Electricity

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 electrical 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 stations and constant and reliable supply of large quantities of electricity to consumers.

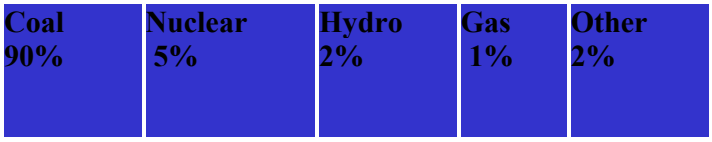
Slide 3: ***SA Power Grid***

- Eskom is a utility company which generates electricity. They transmit it throughout South Africa by means of a national transmission system, from where it is distributed to approximately four million 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 structured integrity.
- The network of transmission lines is called the National Grid.
- Eskom also imports and exports electricity to the neighbouring countries.

Slide 4: ***SA's Electricity Supply***

- Coal, oil, gas and nuclear fuels can be used to heat water and convert it into high temperature and pressure steam at.
- This is done in boilers or reactors.
- The steam is usually, at temperatures of between 500°C and 535°C and is released to turn a large turbine that is connected to a generator, thus generating electricity.
- In this way the energy in the fuel is converted into electricity.
- Alternatively "gas turbines" are used to generate electricity. Gas or liquid fuels (Diesel in the case of Eskom) is used in an engine very similar to a aircraft jet-engine to drive an electric generator.
- In SA Eskom relies on coal-fired power stations to produce approximately 90% of its electricity.
- Eskom uses over 90 million tons of coal per annum.
- At the end of 2007 Eskom had a nett power generating capacity of 37 761 MW (megawatt).
- Eskom sold 218 120 GWh (gigawatt-hour) of electricity in 2007.
  ref. http://af.wikipedia.org/wiki/Eskom

Energy sources responsible for generating Eskom Electricity:



Ref. CRSES 2008

Slide 5: ***The Cost of Coal – a Fossil Fuel***

- Coal mining in South Africa is relatively inexpensive compared to the rest of the world.
- These low costs have had an important effect on the nation's prosperity and potential for development.
- In comparison, mining costs in Europe are almost four times higher.
- In South Africa, our most abundant source of energy is coal.
- However, most of the coal we use is of a low quality with a low heat value and high ash content.

Slide 6: ***Supply vs Demand: the Energy-Balance Problem***

- Electricity has to be generated as needed since batteries are not capable of storing the enormous quantities.
- There is no realistic way of storing large quantities of electricity required for distribution to the user besides large pump-storage schemes like Palmiet, Drakensberg and Ingula.
- So, the instantaneous amount being fed into the grid must always match what the customers 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.
- Electricity supply should be consistent and reliable.
- Much of the electricity and electronic equipment we use depends on voltage and frequency remaining accurate and constant.

- The pattern of the daily demand can be predicted fairly accurately, unless something unexpected happens, such as a sudden deterioration in the weather.
- The main peaks usually start at about 06:00 in the mornings and lasts until about midday.
- A second peak period is normally from about 17:00 until 21:00.

Slide 7: ***Forms of Renewable Energy***

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 a heat pump).

Slide 8: ***The Cost Regarding Renewable Energy***

- Electricity generators based on renewable energy are expensive to build and install.
- However, like anything new on the market, as the technology improves, it will get cheaper.
- Despite such obstacles as SA's cheap electricity environment (based on coal) and the enormous capital costs of setting up a wind farm, the country's R70 million pilot commercial wind-energy project was opened on 23 May 2008 in Darling, a small town north of Cape Town.
- Four giant wind turbines at the Darling Wind Farm with an output of 5.2 MW will be used to generate an estimated 13.2 GWh per year of ‘clean’ electricity to be fed into the national power grid.

Slide 9: ***Decisions***

- 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 CO_2 into the atmosphere.

Slide 10: ***What other countries are doing***

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).

	EU Member State	2005 Figure	2020 Target	% To cover:
1	United Kingdom	1.3%	15%	**13.7%**
2	Denmark	17%	30%	**13%**
3	Ireland	3.1%	16%	**12.9%**
4	France	10.3%	23%	**12.7%**
5	Germany	5.8%	18%	**12.2%**
6	Italy	5.2%	17%	**11.8%**
7	Netherlands	2.4%	14%	**11.6%**
	EU	8.5%	20%	**11.5%**

PRESENTED BY ENERGY.EU

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

Slide 11: ***Assignment***