A new study has analysed trends in the efficiency of fossil fuel power generation in the EU-27. It found that, although improvements in power plant efficiency will reduce greenhouse gas (GHG) emissions, projected rises in demand for energy will outweigh these benefits. Efficiency in power plants alone will thus be insufficient to meet EU Emission Trading Scheme targets.

In 2005, the EU Emission Trading Scheme (ETS)\(^1\) commenced operation. The sectors covered by the system are power generation, energy-intensive manufacturing industries and, as of 2011/2012, aviation. The cap on emissions allowances is designed to lead to a 21 per cent cut in GHGs from these sectors by 2020 compared with 2005 levels. GHG emissions from fossil fuel combustion for power generation account for approximately 30 per cent of total GHG emissions in the EU.

This study is partly based on research conducted for a German power utility on behalf of the European Commission. Improvements in energy efficiency from 1990-2005 and the expected improvements for 2005-2015 were analysed. It used data from the International Energy Agency (IEA) and separate research conducted by the author\(^2\). Figures on CO\(_2\) intensity (i.e. the amount of CO\(_2\) emitted per unit of energy produced) are given in terms of grams of CO\(_2\) per kilowatt hour of power produced (g/kWh).

The energy efficiency of electricity generation is calculated by dividing the energy content of produced electricity by primary energy input, based on net calorific value. The research demonstrates that there is large variation between individual country's energy efficiencies. Coal-fired power generation efficiencies ranged from 28 per cent in the Slovak Republic (i.e. only 28 per cent of energy input is converted into electrical energy) to 43 per cent in Denmark. For gas-fired generation, efficiencies ranged from 30 per cent in Romania and Bulgaria, to 55 per cent in Spain. The figures for oil-powered generation range from 23 per cent in the Czech Republic to 46 per cent in Italy.

The differences in energy efficiency per country are mainly a result of the technology used (e.g. turbine temperature and pressure). Other factors influencing efficiency include the fuel type used (e.g. coal versus lignite), air temperature and cooling method applied, altitude, operation and maintenance, pollution abatement technologies and weather conditions.

In recent decades, the fossil fuel mix has changed. In 1990, 74 per cent was coal. In 2005, just 59 per cent was coal, while gas made up 34 per cent and oil 6 per cent of the mix. Gas-fired power generation has also shown the greatest increase in efficiency at 2.6 per cent per year, compared to 0.6 per cent per year for coal and 0.8 per cent per year for oil. It is estimated that by 2015 the fuel mix will have changed to 50 per cent coal, 46 per cent gas and 4 per cent oil. Energy efficiency will only improve slightly: an improvement of 0.9 per cent per year for gas and 0.5 per cent per year for coal.

CO\(_2\) intensity dropped in the EU from 920g/kWh in 1990 to 720g/kWh in 2005, mainly due to a shift from coal to natural gas and increases in efficiency. Intensity is expected to fall further to 630 g/kWh by 2015. If this trend continues to 2020, then CO\(_2\) intensity would fall to 590 g/kWh.

However, using data from the publication ‘European Energy and Transport, trends to 2030’\(^3\), the study estimates that total GHG emissions from fossil power generation will increase by 10 per cent by 2020. This means that emissions will be well above the level needed to see reductions of 21 per cent. For example, a demand-side improvement in energy efficiency, additional efficiency improvements in power generation, increased renewable energy sources, combined heat and power generation and carbon capture and storage.


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