



s a n e r i
South African National Energy Research Institute

Energy Trends and Strategies in South Africa

*Presentation to NEET Workshop
Sandton, 20-22nd February 2007*

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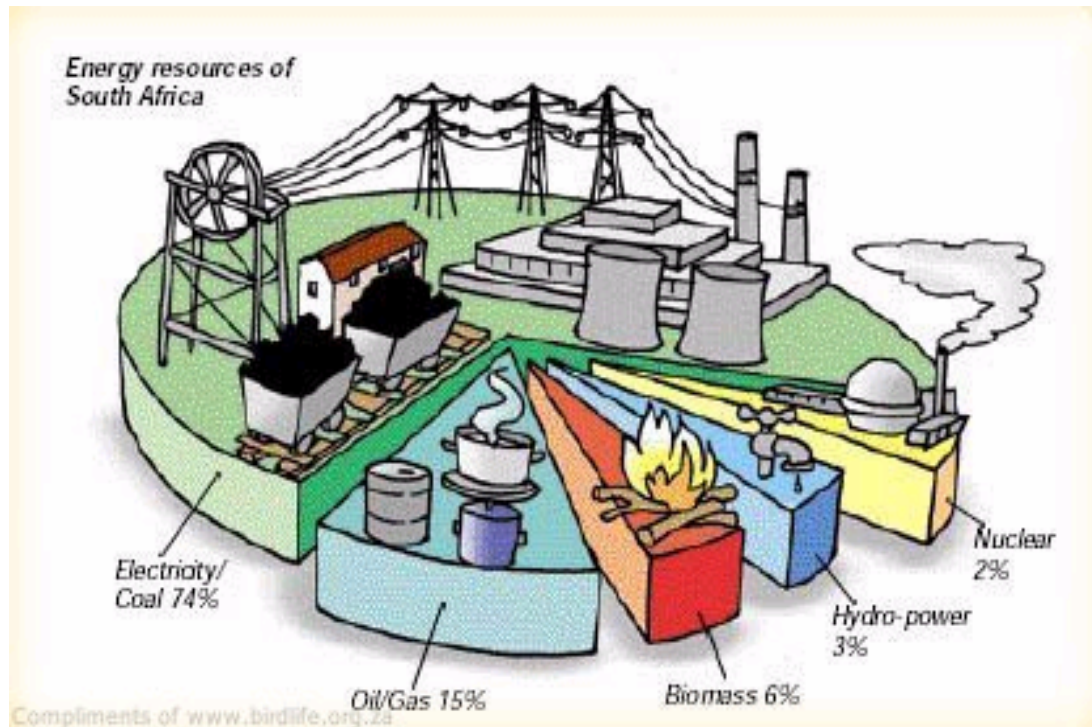
Characteristics of the Energy Sector

- Mining and agricultural economy - energy intensive industries, largely coal dependent
- No investment needed in new power generation in last 20 years
 - Prospect of power shortages more realistic in future
- Low grade coal to produce cheapest electricity in the world
 - But next generation clean coal options are more expensive
- Cheap electricity had negative impact on energy efficiency
- South Africa rated in the top 20 of emitters of greenhouse gases
- Apartheid left majority of citizens without electricity
- Large electrification drive to attain universal access to energy
- Remote communities too expensive to electrify – But....
 - Photovoltaic (SHS) programme - largely unsuccessful (no thermal energy and high maintenance)
 - Paraffin – unacceptable deaths, injuries and damage to property

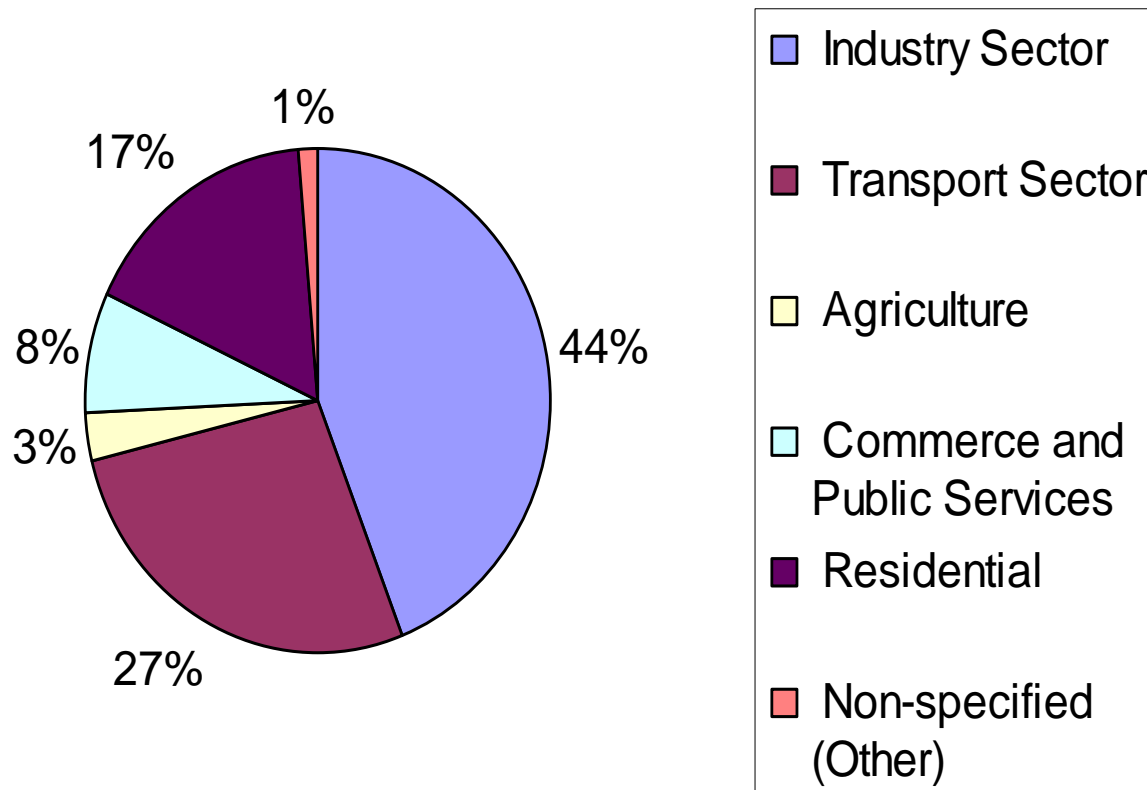


Energy Supply Mix

Energy resources dominated by coal



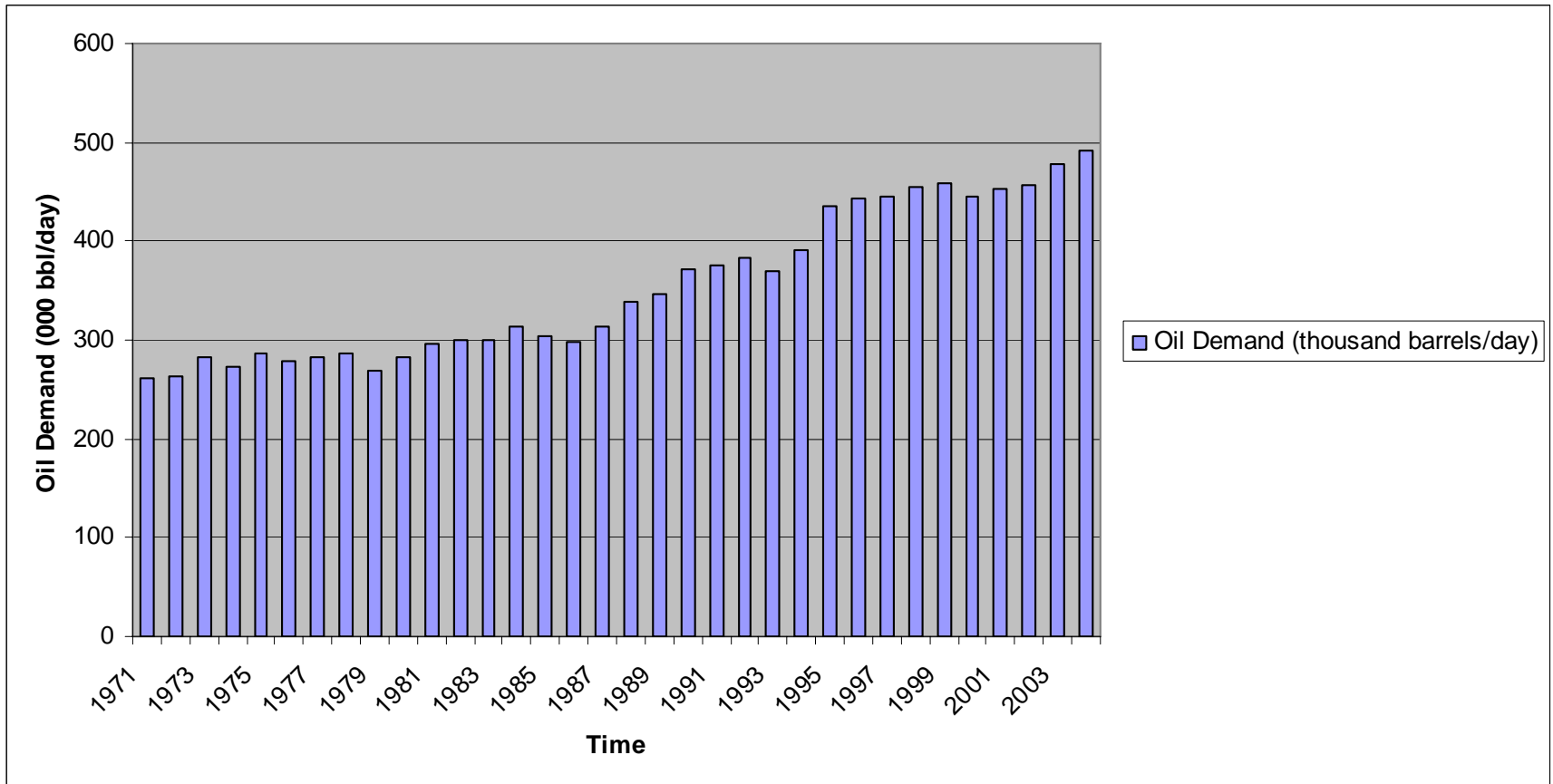
Energy Demand by Sector



Source: *Digest of Energy Statistics, DME, 2001*



Oil Demand in SA



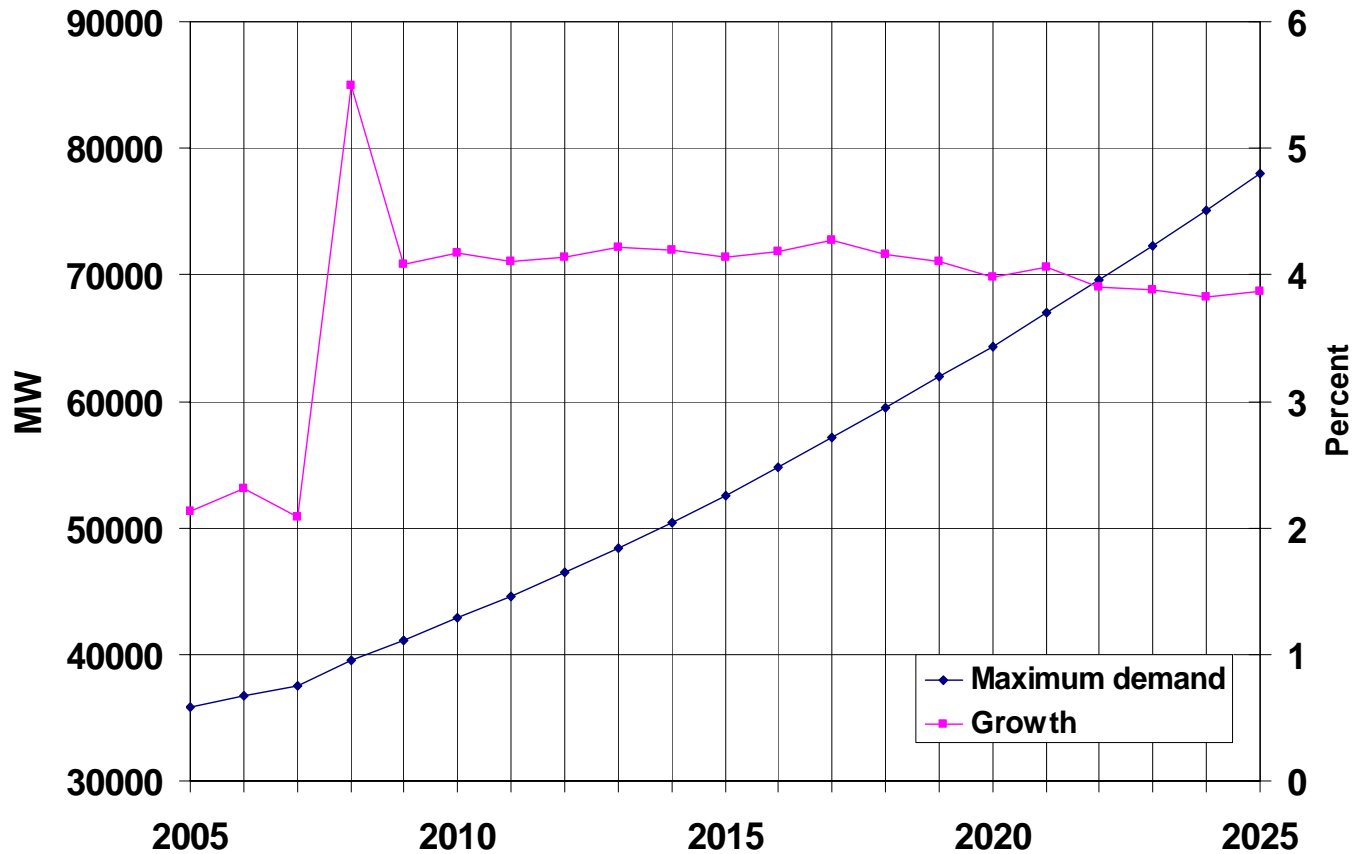
Problem definition – transport sector

- High road usage
 - 6 million vehicles on roads at present
 - 15 million on roads by 2012
- Limited rail expansion plans
 - Opportunities exist for light/ultra-light rail
 - Opportunities for trams to be introduced
- Few options on demand side
 - Feebate system?
 - Energy efficiency measures
- Limited supply side options
 - Hybrid vehicle technology
 - Trams
 - Biofuels

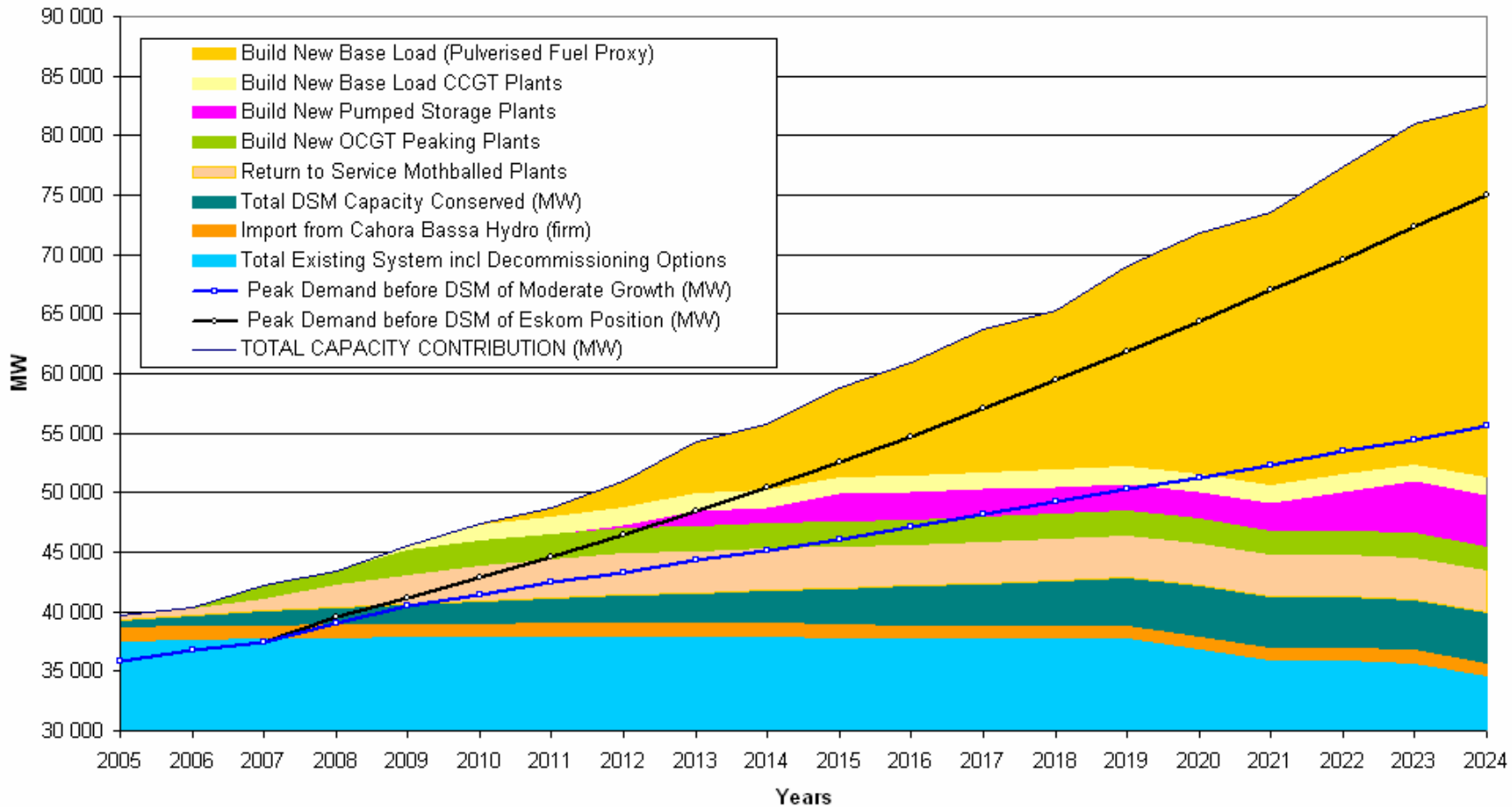


Growth in Electricity Maximum Demand

National + foreign maximum demand position

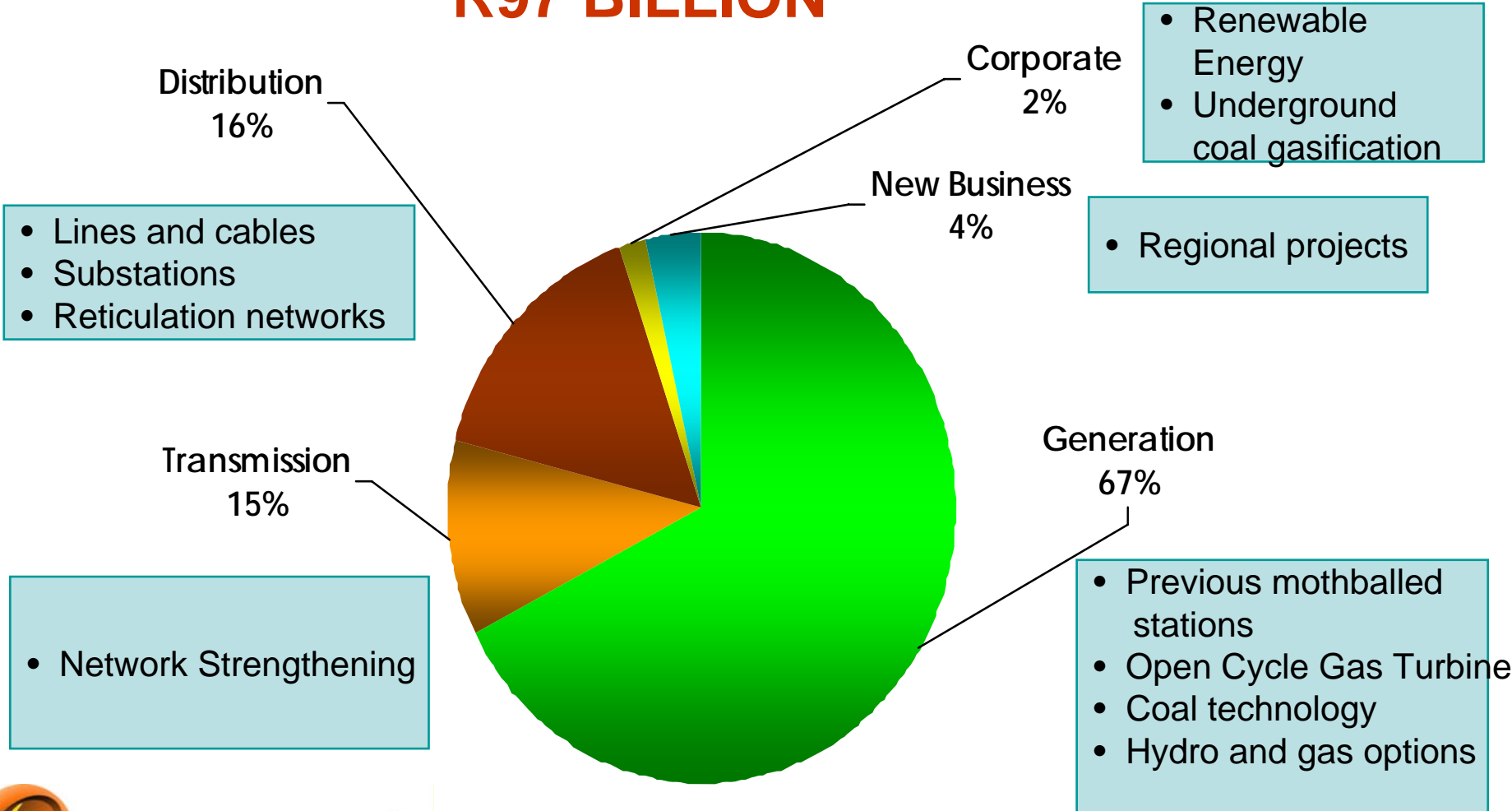


Capacity Outlook

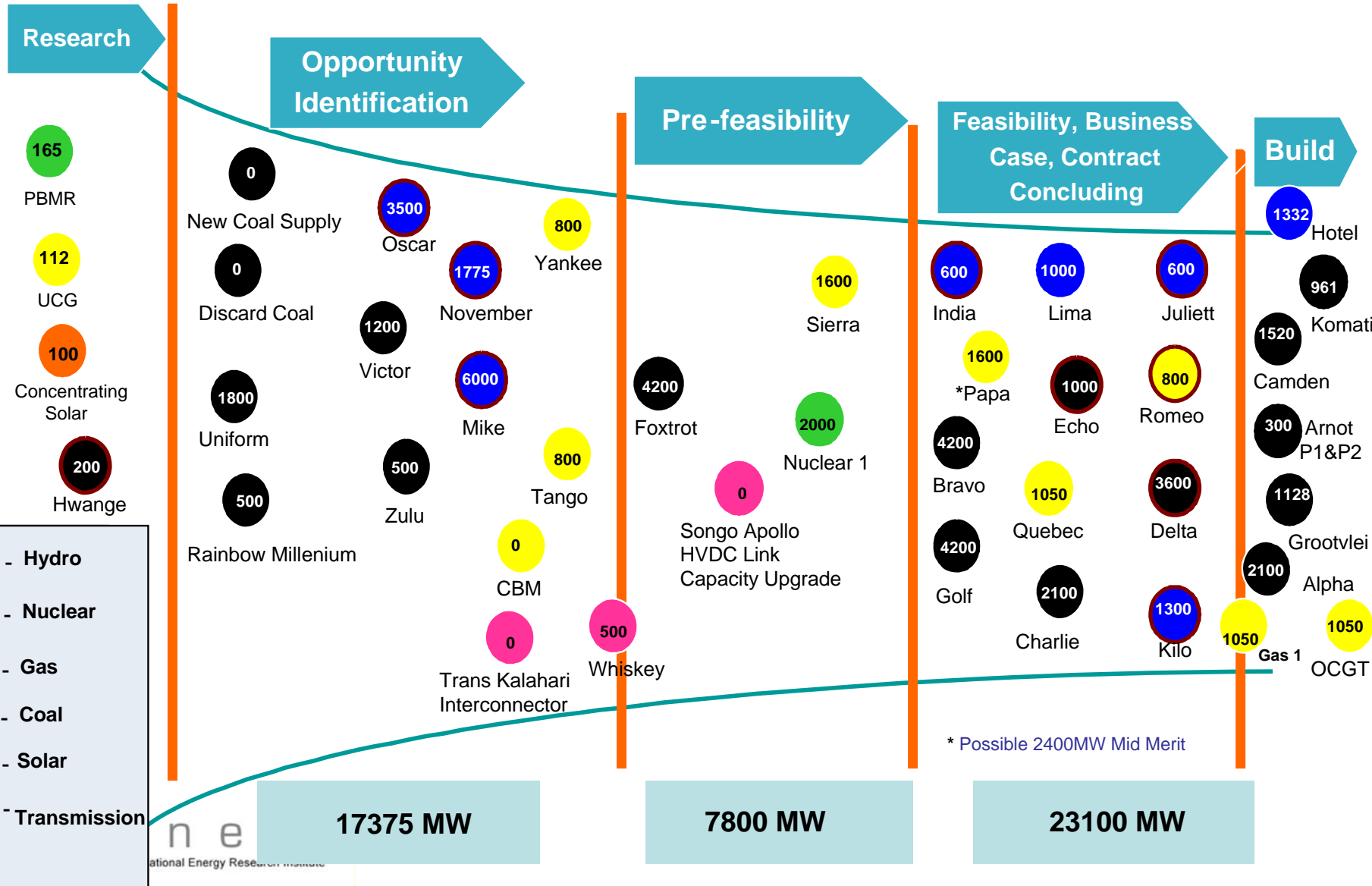


ELECTRICITY FIVE YEAR SPENDING PLAN

R97 BILLION



Electrical Capacity Project Funnel



* Brown outer circle indicates – out of Borders project

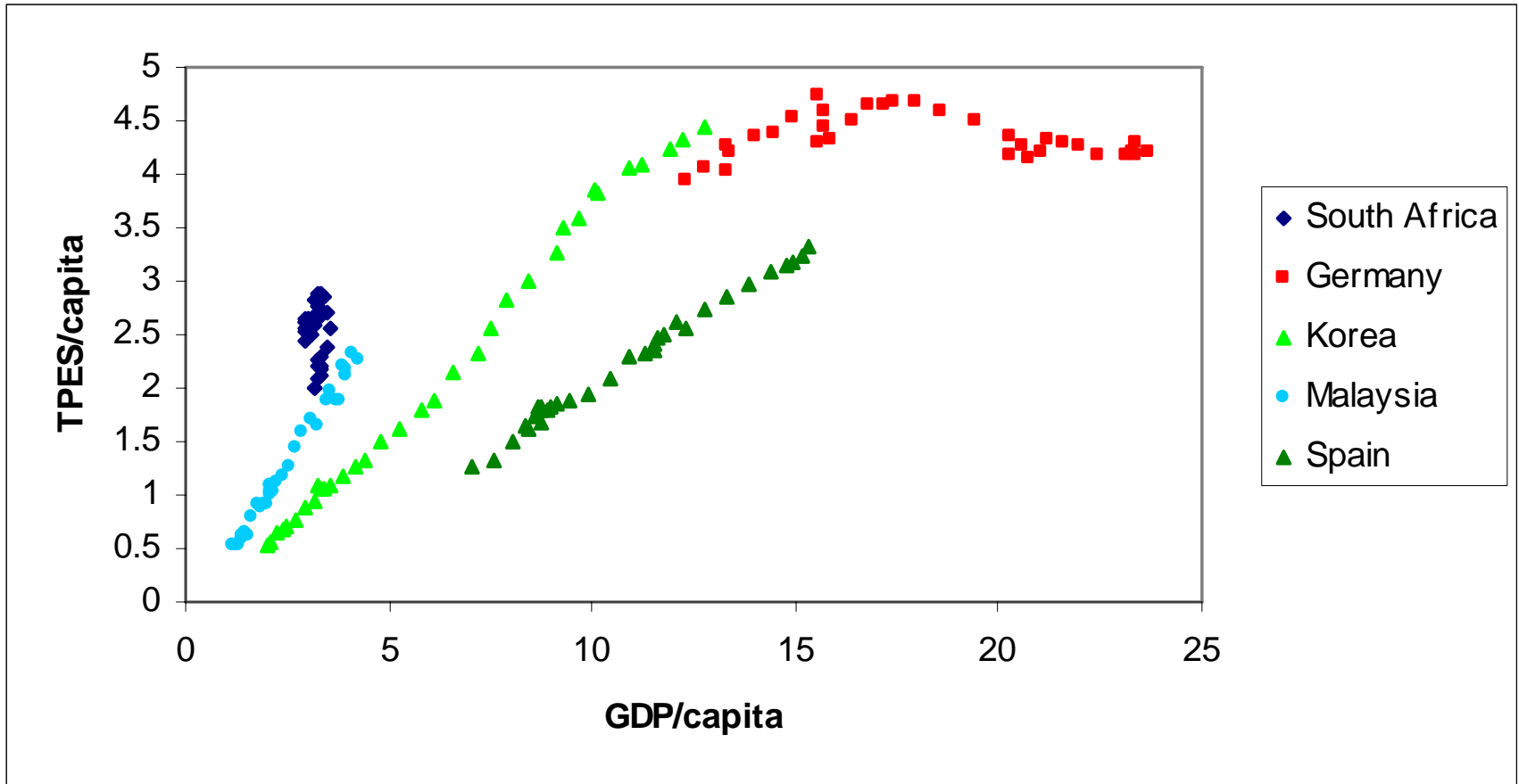
5 year plan - Capacity Additions

	RTS Camden	RTS Grootvlei	RTS Komati	CCGT	Pump Storage	OCGT	Annual Total	Cum Total
2006	380						380	380
2007	380					1000	1380	1760
2008	570	376				1000	1946	3706
2009		376	202	384		904	1866	5572
2010		376	202	1152			1730	7302

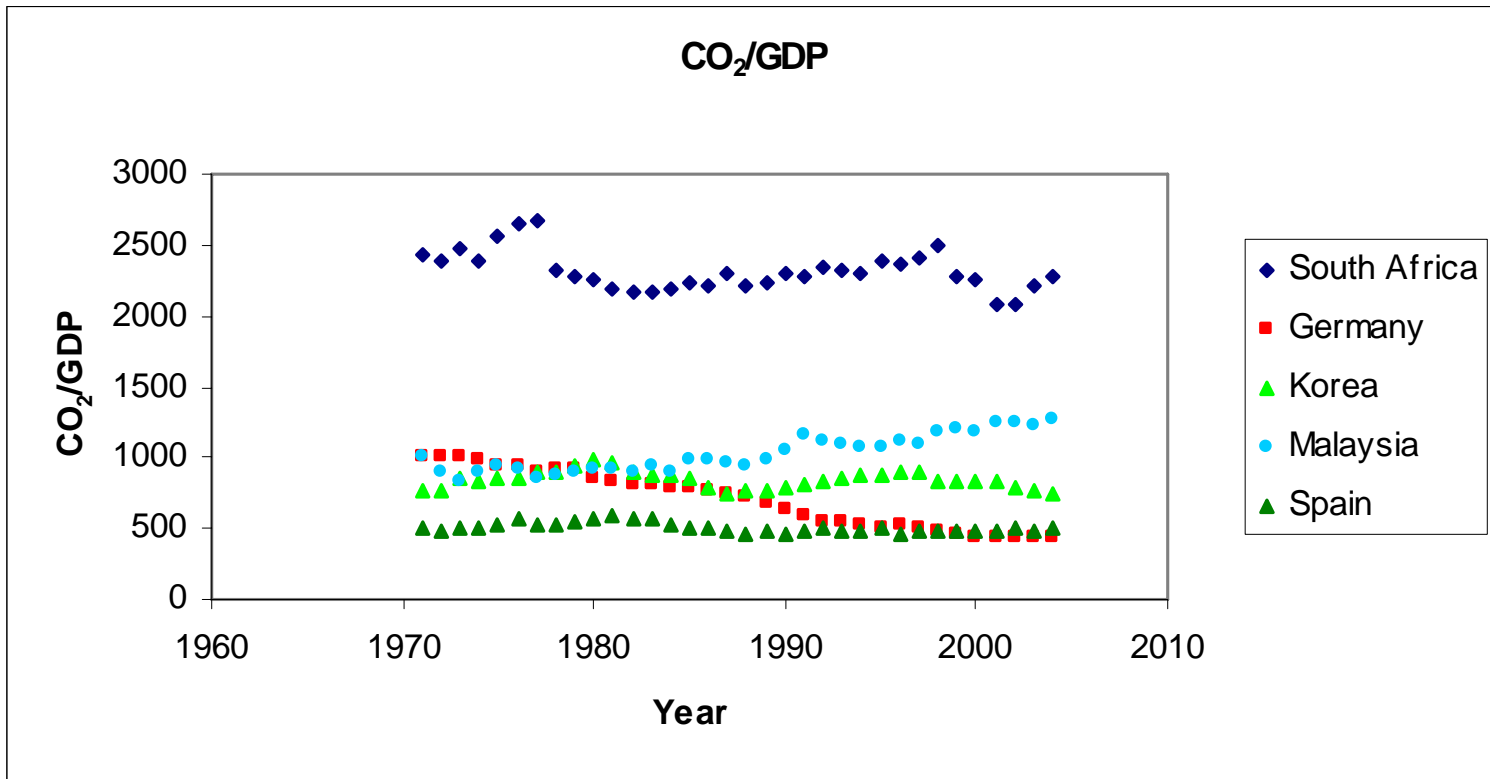
DME IPP



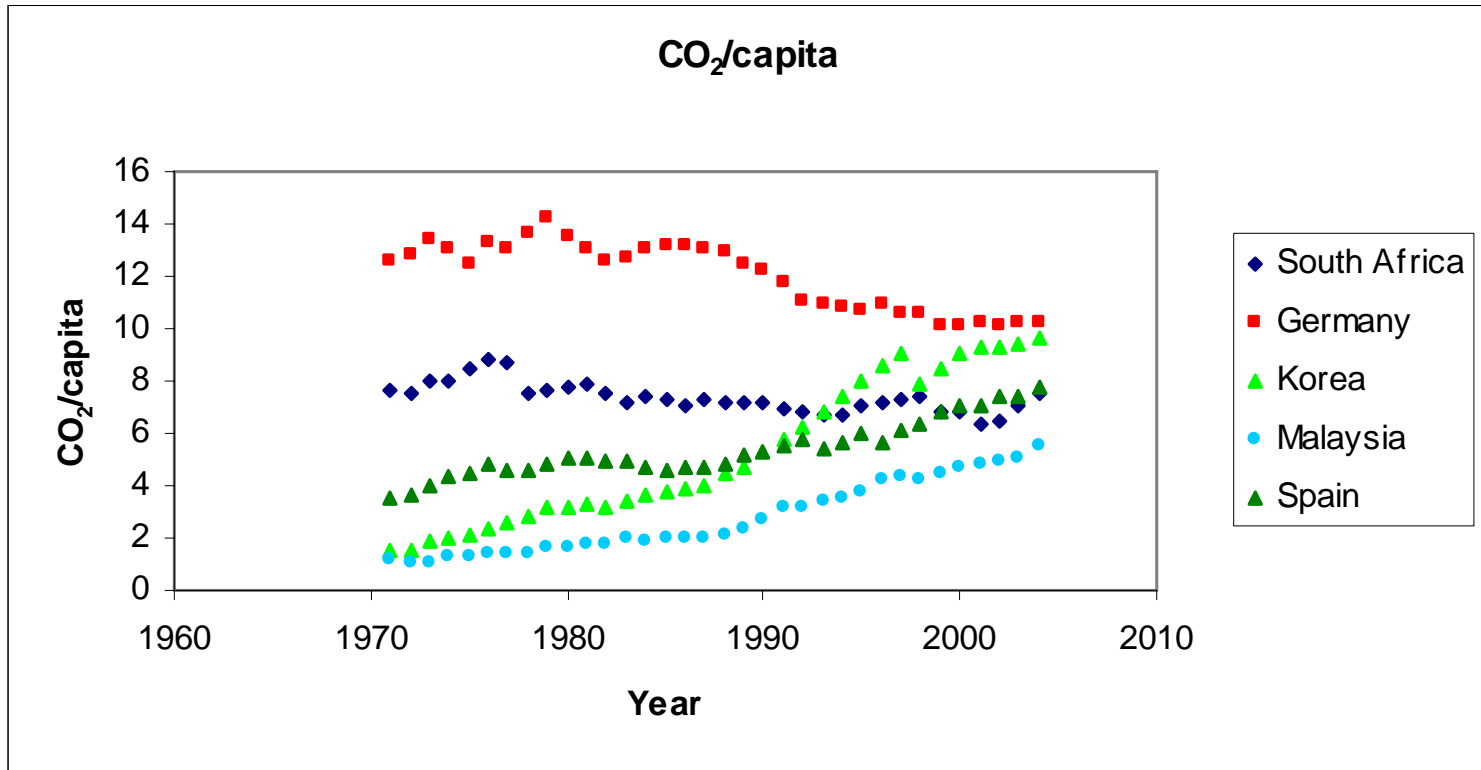
Energy Economic Trends



Trend in CO₂ produced per unit GDP (2000)



Trends in CO₂ production per capita in South Africa



National Government's Objectives

- **Major energy related priorities**
 - Universal access to energy by 2012
 - Ensuring energy security of supply
 - Transformation of the energy sector (Charters)
- **Deputy President to lead the programme of fastracking economic growth through several strategic projects**
 - Accelerated and Shared Growth Initiative of SA (ASGI-SA 2005)
 - Ties in to Government's Plan of Action to improve service delivery
 - Energy related strategic projects selected include
 - Accelerated electrification
 - Biofuels industry development
 - Beneficiation of raw minerals and materials



Energy Policies of SA

- White Paper on Energy in SA (1998)
 - White Paper identified the following objectives:
 - Increasing access to affordable energy services;
 - Improving energy governance;
 - Stimulating economic development;
 - Managing energy-related environmental and health aspects; and
 - Securing supply through diversity (including renewables)
- White Paper on Renewable Energy (2003)
 - Approved by Cabinet in November 2003
 - Follows on the direction set by the Energy White Paper (1998)
 - White Paper calls for:
 - real, measurable increase in renewable energy use, based on prescribed target
 - Calls for strategies to be developed to promote specific areas where RE could be developed
 - Policy aimed to create an enabling environment for renewable energy, setting a platform for industry development.



Renewable Energy Target

- *10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar & small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels.*

- This is equivalent to replacing two (2x 660 MW) units of Eskom's combined coal fired power stations.

Or.

- 1100 million litres of diesel (14% of one year) replaced with biodiesel.

This is in addition to the estimated existing 8-9% renewable energy contribution mainly from fuelwood and waste. More efficient and sustainable use of fuelwood and conversion of the waste for power generation will add to the target.

TO BE REVIEWED MID TERM-2008



Key Energy Strategies

- Renewable Energy
 - Grid-based Renewable Energy Deployment
 - Biofuels Industry Development
- Energy Efficiency
 - Public / Commercial Buildings
 - Industry
 - Residential
 - Power Generation
 - Transport



Grid-Based Renewable Energy Deployment

- Limited project development to date
 - Klipheuvel Experimental Wind Farm
 - 3,2 MW – offtake by Eskom Distribution on cost neutral basis
 - Proposed Darling National Demonstration Wind Farm
 - Phase 1 – 5 MW
 - Project at advanced stage – EIA, PPA concluded
 - Numerous small mini-hydro schemes
 - Used mainly for grid stability
 - Proposed wave energy conversion projects
 - Stellenbosch Wave Energy Converter (W Coast)
 - Pelamis Wave Energy Project (S Coast)
 - Large scale imported hydropower
 - Cahora Bassa (~2000 MW)
 - Hybrid Mini-grid projects
 - Projects in Hluleka, Lucingweni (E Cape)



Grid-Based Renewable Energy Deployment

- Strategy needs to address the impediments to further project development, such as:
 - Lack of market rules governing third party access to the national grid
 - Lack of incentives for purchasers of green power
 - Capital intensive nature of most renewable energy technologies
 - Lack of equitable cost structures for different energy carriers – no externalities factored in
 - Lack of incentive schemes for power producers, either tax concessions or subsidy schemes



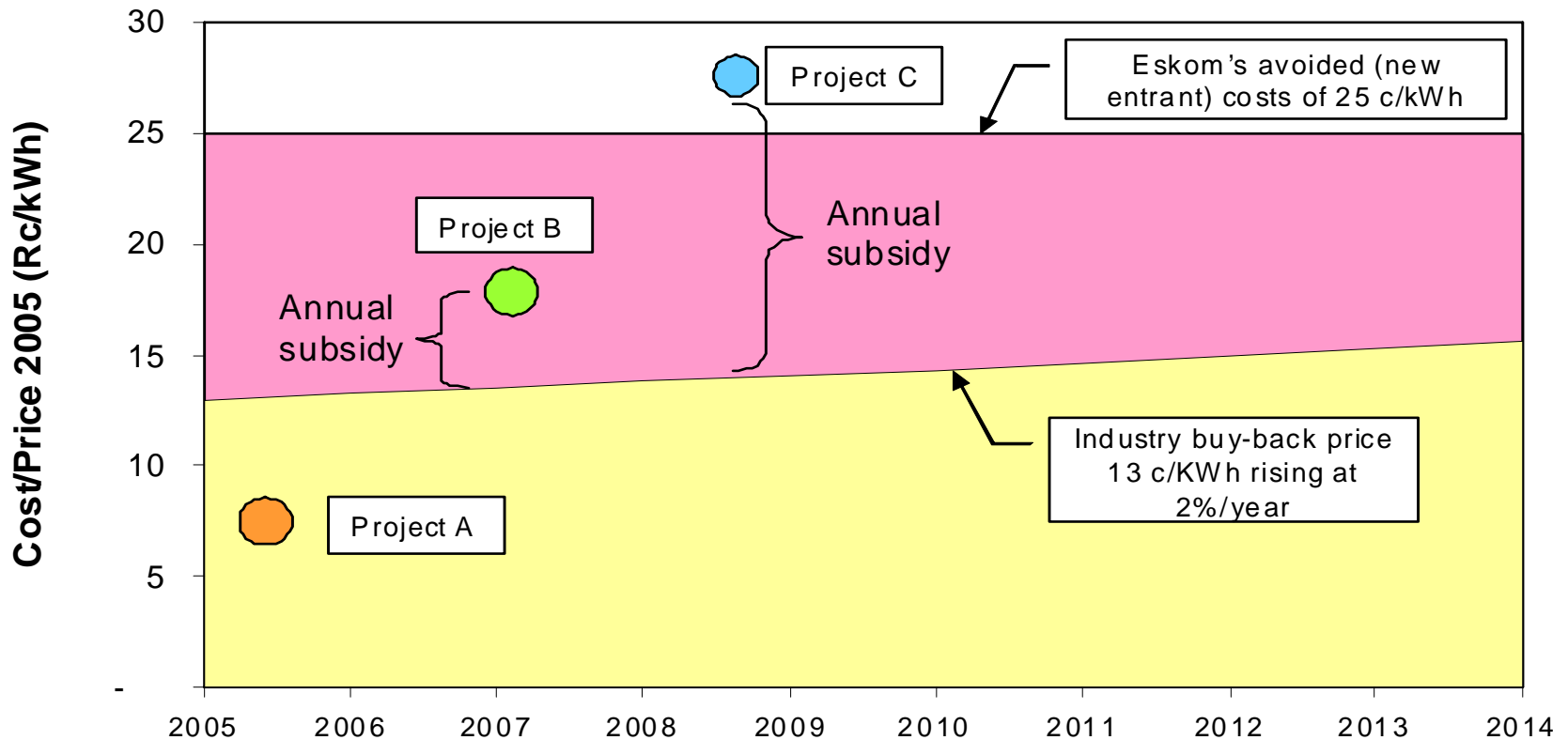
Strategy fundamentals

- Propose top-up feed-in tariff for subsidising RE on the grid
- Propose open market for green power trading
- Propose modified network entry rules to ensure participation from independent power producers



Illustration of proposed Feed-in Tariff

Illustration of degrees of competitiveness under current price arrangements



Biofuels Industry Development

- Cabinet approved development of a biofuels strategy in December 2005, calling for government task team to undertake this activity
- CEF (Pty) Ltd, as responsible state entity tasked with supporting the state in strategy development and financing commercially viable projects
- Consultant appointed in 2006 to develop strategy for market development for bioethanol and biodiesel
- Draft strategy ready by November 2006
- Cabinet approved in November 2006 the release of the Draft strategy for public comment until March 2007



Strategy Outline

- Bioethanol
 - Proposed 8% blend from mix of sugar cane and maize (corn) crops
 - Propose use of surplus crops
 - Recognises limits in available arable land
 - Targets emerging farmers mainly
- Biodiesel
 - Proposes 2% blend from variety of crops, including soya (main crop), rape/canola and olive oil
 - Propose phasing in of this blend, starting with 1% blend
 - Propose working with emerging farmers on land that is not competing with food crops for irrigation and nutrition
- General
 - Incentives are required to make biofuels industry viable
 - Regional approach should be adopted to maximise availability of feedstock



Energy Efficiency Strategy

- National strategy approved by current Deputy President in March 2005
 - Strategy calls for 12% reduction in final energy demand by 2015
 - Target is average of sectoral targets for residential, commercial, industrial and transport
- Energy efficiency in households results not only in increased savings for households but also improved air quality and related health benefits
- Cabinet has also approved public buildings rollout programme in 2003, calling for government to lead by example
- Appliance labelling programme initiated – encourage consumers to choose appliances with efficiency in mind



Linking national policy to energy R&D

- **Major national policy imperatives that impact on energy R&D drivers**
 - Achieving universal access to energy
 - Develop cleaner, safer and more affordable energy products
 - Ensure productive use of energy
 - Ensure energy security of supply
 - Diversify energy supply mix through renewable and alternative energy options
 - Introduce clean coal technologies (+ CCS)
 - Ensure transformation in the energy sector
 - Black and Women's economic empowerment
 - Develop human capital at tertiary institutions

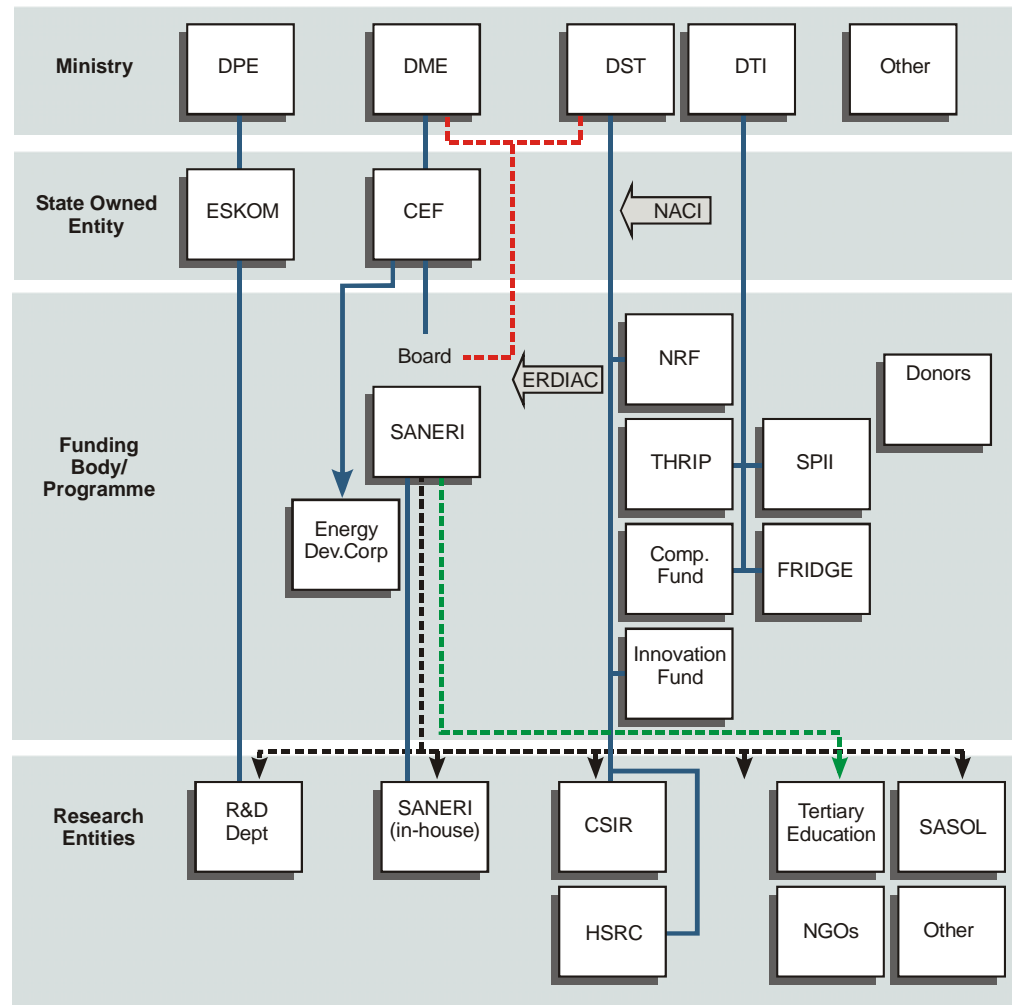


Background to SANERI establishment

- Established in response to concerns from government regarding perceived threat to indigenous energy research capacity
- Established under Ministerial Directive in October 2004 as subsidiary of CEF (Pty) Ltd
- Reports to both DME (strategy) and DST (funding) in terms of governance
- Has mandate to conduct own research or solicit work from external parties



SANERI's position in the national energy R&D institutional and governance system



Legend:

Policy directives,
nomination of Board



NERI Agency Role



Advisory Body



NERI Human
Capacity
Development Role



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State Funding of SANERI

- 2004/05 Establishment Budget Allocation
 - ~ €1.1 million for 2004/05
 - ~ €2.2 million for 2005/06
 - ~ €4.2 million for 2006/07
- Indications from DST in 2006/7 point to budget allocations in Medium Term Expenditure Framework of
 - ~ €4.5 million in 2007/8 (although €16 million required)
 - ~ €4.6 million in 2008/9 (although €19 million required)
- In 2004, Steering Committee requested funding for establishment costs and deemed appropriate funding for strategic initiatives to not be less than €16 million



SANERI Key Objectives

- Ensure long term health of energy research capacity in the country and assist in stimulating a culture of innovation in the energy research environment
- Support the 3 pillars of the National R&D Strategy (2002)
 - Enhanced innovation, including mastering technological development
 - Human resource development and transformation
 - Governance
- Support goals of National Energy R&D Strategy (Draft, 2007)
 - Development of Human Resources
 - Economic Empowerment
 - Stimulate innovation
 - Commercialise energy R&D
- Address deficiencies in current race, gender and age profile of postgraduate students, academia and scientists
- Stimulate socio-economic upliftment through improved access to modern, clean and affordable energy services
- Support economic growth through development of **flagship projects** that will ultimately result in commercial rollout
- Support international collaboration with a view towards development of cooperative partnerships and leveraging additional funding for research projects



Key Challenges Faced by SANERI

- Low PIER&D spend in SA – about 0.8% of GDP is spent on R&D, of which about 6% is Energy
- Low contribution from Black scientists – measured in publications where about 8% is produced from Black Scientists
- Percentage women in energy R&D sector is low, about 26.5% in 2004, which is well below equity targets of government
- Challenge of meeting ASGI-SA goals with consequent increase in demand of natural resources and energy
- Access to modern, clean and affordable energy remains a challenge for about 30% of South Africans
- Long-term funding is not secure, proposed budget allocation of ~ €4.5 million for 2007/8 not adequate for future research needs



Thematic Areas addressed by SANERI (proposed)

- **9 thematic areas identified**
 - Energy infrastructure optimisation
 - Energy Efficiency and DSM
 - Understanding the impact of energy use on the environment
 - Stimulating socio-economic development through the productive use of energy
 - Cleaner fossil fuels, including clean coal technology
 - Renewable energy
 - Alternative energy, including hydrogen economy and fuel cells
 - Energy planning and modelling and
 - Energy policy research



R&D Funding per Thematic Area (2004)

R&D focus area	National total	PIER&D
Energy demand	24	1.6
Informal economy	1.5	14.4
Energy supply	70	37
New and renewable energy	0.5	9
Environmental interaction	2	12
Energy planning and modelling	2	26
Total	100	100
Total funding, R million, 2004	750	45



Human Resource Development and Transformation

- Proposed introduction of research programmes and chairs at suitable tertiary institutions, such as
 - Renewable Energy and Sustainable Energy Programme (Stellenbosch)
 - Advanced Fossil Fuel Use
 - Clean Energy and Household Energy Provision
 - Biofuels
 - Liquid Fuel Optimisation
 - Hydrogen Economy
 - Fuel Cell Development



Cooperative Research Activities

- Intention is to leverage additional funding and stimulate local capacity building through strategic alliances with leading PIER&D centres
- Identify possible synergies and collaborative projects with leading centres such as
 - UK ERC
 - ECN (Netherlands)
 - NEDO (Japan)
 - Oak Ridge National Laboratories (US)
 - NREL (US)
 - Sandia National Labs (US)
 - EPRI (US)
 - CRIEPI (Japan)
 - RISØ National Laboratories (Denmark)



Energy R&D Priorities

- Biofuels
 - Feedstock trials (e.g. algae, sweet sorghum)
 - Fuel quality testing
 - Vehicle performance tests
 - Enterprise model development – small industry participation
 - Biofuel applications in households, e.g. ethanol gel



Energy R&D Priorities

- Grid-connected Technologies
 - Resource assessments (ongoing)
 - Pilot and Demonstration projects
 - Potential for local design and manufacture of components, e.g. heliostats for CSP
 - Potential for development of low-wind speed turbines
 - Potential for development of advanced hybrid mini-grid technology
 - Integrate RE into building design, beyond passive solar design



EE Research Priorities

- Development of sector-specific implementation strategies (support DSM programme)
 - Further studies are required to develop short, medium and long term implementation plan for the following sectors:
 - Transport, including alternative fuels sources and demand side efficiency
 - possible fee-bate system
 - Road to rail modal transfer
 - Biofuels industry development in Public Sector
 - Hybrid vehicle introduction
 - Power generation sector, particularly existing Eskom power stations
 - Increased focus on residential awareness raising
- Promoting energy efficiency in SA
 - Studies are required to:
 - Enhance the role of appliance labelling in other areas, e.g. vehicles, motors, fans, pumps, etc
 - Supporting development of accredited programmes to register energy efficiency practitioners, e.g. ESCOs
 - Determining appropriate fiscal and tax incentive-based schemes for the promotion of use of energy efficient technology in industry



Current Research Programmes

- Renewable Energy
 - Eskom / WWF Renewable Energy Research Fund
 - CEF 500 SWH Programme
- Fossil Fuels
 - Coal 2020 Initiative
 - CSIR Clean Coal (FBC) Programme
- International
 - REEEP
 - GVEP
 - Enerkey
 - Global Research Alliance



SANERI Objectives for workshop

- Identify how the IEA and Saneri can cooperate more effectively
- Identify IAs that are of interest to SA
- Identify the role that Saneri can play in bridging the gap between 1st and 3rd World in relation to IEA activities
- Identify local players that can play a role in enhancing participation in IAs and collaborative projects



Thank You

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