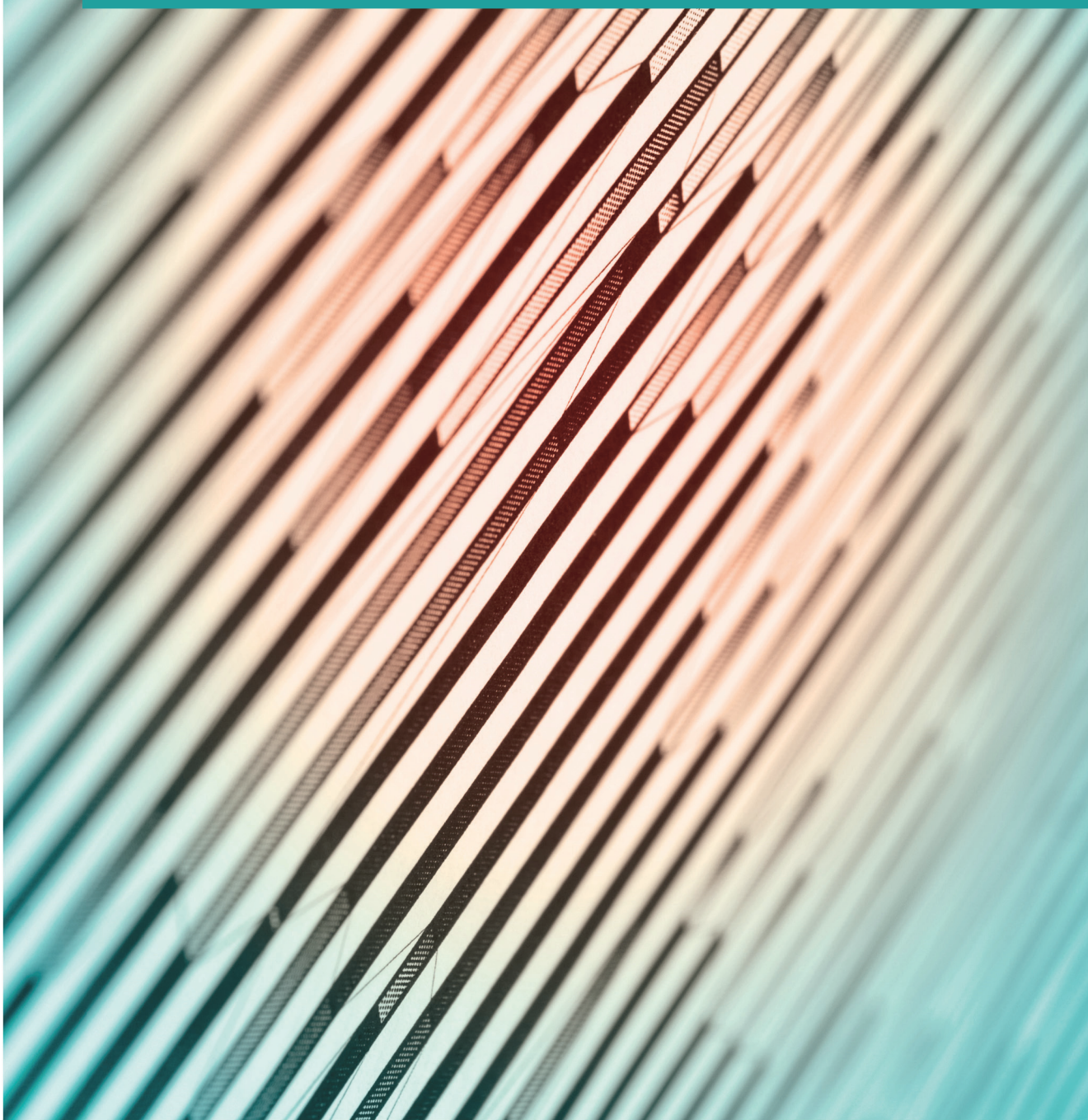


World energy balances: Overview



The following analysis is an overview from the publication *World Energy Balances 2018*.

Please note that we strongly advise users to read definitions, detailed methodology and country specific notes which can be found online at http://wds.iea.org/wds/pdf/WORLDBAL_Documentation.pdf.

Please address your inquiries to stats@iea.org.

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WORLD ENERGY BALANCES: AN OVERVIEW

Global trends

This overview provides a detailed look at energy developments based on complete supply and demand data for 2016 for 150 countries and regions and where available provisional official supply or production data for 2017.

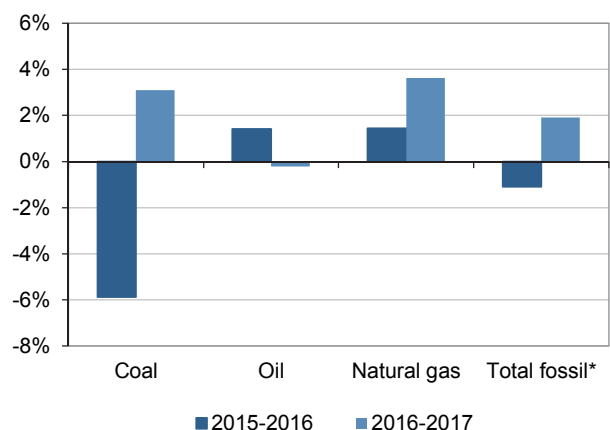
In 2016, global energy demand as measured by TPES increased slightly compared to 2015 (+0.7%) to a little less than 13 800 Mtoe. Such stability resulted from different trends: in non-OECD countries, energy demand rose by 0.9%, but by 0.1% in OECD countries. However, energy demand growth accelerated in 2017 in OECD countries (+0.5%), as discussed in more detail in the OECD section.

Production

For 2017, global country level production data is preliminary and restricted to fossil fuels. Based on these data, production growth of fossil fuels increased after two years of decrease (+1.9% - Figure 1). This was driven by a surge in coal production after two years of decrease (+3.1% in 2017, -5.9% in 2016, -2.3% in 2015). Natural gas production continued to grow and at a higher pace (more than twice the 2016 growth rate, +3.6% in 2017). Crude oil production was fairly stable in 2017 (-0.2%), as opposed to +1.4% in 2016. The increase in coal production was particularly strong in many regions: China (+54 Mtoe, +3.1%), OECD countries (+23 Mtoe, +2.8%) and other non-OECD Asia countries (+23 Mtoe, +3.9%).

Natural gas production increased in all regions in 2017, particularly in non-OECD Europe and Eurasia (+42 Mtoe, +5.8%) and OECD (+25 Mtoe, +2.3%).

Figure 1. Annual average change in global fossil fuels production by fuel



* In this graph total fossil fuels exclude peat and oil shale.

As for crude oil, growth in OECD and Africa (+2.5% and +5.1% respectively in 2017, +47 Mtoe combined) was offset by a decline in the Middle East, non-OECD Americas and non-OECD Asia including China (-1.4%, -3.9% and -3.6% respectively, so -51 Mtoe combined).

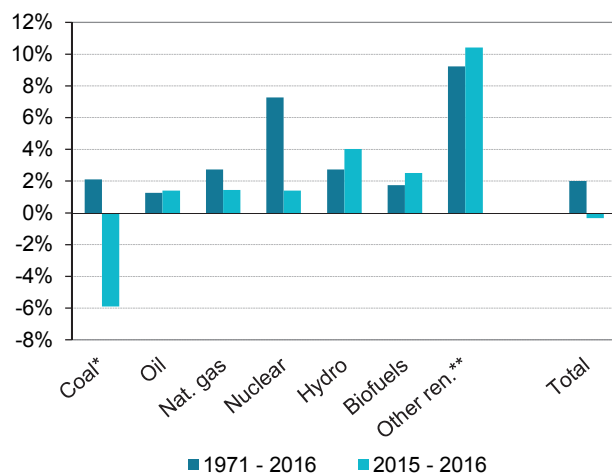
The remainder of the article looks at the detail of 2016 world production and use, and 2017 OECD supply.

World energy production was 13 764 Mtoe in 2016 - 0.3% less than in 2015. Oil, natural gas and nuclear all grew at the same pace (+1.4%), setting new records in many countries.

Fossil fuels accounted for 81% of production - a 0.6 percentage point decrease compared to 2015. Growth in oil and natural gas was entirely offset by the coal production's sharp decline for the second year in a row (-5.9% in 2016, after -2.3% in 2015),

after 15 years of continuous growth. Together the production of these three fossil fuels decreased by 1.1% in 2016 (Figure 2).

Figure 2. Annual average change in global energy production by fuel



* In this graph peat and oil shale are aggregated with coal.

** Includes geothermal, solar thermal, solar photovoltaic and wind.

Among non-fossil sources, biofuels and waste slightly increased their share of the world energy production in 2016 (9.8% compared to 9.5% in 2015), with reviving growth (+2.5% compared to +1.1% in 2015, +0.9% in 2014).

Hydro sharply increased in 2016 (+4.0%) after having been flat in 2015 (-0.03%) due to comparatively bad weather conditions in some regions and the first decline in global production since 1989. Nevertheless hydro provided 2.5% of global production in 2016, not much more than in 2015 (2.4%). Other renewable sources such as solar PV, wind, solar thermal, geothermal, kept on expanding at a fast pace (+31.1%, +14.2%, +3.2%, +4.0%, respectively) but still accounted for less than 2% of global primary energy production together. Finally, nuclear kept constant in 2016 compared to 2015, both in terms of its share of energy production (4.9%) and growth (1.4%).

At a regional level, the OECD was the largest energy producing area just ahead of non-OECD Asia¹ in 2016 as in 2015 (Figure 3). OECD economies produced 30% of global energy, whereas non-OECD Asia accounted for 28% (respectively 30% and 29% in 2015). Though production decreased in both regions (-2.4% in OECD, -2.7% in non-OECD Asia), they

1. In this chapter, non OECD Asia includes China region unless otherwise specified.

Figure 3. Total production by region 2016

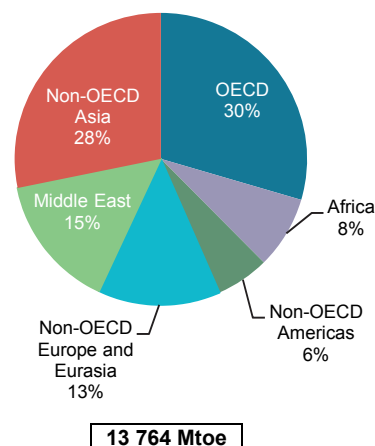
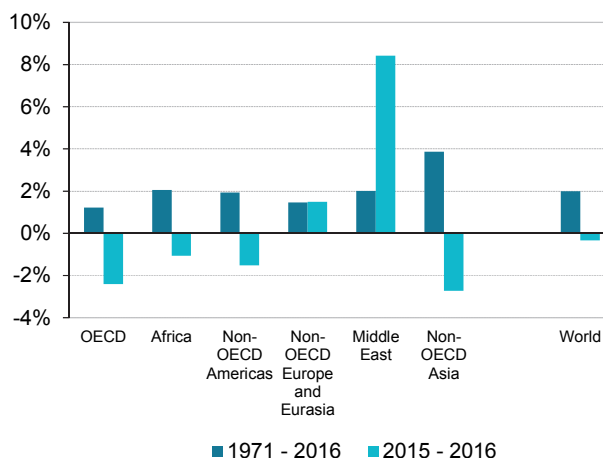


Figure 4. Annual average change in energy production by region



still each produced around 4 000 Mtoe, double the amount produced by the Middle East, the third biggest producing region (+8.4% in 2016 - Figure 4).

The United States remained the biggest energy producer in OECD by far in 2016, with 1 915 Mtoe, even though its production fall was the largest in volume terms in the region (-107 Mtoe). The decrease of the US production in 2016 was not offset by growth in Canada, Australia and Norway (+17.3 Mtoe together), respectively second, third and fourth biggest producers in OECD. Energy production grew in 20 of the 35 member countries of the OECD. OECD countries produced 4 064 Mtoe of energy in 2016.

In non-OECD Asia, energy production significantly decreased (-2.7%), at 3 881 Mtoe in 2016, in the wake of a strong decrease in China (-6.1%), that was not compensated by increases in the two next bigger

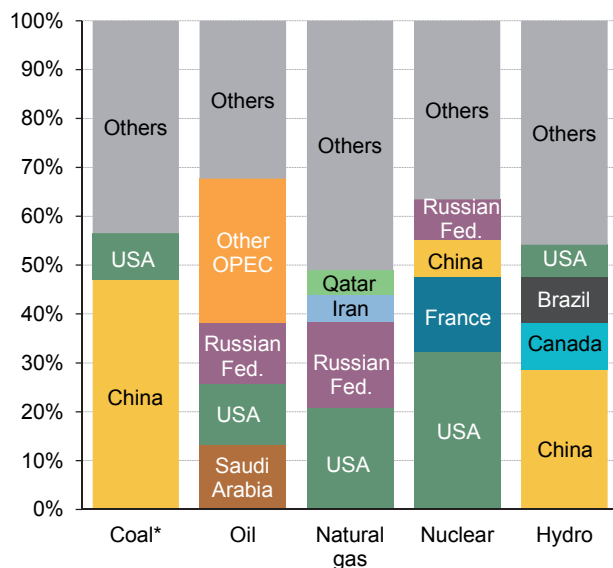
producers India (+3.6%) and Indonesia (+1.9%). In China, energy production in 2016 amounted to almost 2 400 Mtoe (-6.1%), the decline in coal production (-8.7%) and crude oil (-6.9%) being only partly compensated by growth in natural gas, hydro, nuclear and power renewables productions (+1.7%, +4.3%, +24.9%, and +18.2% respectively). In India, energy production increased by 3.6% in 2016, due to increases in coal (+2.9%) and biofuels and waste (+6.6%).

In 2016, the Middle East ranked third, with 2 043 Mtoe of energy produced. Production of energy in the Middle East grew by 8.4%, following an increase of crude oil production in the top producing economies. With 1 862 Mtoe, non-OECD Europe and Eurasia produced 1.5% more energy in 2016 than in 2015.

Africa produced 1 107 Mtoe in 2016, non-OECD Americas 806 Mtoe, a -1.1% and -1.5% decrease respectively.

The IEA family (IEA member economies, Association and Accession countries) represented 53% of the global energy production in 1971, and 58% in 2016.

Figure 5. Largest producers by fuel in 2016



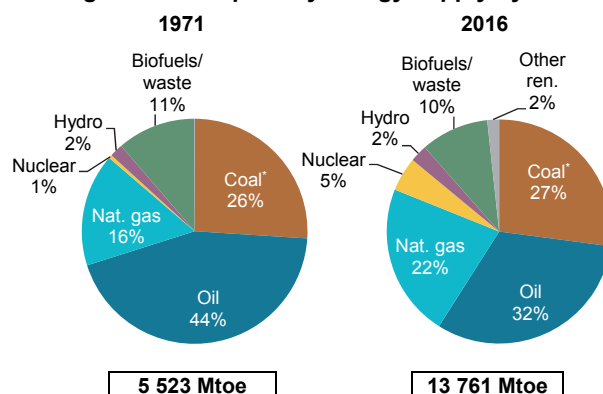
* In this graph peat and oil shale are aggregated with coal.

Energy production is not evenly distributed across countries: for each fuel, less than five countries generally account for more than half of global production (Figure 5). China was not far from producing half of the world coal in 2016, and 29% of hydro. The United States and France combined produced almost 50% of all nuclear. Saudi Arabia, The Russian Federation and the United States contributed slightly less than 40% of the world crude oil – these last two also accounting for 40% of the world natural gas.

Total Primary Energy Supply (TPES)

Between 1971 and 2016, world total primary energy supply (TPES) increased by almost 2.5 times (from 5 523 Mtoe to 13 761 Mtoe) and also changed structure somewhat (Figure 6). While remaining the dominant fuel in 2016, oil fell from 44% to 32% of TPES. The share of coal has increased constantly between 1999 and 2011, influenced mainly by increased consumption in China: in 2011 it reached its highest level since 1971 (29%), peaking at 71% of TPES in China. It has declined since then and represented 27% of world TPES in 2016 (one percentage point less than in 2015). Meanwhile natural gas grew from 16% to 22% and nuclear from 1% to 5%.

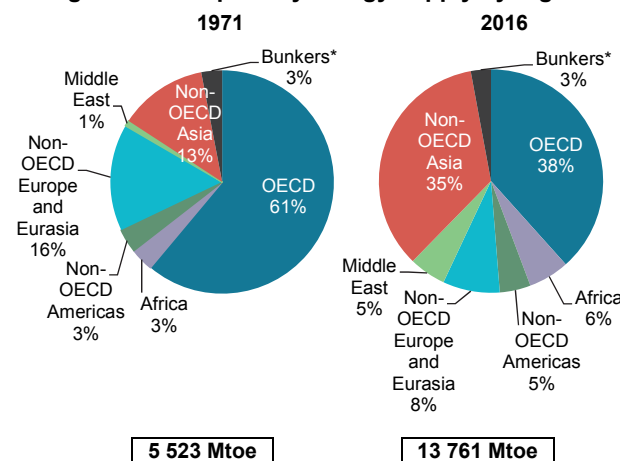
Figure 6. Total primary energy supply by fuel



* In this graph peat and oil shale are aggregated with coal.

Energy demand has evolved differently across the regions between 1971 and 2016. The OECD's share of global TPES fell from 61% in 1971 to 38% in 2016 (Figure 7). It is now almost on par with non-OECD Asia, where energy demand grew seven-fold, and

Figure 7. Total primary energy supply by region

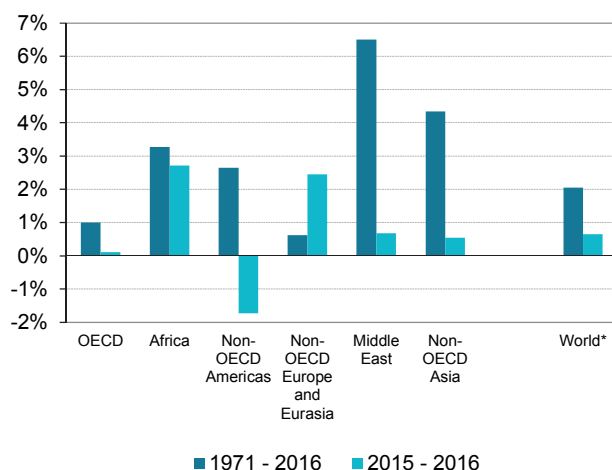


* Includes international marine and aviation bunkers.

whose share of TPES almost tripled over the period. Though its share of global energy demand halved between 1971 and 2016, non-OECD Europe and Eurasia remained the third biggest energy consuming region, with more than 1 100 Mtoe TPES. It was followed by Africa, where energy demand over the period has multiplied by four, reaching 820 Mtoe.

Between 2015 and 2016, global TPES growth accelerated again, compared to the previous year: it increased by 89 Mtoe (+0.7%), reaching 13 761 Mtoe in 2016. During 2016 TPES increased mostly in non-OECD Asia excluding China, Africa, and non-OECD Europe and Eurasia (+3.3%, +2.7% and +2.4% respectively). It decreased by 1.7% in non-OECD Americas, by 1.1% in China, and was fairly stable (+0.1%) in OECD (Figure 8). The IEA family group accounted for 73% of TPES in 2016.

Figure 8. Annual average change in TPES by region



* World also includes international marine and aviation bunkers.

Non-OECD countries account for a continuously growing share of the world energy consumption. In 2016, China accounted for 21.5% of global TPES while the United States accounted for 15.7% (Table 1). India and the Russian Federation ranked third and fourth, respectively. Japan, the second largest OECD consuming country, was in fifth position. Together, these five countries accounted for more than half of the global TPES in 2016.

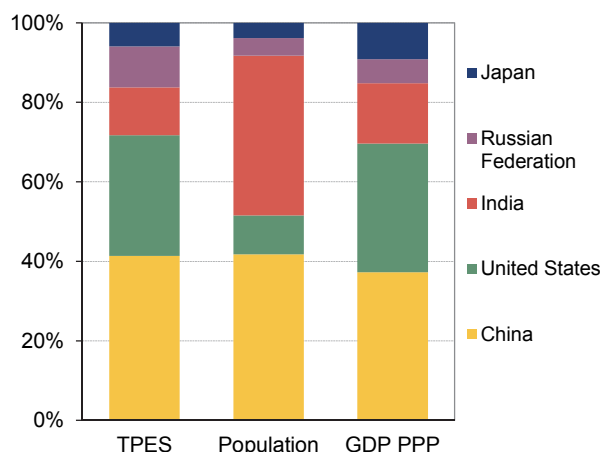
Global energy demand was even more concentrated in 2016 compared to 1971, as the top ten countries represented 62% of global energy demand, as opposed to 56% in 1971.

Table 1. TPES – top ten countries in 2016 and 1971

Country	TPES (Mtoe)	Share in world TPES	
		2016	1971
People's Rep. of China	2 958	22%	7%
United States	2 167	16%	29%
India	862	6%	3%
Russian Federation	732	5%	N/A
Japan	426	3%	5%
Germany	310	2%	6%
Brazil	285	2%	1%
Korea	282	2%	0.3%
Canada	280	2%	3%
Islamic Republic of Iran	248	2%	3%
Rest of the world	5 211	38%	44%
World	13 761	100%	100%

In 2016, the top five countries in terms of TPES accounted for less than half of the world GDP², and world population (48% and 44% respectively) but consumed 52% of total world energy. However, the relative shares of GDP, population and TPES of these five countries significantly varied from one to another (Figure 9).

Figure 9. Top five energy consumers: 2016 relative shares*



* Relative shares within the top five, which differ from shares in the world total.

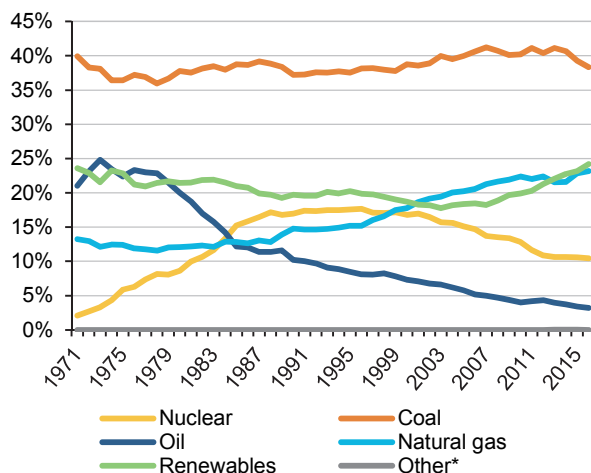
The United States consumed 16% of world energy, with slightly less than 5% of the world's population. Conversely, China and India consumed 22% and 6% of global energy respectively, but accounted for 20% and 19% of the global population. The Russian Federation and Japan also consumed significant amounts of energy in 2016 (5.3% and 3.1% of global TPES respectively).

2. In this chapter, GDP refers to GDP using purchasing power parities.

However, energy intensities differed significantly. To produce the same amount of wealth, as measured by GDP in PPP, the Russian Federation consumed 2.6 times as much energy as Japan (the country with the lowest energy intensity of the five top energy consumers), and twice as much than India, in 2016; naturally such comparisons reflect the importance of specific industries in each country.

Though still dominant, power generation from coal has been decreasing for the three last years, reaching 38.4% of the electricity produced globally in 2016, its lowest share since 2001 (Figure 10). Generation from gas grew slowly to reach 15% in 1990; since then steady increases have seen it grow to 23.2% in 2016. This is a slightly smaller share than renewables (24.2%) which initially was dominated by hydro, but recent growth has come from the development of wind and solar PV. Nuclear production had steadily increased in the 1970s and 1980s, before plateauing at around 17% of electricity production and then declining since the 2000s to reach approximately 10%. Power production from oil peaked at almost 25% of power production in 1973, just before the oil crisis, and has been declining since then. From being the second fuel used for electricity production after coal, it has become the fifth, just above 3% of the global electricity generation in 2016. Whilst globally the use of oil for electricity generation has fallen sharply, it still accounts for over 70% of electricity generation in a number of countries including Lebanon, Iraq or Jamaica. Oil and natural gas combined provided 100% of power production in countries such as Bahrain, Qatar, Trinidad and Tobago and Brunei Darussalam.

Figure 10. World electricity generation mix 1971-2016



* Other includes non-renewable waste and non-renewable heat.

Total Final Consumption (TFC)

Between 1971 and 2016, total final consumption (TFC) was multiplied by 2.25 (Figure 11). However, the energy use by most economy sectors³ did not change and has been fairly stable for several years. Energy use in transport significantly increased, from 23% of TFC in 1971 to 29% in 2016 as well as in 2015. Nevertheless, in 2016 industry remained the largest consuming sector, only one percentage point lower than in 1971 (37%). The residential sector ranked third in 2016 (22%).

Figure 11. Total final consumption by sector

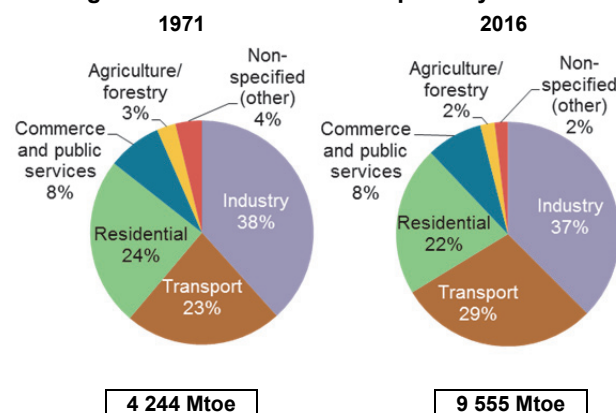
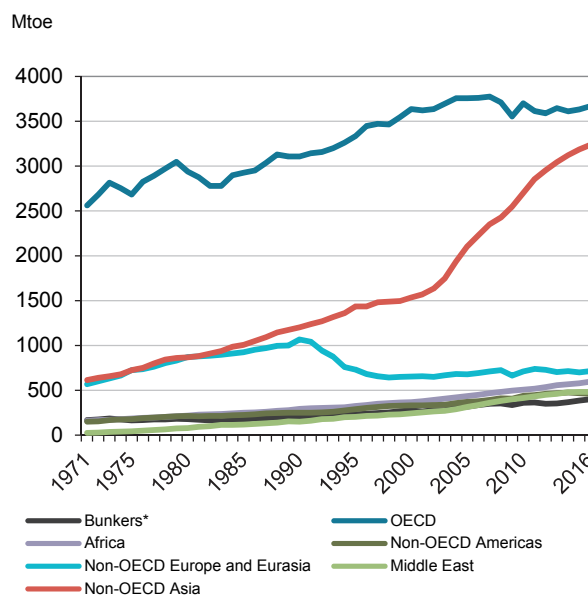


Figure 12. Total final consumption by region



* Includes international marine and aviation bunkers.

3. In this chapter, each sector of final consumption includes its respective non-energy use quantity.

Total final consumption has soared in non-OECD Asia including China since the early 2000s to account for 34% of global TFC in 2016, whilst the mainly increasing trend stopped in OECD with the 2008 economic global crisis, and total final consumption is oscillating around a plateau of yet over 3 500 Mtoe (38% of global TFC, Figure 12).

The following sections briefly describe OECD trends up to 2017 and 1971-2016 energy trends in six different regions of the world: OECD, Africa, non-OECD Americas, non-OECD Asia, non-OECD Europe and Eurasia, and the Middle East.

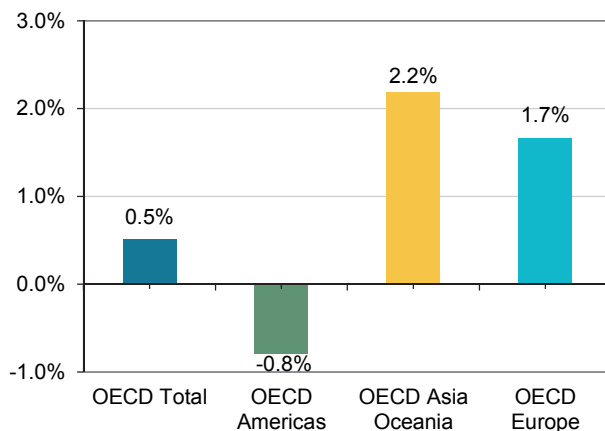
OECD

Key supply trends in 2017

The total primary energy supply (TPES) of the OECD increased slightly in 2017⁴ (5 301 Mtoe), a 0.5% increase compared to 2016 corresponding to an additional 27 Mtoe. OECD regional trends stayed similar to those observed in the previous year.

In OECD Europe, TPES increased by 1.7% following last year's 0.6%, led mostly by Turkey (8%, 11 Mtoe growth) and Spain. In OECD Asia-Oceania, TPES increased by 2.2% at an even faster rate than last year, which can be credited to Korea (4%, 12 Mtoe). On the other hand, in OECD Americas TPES decreased by almost 1% again in 2017 (Figure 13), led by the 1.4% (30 Mtoe) reduction in the United States which was partially offset by a significant growth in Canada (4%, 11 Mtoe).

Figure 13. OECD total primary energy supply 2016-2017 change

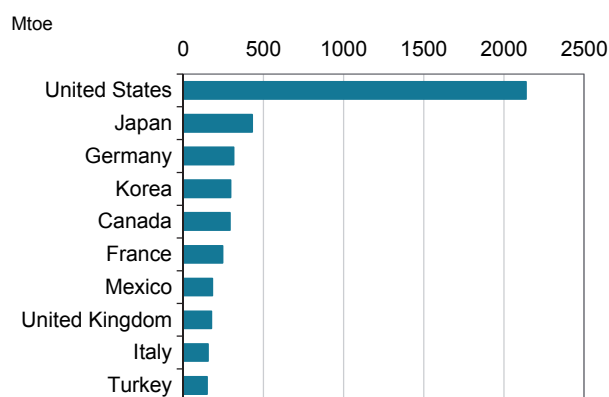


The United States reduction was mainly due to a decreased use of coal and natural gas which both saw declines of 3% of their respective TPES shares in 2017. Simultaneously, the small decrease in oil TPES (1%, -8 Mtoe) was mostly compensated by the increase in renewables TPES (+8 Mtoe, but 5% increase). Interestingly, even though the variation of total oil supply was not significant at the US level, a shift from secondary oil products to primary ones occurred. This is well illustrated by a 5% production

increase of primary oil products and a 13% increase in exports of secondary oil products to reach 212 Mtoe in 2017 – a new record for the US.

In 2017, the United States represented 40% of all OECD TPES, a weight comparable to that of the following largest nine countries when taken all together (Figure 14).

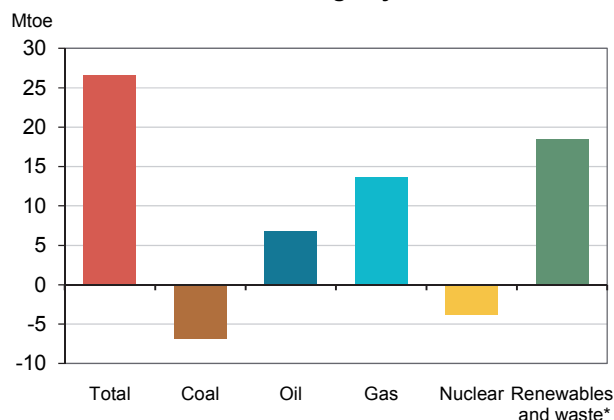
Figure 14. Top ten OECD countries by TPES* in 2017



*Total primary energy supply.

At the OECD level, growth in supply of natural gas and renewables and waste are the drivers of the overall trend, while coal and oil supply trends are cancelling out each other (Figure 15). The OECD increased its use of natural gas (27% of OECD TPES, +1% and +13 Mtoe). Like previous years, renewables and waste TPES increased significantly in 2017, reaching 11% of OECD TPES after a 3% increase in 2017 (+17 Mtoe), linked to its use in electricity generation.

Figure 15. OECD total primary energy supply 2016-2017 change by source



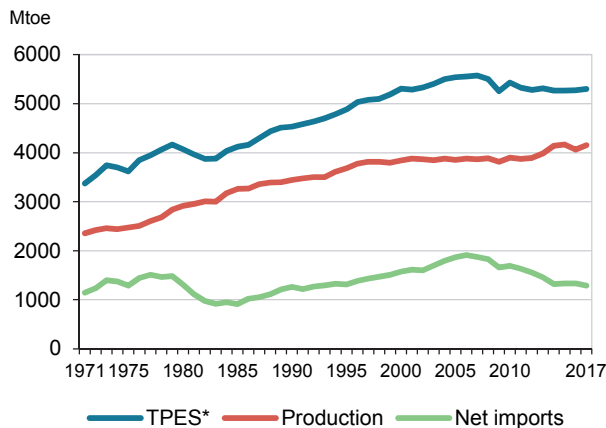
*Includes hydro, geothermal, solar, wind, biofuels, waste.

4. All the energy supply data for 2017 described in this chapter are provisional.

After a slight decline in 2016, energy production in the OECD rebounded in 2017 to reach production levels

similar to 2015 (Figure 16). This 2.3% year-on-year increase allowed the OECD to reach a total energy production of 4 156 Mtoe, which represents the second highest production total in the history of the OECD – the highest having been recorded in 2015.

Figure 16. OECD energy supply and production 1971-2017

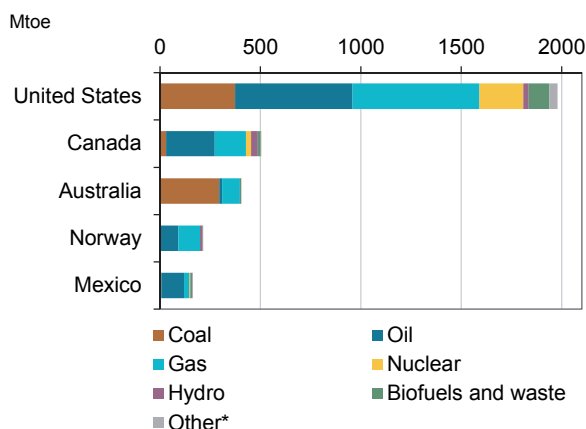


*Total primary energy supply.

Simultaneously, 2017 also saw the net imports of the OECD drop to a record low since 1995 at 1 290 Mtoe, a 3.2% year-on-year decrease. This means that the OECD has reduced its net imports by one-third a decade after registering its all-time high on net imports in 2006.

About half of the energy production in OECD occurs in the United States (48%), with levels in 2017 almost four times larger than those of the second largest producer, Canada (12% - Figure 17).

Figure 17. Top five OECD producing countries 2017



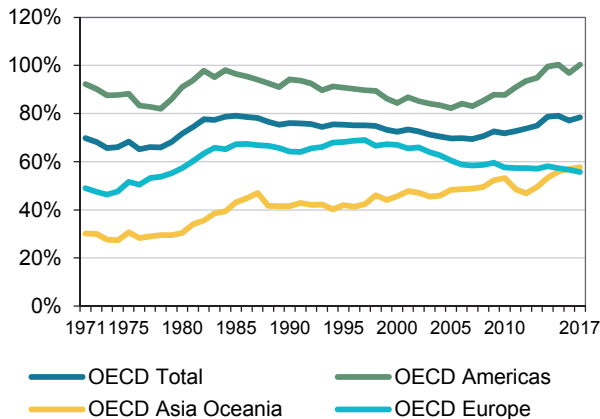
*Other includes geothermal, solar, wind, and heat.

Trends in energy production differed across OECD countries. In the United States, total energy production

increased again in 2017 by 3.3% (63 Mtoe) after a record decline in 2016 – a decrease of 5.3% in total energy production. The 2017 increase in the US in production was driven mostly by coal (7%) and oil (5%), both growing by 25 Mtoe. Coal production increased again in 2017 after 2 years of steep decline (respectively -11% in 2015 and -19% in 2016). This rise in production levels resulted in an increase of five percentage-points in self-sufficiency for the US (defined as production/TPES) compared to 2016, and allowed the country to reach overall self-sufficiency levels unseen since 1975.

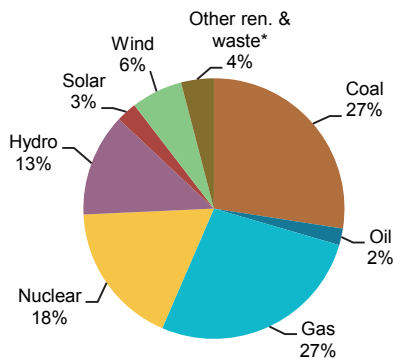
Driven by the trend in the United States, the OECD Americas became self-sufficient again in 2017 with a self-sufficiency slightly above 100%, a feat only achieved once in the history of the OECD in 2015. For the first time the OECD Asia Oceania region (58%) achieved a self-sufficient level above OECD Europe (56%), reflecting the steady increase in energy production levels occurring mainly in Australia (+16 Mtoe, 4% in 2017) but also in Japan (+5 Mtoe, 14% in 2017) over the last few years (Figure 18).

Figure 18. OECD energy self-sufficiency 1971-2017



About a quarter of OECD's TPES is used for electricity generation, where important structural changes have been occurring over the last few years. Overall, the OECD electricity generation mix was still dominated by fossil fuels, representing 56% of the mix in 2017 (Figure 19), a slightly lower level to that of 2016.

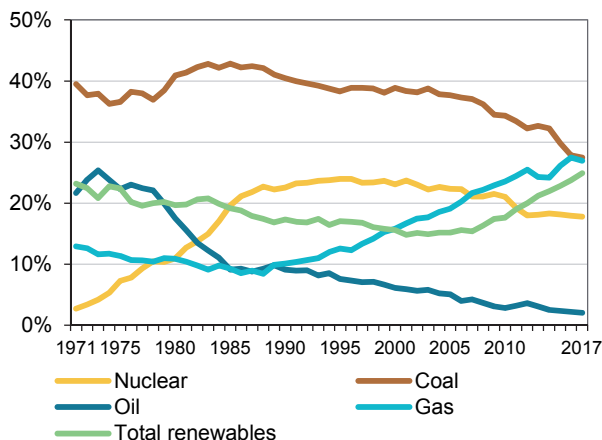
Within the fossil sources, fuel-switching from coal to natural gas continued in 2017, albeit to a lesser extent, as it was not as marked as previous years in the United States. Coal went from 30% in 2015 to 27% in 2017 (3 011 TWh), while gas is now at a similar 27% as well, but remains second (2 957 TWh).

Figure 19. OECD electricity generation mix 2017

*Includes geothermal, tide, biofuels, all waste and heat.

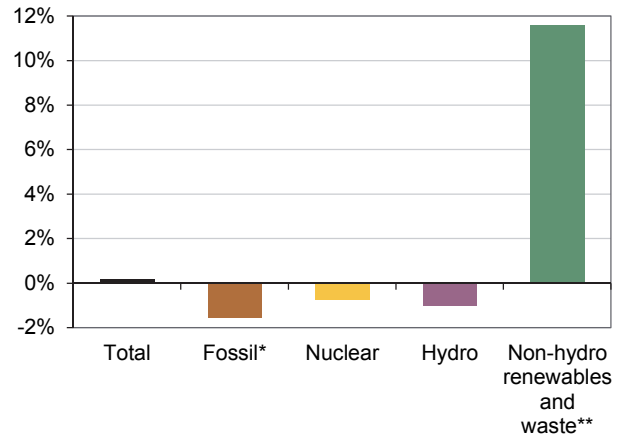
In the United States only, coal electricity generation decreased by 3% in 2017, reducing from 50% of the mix in 2005, to 40% in 2014 and 31% in 2017, whilst gas electricity generation grew from 18% in 2005 to 31% in 2017. However, gas generation decreased in the US in 2017 for the first time since 2013, declining by 106 TWh and going from 33% of the electricity mix to 31%. This decline was however almost entirely offset by significant increase of solar, wind and hydro electricity generation in 2017 (+83 TWh).

Similar trends were observed in OECD Europe, while coal electricity generation remained more stable in OECD Asia Oceania (Figure 20).

Figure 20. OECD electricity generation mix 1971-2017

In the OECD, fossil fuel use in electricity generation continued its decline in 2017 with a 97 TWh decrease (-1.5%), with decreases in electricity generated from coal (-33 TWh) and natural gas (-47 TWh). Non-hydro renewables and waste more than compensated this decrease by generating 148 TWh more than in 2016,

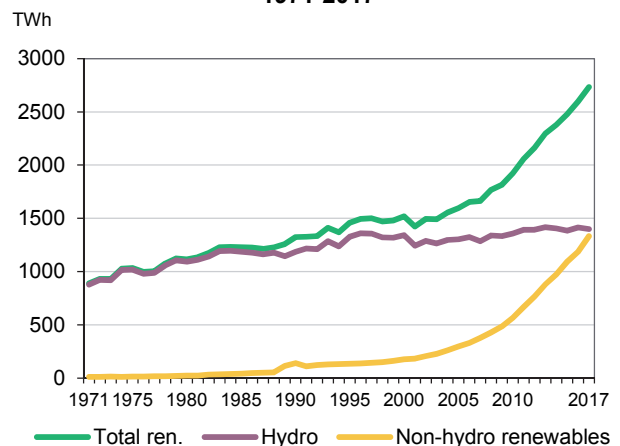
a 12% increase to reach 1 421 TWh. Solar photo-voltaics (+22%, 48 TWh) and wind (+15%, 91 TWh) both saw significant increase of their electricity output and again led the way in 2017 in terms of growth at the OECD level (Figure 21).

Figure 21. OECD electricity generation 2016-2017 change

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

**Includes geothermal, solar, wind, biofuels, all waste and heat.

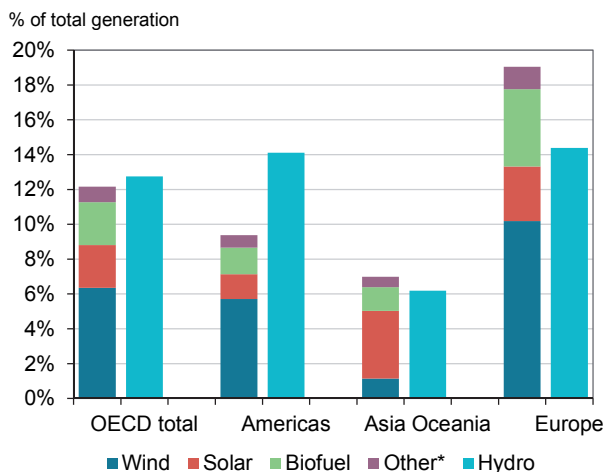
The share of non-hydro renewables and waste continued its upwards trend and achieved a record 13% of total electricity generation in the OECD, comparable with the 13% of conventional hydro. Total renewable sources (hydro and non-hydro) accounted for 2 732 TWh and reached a quarter of total electricity generation (25%), which represented again another all-time high (Figure 22).

Figure 22. OECD renewable electricity generation 1971-2017

In OECD Asia Oceania and OECD Europe, non-hydro renewables provided a larger share of electricity than hydro in 2017 – for the first time ever in the case of OECD Asia Oceania – while the gap between the two is thinning every year at the OECD level

(Figure 23). In OECD Europe especially, 19% of total electricity generation in 2017 can be allocated to non-hydro renewables, significantly more than hydro (14%), bringing the total of all renewables to 33% of total generation.

Figure 23. OECD electricity generation in 2017 shares of renewable sources, by region

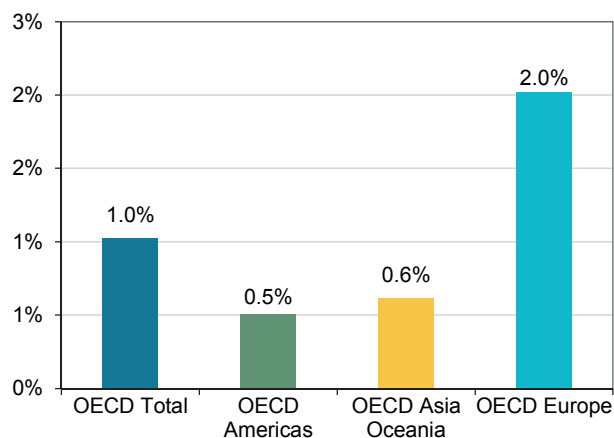


*Other includes geothermal, solar thermal, tide and renewable municipal waste.

Key demand trends in 2016

Alongside trends towards less-carbon intensive electricity generation, 2016 also saw total final consumption (TFC) in the OECD increase by 1% to reach 3 669 Mtoe, 37 Mtoe more than in 2015 (Figure 24). This trend represents the largest increase for the OECD since 2013 (+1.7%) which was followed by a 1% decrease in consumption the following year.

Figure 24. OECD Total final consumption 2015-2016 change by region

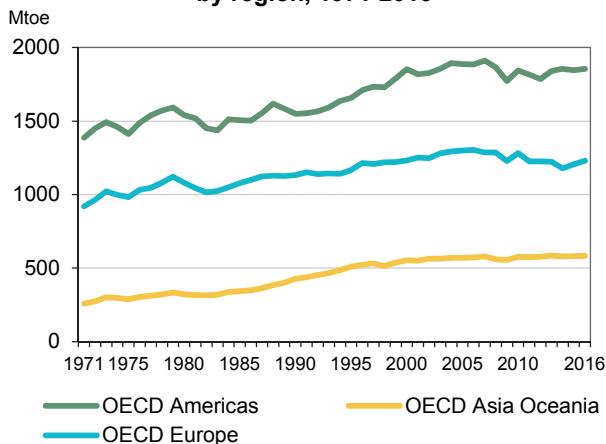


At the OECD regional level, in 2016 final consumption kept increasing for a second year in a row at rates

above 2% in OECD Europe, driven by rises in road transport (+8 Mtoe) and residential (+9 Mtoe).

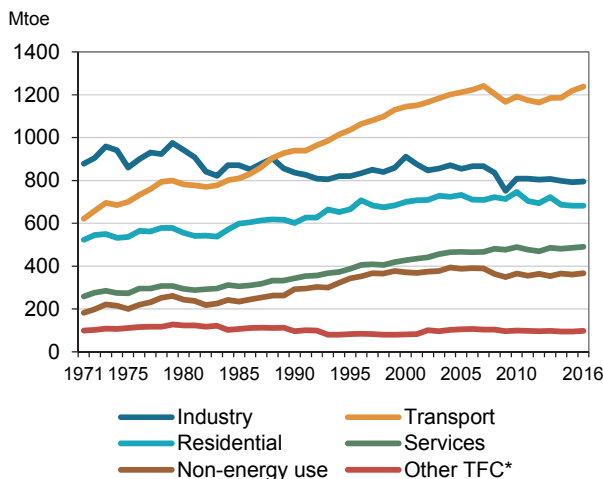
In 2016 TFC increased as well in the other OECD regions at a slower rate of approximately 0.5%. (Figure 25).

Figure 25. OECD Total final consumption by region, 1971-2016



At the sectoral level, the OECD's increase in final energy consumption in 2016 was largely driven by growth in transport (+19 Mtoe). Transport energy consumption increased consistently across the three OECD regions, and accounted for over a third of the OECD TFC. Longer-term trends show that transport has emerged as the largest and fastest growing sector, with the 2016 increase (1.6%) comparable to pre-crisis growth rates and level virtually back to those of 2008 (Figure 26). This increase in transport was particularly significant in road energy consumption in Mexico, Poland, Turkey, and the United States.

Figure 26. Energy consumption per sector in OECD 1971-2016



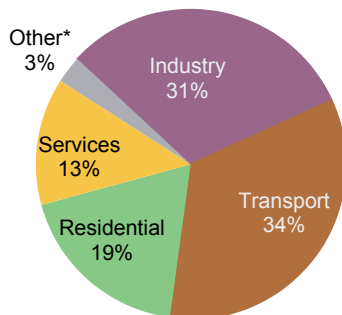
*Other TFC includes agriculture, forestry, fishing and non-specified (other).

On the other hand, energy use in industry, residential and services was on average stable over the last few years across OECD. In 2016 however all these sectors saw a rise in their energy consumption, with increases respectively of 0.4% for industry, 0.1% for residential and 0.9% for commerce and services, at the OECD level.

Residential energy use increased in most northern and continental European countries in 2016 in response to meteorological conditions and colder climate, with reported increases of 8% in Finland, 5% in Czech Republic, Germany and France, 4% in Sweden and Switzerland among others.

The structure of OECD TFC shows that transport was again the largest energy consuming sector in 2016, accounting for roughly a third of final energy consumption, followed by industry with 31% (Figure 27). Such shares were very stable over the last few years, but have reversed since 1971, when industry accounted for 41% of TFC and transport for 24%.

Figure 27. OECD Total final consumption by sector 2016

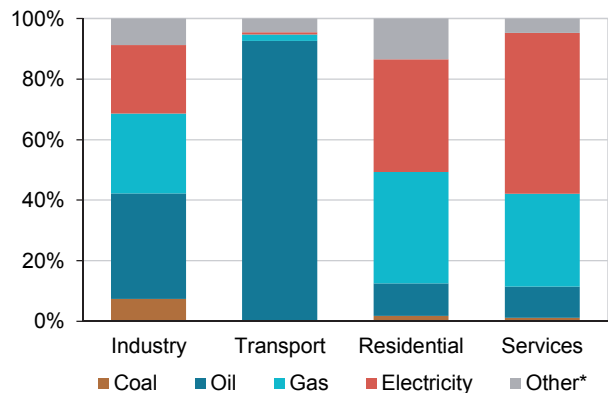


*Other includes agriculture, forestry, fishing and non-specified.

Differences in economic structure affect the energy mix at national level, as sectors use fuels differently. In particular, transport almost completely relies on oil, while residential and services in the OECD use a lot of electricity and gas. Coal, mainly used for electricity generation, is used very little by final consumers (Figure 28). More specifically in 2016, while transport strongly relied on oil products (mainly gasoline and diesel), electricity accounted for 37% and 53% of total energy consumption in residential and commerce/services, respectively, with these shares increasing over time.

With slight variations in TFC and a growing GDP, the general decoupling of economic growth from energy

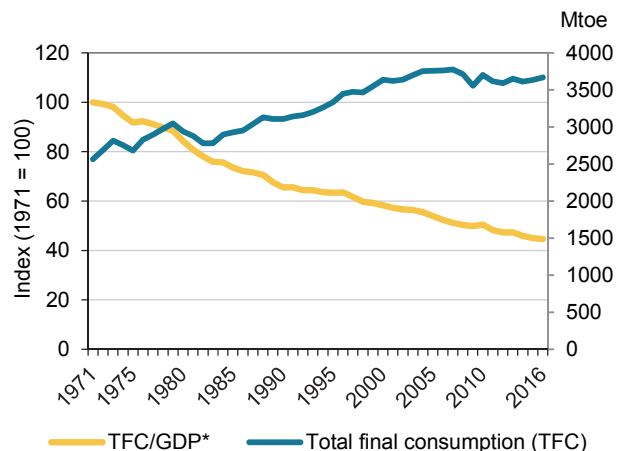
Figure 28. Total final consumption by sector: shares by energy source, 2016



*Other includes biofuels and waste, direct use of geothermal/solar thermal and heat.

consumption observed over the years continued across the OECD (Figure 29). As a result final energy intensity – defined as TFC over GDP – for the OECD decreased significantly since 1971, starting at 0.168 toe per thousand 2010 USD PPP to reach 0.075 in 2016.

Figure 29. Final energy intensity* in OECD 1971-2016



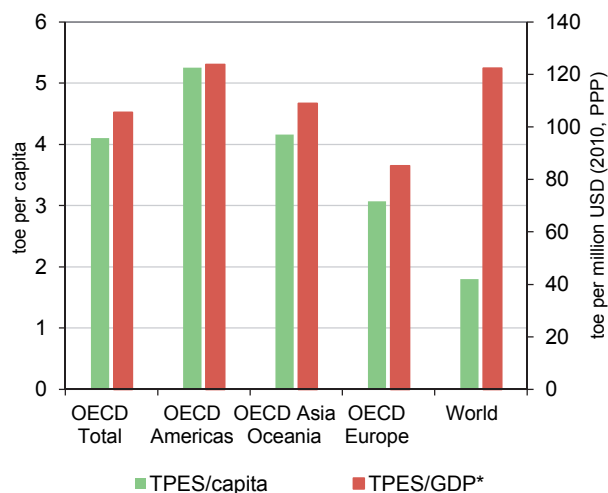
*GDP based on 2010 USD PPP. Total final consumption in Mtoe.

The OECD and IEA in the world

With 4.1 toe per capita in 2017 (compared to a world average of 1.8 toe per capita), the OECD is the most energy-intensive region, in terms of TPES/population (Figure 30). Several factors explain these high levels: an electrification rate of virtually 100%, a high rate of cars per household, large industry and service sectors, high heating degree-days and a high GDP per capita. However, this indicator decreased for the OECD from its 2014 level of 4.2 toe per capita.

While OECD levels of energy per capita are generally larger than the world average by a factor of two, with some regional variations, OECD levels of energy intensity of the economy (TPES/GDP, based on PPP) tend to be slightly lower than the world average, possibly reflecting a less energy-intensive economic structure and a generally more advanced development in efficient use of energy, with high efficiency in transformation and some final consumption sectors.

Figure 30. OECD energy indicators by region 2017



*GDP based on 2010 USD PPP.

While energy intensity is on a declining trend across the whole OECD (27% lower in 2017 compared to 2000), levels have been historically lower in OECD Europe than in OECD Americas, with OECD average comparable with the levels of Asia Oceania since around the year 2005 (Figure 31).

In 2016, the OECD accounted for 17% of global population, 45% of GDP, 39% of TPES and 30% of energy production (Figure 32). These shares have remained stable over the last few years, but we can observe a slight decline in the OECD share of global TPES in 2016 (-0.5%). However, they have significantly changed since 1971, when the region accounted for 61% of the global energy supply, and 65% of GDP.

These shares are significantly larger when considering the full group of countries tightly connected with the IEA: IEA (which in this edition includes Mexico for the first time), its Accession (Chile) and Association countries (Brazil, China, India, Indonesia, Morocco, Singapore and Thailand) altogether accounted for around three quarters of the world GDP and TPES in 2016. More precisely, the IEA family group accounted for 61% of global population, 76% of GDP, 73% of TPES, 56% of energy production, and 70% of TFC.

Figure 31. TPES per GDP of OECD by region 1971-2017

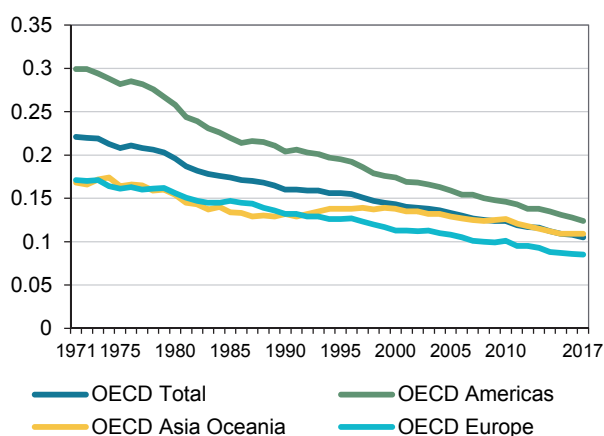
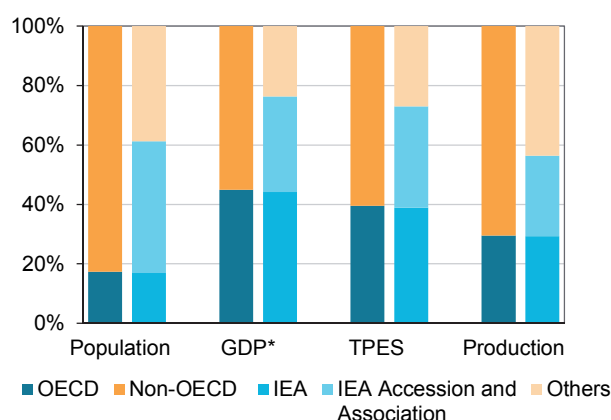


Figure 32. OECD and IEA in the world, 2016



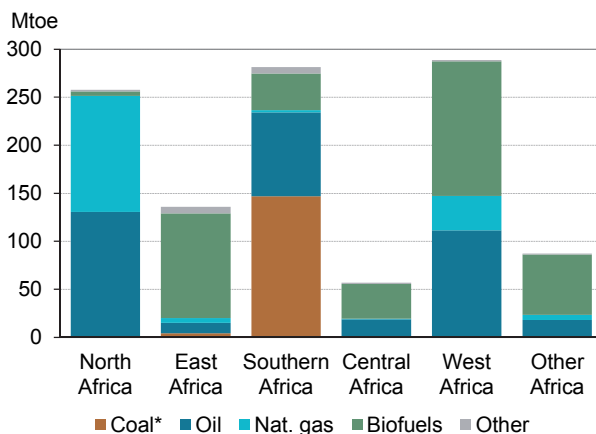
*GDP based on 2010 USD PPP.

Africa

In 2016, Africa produced 8.0% of the world's energy, a similar share as in 1971 (7.8%). African production is dominated by biofuels and waste (35%), and oil (34%), followed by natural gas (15%) and coal (14%). Africa's share of global TPES increased from 3.5% in 1971 to 5.9% in 2016; and despite many African countries being dependent on imports of fossil fuels, as a region it is energy self-sufficient and a net exporter of coal, natural gas and crude oil.

Fossil fuels production is unevenly distributed across Africa (Figure 33). West Africa was the main producer of crude oil in 2016, due to Nigeria (more than 24% of the African crude oil). North Africa produces mainly crude oil and natural gas: in 2016 Algeria accounted for almost 48% of the natural gas and 19% of the crude oil in Africa, and Egypt for 9% of crude oil and 18% of natural gas. Southern Africa is characterized by the high share of coal and of crude oil; South Africa, the fifth largest coal exporter in the world, produced 96% of African coal in 2016 whereas Angola is the second biggest producer of crude oil in Africa, with 23% of the region production. Energy production in East and Central Africa remains dominated by solid biofuels.

Figure 33. Energy production by sub-region in 2016
Africa



* In this graph peat and oil shale are aggregated with coal.

North Africa includes Algeria, Egypt, Libya, Morocco and Tunisia;

East Africa includes Eritrea, Ethiopia, Kenya, Mauritius, Mozambique, South Sudan, Sudan and United Republic of Tanzania;

Southern Africa includes Angola, Botswana, Namibia, South Africa, Zambia and Zimbabwe;

Central Africa includes Cameroon, Congo and Democratic Republic of Congo;

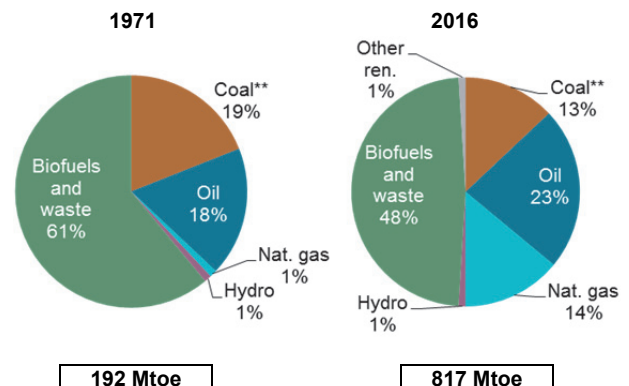
West Africa includes Benin, Côte d'Ivoire, Gabon, Ghana, Niger, Nigeria, Senegal and Togo.

In 2016, Africa's crude oil production continued declining (-5.9%, following -1.3% in 2015, -5.0% in 2014 and -7.9% in 2013), led by Nigeria (-13%) and

Libya (-5%). Production also decreased in Ghana, South Africa and South Sudan (-14%, -17% and -20%, respectively) but increased in Algeria (+2%) and Côte d'Ivoire (+49%, reaching 670 ktoe). Africa represented 8% of world crude oil output and it exported 78% of this production in 2016.

The production and consumption of biofuels (mainly fuelwood) is significantly higher across Africa (48% of total TPES in 2016) than the world average (10% of total TPES). The presence of large forests, agro-industry, agriculture, a large rural population, and a low GDP per capita have resulted in a large use of solid biofuels for cooking. Because of the extensive use of wood and charcoal with its low efficiency, energy intensity⁵ is higher than the world average.

Figure 34: Total primary energy supply* by fuel
Africa



* Excluding electricity trade.

** In this graph peat and oil shale are aggregated with coal.

However, the share of biofuels and waste in TPES, dominated by solid biofuels, has decreased significantly between 1971 and 2016 (Figure 34), due to increased electrification, and particularly the recent development of power generation from natural gas. Natural gas share in TPES increased steeply from 1% in 1971 to 14% in 2016. Coal continued to represent an important share of African TPES (13% in 2016) even if it has declined since 1971. Its share is largely due to South Africa, where coal represented in 2016 89% of the country's primary production, 70% of TPES, 91% of electricity generation and 24% of total final consumption.

In 2016, power generation in Africa was almost nine times the level in 1971 (Figure 35), whilst also seeing a significant change in the fuel mix. Natural gas was barely nil in 1971 but in 2016 provided almost

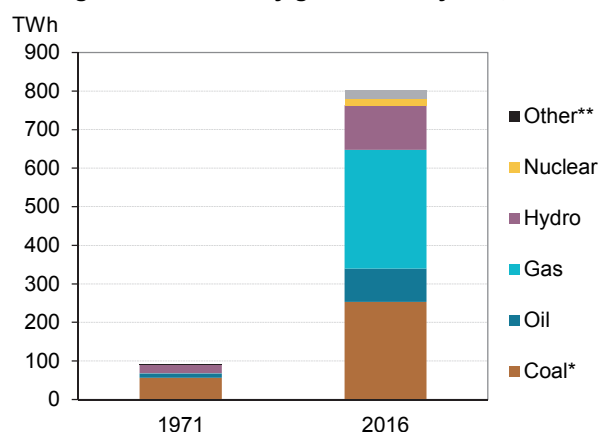
5. Measured by the ratio TPES/GDP.

308 TWh of electricity, a 37% share (compared to 27% in OECD, 40% in non-OECD Europe and Eurasia, and 69% in the Middle East). Its share in the power mix reached even higher level in gas-producing countries such as Algeria (98%), Nigeria (82%), and neighbouring importing countries like Tunisia (96%). In 1971, coal was the first fuel used for power generation in Africa (61%); in 2016 it ranked second after natural gas and accounted for 31% of power generation, providing 254 TWh. Hydro was the second provider of electricity in Africa in 1971 (23 TWh, 26% of the power produced in the continent) and ranked third in 2016 with 116 TWh.

Electricity production reflects the disparity in fossil fuel resources between sub-regions of Africa. In 2016, North African countries plus South Africa, represented only 25% of the population but generated 79% of the electricity in Africa. Access rates are increasing, but electricity remains a scarcity for most Sub-Saharan African countries, with national electrification rates in 2016 averaging 42%, compared

to 51% for the whole continent, but only 22% in rural Sub-Saharan areas, and much less in some countries (2% in Burkina Faso, 1% in Chad, Central African Republic, Djibouti and even less in the Democratic Republic of Congo, Niger or South Sudan)⁶.

Figure 35. Electricity generation by fuel, Africa



* In this graph peat and oil shale are aggregated with coal.

** Other includes non-renewable waste and non-renewable heat.

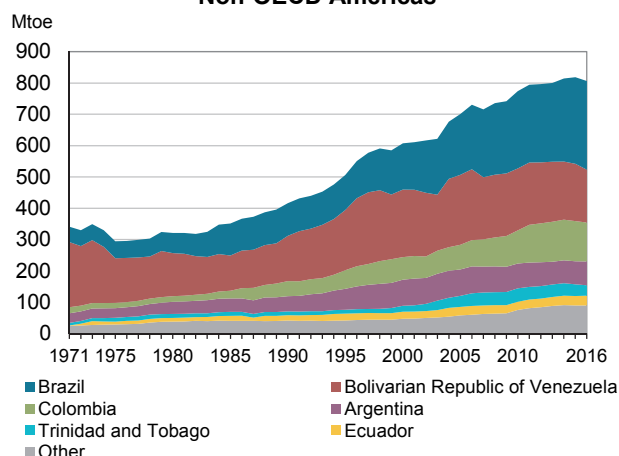
6. Electrification rate extracted from the World Energy Outlook 2017 electricity database: www.iea.org/energyaccess/database/

Non-OECD Americas

In 2016, non-OECD Americas' main energy producers were, in descending order, Brazil, the Bolivarian Republic of Venezuela, Colombia, Argentina, Trinidad and Tobago and Ecuador (Figure 36). Together they produced 89% of the region's total energy production (806 Mtoe). Brazil alone was responsible for 35% of the region's production in 2016.

Non-OECD Americas produced 12 Mtoe less in 2016 compared to 2015. This -1.5% decrease was mainly due to a production drop in Venezuela (-8.1%), Colombia (-2.8%) and Trinidad and Tobago (-9.6%) that the increase of energy production in Brazil (+2.4%), Argentina (+2.7%) and Ecuador (+1.8%) did not offset.

**Figure 36. Energy production by country
Non-OECD Americas**

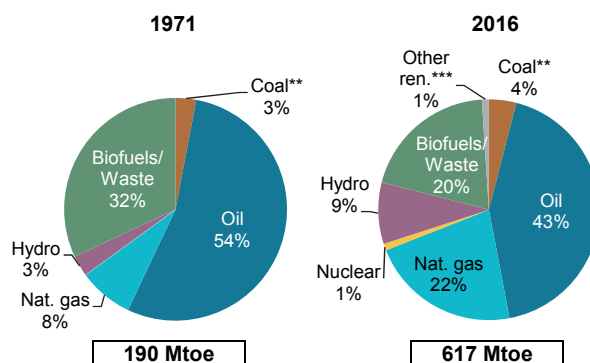


In Colombia, which accounted for 95% of the region's coal, coal production increased by 5.8%, reaching a level of 58.8 Mtoe. In Venezuela, crude oil production declined for the fifth year in a row (-10%). On the contrary in Brazil, non-OECD Americas' second oil producer, crude oil production rose by 3% in 2016. The region's natural gas production was fairly stable in 2016 (+0.4%), as increased production in Argentina (+7.1%) and Venezuela (+6.6%) was offset by lower productions in some of the region main providers, Trinidad and Tobago (-9.5%) and Bolivia (-4.7%).

Overall the energy mix in non-OECD Americas in 2016 was similar to 2015: oil provided the biggest share of TPES in the region (43% - Figure 37), followed by natural gas (22%) and biofuels and waste (20%).

Thirty-one per cent of Non-OECD Americas TPES came from renewables, whereas this share was only 14%

**Figure 37. Total primary energy supply* by fuel
Non-OECD Americas**



* Excluding electricity trade.

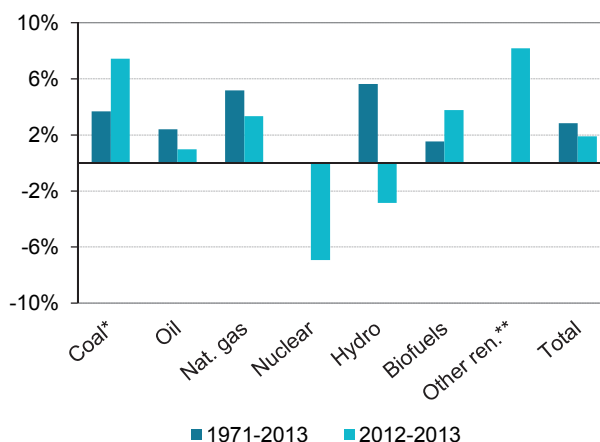
** In this graph peat and oil shale are aggregated with coal.

*** Includes geothermal, solar thermal, solar photovoltaic and wind.

in the world. With a 20% share of the TPES (twice more than globally), liquid biofuels (and in particular transport biofuels in Brazil) in addition to traditional solid biofuels, are significant in non-OECD Americas. Following a steady 3% increase in the last three years, biofuels production increased at a slower pace (+0.7%) in 2016. On the contrary, after four years of decline, hydro production increased by 3.8% in 2016, mainly due to the higher production in Brazil (+5.9%) and Paraguay (+14.4%). Hydro accounted for 55% of total Non-OECD Americas power generation, a much higher share than globally (16%).

In 2016, other renewables (solar thermal, solar photovoltaic, wind, geothermal), saw a 21% increase in production compared to 2015 (Figure 38), led by a +41% production increase in Brazil, the biggest producer of other renewables in the region.

**Figure 38. Annual change in TPES by fuel
Non-OECD Americas**



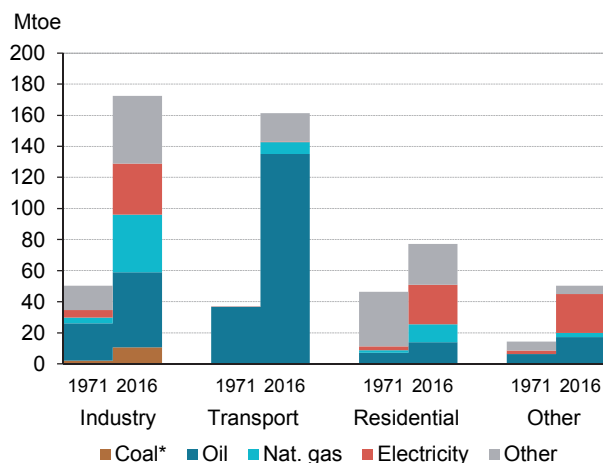
* In this graph peat and oil shale are aggregated with coal.

** Includes geothermal, solar thermal, solar photovoltaic and wind.

In 2016, industry remained the biggest energy consuming sector (37%), followed by transport (35%) and residential (17%). Industry increased from 50 Mtoe in 1971 to 173 Mtoe in 2016. However, transport saw the largest increase in growing energy final consumption by more than four times since 1971 (Figure 39). Residential nearly doubled over the period, and ranked third in 2016.

In 1971, oil accounted for half of total final consumption (TFC) and it peaked at 55% in 1979 before the second oil crisis. However the increasing role of electricity and gas in the residential and the industry sectors lead to a slowly diminishing share of oil in TFC to 46% in 2016. The share of electricity has almost tripled during that period, reaching 18% in 2016. Natural gas consumption increased from less than 4% to 13%, mainly driven by industry (from 7% to 22%) and residential (from 4% to 15%) use.

**Figure 39. Total final consumption
by sector and fuel
Non-OECD Americas**

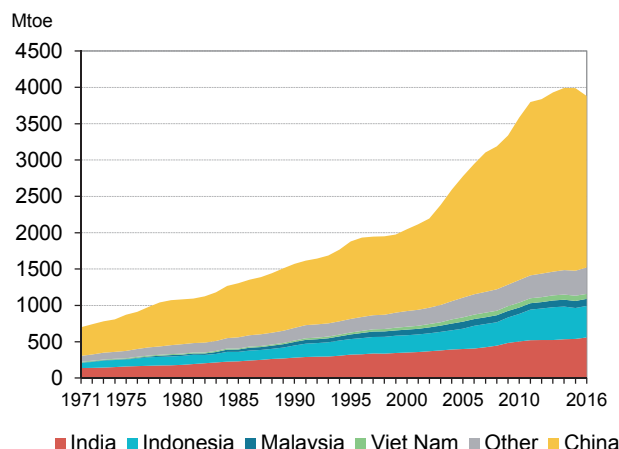


* In this graph peat and oil shale are aggregated with coal.

Non-OECD Asia

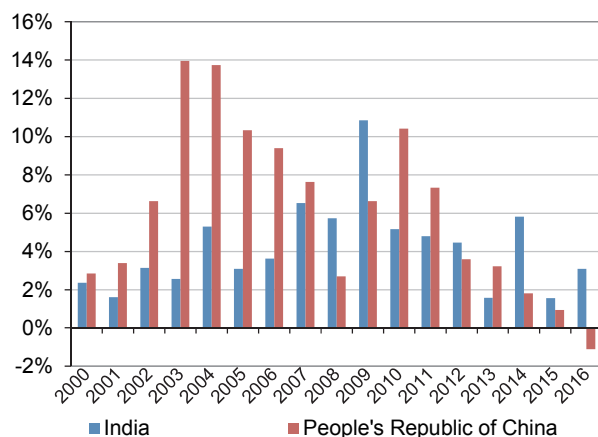
Since the early 1990s non-OECD Asia has been the second largest energy producing region in the world behind the OECD, accounting for almost 28.2% of global production in 2016. China alone provided 60.8% of energy production in the region in 2016 (Figure 40) compared to 63.0% the previous year. India and Indonesia together accounted for a quarter of the region production (14.4% and 11.2% respectively).

**Figure 40. Energy production by country
Non-OECD Asia**



In 2016, non-OECD Asia's total primary energy supply (TPES) increased again, but at a much slower rate compared to previous years (+0.5% in 2016 compared to 1.2% in 2015 and +2.7% in 2014). It thus seems decoupled from the economic growth, where GDP increased by 6.1% in Asia in 2016. This decoupling is particularly true in China, where GDP increased by 6.6% in 2016, while TPES decreased by 1.1%. In India, GDP increased by more than 7% in 2016 whilst

**Figure 41. TPES annual change
India and People's Republic of China**

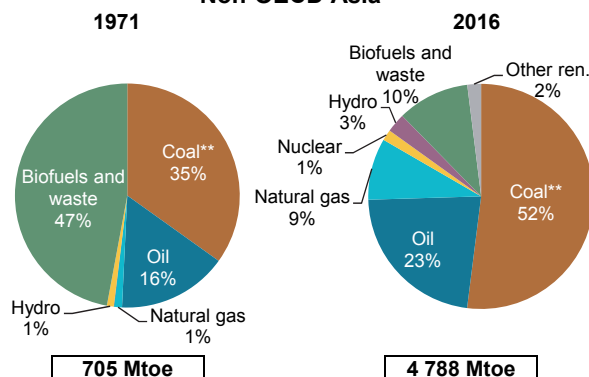


TPES increased by 3%. TPES in India has been growing at a rate of 5.0% per annum since 2006, compared to 3.4% between 1996 and 2006, and is now growing at a faster rate than in China (Figure 41).

In 2016, non-OECD Asia accounted for 34.8% of global TPES. However, since its production does not cover its demand, the region is a net importer. China and India's self-sufficiency continued to decline in 2016 (79% and 65% respectively) since they peaked - at 108% in 1985 for China and 96% in 1984 for India. Indonesia covered 189% of its energy needs in 2016, but still is a net importer of crude oil.

In 2016, the share of biofuels in TPES decreased to 10% from 47% in 1971; natural gas has reached 9% of TPES, from negligible in 1971. Coal has been by far the main energy source in non-OECD Asia since 2012, supplying more than half of its energy demand (Figure 42), compared to 27% globally. This is also the case in the main energy consuming countries (Figure 43).

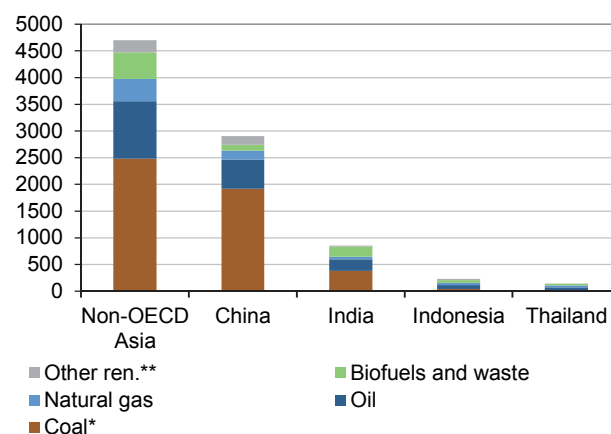
**Figure 42. Total primary energy supply* by fuel
Non-OECD Asia**



* Excluding electricity trade.

** In this graph peat and oil shale are aggregated with coal.

**Figure 43. TPES by country in 2016
Non-OECD Asia**

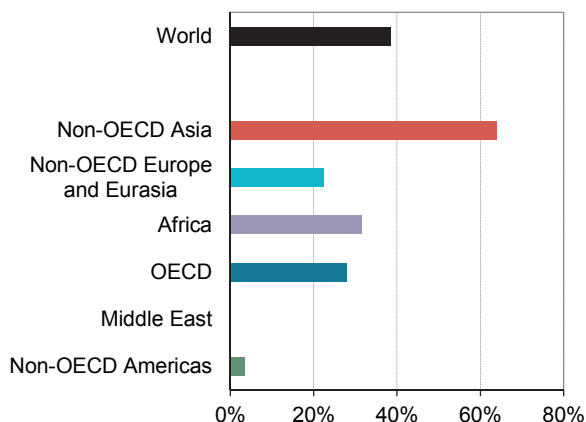


* In this graph peat and oil shale are aggregated with coal.

** Includes geothermal, solar thermal, solar photovoltaic and wind.

Coal's significance is partly explained by its use in power generation: in 2016, coal represented 64% of the regional electricity mix, versus 38% globally (Figure 44). Coal provided 69% of electricity in China, 75% in India and 54% in Indonesia. In China, the power mix is gradually shifting from coal to other sources of energy (natural gas, nuclear, hydro and other renewables).

Figure 44. Share of coal in electricity generation in 2016

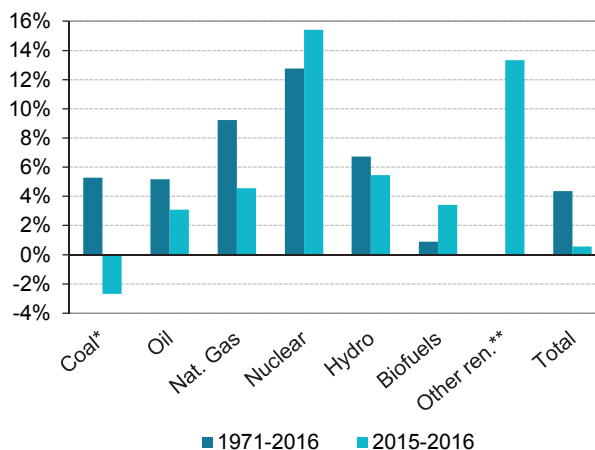


In 2016, total electricity generation in non-OECD Asia increased by 6.1%, mainly driven by India (+7.6%, almost 1 500 TWh produced in 2016) and China (+5.9%, close to 6 200 TWh produced in 2016). Electricity production has grown in the region at an average annual rate of 8.1% since 1971.

The use of coal in TPES decreased in 2016 whilst the use of oil, gas, biofuels and hydro increased. However, the most significant growth came from nuclear followed by other renewables (geothermal, solar photovoltaic, solar thermal and wind, Figure 45).

Total final consumption in non-OECD Asia has increased by five times over four decades (Figure 46) and the mix has changed considerably. The share of traditional biofuels (biomass, waste) has fallen to a third of its 1971 level (53% of total energy consumption in 1971 compared to 13% in 2016), resulting in coal, with approximately the same share in 1971 and 2016 (29% and 27% respectively) now being the biggest fuel consumed. The share of oil in total final consumption has doubled (from 15% to 30%), and that of electricity rose from 3% to 20%. With a seven-fold increase, industry is by far the biggest energy consuming sector in non-OECD Asia, representing 51% of the region total final consumption in 2016.

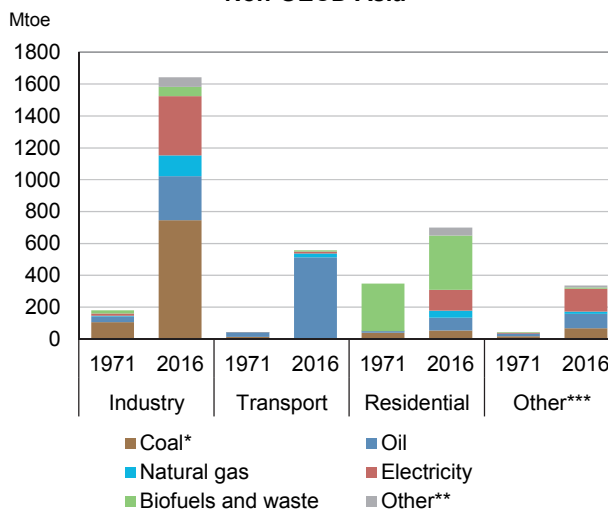
Figure 45. Annual growth in TPES by fuel Non-OECD Asia



* In this graph peat and oil shale are aggregated with coal.

** Includes geothermal, solar thermal, solar photovoltaic and wind.

Figure 46. Total final consumption by sector and fuel Non-OECD Asia



* In this graph peat and oil shale are aggregated with coal.

** Includes direct use of geothermal, solar thermal and heat.

*** Includes non-energy use.

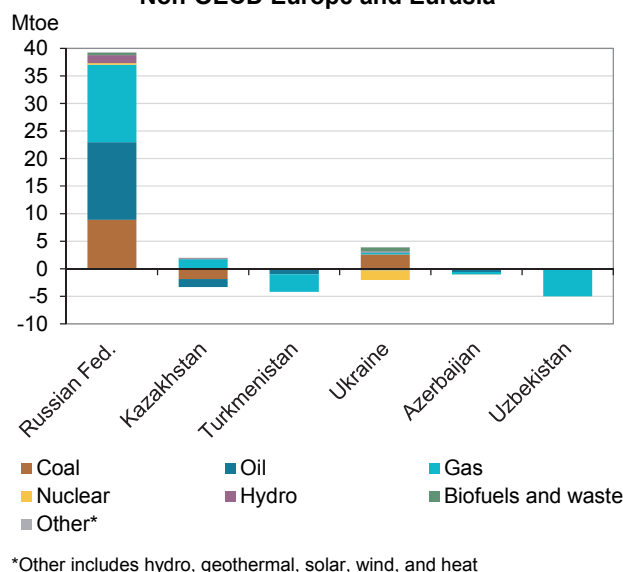
Though coal is still the main fuel consumed in industry (45% in 2016) it is now followed by electricity (23%).

The residential sector is now the second largest consumer behind industry, and has doubled between 1971 and 2016. Though traditional biomass is still the main fuel consumed in the residential sector, electricity, oil and natural gas have significantly increased. Energy consumption has multiplied 13 times in the transport sector, relying mainly on oil.

Non-OECD Europe and Eurasia

In 2016, total energy production in non-OECD Europe and Eurasia increased by 1.5% (+27 Mtoe), contrasting with a decline observed in all other regions except the Middle East. This growth was largely driven by a 2.9% increase of energy production in the Russian Federation, which represented 74% of the total regional production. Production of natural gas, crude oil and coal all increased in the Russian Federation between 2015 and 2016 (by 14 Mtoe for the two former, and by 9 Mtoe for the latter). By contrast, energy production decreased in all other major energy producers in the region, except Ukraine (Figure 47).

Figure 47. Top producers
Annual change in production in 2016
Non-OECD Europe and Eurasia

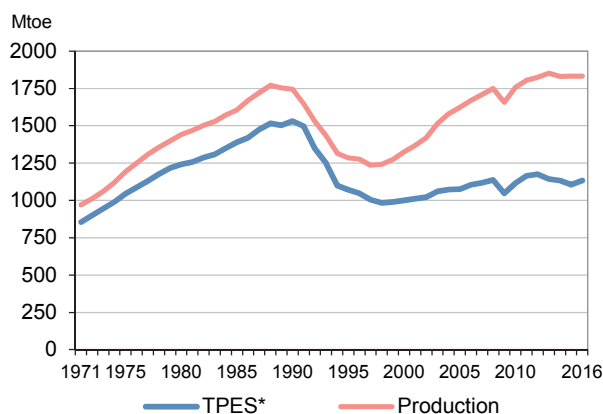


Preliminary data for 2017 shows that the Russian Federation was the second world's largest producer and remained the first net exporter of natural gas (respectively 694 bcm and 217 bcm), the third largest producer of crude oil (548 Mt), and was the sixth largest producer and third net exporter of coal (161 Mt). Turkmenistan remained the sixth largest exporter of natural gas and Kazakhstan the eighth largest exporter of coal.

Energy production is very unevenly distributed across non-OECD Europe and Eurasia. Although the region as a whole is energy self-sufficient (Figure 48), it includes some of the most energy import-dependent countries in the world: in 2016, only 3% of Malta's energy consumption was covered by domestic production.

The self-sufficiency ratio was 6% for Cyprus and 15% for Belarus. In contrast, Azerbaijan produced four times more energy than it consumed.

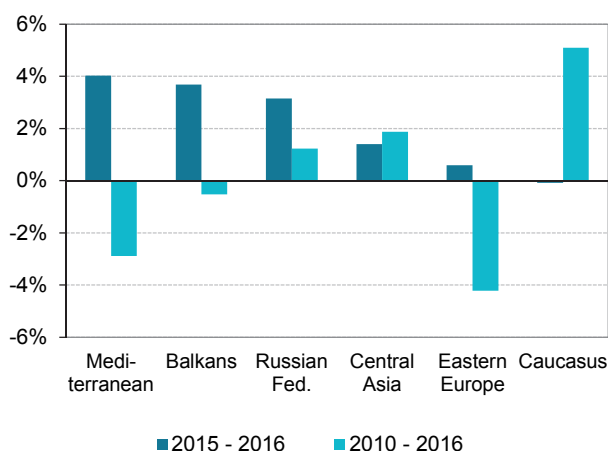
Figure 48. Energy production and use, 1971-2016
Non-OECD Europe and Eurasia



*Excludes electricity trade.

In 2016, energy use as measured by the Total Primary Energy Supply (TPES) in non-OECD Europe and Eurasia increased by 2.4% (27 Mtoe), the first annual increase observed since 2012. At sub-regional level, the highest growth (4%) was observed in the Mediterranean countries Cyprus, Gibraltar and Malta (Figure 49). These countries however represented less than 1% of the region. The Russian Federation's energy use increased by 3.1% (22 Mtoe) between 2015 and 2016.

Figure 49. Annual average change in total primary energy supply by sub-region
Non-OECD Europe and Eurasia



Balkans is Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Former Yugoslav Republic of Macedonia, Kosovo, Montenegro, Romania and Serbia;

Caucasus is Armenia, Azerbaijan and Georgia

Central Asia is Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan;

Mediterranean is Cyprus, Gibraltar and Malta

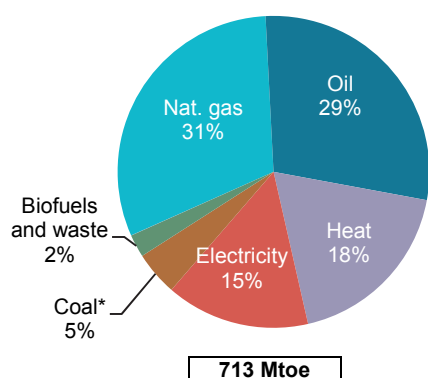
Eastern Europe is Belarus, Moldova, Ukraine and Lithuania.

Note: Estonia, Latvia and Slovenia are OECD members. Lithuania was not an OECD Member at the time of preparation of this publication. Accordingly, Lithuania does not appear in the list of OECD Members and is not included in the zone aggregates.

Energy use also increased in Ukraine (+1.6%) and Kazakhstan (+5.0%), respectively the second and third largest energy consumers in the region.

In 2016, natural gas had the largest share in the regional total final consumption (31%), followed by oil (29%), heat (18%) and electricity (15%). Biofuels and waste represented only 2% of total final consumption in non-OECD Europe and Eurasia in 2016, but this share is likely underestimated (Figure 50): for instance, Georgia and the Republic of Moldova were recently able to carry out a detailed survey on household consumption which revealed that biofuels and waste are a main source of energy for households.

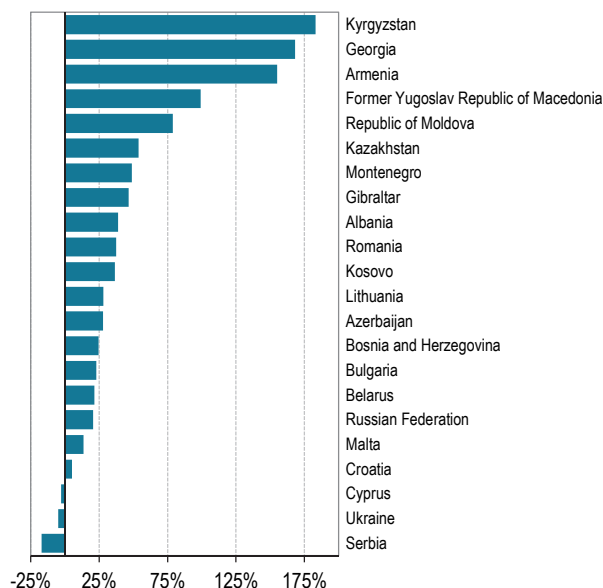
**Figure 50. Total final consumption by fuel
Non-OECD Europe and Eurasia
2016**



* In this graph peat and oil shale are aggregated with coal

Over the past decade (2006-2016), road transport consumption in non-OECD Europe in Eurasia has increased by 23%, increasing demand for oil products. Road transport consumption more than doubled in Armenia and Georgia -Figure 51).

**Figure 51. Road transport,
change in energy consumption 2006-2016
Selected countries - Non-OECD Europe and Eurasia**

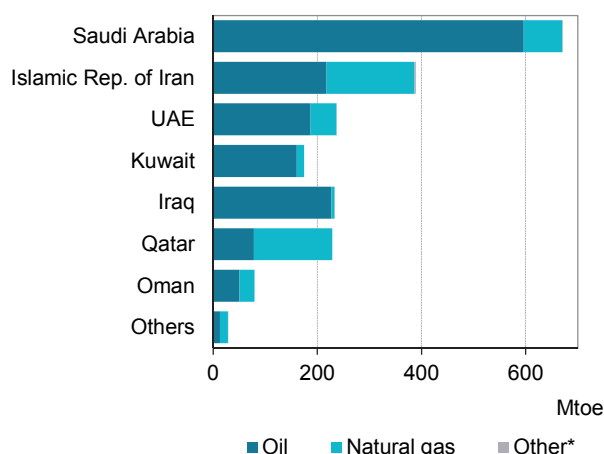


The regional electricity mix in 2016 was dominated by natural gas (40%), followed by coal (22%), and nuclear (17%). Non-OECD Europe and Eurasia was the second largest nuclear-producing region in the world, with the Russian Federation, Ukraine, Bulgaria, Romania, and Armenia producing a total of 307 TWh (11.8% of world). Renewables, largely hydropower, accounted for 19% of the regional electricity mix in 2016, with a record high share in Tajikistan and Kyrgyzstan (over 90% of power generation). Solar and wind electricity generation, though increasing (+1.9% from 2015), accounted only for 1.0% of regional electricity output.

Middle East

With energy production more than 2.5 times as large as its demand, the Middle East has the highest energy self-sufficiency ratio in the world. The region produced nearly 15% of global energy in 2016, an increase from just over 13% for the previous five years. This growth is largely driven by oil and gas, where the Middle East produced 34% of global oil, and nearly 17% of the world's gas. The Middle East's global share of natural gas production has increased every year since 1997.

**Figure 52. Energy production in 2016
Middle East**



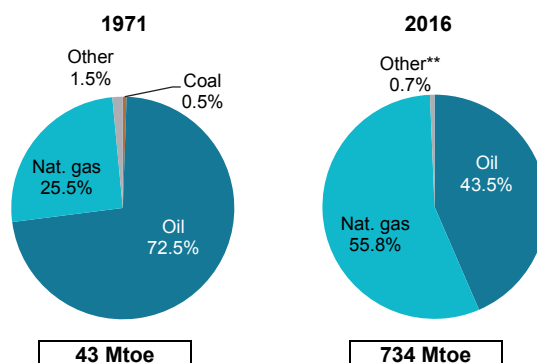
* Includes coal, nuclear, hydro, other renewables, biofuels and waste

Saudi Arabia was still by far the largest oil producer in the region with 39%, followed by Iraq and Iran, with 15% and 14% respectively (Figure 52). With 33% of the Middle East's natural gas production, Iran maintained its position as the region's largest producer of natural gas in 2016, closely followed by Qatar at 30% of the regional production. Iran's natural gas production increased by 9% in 2016, indicating faster growth compared to the 5% increase seen in 2015. Meanwhile natural gas production in Qatar was fairly steady with 1% growth in 2016 compared to 3% in 2015.

In 2016, the major growth in oil production was seen in Iran and Iraq, with 33% and 28% respectively. Other notable growth in oil production was seen in Kuwait and Qatar, each with 4%. Oil production continued to decline in Syria (-5%) in 2016, though not as drastically as in 2015 - with a nearly 40% decline. Similarly, Yemen also saw a dramatic deterioration of oil production, with a 39% drop due to political unrest and the halting of oil and gas activities in 2015.

Alongside increasing its production, the Middle East is also the fastest growing region in terms of TPES. Over the period from 1971 to 2016, TPES grew on average by 7% per year. In 2016, this supply is almost exclusively based on oil and natural gas (Figure 53). Natural gas has partially displaced oil, more than doubling its share between 1971 and 2016.

**Figure 53. Total primary energy supply* by fuel
Middle East**

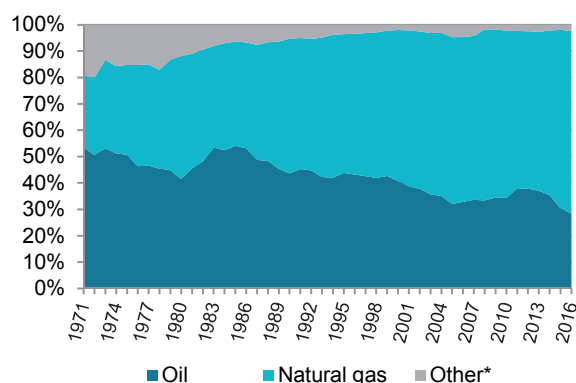


* Excluding electricity trade.

** Includes coal, nuclear, hydro, other renewables, biofuels and waste

Key factors driving the rapid development of natural gas in the Middle East are power generation and the petrochemical sector. This is illustrated by the share of oil in electricity production continuing to shrink, starting with 54% in 1971 and reaching 28% in 2016 (Figure 54).

**Figure 54. Electricity generation by source
Middle East**



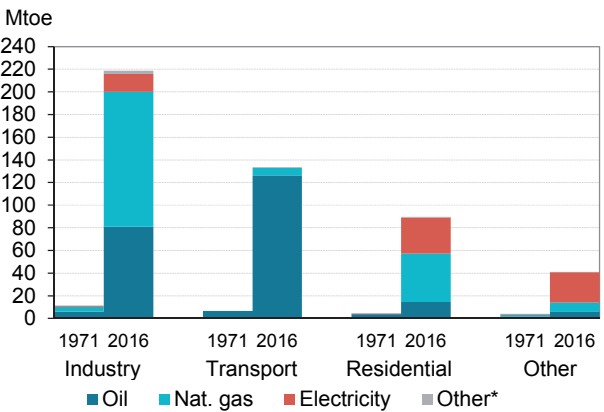
* Includes coal, nuclear, hydro, other renewables, biofuels and waste.

In contrast, the share of natural gas in electricity production continually increased, from 27% to 69% in the same period. In 2016, natural gas continued to provide almost all the electricity generated in Bahrain, Qatar, the United Arab Emirates, and in Oman. In Iran and Jordan, natural gas's share in electricity generation

reached over 80% in 2016. In Jordan, this change has come swiftly, with natural gas generating just 48% of the electricity in 2015, as a result of the government promoting the fuel swap.

Over the last four decades, total final consumption expanded in all sectors, particularly industry and transport, which increased twenty fold. In 2016 oil accounted for 95%, 37% and 16% of final consumption in transport, industry and residential, respectively (Figure 55). Oil is responsible for 47% of total energy consumption in the Middle East. Also in 2016, natural gas met 55% and 47% of final consumption in industry and residential, respectively. Electricity tripled its share in final energy consumption from 5.6% in 1971 to 15.5% in 2016.

Figure 55. Total final consumption by sector and fuel
Middle East



* Includes coal, other renewables, biofuels and waste