Annex 7.e Emissions from buildings sector

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

Now

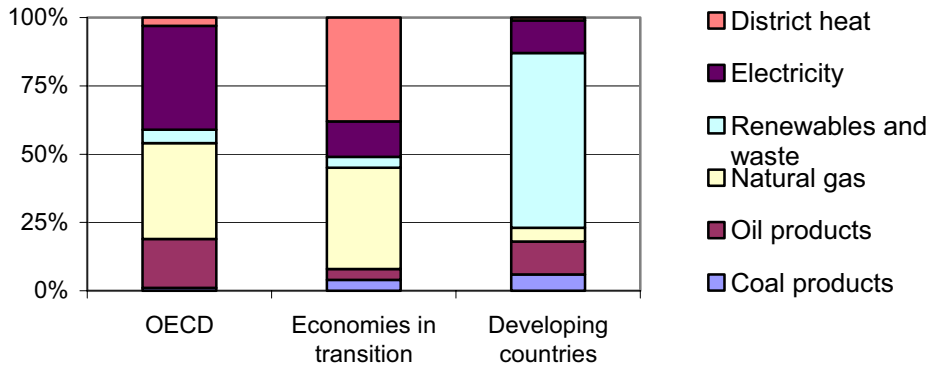
Buildings account for 8% of greenhouse gas emissions, or 20% if upstream emissions associated with electricity and heat are included. Greenhouse gas (GHG) emissions from buildings arise from:-

1. Direct combustion of fossil fuels in residential and commercial buildings, amounting to 3.3 $GtCO_2$[1]. Almost half of these emissions were from combustion of oil, around 40% from gas, and the remainder from coal[2].
2. Upstream (indirect) CO_2 emissions from the power sector via demand for electricity and district heat. Buildings consume about half of the electricity and heat produced by the power sector. In this way buildings were indirectly accountable for about 5.4 $GtCO_2$ in 2003[3].
3. Combustion of biomass produces small quantities of nitrous oxide and methane.

The dominant sources of energy used in buildings worldwide are traditional biomass (supplying almost one third), natural gas (one fifth) and electricity (almost one quarter). Other energy sources include oil (supplying almost one fifth of energy need), with coal, heat and other renewables supplying the remaining quarter of global energy needs[4].

However sources of energy used in buildings vary significantly by country (see figure 1). Electricity and natural gas are the dominant inputs in OECD and transition economies. However, renewables and waste constitute almost two-thirds of final energy consumption in developing countries (mainly traditional biomass for heating and cooking). This reflects the low level of electrification in developing countries. District heat includes centrally operated heating (and sometimes cooling) systems that service communities and sometimes entire cities or other large areas. Among transition economies, a relatively large share of energy consumption is district heat.

Figure 1 Share of final energy consumption for residential and commercial buildings by fuel, 2003[5]



Buildings provide or host a range of different energy services including in particular: heating, appliances and lighting. For example, in residential buildings in IEA-11 countries, space

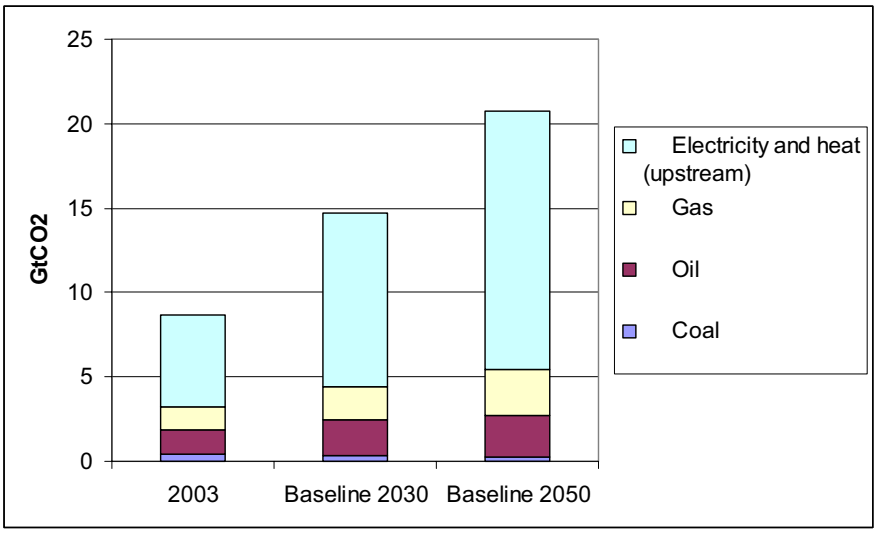
[1] IEA (2006a).
[2] IEA (2006a).
[3] IEA (2006a).
[4] IEA (2006b).
[5] Adapted from IEA (2006a)

heating is by far the largest accounting for over half of energy use, followed by water heating and appliances at about a fifth each.[6]

Historical and business as usual projected trends

Between 1990 and 2004, direct and upstream CO_2 emissions from buildings increased by less than one fifth[7]. Direct emissions remained broadly constant over this period, reflecting a switch from coal to gas and a small increase in direct consumption of fossil fuel. Upstream CO_2 emissions increased as electricity and heat consumption rose, mainly due to a proliferation of appliances.

Figure 2[8] Direct and upstream CO2 emissions in 2003 and projected business as usual emissions for 2030 and 2050



On business as usual trends, direct and upstream CO_2 emissions from buildings are expected to rise 70% and 140% to 2030 and 2050 respectively (see figure 2). Upstream emissions are expected to grow more rapidly because more buildings are expected to be electrified and the demand for electrical appliances is expected to increase.

Drivers of emissions growth

Economic and social development. Economic growth drives demand for commercial and residential floor space. It also drives an increase in the demand for energy to use appliances for heating, lighting, cooking, and various electrical appliances such as computers and televisions. This trend is likely to be particularly marked in transition economies and the developed world where economic growth is likely to be greatest. The climate in different countries will also affect the demand for energy to heat and cool buildings.

Energy Efficiency. Energy demand will be influenced by the energy end-use efficiency. For example, advanced technologies for appliances such as air conditioners use 30-40% less energy than 10 years ago. Energy demand is also affected by the efficiency of the building its self, for example the level of insulation of the building fabric. Construction in the developing world is expected to grow much faster than in OECD countries, so the energy efficiency of new buildings will be an important determinant of future emissions growth (because once a

[6] Figure for 1998. IEA (2004)
[7] Stern Review calculations based on an assumption that the buildings sector consumes almost half the electricity and heat produced by the power sector (see WRI (2005)).
[8] Figure adapted from IEA (2006a).

building is built, it lasts a number of decades and is costly to retrofit with efficiency improvements).

Carbon Intensity. The degree of electrification in a country and the energy source used to generate electricity and heat also influences emissions from the buildings sector. For example, the upstream CO2 emissions from buildings in France are very low because nuclear is the main source of electricity in the country.

Prospects for cutting emissions

Energy efficiency measures and changing the fuel mix (from coal to gas, or fossil fuel to renewable) could deliver significant emission savings from the buildings sector. For example, the IEA estimate that the building sector could contribute emission savings of 8 $GtCO_2$ by 2050 at a cost of up to \$25/tCO_2[9]. These emission savings include direct emissions and upstream emissions from the power sector. The emission saving potential in the short to medium term is also quite high compared to some other sectors.

Much of the energy efficiency savings could be delivered at low or even negative cost as many of the measures pay for themselves through lower fuel bills in the future. For example, the IEA finds that savings from appliances and lighting are particularly low cost and could yield up to half of the sector's savings by 2050. They estimate that \$1 invested in energy efficiency saves more than \$2 in avoided investment in generation capacity.

In the longer term, progressively more emissions could be saved by making changes to energy systems in buildings. For example, through innovative building design, lighting systems, and heating and cooling technologies.

References

IEA (2004) *30 Years of Energy Use in IEA Countries*, International Energy Agency.

IEA (2006a) *Energy Technology Perspectives*, OECD/IEA, Paris.

IEA (2006b) *World Energy Outlook 2005*, OECD/IEA, Paris

WRI (2005), *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy*, World Resources Institute, USA.

WRI (2006) Climate Analysis Indicators Tool (CAIT) on-line database version 3.0., Washington DC: World Resources Institute, available at http://cait.wri.org

[9] IEA (2006a).