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COVER NOTE

From:	Secretary-General of the European Commission, signed by Ms Martine DEPREZ, Director
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To:	Ms Thérèse BLANCHET, Secretary-General of the Council of the European Union
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Delegations will find attached document SWD(2023) 1 final - PART 3/6.

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COMMISSION STAFF WORKING DOCUMENT

Accompanying the document

REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

JRC technical report on "Assessment of the potential for energy efficiency in electricity generation, transmission and storage"

{COM(2023) 1 final}

Contents

2.3 Current efficiency of the European thermal power plants

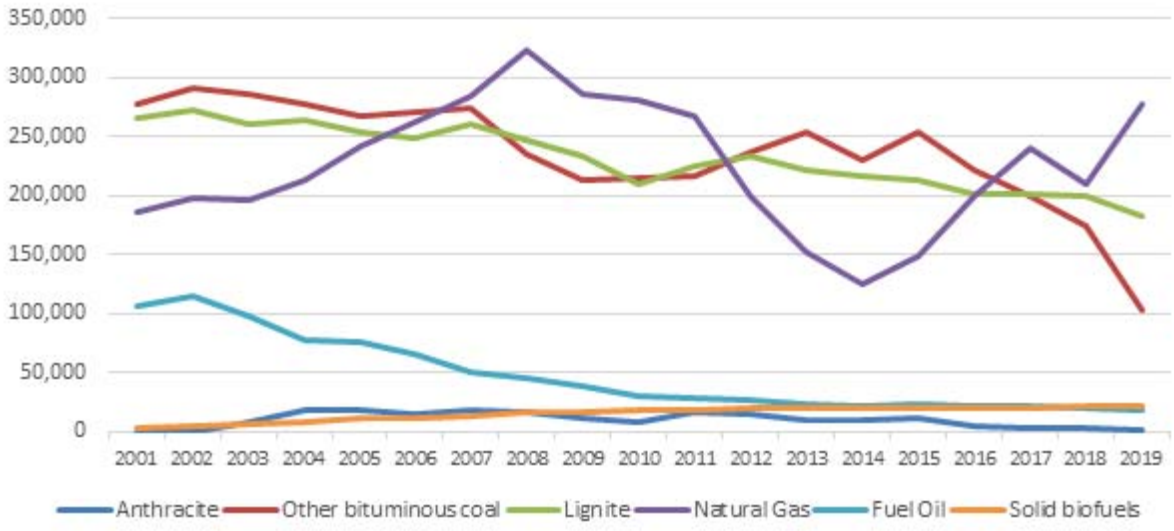
Using the data available in the Eurostat database [1], the yearly average efficiency and production of the European thermal plants can be calculated, computing the ratio (using suitable units):

$$Efficiency = \frac{Gross\ electricity\ production}{Energy\ content\ of\ the\ primary\ source}$$

Regarding the EU27 thermal plants, the following graphs show the gross production of electricity in thermal power stations and the gross efficiency of coal and gas plants till 2019[1] (Figure 12 and Figure 13): lignite and other bituminous coal still represent the main source of electricity.

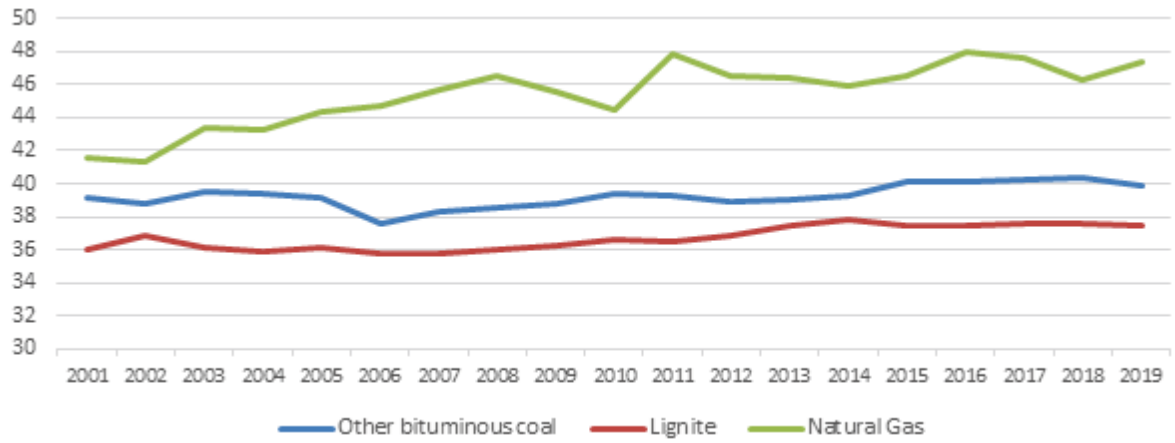
It is worth noticing that efficiencies are average values and include any loading level of generators as well as starting (when different fuels – e.g., diesel – can be used and in general the efficiency is very low). Moreover, there is no difference made between OCGT and CCGT, so that it is difficult to make conclusions about the distinct efficiency resulting from the two gas technologies.

Figure 12. Gross electricity production [GWh]. Elaboration of data from [1].



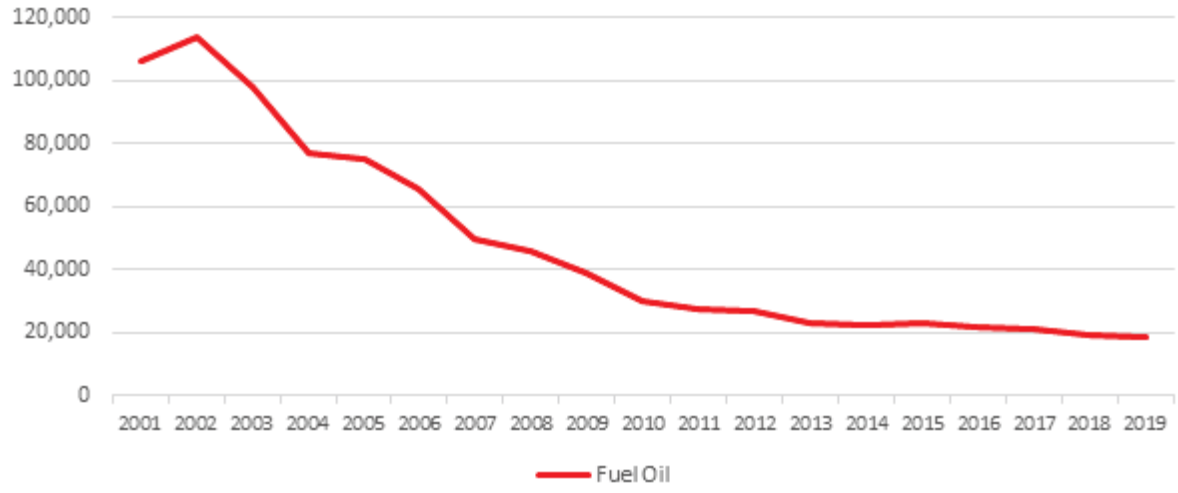
1 Gross production of electricity and derived heat from combustible fuels by type of plant and operator [nrg_ind_pehcf]

Figure 13. Gross Efficiency of the Thermal plants. Elaboration of data from [1].



Concerning oil power stations, the high cost of the fuel combined to low efficiencies and environmental issues led the operators to dismantle, decommission or reconvert them into the more efficient combined cycle plants as already underlined in 2004 by [19] and in [20]. The electricity produced[2] by these plants (Figure 14) faced a huge decline in the last 20 years [1], confirming this change.

Figure 14. Electricity production of the European oil thermal plants [GWh]. Elaboration of data from [1].



2.4 Summary of the thermal plant efficiencies

Table 2 reports a summary of the efficiencies of the described thermal plants:

Table 2. Efficiencies of thermal plants.

Fuel	Coal			Oil	Gas		
Type	**Subcritical**	**Supercritical**	**Ultra-supercritical**	**Rankine**	**Rankine**	**OCGT**	**CCGT**
Efficiency	36 %	40-42 %	47 %	38-40 %	38-40 %	38-40 %	56-64 %

2 Gross production of electricity and derived heat from combustible fuels by type of plant and operator [nrg_ind_pehcf]: Fuel Oil

In order to evaluate a reasonable simple scenario, based on the decision of complete European coal phase out by 2030 [21], we estimated the saving of primary energy assuming that the amount of energy produced in 2019 (which is the latest year with available consolidated data) by coal power stations, is substituted by the most efficient CCGT thermal power stations. That scenario is on one side realistic enough, as the de-carbonisation has been already decided in Europe and can be considered a matter of fact, and on the other side it is also conservative, as that energy might be substituted also by RES generation, thus resulting in further primary energy savings.

Considering 2019 (EU27), the electrical energy produced by coal plants (other bituminous coal and lignite) has been equal to 284.92 TWh, corresponding to 743.20 TWh of combustible fuel [1]. Hence, the average efficiency has been 38.3 %. The same amount of electricity could be produced by last generation CCGTs with the best efficiency of 64 %: in that case, the required primary energy would be 284.92/0.64=445.19 TWh, thus saving 743.20-445.19=298.01 TWh of primary energy per year, corresponding to 25.62 Mtoe. It is worth noticing that this value is on the safe side, given that auxiliary services of coal power stations are much more requiring than auxiliary services of CCGT power stations, thus resulting in further primary energy saving. That substitution would also imply as further advantage from the environmental point of view a significant amount of CO_2 savings, as the primary fossil fuel would be gas instead of coal.