

Energy and CO₂ emissions in the OECD

With detailed data up to 2015¹

1. Data based on the 2017 preliminary editions of the IEA *World energy balances*, and the IEA *CO₂ Emissions from fuel combustion* databases (for OECD countries).

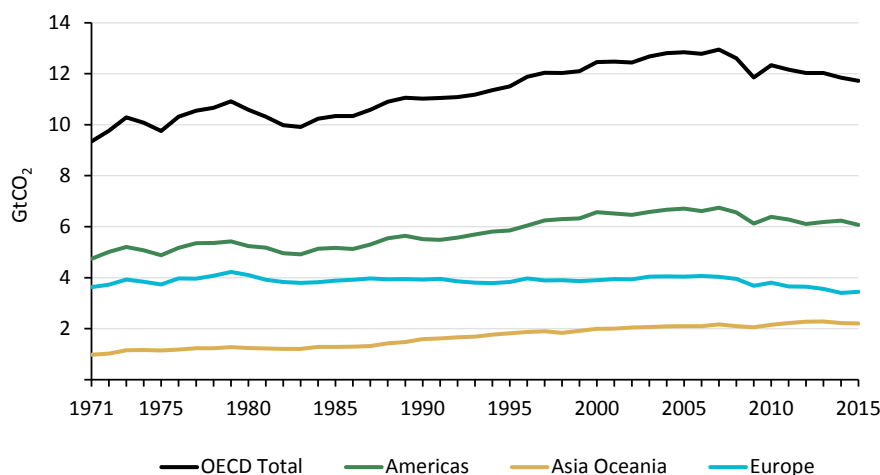
Introduction

The underlying analysis shows some of the key features of OECD countries emissions, energy consumption and production based on the IEA release of preliminary 2015 energy data for OECD.

Continued decrease in CO₂ emissions from fuel combustion

Total OECD CO₂ emissions from fuel combustion fell by 1.1% to 11.7 GtCO₂ in 2015 - a fifth year of decrease since the post-crisis rebound of 2011. OECD emissions decreased by 9.5% (or 1.2 GtCO₂) since their peak level of 12.9 GtCO₂ in 2007, and in 2015 were at their lowest level since 1995. On a regional basis, trends differed. CO₂ emissions increased by 1.5% in OECD Europe; fell by 0.7% in OECD Asia Oceania; and by 2.6% in OECD Americas (Figure 1).

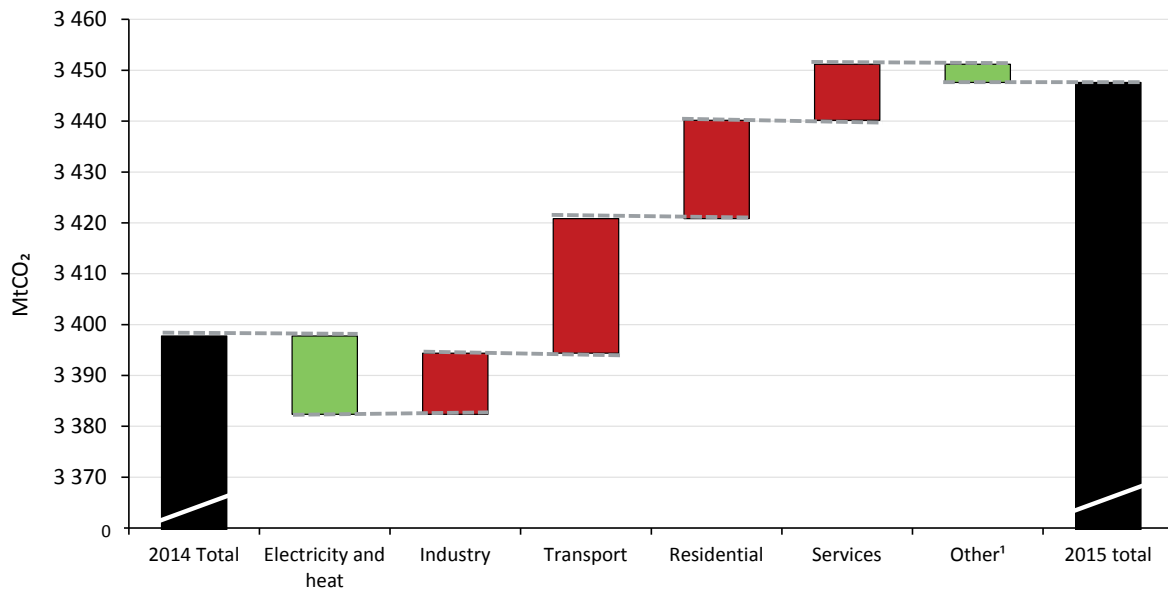
Figure 1. OECD CO₂ emissions from fuel combustion (1971-2015)



Europe increase in emissions driven by transport and climate

The 1.5% increase in OECD Europe in 2015 was essentially due to increased emissions in the transport and residential sectors - the latter following a relatively low 2014 figure linked to warmer winter conditions (Figure 2).

Figure 2. OECD Europe CO₂ emissions variation (2014-2015) by sector

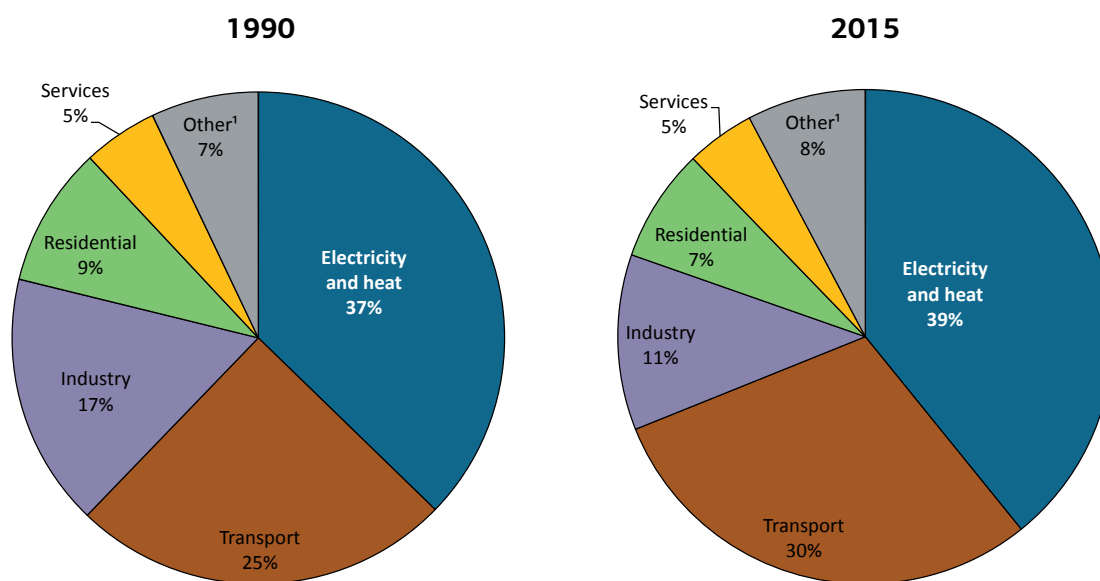


¹Other includes agriculture/forestry, fishing, other energy industry own use, and other emissions not specified elsewhere.

Transport continued to increase its share, although power generation remained the largest emitting sector

In 2015, power generation was the largest emitting sector (39%), followed by transport (30%). Over the past 25 years, the share of electricity and heat in total emissions has remained relatively constant, while the share of transport has grown by 5 percent points, with industry dropping by 6 percent points, due to structural changes in the economy as well as efficiency improvements. The average annual growth rate of transport emissions since 1990 was 1.0% while industry decreased on average by 1.2% annually (Figure 3).

Figure 3. OECD CO₂ emissions by sector



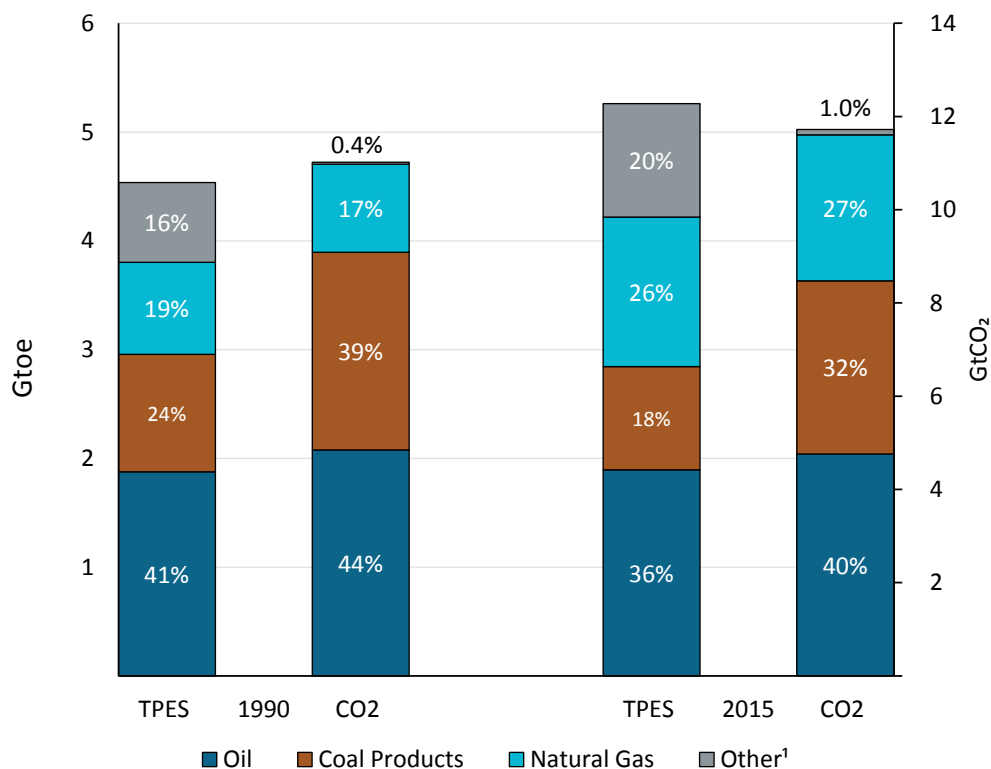
¹ Other includes agriculture/forestry, fishing, other energy industry own use, and other emissions not specified elsewhere.

Oil remained the largest source of OECD emissions

In 2015, across the OECD as a whole, oil was responsible for the largest share of CO₂ emissions from fuel combustion (40%), followed by coal (32%), gas (27%), whilst 20% of the total primary energy supply (TPES) derives from carbon neutral sources (Figure 4). Although coal represented 18% of the OECD TPES, it accounted for nearly a third of CO₂ emissions due to its heavy carbon content per unit of energy released.

Overall, CO₂ emissions per unit of TPES decreased by over 8% between 1990 and 2015, and at a stronger rate in the recent years .

Figure 4. 1990 and 2015 OECD primary energy supply and CO₂ emissions by fuel:



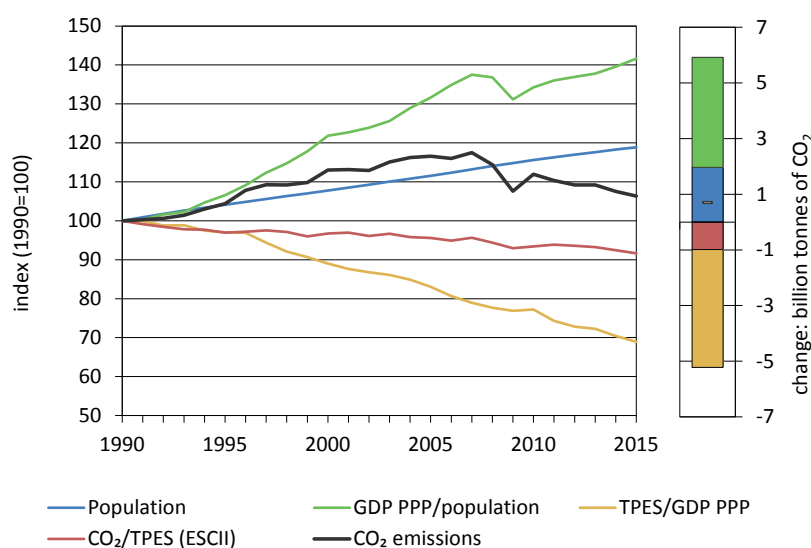
¹ Other includes nuclear, hydro, geothermal, solar, tide, wind, biofuels and waste.

Strengthened decoupling of CO₂ emissions from GDP growth over time

While total emissions in 2009 and 2015 were comparable, there have been changes to the underlying drivers (Figure 5). Over that period, the economic output grew by 8%, but this was accompanied by a decline in the energy intensity (TPES/GDP: -10%)¹, although the carbon intensity of the energy mix did not change much with CO₂/TPES -1.4% lower than in 2009. Declines in energy intensity - which measures the energy needed per economic output - can be driven by improvements in efficiency and structural changes in the economy, among other factors.

Over the longer period of 1990-2015, the decoupling of economic growth from energy consumption has been very significant (TPES/GDP: -31%). The carbon intensity of the energy mix declined, but not as much (CO₂/TPES: -8%) due to a continuing reliance on fossil fuels as a source of energy. Compared with their 1990 levels, OECD CO₂ emissions from fuel combustion were 6% higher in 2015 than in 1990. Still, in recent years, the decoupling of CO₂ and GDP trends was intensified due to a stronger carbon intensity decline, mainly linked to changes in the electricity mix.

Figure 5. CO₂ emissions and drivers

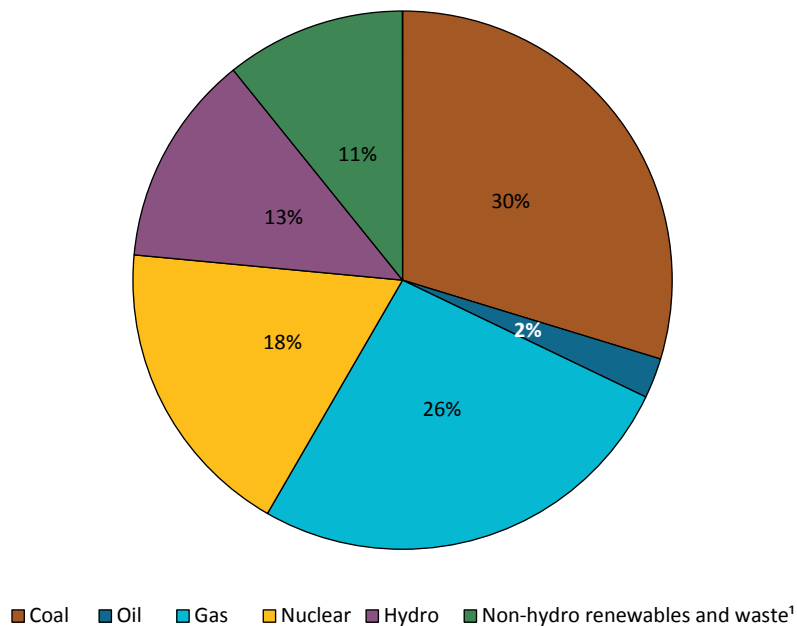


1. CO₂ emissions from fuel combustion can be broken down into the product of four driving factors: population, per-capita economic output (GDP/population), energy intensity of the economy (TPES/GDP) and carbon intensity of the energy mix (CO₂/TPES), through a decomposition known as the "Kaya identity": CO₂ = CO₂/TPES x TPES/GDP x GDP/population x population.

Continued electricity decarbonisation: coal to gas switch and rising share of renewables in the electricity mix

Overall, the OECD electricity generation mix was still dominated by fossil fuels in 2015 (58%, Figure 6). However, a pronounced switch from coal to gas - the two main fuel in the generation mix - occurred, with coal declining from 32% of the mix in 2014 (3 459 GWh) to 30% in 2015 (3 213 GWh), while gas went from 24% (2 635 GWh) to 26% (2 847 GWh). This switch at the OECD level was mostly due to the USA – responsible for about half of the coal- and gas-based generation in the OECD. There, electricity generation from coal decreased by 14% in 2015, while gas generation increased by 18%.

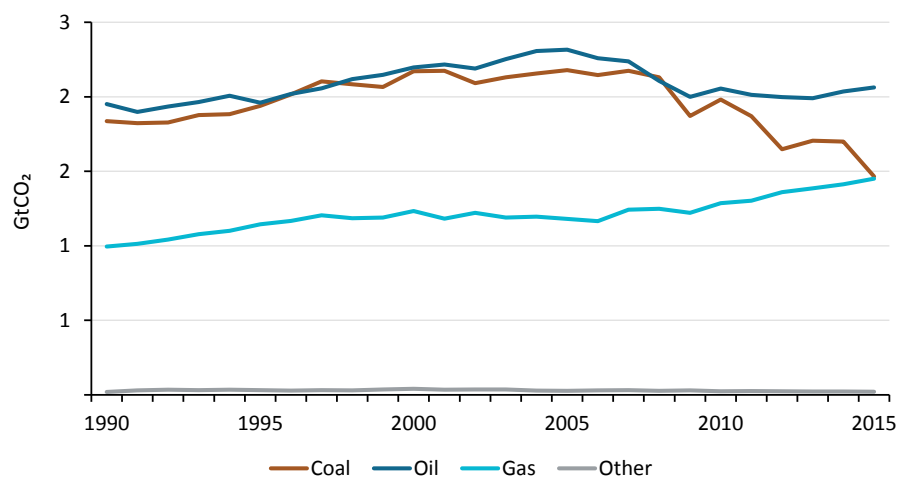
Figure 6. OECD electricity generation mix (2015)



¹ Includes geothermal, solar, wind, tide, biofuels, waste and heat.

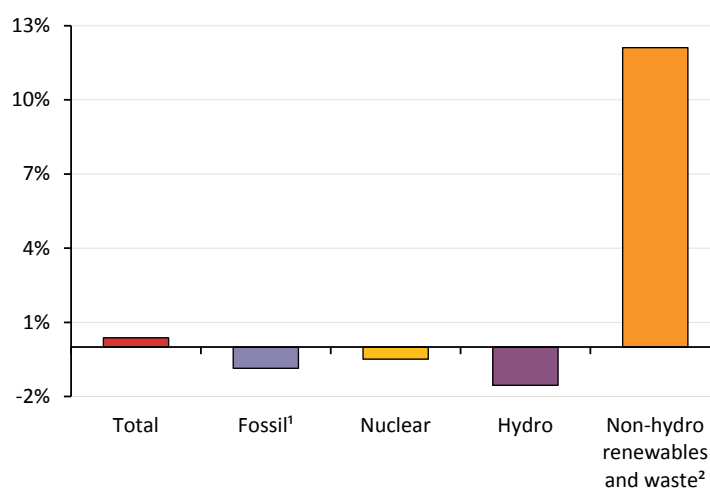
As a consequence of this fuel switching, 2015 was the first year when USA emissions from gas practically equalled emissions from coal sources (Figure 7).

Figure 7. USA CO₂ emissions from fuel combustion by fuel (1990-2015)



Besides coal-to-gas switch, the OECD continued to see renewable electricity increases. In 2015, hydro electricity generation accounted for 13%, while non-hydro renewables and waste rose to 11%. Generation from non-hydro renewables increased by 12% in 2015, led by solar photovoltaic (+24%) and wind (+14%). The share of fossil fuel in total electricity generation decreased by 1% (Figure 8).

Figure 8. OECD electricity generation: 2014-2015 change

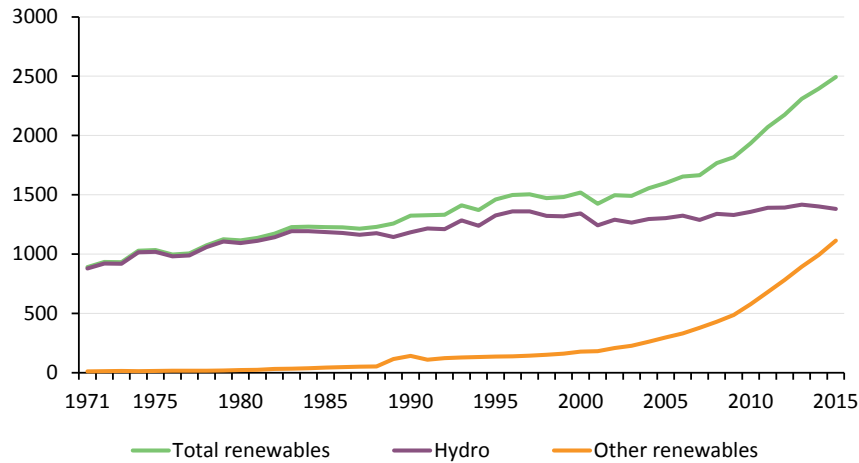


¹ Fossil includes coal, peat, oil shale, oil and gas.

² Includes geothermal, solar, wind, tide, biofuels, waste and heat.

Total renewable electricity generation accounted for 2 494 TWh in 2015 across OECD, which is an all-time high (Figure 9). In OECD Europe, non-hydro renewable electricity generation (606 TWh, driven by 306 TWh of wind) overtook hydro for the first time in 2015.

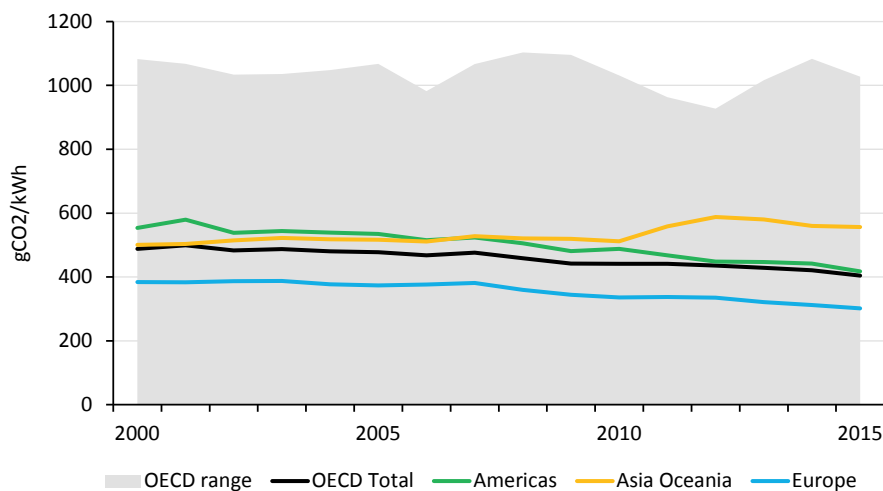
Figure 9. OECD electricity generation from renewables: 1971-2015



In 2015, OECD electricity generation produced 404 gCO₂/kWh, 4% less than in 2014 and over 20% less than in 1990, to reach its lowest levels to date¹, visible in both OECD Europe and OECD Americas (Figure 10).

OECD Europe, which has the least carbon-intensive electricity of the OECD regions, saw recent per-kWh emissions reductions primarily driven by an increased share of renewables in the mix (2015: 31% vs. 2008: 21%). By comparison, in OECD Americas, the decline was caused by both an increased share of renewables (2014: 20% vs. 2008: 16%) and the impact of fuel switching between coal and natural gas. In OECD Asia Oceania, where the carbon intensity of electricity generation increased sharply following the Fukushima Daiichi accident in Japan, emissions per kWh of electricity generation also declined in 2015.

Figure 10. CO₂ emissions per kWh of electricity generation



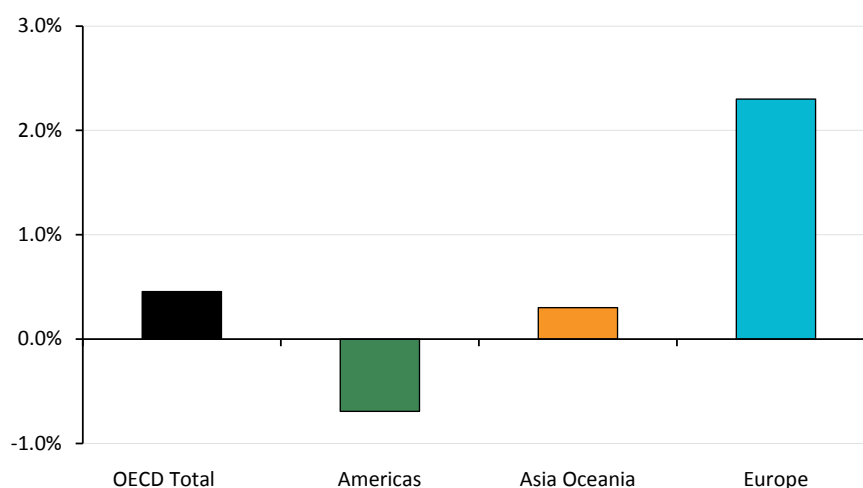
1. CO₂/kWh of electricity generation data are available from 1990.

Higher final energy consumption in Europe, lower in OECD Americas

Besides trends towards less-carbon intensive electricity generation, 2015 saw total final consumption (TFC) in the OECD increasing slightly by 0.5%, following last year's decrease of 0.7% (Figure 11).

At a more disaggregated level, industry and residential consumption decreased by 1%, whilst transport consumption increased by nearly 2%, notably through an increase in road consumption from 1 069 Mtoe to 1 089 Mtoe, half of which happened in the USA. In OECD Europe, the over 2% increase in TFC was mostly driven by increases in residential energy consumption (+12 Mtoe), road transport (+8.3 Mtoe) and commerce and public services (+7 Mtoe). As mentioned earlier, the increase in buildings consumption was also linked to weather conditions.

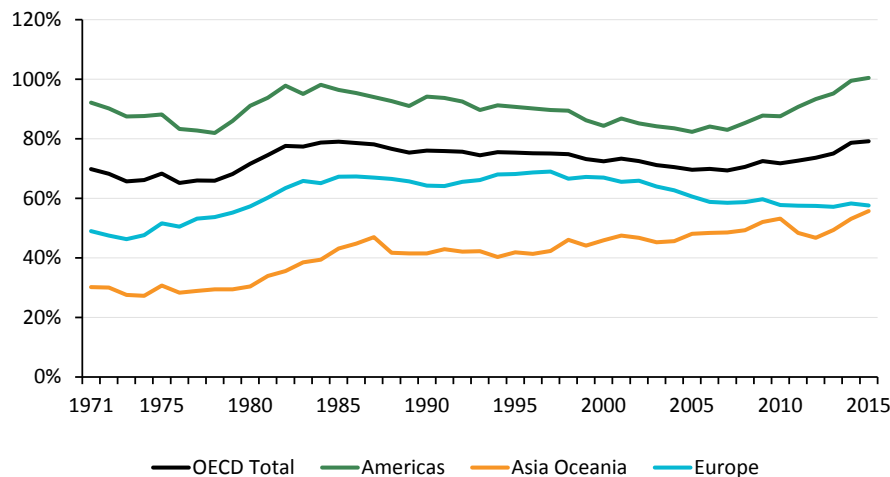
Figure 11. OECD Total final consumption: 2014-2015 change



OECD Americas reached self sufficiency despite little production increase

The 2015 decrease in TFC contributed to make the OECD Americas (Canada, Chile, Mexico and the United States) overall energy self-sufficient, although still needing to import some fuels and export others. This is the first time for any of the OECD regions since the IEA was created (Figure 12).

Figure 12. OECD energy self-sufficiency by regions: 1971-2015



Total energy production in the OECD slightly increased from 4148 Mtoe in 2014 to 4164 Mtoe. Coal production significantly decreased across the OECD by 6% (54 Mtoe), while crude oil and natural gas production both increased by 3% (respectively, 33 Mtoe and 30 Mtoe). Noticeably, primary energy production from solar, tide and wind also significantly increased by 15% (10 Mtoe). Overall, the OECD TPES remained flat in 2015 at around 5,262 Mtoe, with the decrease in Americas (-1.4%) compensated by an increase in Europe (1.6%).

Geographical Coverage¹:

OECD Americas includes Canada, Chile, Mexico and the United States.

OECD Asia Oceania includes Australia, Israel², Japan, Korea and New Zealand.

OECD Europe includes Austria, Belgium, the Czech Republic, Denmark, Estonia (from 1990), Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia (from 1990), Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia (from 1990), Spain, Sweden, Switzerland, Turkey and the United Kingdom.

OECD Total includes Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia (from 1990), Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia (from 1990), Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia (from 1990), Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

Sources:

2017 Preliminary edition of *World Energy Balances* (OECD countries), OECD/IEA, Paris

2017 Preliminary edition of *CO₂ Emissions from Fuel Combustion* (OECD countries), OECD/IEA, Paris

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