Annex 7.b Emissions from the power sector

This annex outlines sources of emissions from the power sector now, historical and projected business as usual trends, drivers behind growth in emissions, and prospects for emission cuts.

Now

Emissions from the power sector[1] are currently 10.3 $GtCO_2$ (24% of total greenhouse gases)[2]. Fossil fuels account for three quarters of the fuel used in this sector, of which coal is most dominant (see figure 2). Coal is also responsible for the majority of emissions from this sector (see figure 1).

Under half of the electricity and heat produced is used in buildings (residential and commercial), around one third in industry, just under one tenth in energy production and processing (such as refineries), and the remaining less than one tenth is lost in transmission and distribution.

OECD North America is currently by far the largest single emitter of power sector emissions (3 $GtCO_2$), followed by China (1.7 $GtCO_2$), OECD Europe (1.6 $GtCO_2$) and transition economies (1.4 $GtCO_2$).[3] OECD North America also has among the highest emissions per capita (7 tCO_2/person), more than twice the level of OCED Europe and six times the level of China.

Figure 1 CO_2 emissions from the electricity and heat sector

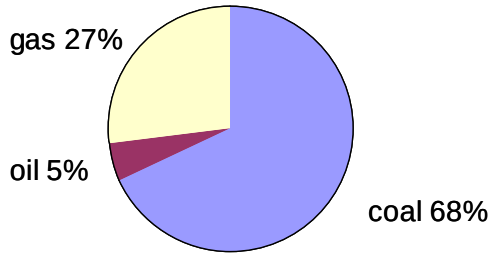
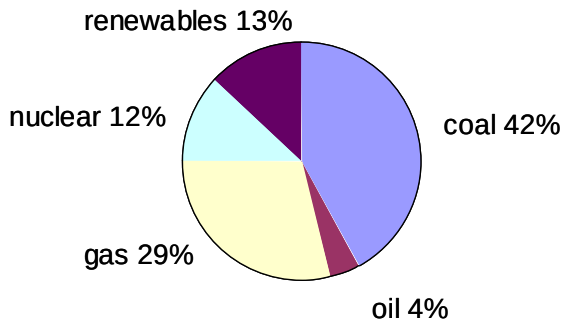


Figure 2 Fuel used by the electricity and heat sector

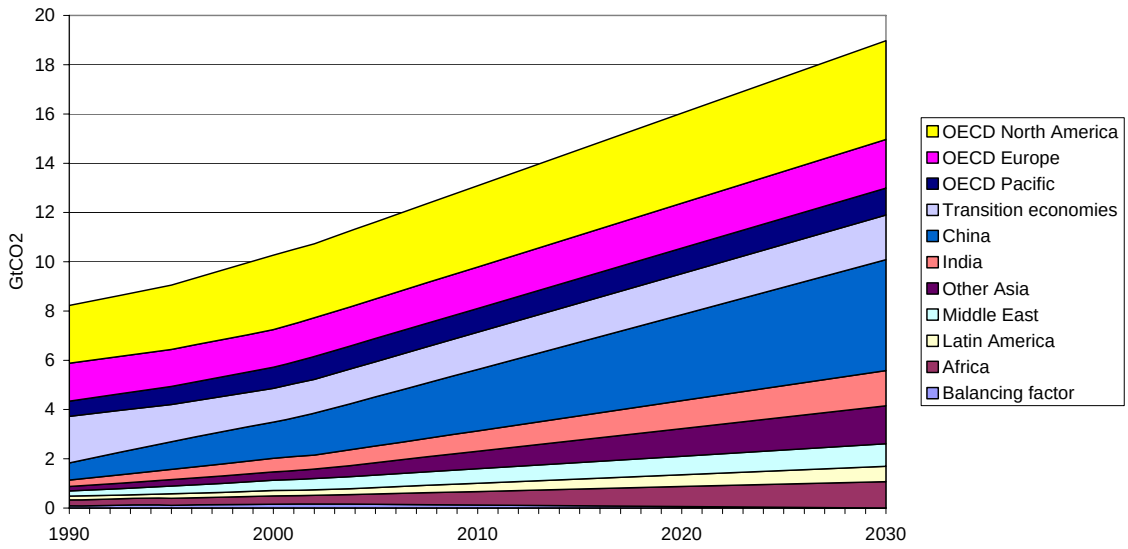


[1] This sector includes emissions from electricity and heat plants, Combined Heat and Power plants and plants that produce fuel for their own use (autoproducers). The data presented here is on a by source basis (for discussion of by source estimates, see chapter 7).
[2] Source: WRI (2006). The emissions measured here are CO_2. Hydroelectric power dams also produce methane emissions; there are no available estimates for this, but it may be significant.
[3] Figures for 2002, WRI (2006).

Historical and BAU projected trends

Power sector emissions increased by 31% between 1990 and 2002, making it the fastest growing sector over the period. Developing countries were among those to experience the greatest growth in emissions over this period. In particular, emissions from China, India, other Asian countries and the Middle East more than doubled. This compares to an increase of 22% in emissions from OECD countries over the same period.

Figure 2 Power sector CO_2 emissions by country 1990-2030[4]



Under business as usual conditions, total power sector emissions are expected to reach 19 $GtCO_2$ by 2030 and 34 $GtCO_2$ by 2050, a three-fold increase on current levels[5]. China is expected to overtake OECD North America as the largest emitter of power sector emissions in the next decade or so; however by 2030 China will still have less than half the emissions per head that OECD North America has[6].

Drivers

A key driver of growth in emissions from the power sector is income. As economies become richer, they demand more power. The countries expected to experience the fastest growth in emissions are also those expected to have the most economic growth: about half of the increase in emissions between now and 2030 is from growth in India, China and Africa.

Emissions by country are also affected by choice of fuel. The fuels producing most emissions per unit of energy are coal, followed by oil, then gas[7]. A country's choice of fuel is largely determined by its natural resource endowments. South Africa, China, India and the US have abundant supplies of coal and use this to supply at least half of their energy.

Fuel choice can also be the result of historic investment in generation capacity. For example, the decision by France to invest in nuclear power decades ago means it now supplies 75% of

[4] Data source: WRI (2006) and WEO (2004). Latest data from WEO (2006b) suggests that power sector emissions are expected to reach 20.1 $GtCO_2e$ in 2030 under BAU conditions. The country level breakdown consistent with this new emissions estimate was not available at time of going to print.
[5] Projection for 2030 from IEA (2006b). Projection for 2050 from IEA (2006a).
[6] WBCSD (2004).
[7] WRI (2005). Oil is about three quarters as polluting as coal, and gas is just over half as polluting as coal. The carbon emissions factor for coal is based on anthracite coal.

the country's electricity. Historic investment can also influence efficiency of power generation and subsequent emissions.

Prospects for emission savings

To reach a 550ppm CO_2e stabilisation trajectory in a cost effective manner, electricity production is likely to have to be 60% less carbon intensive that it currently is[8]. There is a range of technologies that can help achieve this.

Carbon capture and storage (CCS), whereby CO_2 emissions are captured at source and transported to an underground storage site, is likely to play a particularly important role. Details of CCS are found in chapter 9, box 9.2. CCS is most cost effective when used at efficient fossil fuel power plants. This could save 4 $GtCO_2$ in 2050 at a cost of \$25/tCO_2[9].

Renewables (such as biomass, hydropower, geothermal, wind and solar) are likely to be another important source of carbon savings. For example, it could save 3 $GtCO_2$ by 2050 at \$25/tCO_2[10]. The choice of renewables will differ by country according to local conditions.

The emissions saved by nuclear power will depend on to what extent costs come down and public acceptance issues are resolved. For this reason, estimates of emission savings from nuclear vary significantly: by 2050, at a cost of \$25/tCO_2, the IEA find it could save 2 $GtCO_2$ and Dennis Anderson estimates it could save 6 $GtCO_2$[11].

Fossil fuel power plants could also yield carbon savings. For example, switching from coal to gas can save 50-75% of the emissions per kWh because natural gas has a lower carbon content than coal and also natural gas combined cycle power plants are more efficient than coal ones[12].

Emissions from the power sector can also be cut if demand from the end-user sectors (mainly buildings and industry) is reduced.

References

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[8] IEA (2006a).
[9] IEA (2006a).
[10] IEA (2006a).
[11] IEA (2006a). Dennis Anderson analysis is presented in chapter 9 of the report.
[12] IEA (2006a).