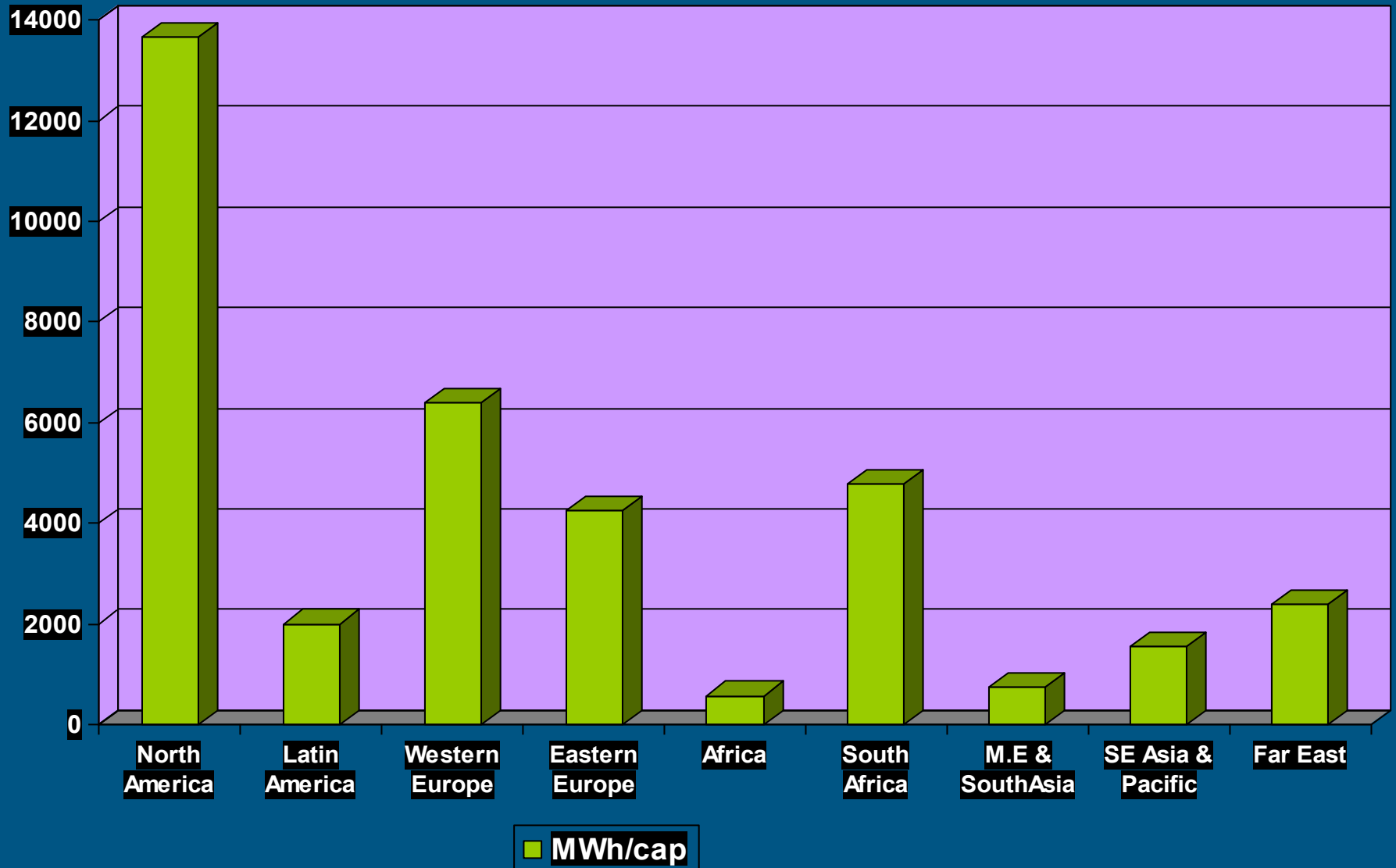
Energy Market Drivers

- **Growth in energy demand**
- **Safety**
- **Environmental concerns**
- **Cost of Supply**
- **Environmental Cost (Carbon Taxes, Clean carbon technologies)**
- **Security of Supply (Availability)**
- **Security (Non-proliferation)**
- **Extend valuable carbon fuel resources**
- **Disposal of all types of Waste**
- **Transmission Congestion**
- **Plant replacement**

World Electricity Consumption



World Electricity Consumption (per capita)



Global Nuclear Market

	2005	2015	2025	2040
	GW	GW	GW	GW
Global Demand	3,983	4,593	5,501	7,189
Current nuclear capacity	372	328	179	66
Projected future nuclear %	9.3%	8.9%	12%	15.0%
Future nuclear capacity	372	408	660	1,078
Replacement existing nuclear		44	193	305
New nuclear sites		36	288	707
TOTAL NEW NUCLEAR BUILD		80	481	1,012

Nuclear Renaissance

- 441 nuclear reactors operating in 30 countries
- 38 nuclear plants being built in 12 countries
- China plans to build 27x1000MW reactors over the next 15 years
- France plans to replace 58 reactors with new EPRs at a rate of 1600MW per annum
- India plans 10-fold increase in nuclear power
- Environmentalist Patrick Moore and co-founder of Greenpeace James Lovelock called for massive expansion of nuclear power to combat global warming

The future

Nuclear Energy

*Assessing the
role of the
Nuclear
Power as a
component of
the Energy
Mix in Africa*



The Nuclear Option

- **South Africa has nuclear power**
- **Planning to expand nuclear infrastructure**
- **Egypt has ordered first NPP**
- **At least 6 African countries notified IAEA intention to develop NPPs**
- **Nuclear power in Africa is a reality**

The Nuclear Option

- **Economic Development**
- **Environmental Considerations**
- **Cost Advantage**
- **Localisation and Industrial Development**
- **Safety Record**
- **Uranium is an African Resource**
- **Enabling Framework**

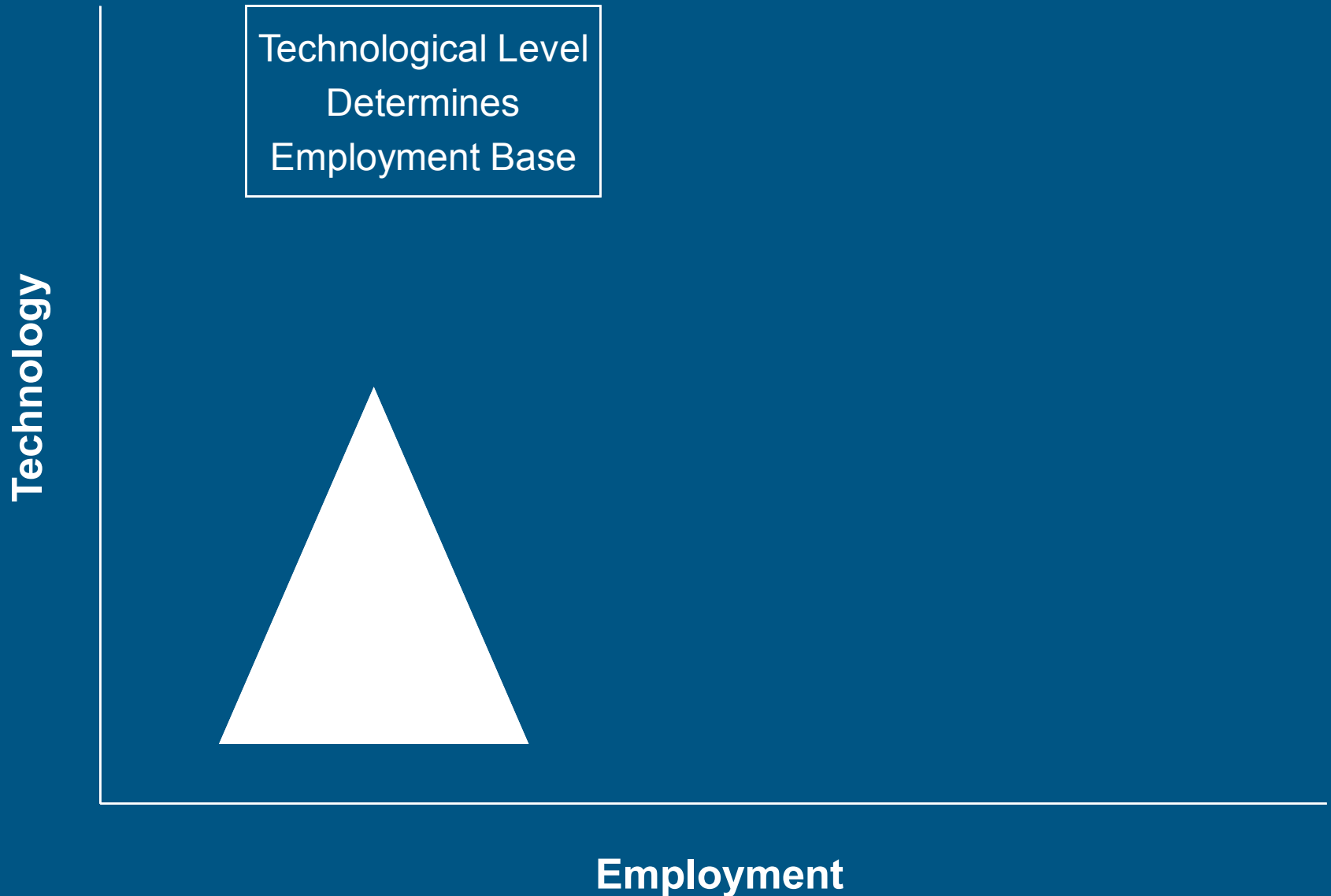
The Nuclear Option

Economic Development

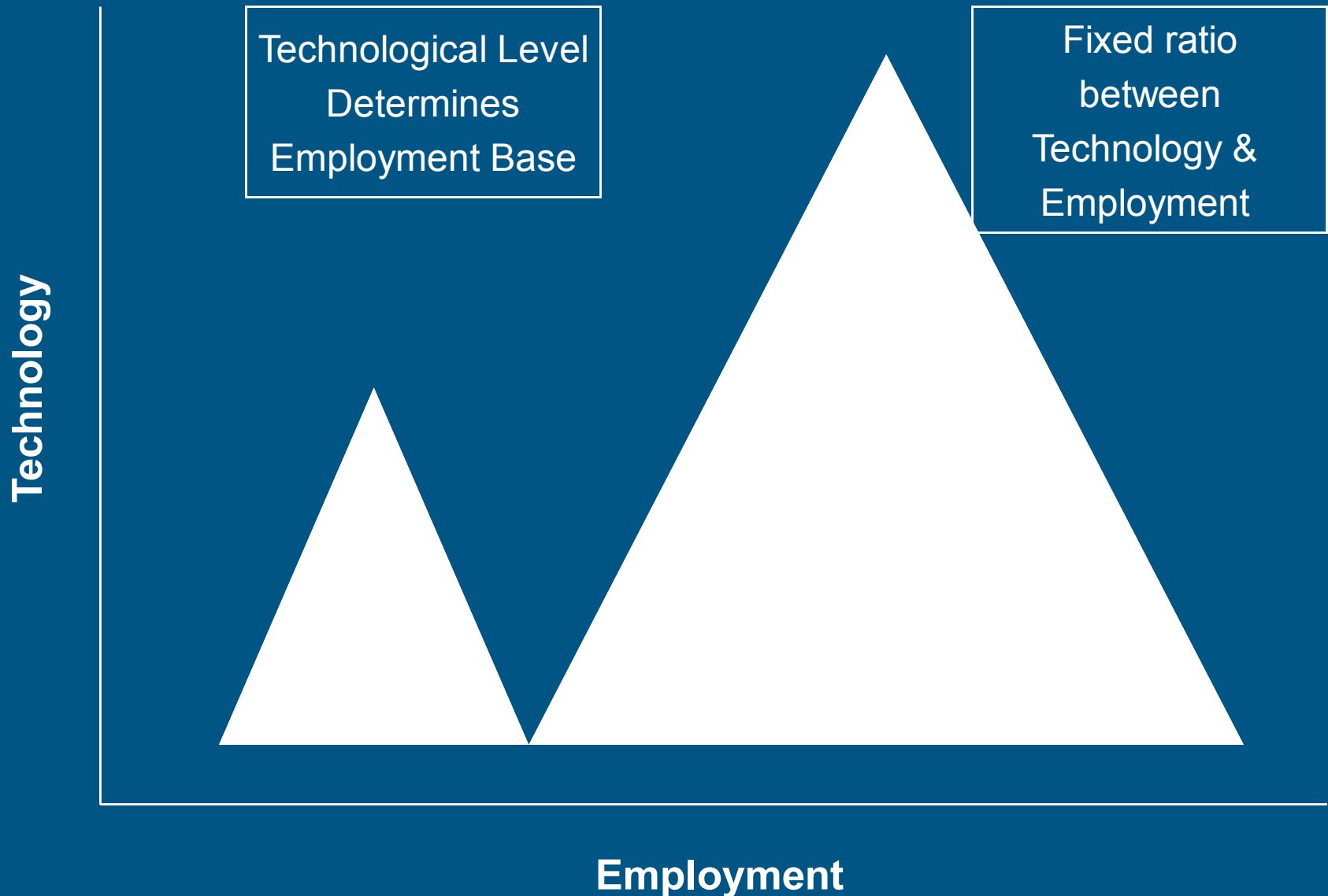
Economic Development Driver

- **Technology has become the principal economic differentiator and development driver**
- **Africa is a resource rich continent and has traditionally relied upon resource exports for economic development**
- **Need to expand the technology base of the countries in Africa**

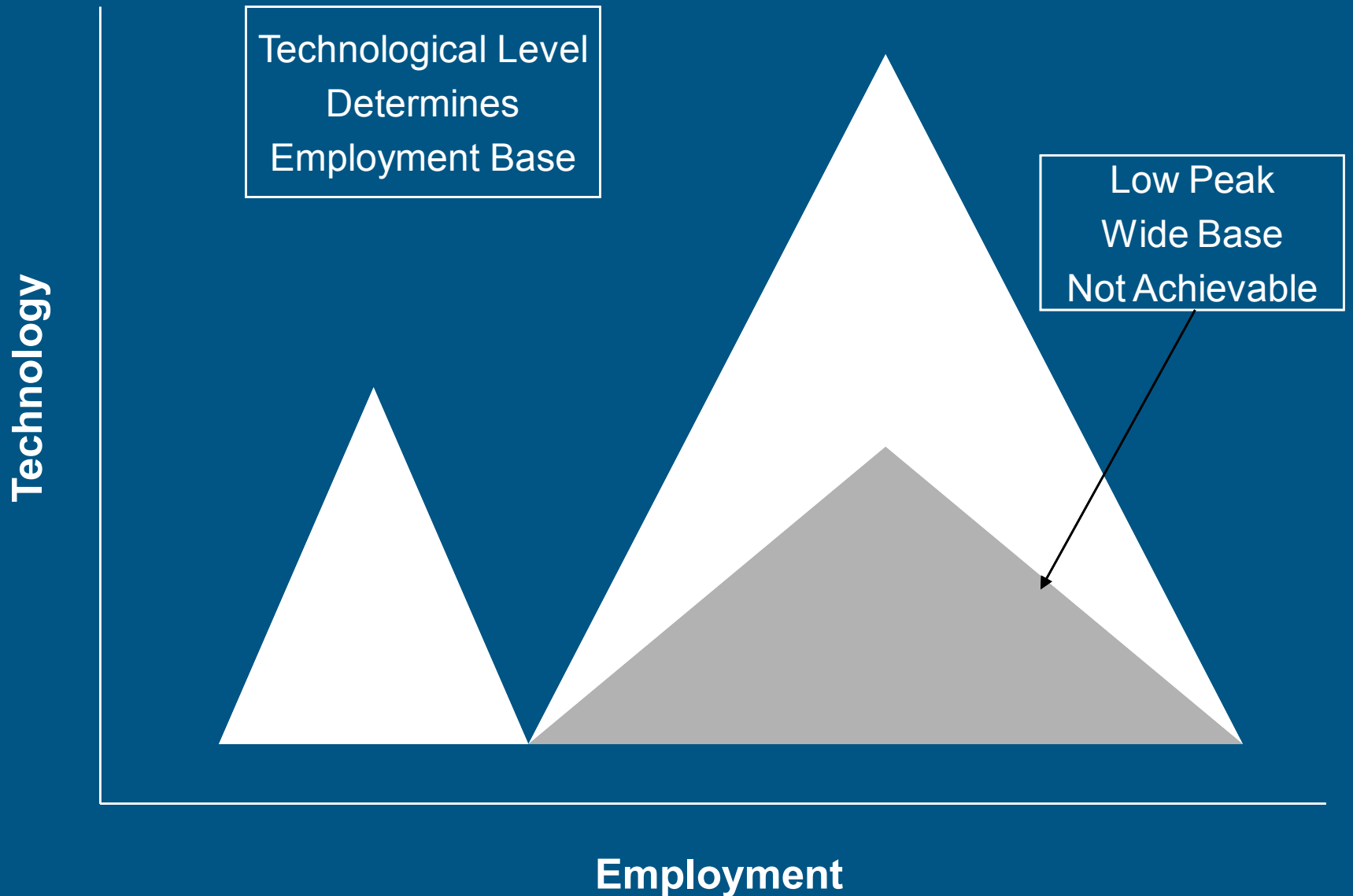
Technology/Employment Triangle



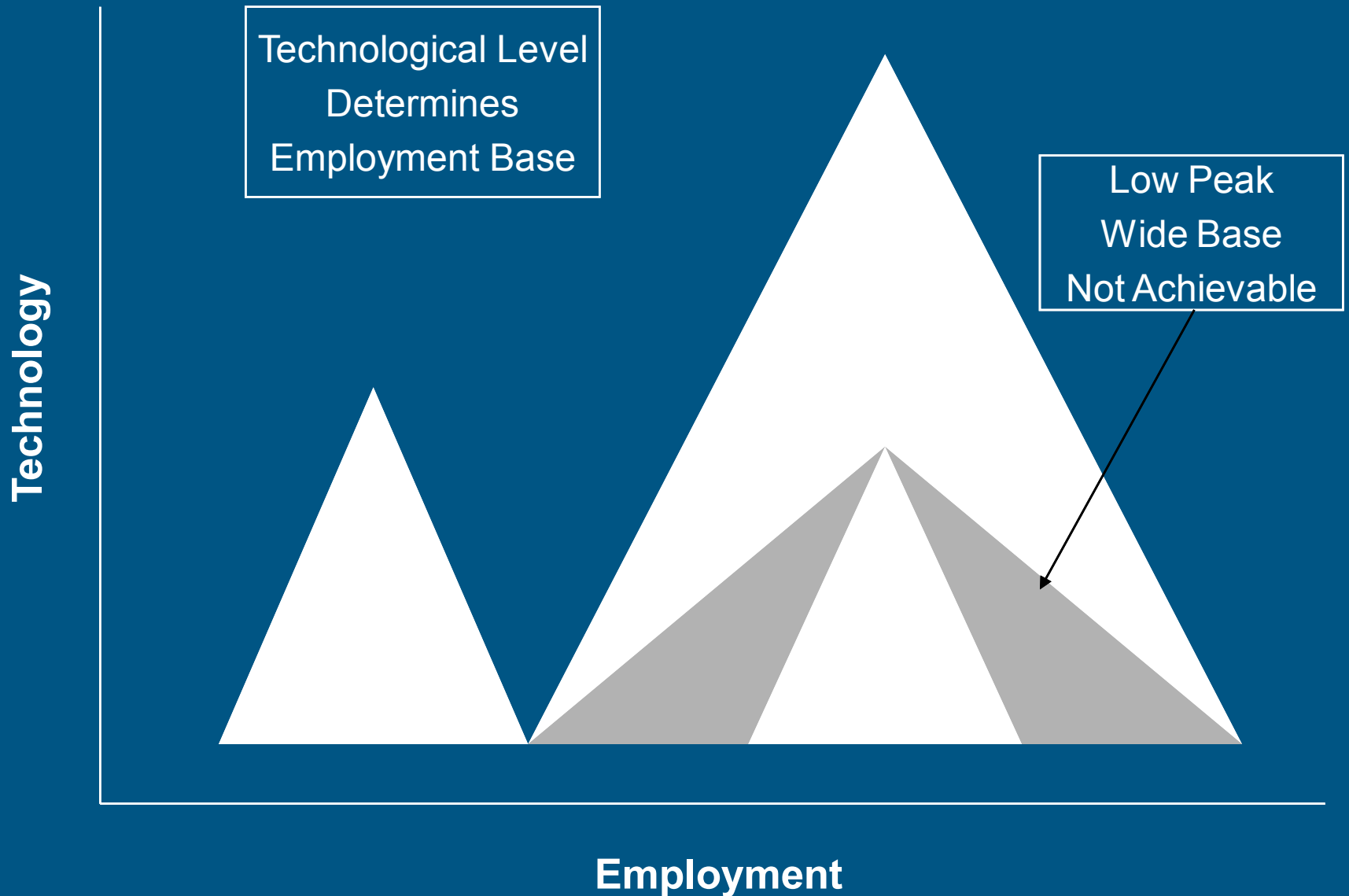
Technology/Employment Triangle



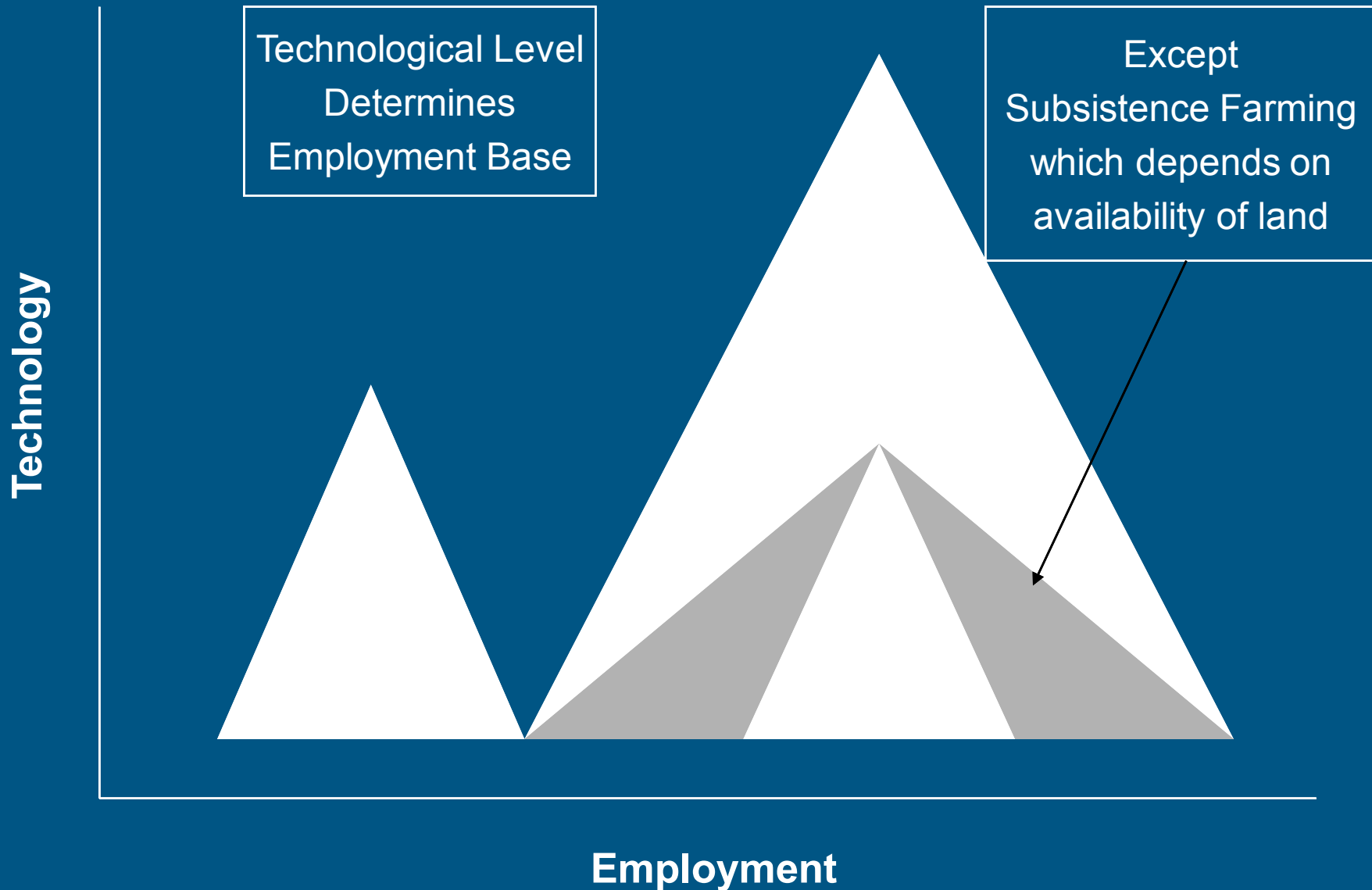
Technology/Employment Triangle



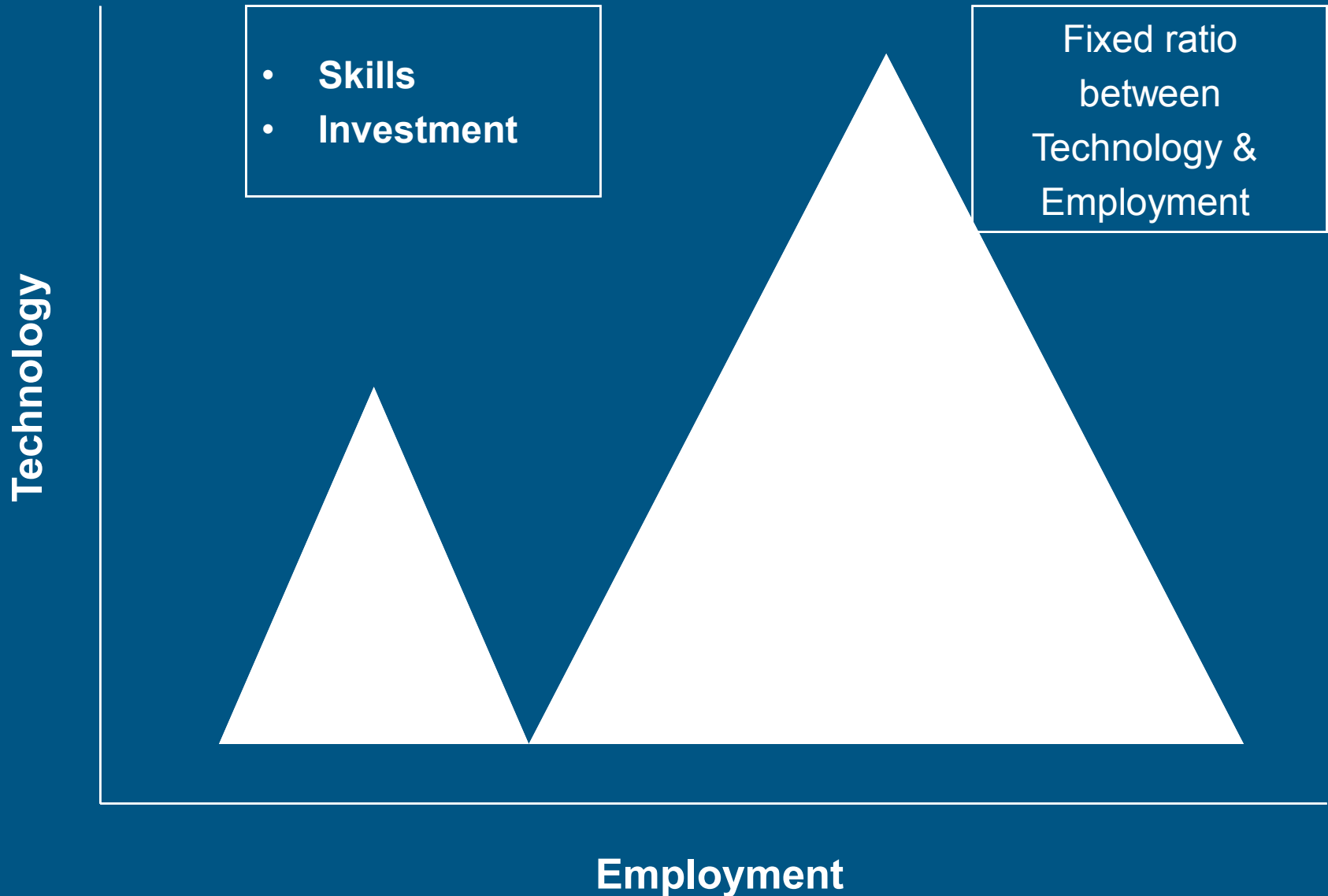
Technology/Employment Triangle



Technology/Employment Triangle



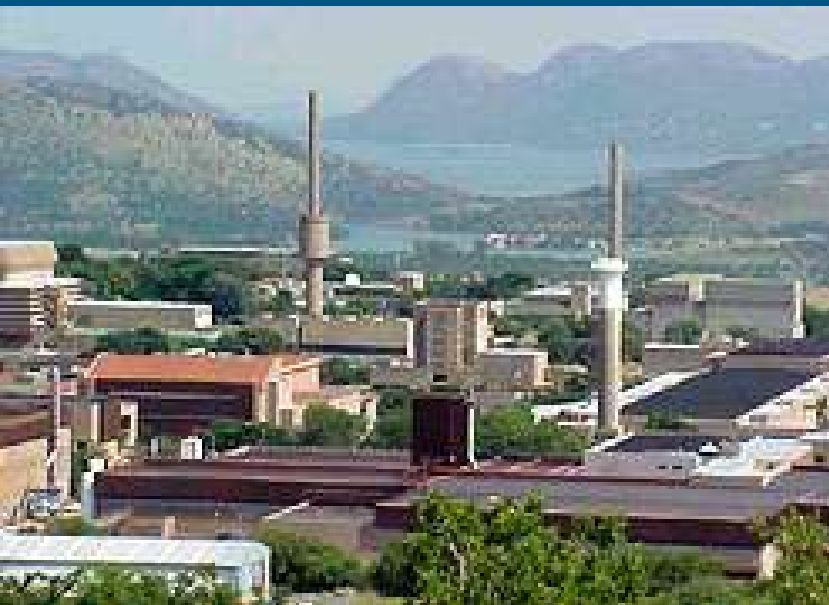
Technology/Employment Triangle



Example: Safari Reactor



1949: The Atomic Energy Board is instituted as an autonomous research organization



1960: South Africa buys a 6,66 MW American Oak Ridge research reactor. Called Safari, it goes critical in 1965 at Pelindaba near Pretoria

Nuclear Power

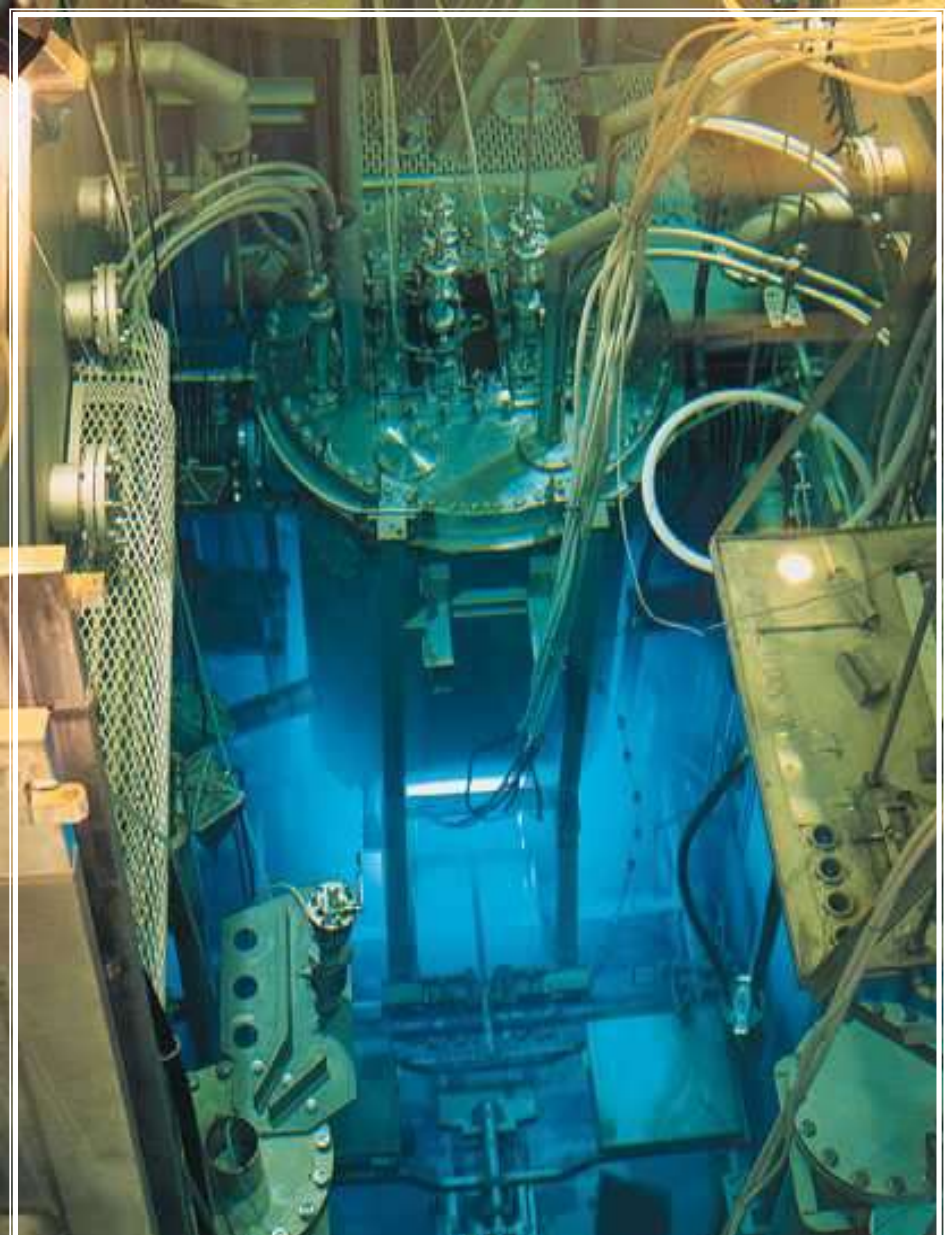
1977: The French company Framatome is awarded a turnkey contract for building two 900 MW PWR units at Koeberg. The first unit is commissioned in 1984 and the second in 1985.



Pelindaba Site, Pretoria



Medical Isotopes



The Safari reactor runs at 20 MW and is a major source of medical isotopes internationally. South Africa is the world's third biggest supplier of bulk radio chemicals for use in radiopharmaceuticals, both for diagnoses and therapy



Window of Opportunity

**Window of Opportunity
arose with the decision in
Germany to discontinue
the HTR development
work in 1990**

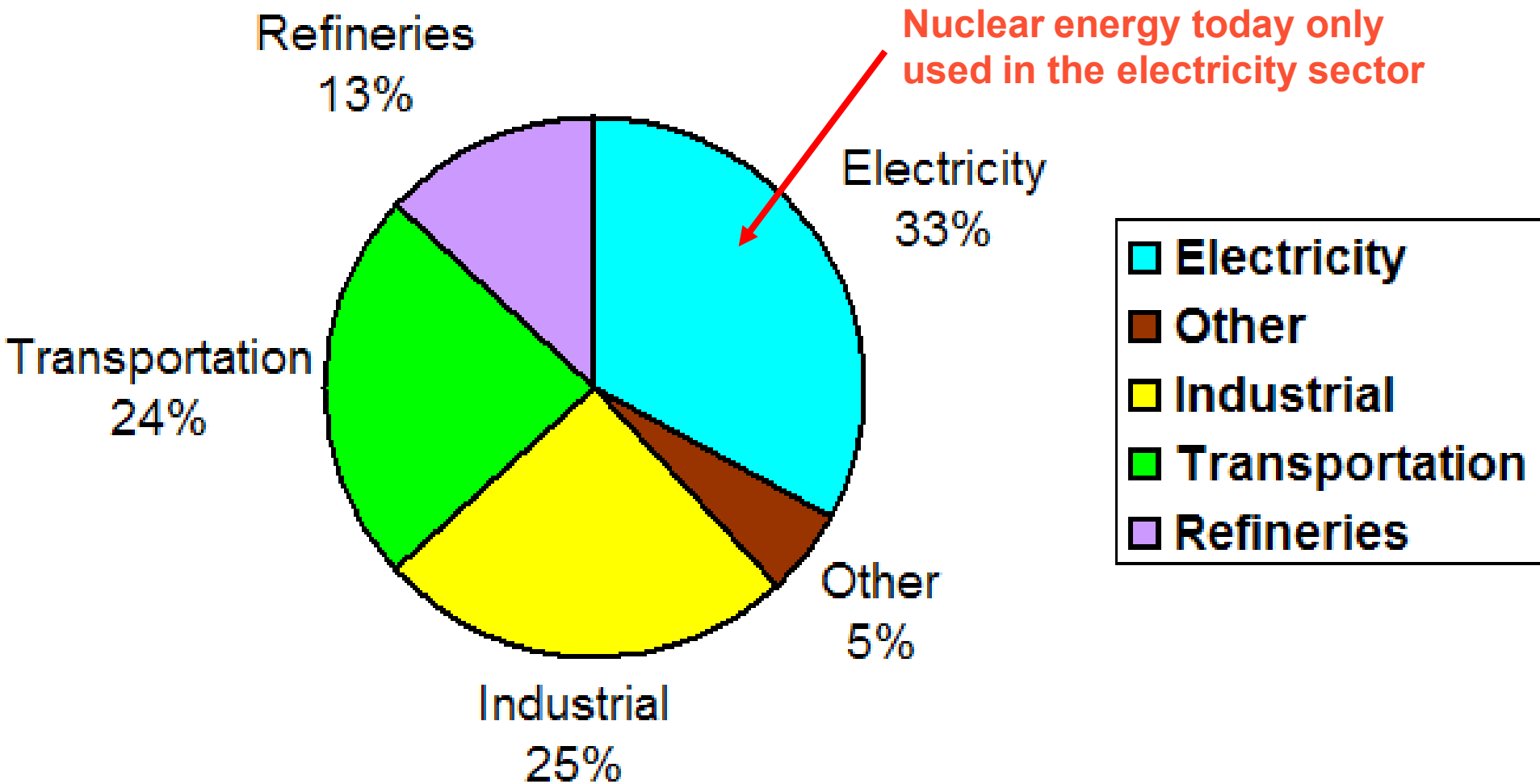
**Pebble Bed technology
transferred to SA in 1996**

**PBMR Company
established in 1999**

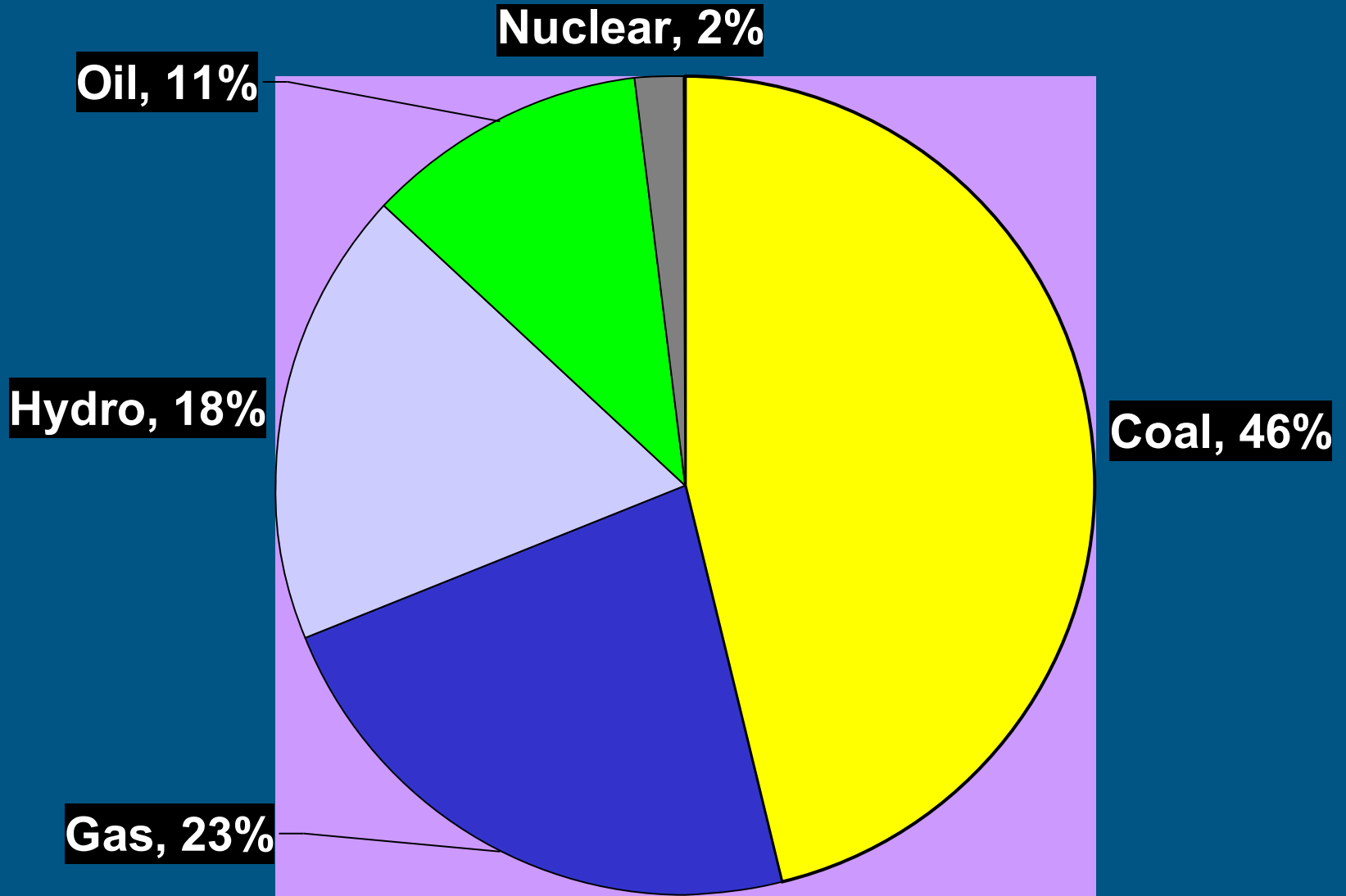
The Nuclear Option

- **Economic Development**
- **Environmental Considerations**

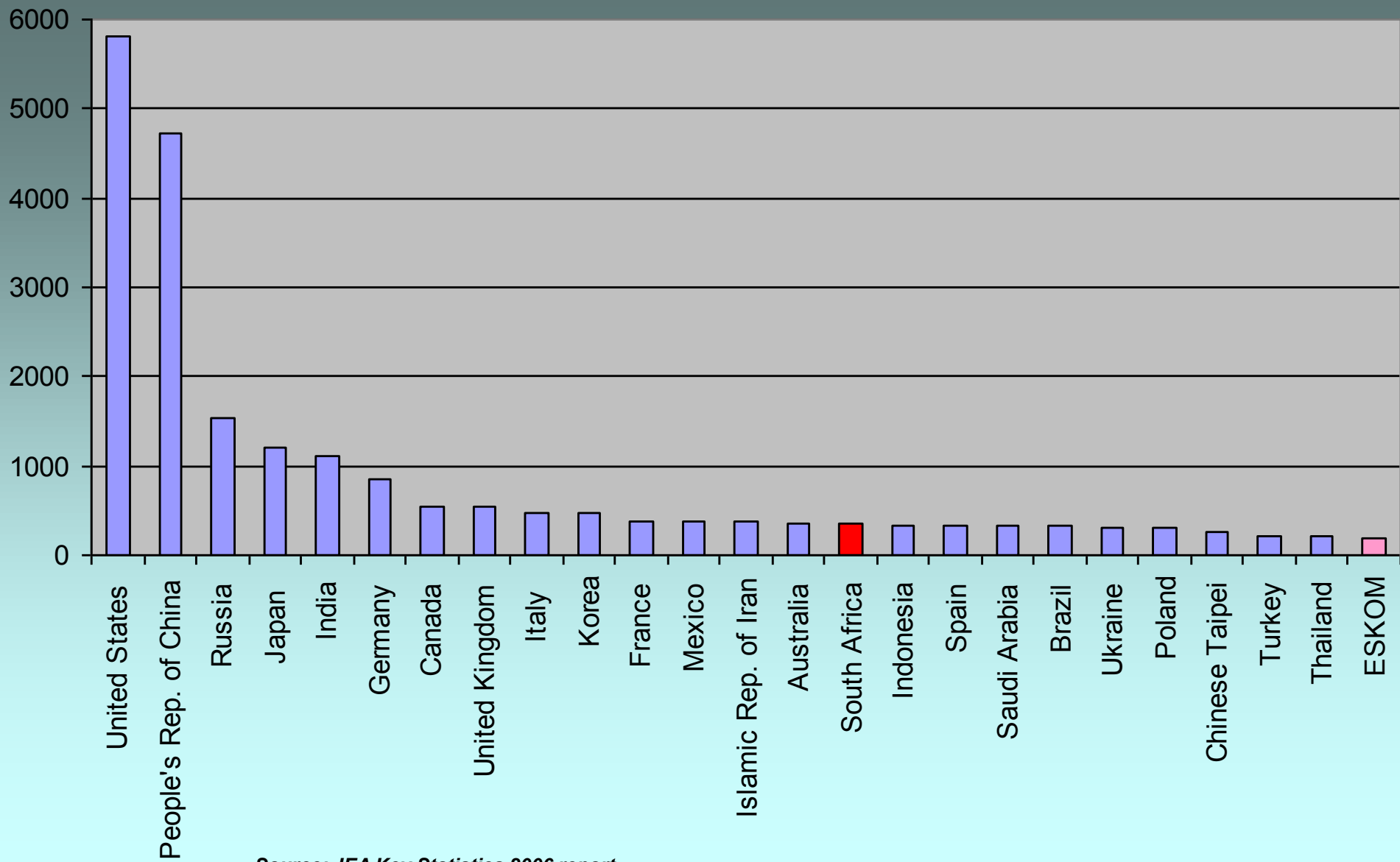
Global CO2 Emissions



Africa Electricity Generation (by fuel)



CO2 Emissions (Million t)



Source: IEA Key Statistics 2006 report

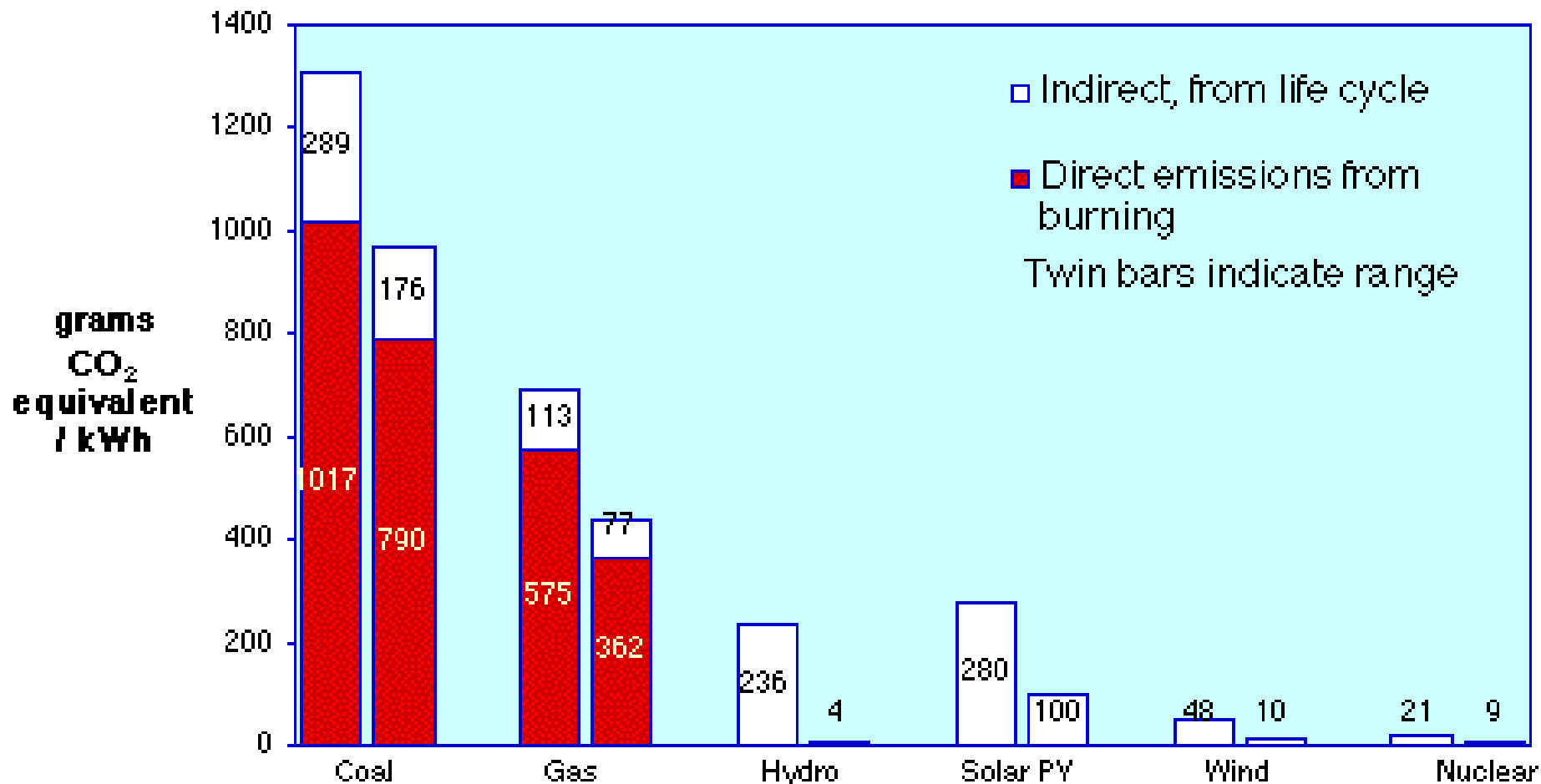
CO2 Emissions

■ NOTE:

- The previous slide highlights the fact that South Africa is 15th in the world in terms of total CO2 emissions
- If ESKOM were a “country” it would rank number 25th in the world for total CO2 emissions
- CO2 reduction therefore has to be a serious Government thrust

Comparative CO₂ Emissions

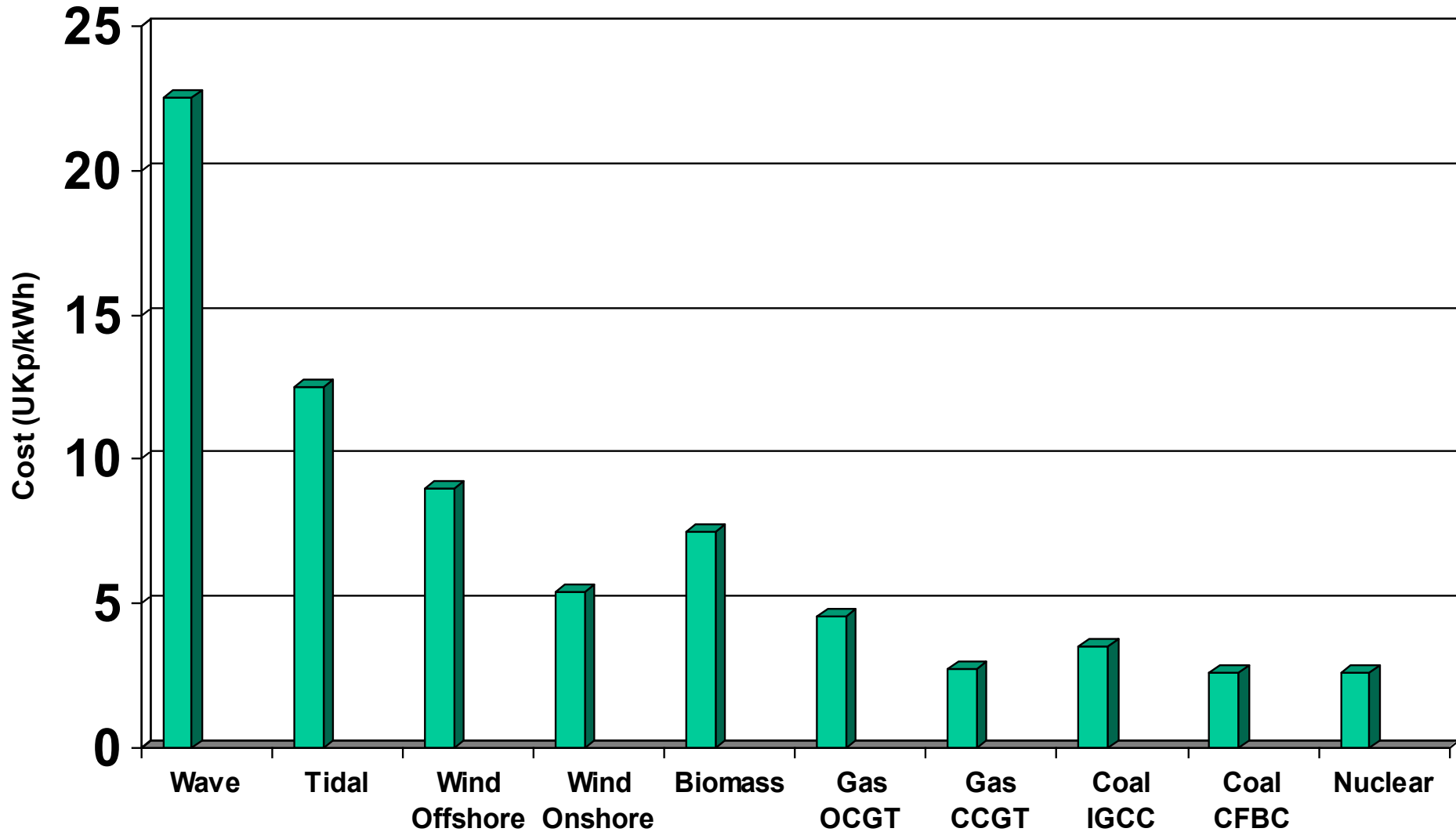
Greenhouse Gas Emissions from Electricity Production



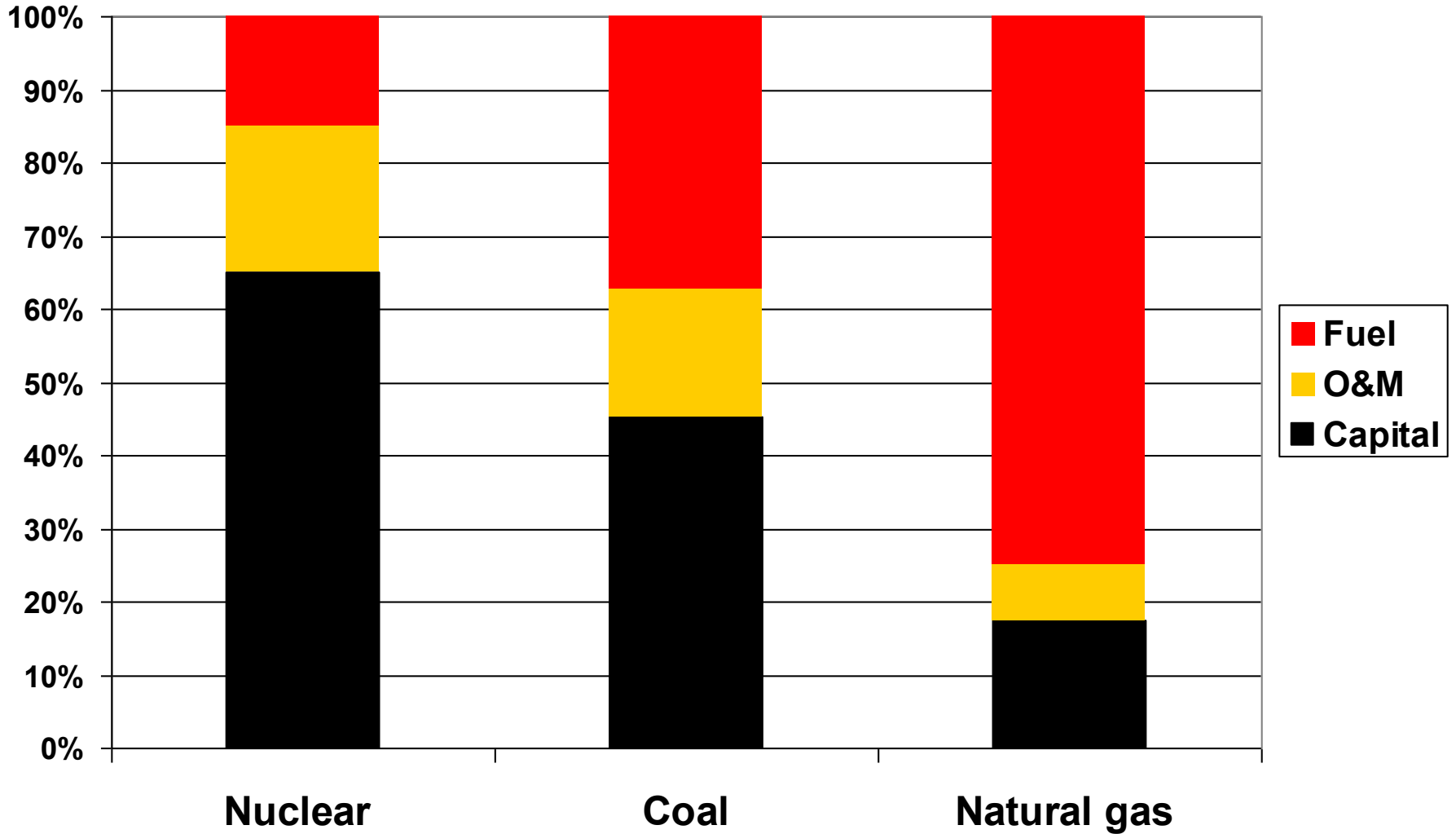
The Nuclear Option

- **Economic Development**
- **Environmental Considerations**
- **Cost Advantage**

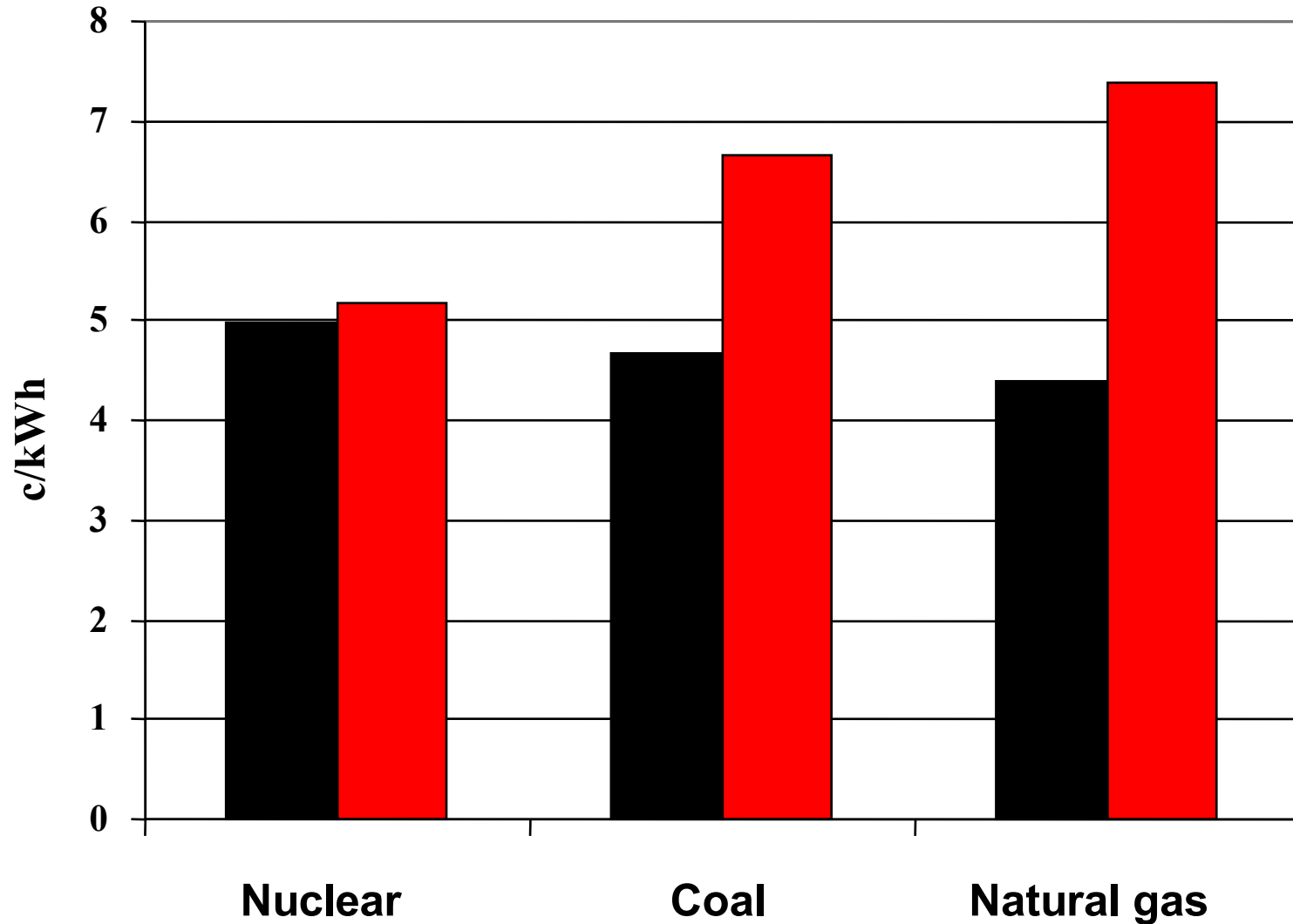
Comparative Costs



Cost Structure



Doubling of Resource Cost



Smaller Reactors becoming available

- Suitable for distributed power
- Suitable for smaller grids
- Modular expansion options
- Reduced financial risk
- Reduced operational risk
- Other applications:
 - Water desalination
 - Non-power usage
- Examples:
 - PBMR in South Africa & China
 - Russian developments
 - Toshiba 4S
 - Argentina
 - Hyperion Reactor

The Nuclear Option

- **Economic Development**
- **Environmental Considerations**
- **Cost Advantage**
- **Localisation and Industrial Development**

Localisation Mission

- **Participate in the establishment of an economically viable and sustainable nuclear industry**
- **Development of skills, job creation and promotion of Black Economic Empowerment through the nuclear industry**
- **Export of capital goods and value-added products and minimising the outflow of foreign reserves**
- **Exploiting SA based technology**

Localisation



2000

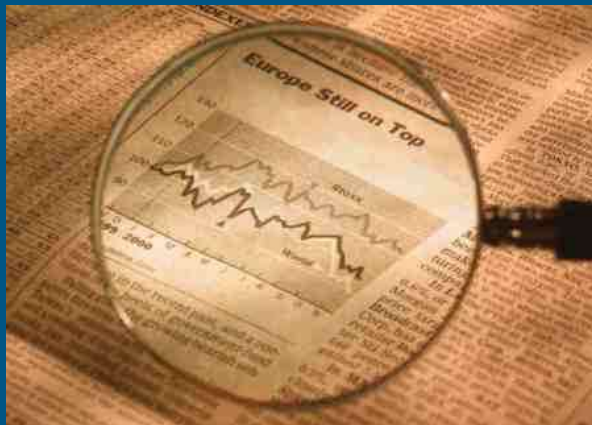
Industry & Technology Upgrade

2030



Industrial Development

- Heavy Industry Recapitalisation
- Strategic Investments
- Production Technology R&D
- Competitiveness and Cost Reduction Strategies
- International Benchmarking
- Quality Assurance and Certification

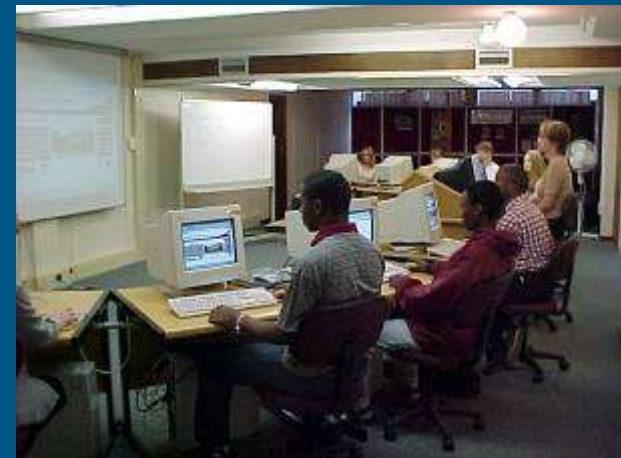


Corporate Tiers & CSDP

- Existing companies
 - Existing companies that can be upgraded
 - New companies
-
- Launch of the CSDP (Competitive Supplier Development Program)

Skills Development

- ❑ University Education
- ❑ Artisans
- ❑ Learnership Programmes
- ❑ Mentoring Programmes
- ❑ Project specific Training Programmes
- ❑ International Exchange Programmes



Other Initiatives

- **National Nuclear Policy**
- **University Centres of Excellence**
- **WNU Training Seminars**
- **Active R&D Program**
- **Studies of Complete Fuel Cycle**
- **Various bilateral cooperation Treaties**
- **Establishment of WINSA and YPNA**

- To act as a public voice for the nuclear industry
- To actively promote the maximum local industrialisation and economic clustering of nuclear manufacturing in South Africa
- To promote excellence and a culture of safety and security within the industry
- To promote skills development, job creation and Black Economic Empowerment through the nuclear industry in South Africa
- To facilitate coherence and to avoid duplication of effort in the development and expansion of the nuclear industry
- To promote public understanding of nuclear technology
- To act as a sounding board to Government on policy formulation
- To promote a common approach to research and related scientific issues and the role of universities
- To facilitate the solution of problems or obstacles faced by the industry

■ Board

- Sponsor members

- Elected Members

■ Sub-Committees

- Manufacturers

- Education

- Regulatory

- Communications

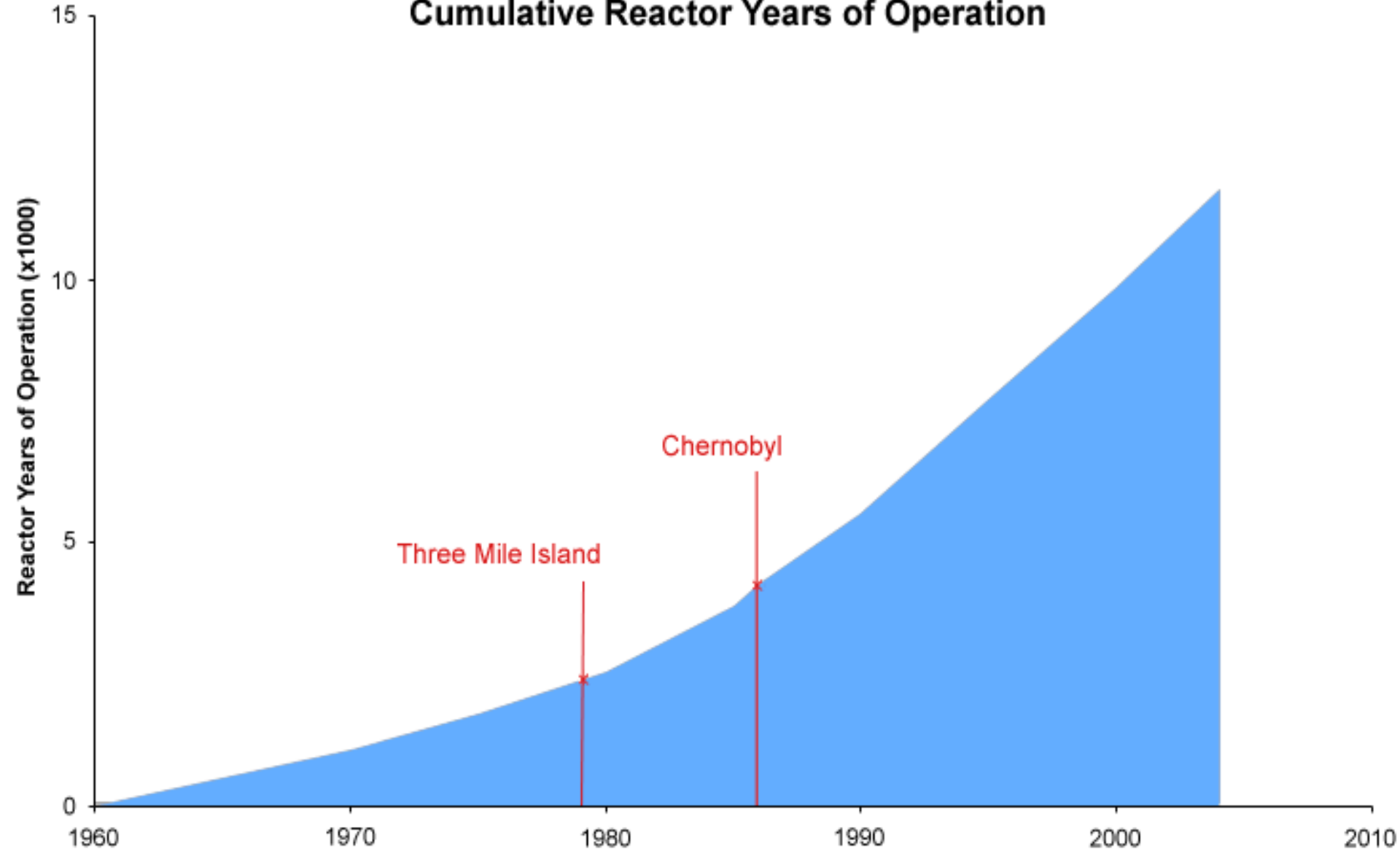
- Finance

The Nuclear Option

- **Economic Development**
- **Environmental Considerations**
- **Cost Advantage**
- **Localisation and Industrial Development**
- **Safety Record**

Nuclear Safety

Cumulative Reactor Years of Operation



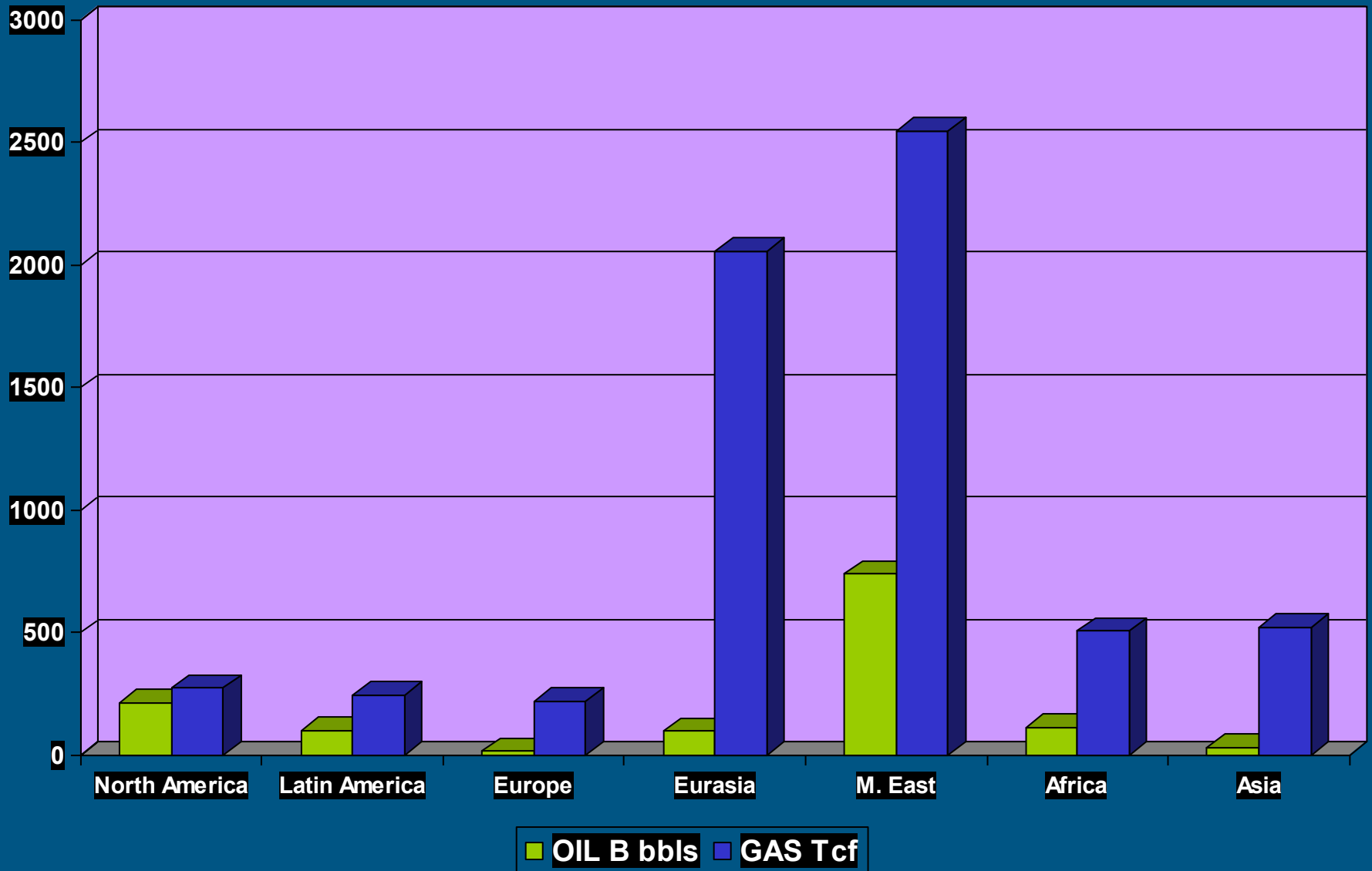
Modern Safety Features

- **Inherent and Passive Safety**
- **Slow Reaction Times**
- **Proliferation Resistance**
- **Training Simulators**
- **Advanced Fuel Systems**
- **Safe waste disposal**
- **International scrutiny & Transparency**

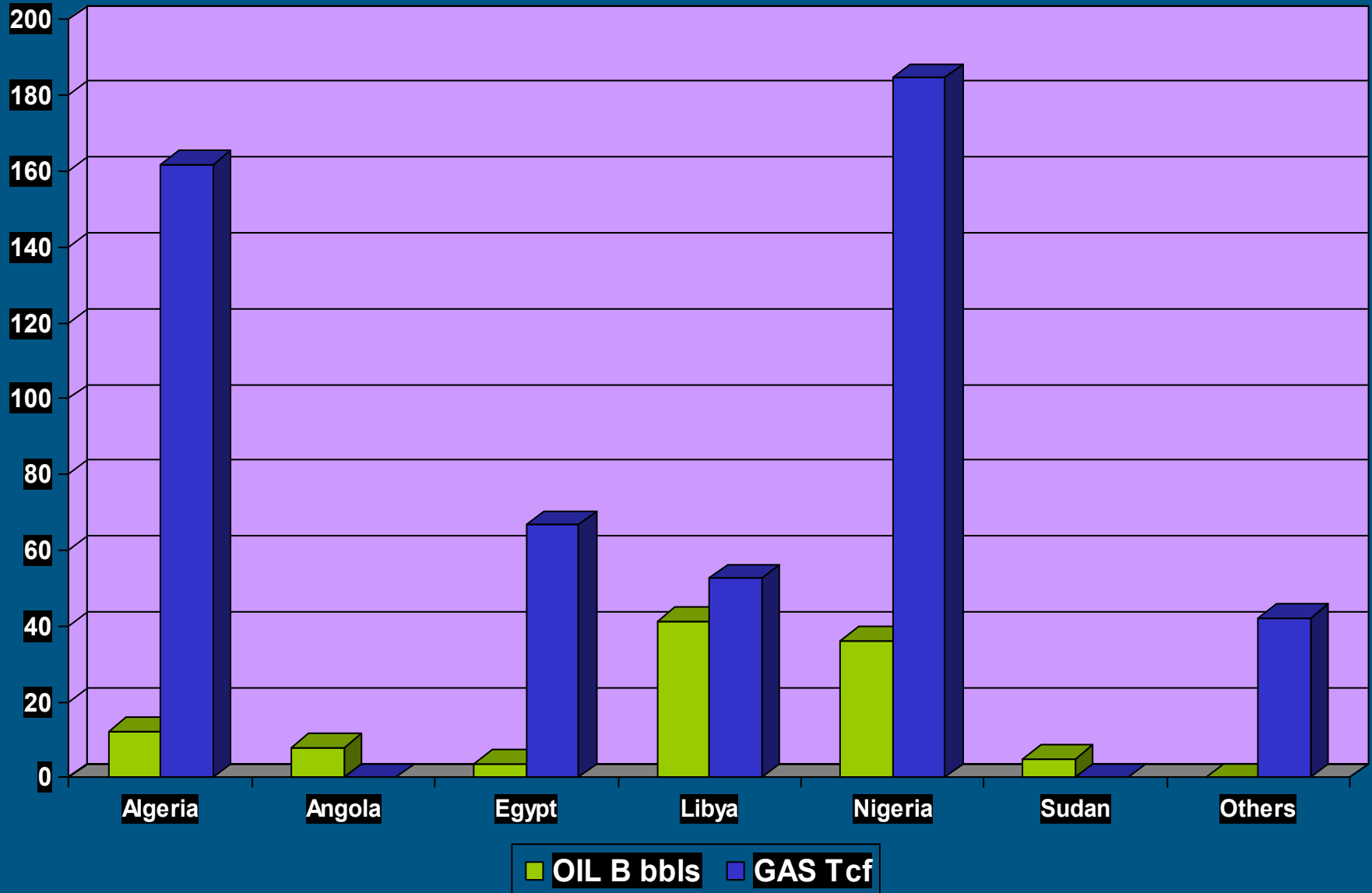
The Nuclear Option

- **Economic Development**
- **Environmental Considerations**
- **Cost Advantage**
- **Localisation and Industrial Development**
- **Safety Record**
- **Uranium is an African Resource**

World Oil & Gas Reserves



Africa Oil & Gas Reserves



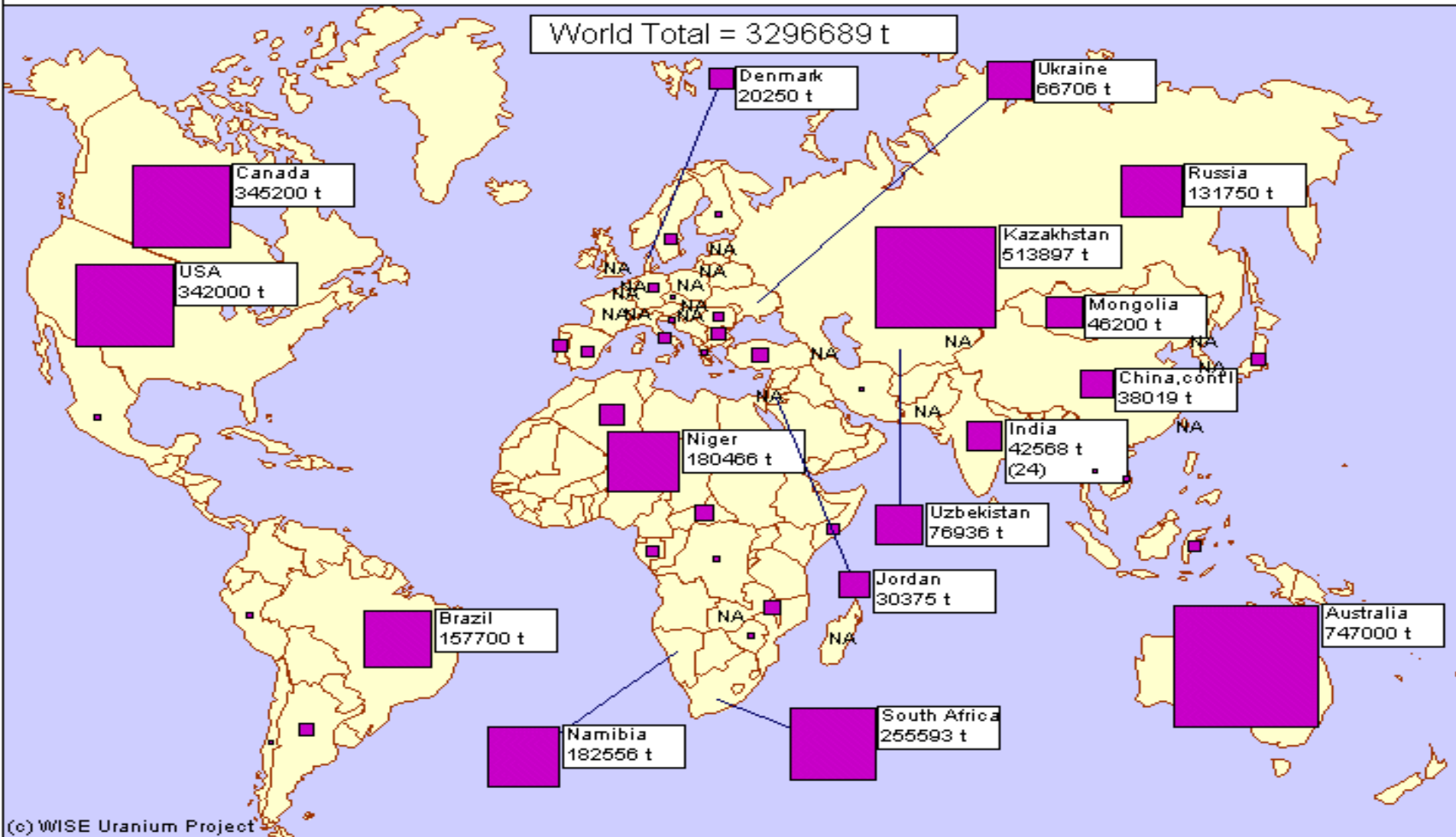
Global uranium reserves

Australia	1,143,000 t	24%
Kazakhstan	816,000 t	17%
Canada	444,000 t	9%
USA	342,000 t	7%
South Africa	341,000 t	7%
Namibia	282,000 t	6%
Brazil	279,000 t	6%
Niger	225,000 t	5%
Russia	172,000 t	4%
Uzbekistan	116,000 t	2%
Ukraine	90,000 t	2%
India + China	127,000 t	2.7%
Other	493,000 t	7.7%
TOTAL	4,743,000 t	

Global uranium reserves

Uranium Resources (RAR - \$130/kg U)

[t U] Reasonably Assured Resources, recoverable res. as of 1/1/2005, Cost range < US\$130/kg U (OECD 2006)



t = metric tonne ; NA = Data not available

The Nuclear Option

- **Economic Development**
- **Environmental Considerations**
- **Cost Advantage**
- **Localisation and Industrial Development**
- **Safety Record**
- **Uranium is an African Resource**
- **Enabling Framework**

Enabling Framework

- **Political Framework**
- **Responsible Owner**
- **Regulatory Framework**
- **Merchant Operator**
- **Fuel Supply and Waste Management**
- **Finance**
- **Contract Management**
- **Training and Education**
- **Industrial Infrastructure**

Cooperative Nuclear Framework

- Various African states have notified IAEA of intent to introduce NPPs
- Wish to propose a cooperative nuclear framework for Africa:
 - South Africa wishes to assist where possible in Africa
 - 13 African countries already cooperating in new regulatory form
 - Necsa assisting with medical waste in many countries
 - Various bilateral discussions underway
- Propose establishing an African Nuclear Consortium

African Nuclear Conference



- **NIASA wishes to arrange the first all Africa Nuclear Conference arly 2010**
- **Purpose: To establish a cooperative framework for nuclear cooperation in and development in Africa**
- **Eager to cooparte with PIESA in this regard**

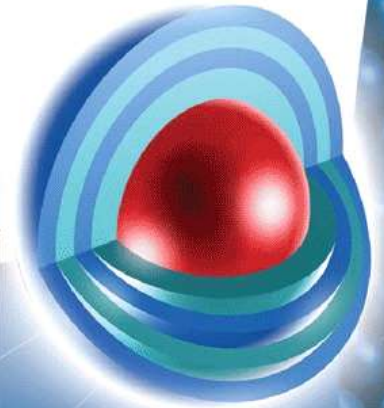
Conclusion

**Africa should play its rightful
role in the exploitation and
development of nuclear
technology and derive its
benefits**



P B M R

Is Nuclear Power an Option for Africa?



Thank you