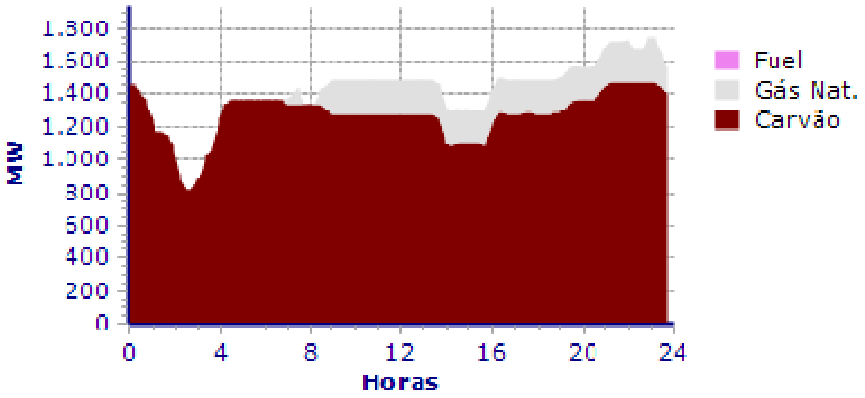
ipt Instituto Politécnico de Tomar

**MASTER IN CHEMICAL TECHNOLOGY**

**Mid Test of Environment and Energy – 16 April 2015**

1. The following figure shows the diagram for coal and natural gas consumption, in Portugal, for the 13/04/2015 day in MW.




i) Are these renewable or non-renewable sources? Justify. II) make an estimate of the contribution of thermal power stations for the production of electricity, this day, in GWh. iii) Describe the main environmental impacts resulting from the operation of a thermal power station.

2. Show, schematically, the evolution of temperature of the Earth's surface since the middle of the last century. What are the main gases responsible for this effect? What key measures can be taken to mitigate this effect?

3. A 1000 MW thermal plant uses natural gas (formula $CH_4$) with a calorific value of 50 MJ/kg in a combined cycle with 45% of thermal efficiency. I) which means an efficiency of 45% II) Calculate the amount of $CO_2$ emitted (ton/year) (iii) If the thermal efficiency of the steam cycle (Rankine) is 30%, calculate the Brayton cycle efficiency.

4. Nuclear power plants produce about 17% of the global electricity consumption needs. I) Explain why does not exist (or is highly attenuated) the risk of explosion of a nuclear reactor, as opposed to an atomic bomb; II) Sketch the generic scheme of a nuclear power plant. III) Calculate the mass deficit (in amu) for the following reaction that occurs in a nuclear reactor:

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{142}_{56}Ba + ^{92}_{36}Kr + 2\,^{1}_{0}n + 3\times10^{-11}\,J$$

Data: c = $3\times10^{8}$ m/s ; 1 amu = $1.66\times10^{-27}$ kg