

Electricity

Slide	Index
1	Introduction
2	Generating Electricity
3	SA Power Grid
4	SA Electricity Supply
5	Abundant Energy Source: Coal
6 – 7	Supply vs Demand:
6	Electricity Demand Pattern
7	The Energy Balance Problem
8 – 10	Renewable vs Non-Renewable:
8	Alternatives to Fossil Fuels
9	Comparison of Energy Technologies
10	South Africa's Future Electricity Supply
11	REIPPPP
12	Renewable Energy Targets: European Union
Table:	Renewable vs Non-renewable Energy

Slide 2: *Generating Electricity*

- In 1831 Michael Faraday discovered that if magnets and a conductor (e.g. a piece of copper wire) move in relation to one another, electricity can be generated.
- Faraday found that the mechanical energy used to move a magnet inside a wire loop (coil) could be converted into electrical energy, flowing through the wire.
- Faraday's discovery could be summarised as the flow of electrons when a wire loop or coil rotates in a magnetic field.
- A generator converts mechanical energy into electrical energy. That is when a wire loop or coil rotates in a magnetic field.
- A generator consists of a coil, magnets and split rings.
- The magnets can be permanent magnets or electromagnets which produce a magnetic field.
- The ends of the coil wires are connected to the split rings.
- The electric current flows from the coil to the external circuit by means of brushes which come into contact with the split rings.
- It is this discovery which has led to the development of modern power plants, providing a constant and reliable supply of large quantities of electricity to consumers.

Slide 3: *SA Power Grid*

- Eskom is a utility company which generates and distributes electricity. It transmits electricity throughout South Africa by means of a national transmission system, from where it is distributed to the end users.

- Eskom also delivers bulk supplies to approximately 180 municipal distributors.
- Power stations all over South Africa are linked by transmission lines.
- Transmission lines are supported by pylons.
- 'Transmission' means 'to send from one place to another'.
- Transmission lines are manufactured predominantly from aluminium and copper, with steel wire for structural integrity.
- The network of transmission lines is called the National Grid.
- Eskom also imports electricity from neighbouring countries such as Mozambique and exports to neighbouring countries such as Namibia and Botswana.

Slide 4: SA Electricity Supply

- Coal, oil, gas and nuclear fuels can be used for heating water, converting it into steam at high temperatures and under high pressure.
- This is done in boilers or reactors.
- The steam, which is usually heated up to temperatures of between 500 °C and 535 °C, is released to turn a large turbine that is connected to a generator to generate electricity.
- In this way the energy in the fuel is converted into electrical energy.
- Alternatively, gas turbines are used to generate electricity. Gas or liquid fuels (diesel in the case of Eskom) are used in an engine very similar to an aircraft jet engine to drive an electric generator.
- In SA Eskom relies on coal-fired power plants to produce approximately 85% of its electricity.
- Eskom uses over 1 192 million tons of coal per annum.
- In 2014/2015 Eskom's coal-fired power plants produced 223.4 million tons of CO₂.
- During 2014/2015 Eskom had a net power-generating capacity of 42 090 MW (megawatt).
- In 2014/2015 Eskom sold 226 300 GWh (gigawatt-hour) of electricity.

REF. <http://www.pmg.org.za/files/doc/2012/120509eskom-edit.pdf>

http://www.eskom.co.za/IR2015/Documents/Eskom_fact_sheets_2015.pdf

Slide 5: Abundant Energy Source: Coal

- In South Africa our most abundant source of energy is coal – a fossil fuel.
- South Africa produces an average of 224 million tonnes of marketable coal annually.
- However, most of the coal we use is of a low quality with a low heat value and high ash content – the high-quality coal is exported.
- More lower-quality coal is required to generate a specified amount of electricity compared to if higher-quality coal is used.
- Mining coal in South Africa is relatively inexpensive compared to the rest of the world.
- This low cost has had an important effect on the nation's prosperity and potential for development.
- It enabled us to keep our electricity cost per unit quite low, especially compared to Europe, where the cost per unit is four times more.

- However, this scenario is rapidly changing.

Slide 6: Supply vs Demand: Electricity Demand Pattern

- Much of the electricity and electronic equipment we use depend on voltage and frequency remaining accurate and constant.
- So, the instantaneous amount being fed into the grid (i.e. electricity generated) must always match what the consumers are taking out. This varies not only from day to day, but from minute to minute.
- As the demand increases, more stations must be brought online.
- The pattern of the daily demand can be predicted fairly accurately, unless something unexpected happens, such as a sudden deterioration in the weather.
- The first peak period in a day usually start at about 06:00 in the morning and last until about 10:00.
- The main peak period is normally from about 17:00 until 21:00.

Slide 7: Supply vs Demand: The Energy Balance Problem

- Electricity supply should be consistent and reliable.
- Electricity has to be generated as needed since batteries are not capable of storing enormous quantities.
- There is no realistic way yet to store large quantities of electricity required for distribution to the user, besides large pump-storage schemes like Palmiet, Drakensberg and Ingula.

Practical Example of Energy Supply vs. Energy Demand:

- To supply electricity to a 220 W computer used 365 days per year, 938 kg coal is needed – that is almost one ton, or a whole bakkie load!

Slide 8: Renewable vs Non-Renewable: Alternatives to Fossil Fuels

There are many other methods by which electricity can be generated, for example, by harnessing solar or wind energy.

The main renewable resources used today are:

- **Solar Energy** – converted to electricity in photovoltaic panels OR converted into useful heat by solar collectors OR converted into electricity in thermal power stations.
- **Biomass** – converted into useful heat through combustion or gasification OR converted into biofuels.
- **Wind** – converted into electricity by wind turbines.
- **Hydro/Water** – converted into electricity by hydro turbines.
- **Ocean: tidal, wave and ocean current energy** – converted into electricity by ocean devices.
- **Geothermal** – converted into electricity utilizing a steam turbine OR used as thermal energy.

Slide 9: Renewable vs Non-Renewable: Comparison of Energy Technologies

- At this point in time we are still making use of more non-renewables rather than renewables.
- This is due to SA's cheaply available electricity environment (based on coal) and the capital costs of erecting renewable energy plants.
- However, this situation is changing.
- Electricity costs are rising yearly and will continue to do so.
- Mining costs of coal, our main source of energy, are rising.
- The accompanying environmental impact of burning fossil fuels is escalating.
- At the same time the research and development of renewable energy technologies are becoming better and cheaper.
- The demand for renewables is becoming bigger.
- Subsequently it is becoming cheaper to install renewable energy.
- This means that renewable energy is becoming a viable option for generating electricity as an alternative to non-renewables

Slide 10: *South Africa's Future Electricity Supply*

- The Integrated Resource Plan (IRP) for Electricity was initiated by the Department of Energy in 2010.
- The IRP sets out the new build plans for South Africa's future diverse electricity supply from 2010 to 2030.
- It is a dynamic plan which investigates various scenarios and outcomes, constantly being updated.
- It set the groundwork for the REIPPPP.

Slide 11: *REIPPPP: Renewable Energy Independent Power Producer Procurement Programme*

- Decisions will have to be made as to whether to invest in renewable energy systems or to carry on burning fossil fuels and paying the environmental cost that is linked to releasing more and more CO₂ into the atmosphere.
- The National Energy Regulator (NERSA) is a regulatory authority whose mandate is to regulate the electricity, piped-gas and petroleum pipelines industries in terms of the Electricity Regulation Act of 2006.
- The Renewable Energy Independent Power Producer (IPP) Bid Programme and the procurement of an IPP for new generation capacity was gazetted by the Department of Energy (DoE) in May 2011 (Eskom, 2015).
- This IPP Procurement Programme has been designed so as to contribute towards the target of 3 725 megawatts for 2010-2030, and towards socio-economic and environmentally sustainable growth, and to start and stimulate the renewable industry in South Africa (DoE, 2012).
- In the 2014 report on the South African IPP Procurement Programme, Anton Eberhard, member of the National Planning Commission, indicated that an investment of 3 922 MW renewable-energy-generating capacity has been secured in the first three bidding rounds and it is judged to be highly successful by the programme stakeholders (Eberhard, 2014).

Slide 12: *Renewable Energy Targets: European Union*

- The EU is working to reduce the effects of climate change and establish a common energy policy.
- By 2020 renewable energy should account for 20% of the EU's final energy consumption (8.5% in 2005).
- The latest figures available are that the share of renewables in energy consumption in the EU rose further to 16% in 2014. (Eurostat news release Feb 2016)

PRESENTED BY ENERGY.EU

Ref. <http://www.energy.eu/#renewable>

<http://ec.europa.eu/eurostat/documents/2995521/7155577/8-10022016-AP-EN.pdf/38bf822f-8adf-4e54-b9c6-87b342ead339>