A World of Energy

2019 Edition

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Group Strategy Department

More than any other factors, threats to the global climate change and to natural resources have forced the energy sector to embrace far-reaching change. Although the required direction of travel is now better understood, progress can be difficult to measure and its results are uncertain.

It is our task at ENGIE Group Strategy to size up current developments and future trends over and above the often mixed messages coming out of day-to-day news. This is what we attempt to do in this annual report, which offers thorough and factual analysis of the energy market.

Our first observation is that world energy trends carry considerable inertia. A recovery in emerging countries' economies in 2018 prompted an upturn in coal consumption, ensuring higher CO_2 emissions. Temperatures have risen further and there are more and more extreme climate events. Climate change sceptics have bounced back on the international stage, and despite another alarming report from the IPCC, COP24 failed to tighten environmental constraints.

Exiting coal is essential in reaching environmental objectives. It is manifestly under way in the European Union and accelerating in the USA, where shutdowns of coal-fired plants have multiplied despite the relaxation of environmental constraints under the Trump administration. China is also looking to curb its use of coal, but its share of the energy mix still makes it indispensable in emerging countries.

Likewise, the improvement of energy efficiency, essential pillar of the energy transition, is still insufficient to curb global energy demand; harnessing its full potential requires doubling its pace of development and tripling investment, in priority in three sectors: industry in China, transportation in North America and building in Europe.

That said, there are plenty of signs that things are changing, sometimes quite rapidly. That goes for electricity generation, for example, where renewables accounted for 65% of new capacity over the last two years. The electricity sector, which is undergoing a major transformation, will have to address many challenges: the integration of RES and the availability of metals used by these technologies, dynamic demand management, the profitability of electricity storage using batteries in the short term but also green gases, hydrogen and methane, in the longer term.

Less carbon-intensive, natural gas is the favoured alternative to meet ever-growing energy needs. Already part of the IEA and Greenpeace "2 degrees" objectives, gas is intended to achieve carbon neutrality through biogas and power-to-gas. This would help resolve large-scale and long-term RES power storage issues, and also pave the way for decarbonisation of uses that are difficult to electrify.

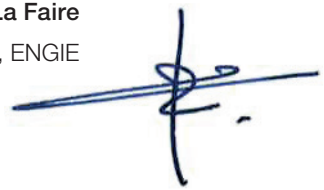
2018 was a record year for citizen action on climate change. Circular economy principles such as recycling and shared use generated heightened interest, while the EU passed its Clean Energy Package in November 2018. This aims at a 40% cut of its GHG emissions by 2030.

These comments drawn from our 2018 overview show the global energy situation at a crossroads. This new edition of A World of Energy explains why in some detail.

I hope this report proves useful to you and your work,

Antoine de La Faire

Director of Group Strategy, ENGIE



Our group is a global reference in low-carbon energy and services. In response to the urgency of climate change, our ambition is to become the world leader in the zero carbon transition "as a service" for our customers, in particular global companies and local authorities. We rely on our key activities (renewable energy, gas, services) to offer competitive turnkey solutions.

With our 160,000 employees, our customers, partners and stakeholders, we are a community of Imaginative Builders, committed every day to more harmonious progress.

Turnover in 2018: 60.6 billion Euros. The Group is listed on the Paris and Brussels stock exchanges (ENGI) and is represented in the main financial indices (CAC 40, DJ Euro Stoxx 50, Euronext 100, FTSE Eurotop 100, MSCI Europe) and non-financial indices (DJSI World, DJSI Europe and Euronext Vigeo Eiris – World 120, Eurozone 120, Europe 120, France 20, CAC 40 Governance).

ENGIE profile

Key figures at December 31, 2018

- **160,000** **employees** throughout the world
- **€60** **billion** in 2018 revenues
- **€12** **billion** of investments planned between now and 2021, including about **€5 billion** in customer solutions, nearly **€2.5 billion** in renewable energies, and close to **€3billion** in gas and electricity networks
- **9** **GW** of additional renewable capacity between 2019 and 2021
- **2** **drivers of growth:** customer solutions and renewables
- An investment fund of **€50** **million** to support energy access

ÉLECTRICITY

104.3 GW of installed power-production capacity of which **24.8 GW** in renewable energy (24% of the portfolio)

420 TWh of electricity generated in 2018

No.2 electricity producer and supplier in France

No.1 in solar and wind energy in France

No.2 purveyor of installed EV charging stations

NATURAL GAS

Long-standing leader in gas distribution in France

Among the top gas sellers and importers in Europe

No.1 gas infrastructure operator in Europe with a portfolio including transmission networks, distribution networks, storage, and LNG terminals

€800 million pledged within the next five years to develop green gases

No.1 demonstrator of green hydrogen injection in the French gas distribution network

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Summary

The energy market in 2018: overview and key issues

Economy & Energy mix: 2017–2018 overview

The world economy posted mixed performance in 2018: behind a very satisfactory global performance, driven by US dynamism, protectionist temptations threaten long-term stability. China's growth is slowing down, as the country shifts from accumulating capital to fostering innovation and domestic consumption, a model that is inherently more moderate in terms of growth. Higher oil prices in 2018 have supported commodities-based economies (Russia, the Arabian Peninsula countries).

World energy production is enjoying a period of dynamism that began in 2017 (+2.3%) and continued in 2018, with an increase in gas (+5%), oil (+2.4%) and coal (+1%) production, according to first estimates. This is due to the strong health of the global economy, which resulted in a significant recovery in emerging countries' energy needs, and to a 2017 and 2018 rise in fossil fuel prices that boosted production.

Final energy demand accelerated in 2017 and 2018 (+2.5% in 2017 after +1.1% in 2016) driven by electricity consumption (+2.6% in 2017), which is fueled by global economic growth, increasing electricity uses and electrification rates around the globe, and by natural gas (+4%) that boasts greater competitiveness and substitution against coal.

Energy efficiency, close to its upward trend of +1% per year (+1.1% in 2017; excluding structural effect) **remains largely insufficient** to achieve environmental objectives. They require an annual improvement of +3.4% to contain the temperature increase below 2°C.

CO_2 & climate: 2017–2018 overview

2018 brought no reassurance on climate change. The uptrend in the world's man-made CO_2 emissions resumed at a similar rate to that of the past decade (up 2.7%).
Extreme weather resulted in increasingly severe human and environmental damage (2018 World Meteorological Organization report), with around 2.3 million people forced to leave their homes.
The November 2018 IPCC report on the consequences of a 2°C and a 1.5°C temperature rise, although alarming, did not succeed in convincing governments to tighten constraints or step up their individual commitments to reduce CO_2 emissions (INDCs) at COP24.
Global warming sceptics and fossil fuel industries' interests bounced back on the international scene. At the same time, world economic growth boosted energy needs in emerging countries that are still heavily reliant on coal.

Unprecedented signs emerged from civil society. This was particularly true of young people, who like the Swedish activist Greta Thunberg at COP24, helped spread the climate change message across the world. **2018 was a record year for citizen activism around climate change,** and legal proceedings against states have become more and more numerous. **The EU passed its Clean Energy Package** (CEP) **in November 2018,** which incorporates an objective to reduce GHG emissions by 40% from their 1990 levels by 2030. In doing so, the EU not only complies with the Paris Agreement but has also asserted its leadership in renewable energy.

Electricity: 2017–2018 overview

The growth of renewable energy in the global electricity mix has intensified further in the last two years; in 2017, they accounted for 65% of additional electrical capacity and 50% of electricity production growth. Today, they are equal to coal capacity and account for a quarter of global electricity generation.

But the surge in electricity demand in the past two years also pushed coal generation in developing countries, especially in Asia; coal is still feeding 38% of global power generation and 69% in Asia. By contrast coal generation has been retreating in Europe and the US, triggered by increasing rates of coal capacity retirements in 2018.

World electricity consumption continues mounting owing to rising incomes and burgeoning electrification in developing countries, while digitalization and extended use of electricity are the major drivers in advanced economies. Thus in 2018, with the support of the global economy, electricity demand has increased noticeably in all regions, while the trend over the decade was rather moderate (annual average of +2% since 2010).

In Europe, tight environmental policies have a direct impact on the electricity market, particularly noticeable in 2018: while wholesale prices increased by almost +30%, in the wake of rising carbon prices, the frequency of negative hourly wholesale prices heightened due to the very high rates of wind and solar penetration. Likewise, residential electricity prices in the EU have over the years increased much in line with the rise in renewable support to developers that are passed through to consumers.

Natural gas: 2017–2018 overview

- **Higher prices and good demand prospects are boosting natural gas production in the major basins.** World natural gas output is expected to have increased by 5% worldwide in 2018 (ENGIE estimates). It rose to record levels in the USA, climbing 9% on the back of buoyant domestic demand, as well as in Russia, where it jumped 5% amid higher exports to Europe.
- **In Europe, natural gas production contracted again** (down 4% in 2018). Its gas fields are maturing and Dutch production had to be cut following earthquakes in the Groningen field.
- **Chinese production** is approaching levels of Norwegian and Dutch output combined.
- **Shale gas has become an integral part of the world gas market** but production has still not developed significantly outside North America.
- **Early figures for 2018 show vigorous gas consumption** (an estimated 4% increase), especially in North America and Asia. A stronger world economy in 2018 and environmental policies have favoured gas use, even though temperatures have been particularly warm over the past four years.
- **IEA 2017 forecasts published in the 2018 World Energy Outlook confirm the prominence of natural gas:** it is the only fossil energy whose share in the energy mix is set to increase in all three scenarios – New Policies (reference scenario), Current Policies and Sustainable Development.
- **LNG international trade expanded nearly 10% in 2018, driven in almost all regions by increased demand.** Pipeline gas trade with Europe, the main buyer of gas in this form, rose 1.5%. 2017 and 2018 saw confirmation of a recovery in international trade that started in 2016, reflecting depleted European fields and strong Asian demand. Thanks to their flexibility, Floating Storage and Regasification Units (FSRU) have opened new LNG markets.
- Having severely weakened into 2016 in a context of abundant supply, gas prices picked up on the European and Asian markets in 2018. At around $3/MMBtu, Henry Hub prices recovered slightly from their depressed 2016 levels.

Oil: 2017–2018 overview

World oil production renewed with growth in 2018, rising 2.4% driven mainly by higher output in the USA, Canada, Iraq and Iran. Surging unconventional oil production has meant that the USA has been the world's leading oil producer since 2017, ahead of Saudi Arabia and Russia.

The rebalancing of the oil market was confirmed in late 2017 and into 2018. Prices rose until October 2018, but fears of overproduction, particularly in the USA, and signs of faltering world economic growth weighed heavily on the market and prices fell dramatically into year-end.

Oil consumption increased 1.6% in 2018 following a 1.7% gain the previous year. The USA remained the largest world consumer, although growth in the transport and petrochemical sectors in Asia is reducing its lead. Demand for oil for power generation and heating is declining worldwide.

Oil prices rose steadily through 2017 and 2018 on the back of agreement between OPEC and its partners. The Brent crude average climbed from $54 in 2017 to $71 in 2018. Prices are still volatile however, driven largely by world growth forecasts, US unconventional oil production levels and quota compliance within OPEC.

Coal: 2017–2018 overview

The death of coal has been exaggerated, certainly among commentators in Europe, after four years of declining world consumption (-1% per year in 2013-17). The coal industry has proved to be more resilient than expected, with demand increasing almost 1% in 2017 and 2018. Heightened electricity requirements in Asia were partly responsible.

The EU is clearly moving out of coal (-2% in 2017 and 2018), even in the electricity sector where consumption has dropped 30% since 2000 and by 4% in 2017. The situation is slightly different for Europe as a whole as demand remains strong in Turkey (up 4.9% in 2017).

In the USA, Donald Trump's pro-coal policy – a reversal of Barack Obama's Clean Power Plan – is failing to revive demand. Coal consumption has been trending lower since 2000 (-2% per year). More and more American coal-fired plants are closing down: the number of closures doubled between 2017 and 2018.

Coal production rebounded 2.9% in 2017 after a 5.5% slump the year before that China had orchestrated to boost prices. It increased again in 2018. China is the world's leading coal producer and slashed output 8% in 2016 to absorb persistent world overproduction; it increased output by 3.3% in 2017 to meet domestic demand. Most producer countries did the same, except Germany, Poland and Australia.

Chinese measures to purge coal stocks had their desired effect, with prices reverting to high levels. By controlling domestic production and imports, the Chinese government is effectively regulating international coal prices. Its objective is to maintain a $65-75 per tonne range (450-525 yuan) over the medium term. Prices exceeded this target in both 2017 and 2018, however: CIF ARA coal imported into Europe hit $85 per tonne in 2017 and $92 per tonne in 2018, encouraging the opening of new Chinese mines and boosting world production.

GDP

The 2018 global growth rate remains constant compared to 2017 (+3.7% real GDP growth)

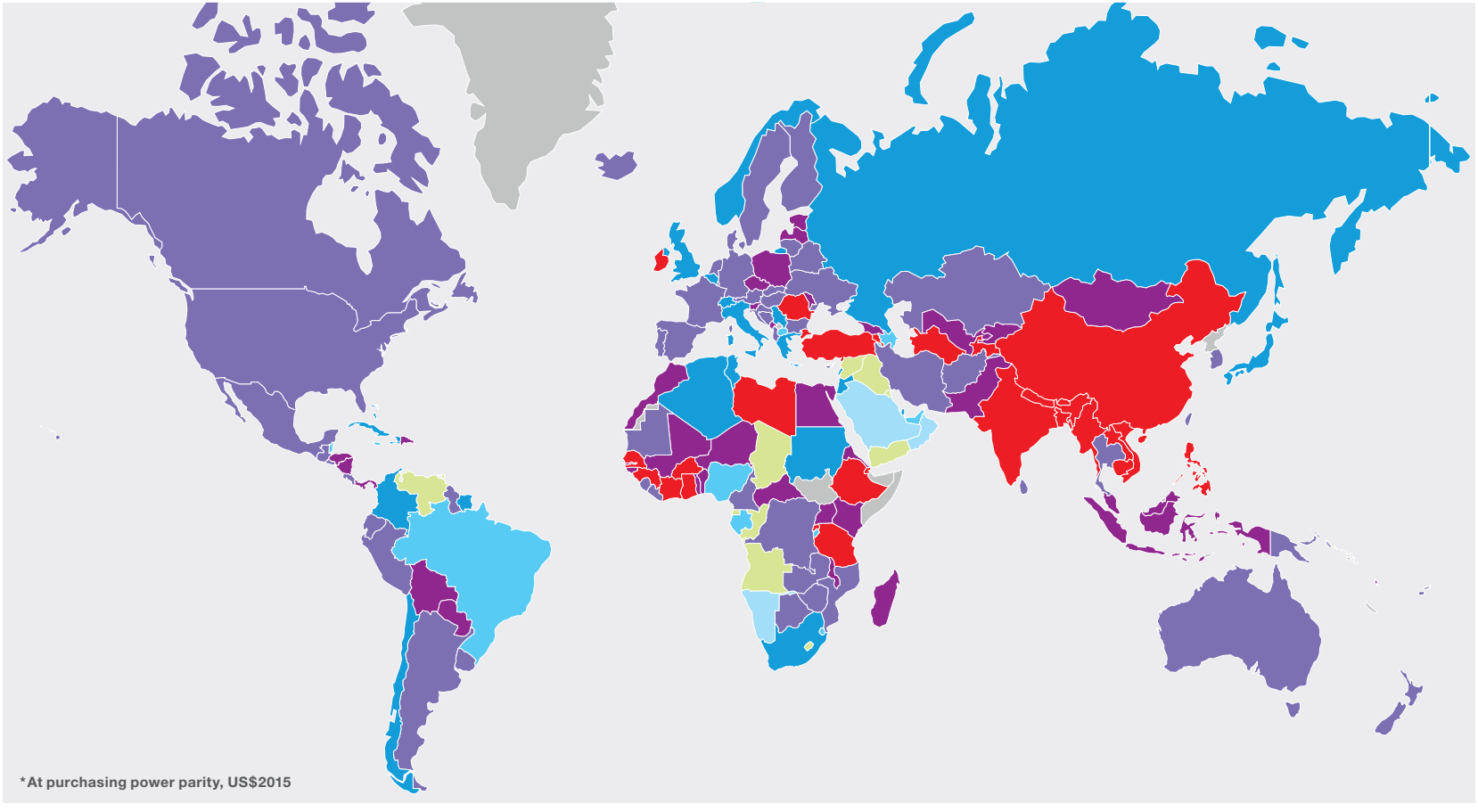
Energy production

World energy production is enjoying a period of dynamism that began in 2017 and continued in 2018 due to the strong health of the global economy and the rise in fossil fuel prices

Economy & energy context

World economy

GDP* GROWTH RATE BY COUNTRY IN 2017



*At purchasing power parity, US$2015

Source: Enerdata, Global Energy & CO_2 Data (2018)

World economy

The world economy remained robust in 2018, despite the lure of protectionism among the major powers

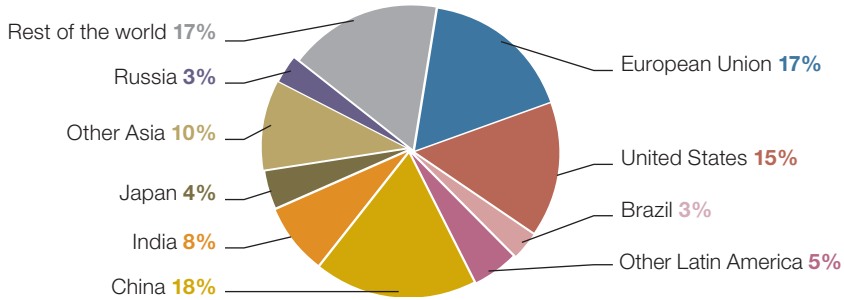
The world economy posted mixed performance in 2018. Stable GDP growth (3.7% for the second consecutive year) masked contrasting regional situations. The USA generated vigorous economic activity, but data from China and Europe were somewhat disappointing (growth rates of 6.6% and 2.2%, respectively).

Trade disputes and protectionist policies threaten future growth. The USA opened hostilities in March 2018 with duties on aluminium and steel imports and has since extended its list of Chinese products subject to tariffs further. China has retaliated by taxing American (mainly agricultural) exports. All in all, new customs duties now cover 2.5% of international trade. Against this backdrop, cross-border trade growth slowed from 5.4% in 2017 to 3.8% in 2018; this fed through to a drop in capital goods production in Europe and Asia.

Monetary policy normalisation in advanced and developing economies points to tighter credit conditions. Share prices fell over the second half of 2018, reflecting declining confidence in the world economy. In combination with the US dollar appreciation, this correction is driving substantial volumes of capital out of developing markets. Some of them – Argentina and Turkey, for example – are particularly vulnerable financially, as are generally those with debt denominated in US dollars.

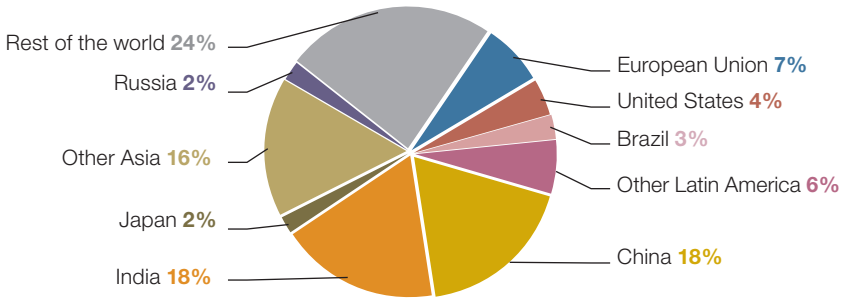
In low income countries, growth held up because of continued investment in infrastructure and good weather, which boosted agricultural production. Foreign direct investment (FDI) also supported economic activity in several African countries.

WORLD GDP* IN 2017 – TOTAL: US$ 122,285 BILLION



*At purchasing power parity, US$$_{2015}$$

WORLD POPULATION IN 2017 – TOTAL: 7,500 MILLION



Source: Enerdata, Global Energy & CO_2 Data (2018)

World economy

US GDP rose 2.9% in 2018 after a 2.2% gain in 2017. The increase in activity was underpinned by corporate and personal tax cuts – the Tax Cuts and Jobs Act came into force in December 2017 – as well as buoyant domestic demand. The labour market remained robust, and the unemployment rate fell to 3.8%, an almost 50-year low. A jump in the participation rate to 73% in 2017 meant higher real wages and labour productivity.

According to the World Bank, the boost imparted by tax cuts will ensure that US economic growth will be at least as vigorous in 2019 as it was in 2018. The budgetary impact of the stimulus will become tangible as early as 2020, however. Monetary policy remains accommodating, but a rise in the federal funds rate from its current 2.5% will weigh on future growth. Higher tariffs will hamper American exports and investment.

The EU economy has not been as strong as expected, posting 2.2% growth in 2018 after 2.7% in 2017, and 2.1% in the eurozone after 2.5% the previous year. Stagnating exports were a major factor. But the EU unemployment trend confirmed its downtrend, easing from 10.8% in 2013 to 7.6% in 2017 and 6.9% in 2018, with a participation rate of 73.6% in 2017.

The European Central Bank ended its government bond-purchase programme and kept its key interest rates in negative territory. The eurozone inflation rate stabilised around 1%, below the ECB's 2% target. National fiscal policies are diverging: Germany is benefiting from budgetary stimulus while countries such as France are struggling with tighter austerity. The business community is concerned about the sustainability of Italian public debt, and uncertainty over Brexit negotiations is worsening ahead of the 29 March 2019 deadline.

GDP and Population	Real GDP growth rate		GDP, Purchasing power parity, US$$_{2015}$ (US$ billion)		Per capita GDP, US$$_{2015}$ (US$ thousand)		Population (million)	
	2010-2017*	2016-2017	2016	2017	2016	2017	2016	2017
Europe	1.6%	3.0%	23,110	23,810	30	31	623	625
European Union	1.3%	2.7%	19,993	20,523	33	33	511	513
North America	1.8%	2.3%	20,012	20,469	56	56	359	362
Canada	2.0%	3.0%	1,622	1,672	44	44	36	37
United States	1.8%	2.2%	18,390	18,798	57	58	323	325
Latin America	1.4%	1.1%	9,195	9,298	8	8	634	641
Brazil	0.3%	1.0%	3,101	3,131	8	8	208	209
Asia	5.0%	5.7%	47,144	49,852	6	6	3,999	4,039
China	6.6%	6.9%	21,140	22,589	9	9	1,379	1,386
South Korea	2.6%	3.1%	1,847	1,903	28	28	51	52
India	5.9%	6.7%	8,591	9,165	2	2	1,300	1,317
Japan	1.0%	1.7%	5,225	5,316	35	36	127	127
Pacific	2.4%	2.3%	1,353	1,384	37	37	39	40
Australia	2.3%	2.2%	1,130	1,155	52	52	24	25
CIS	1.6%	2.1%	5,163	5,273	7	7	289	290
Russia	1.2%	1.5%	3,607	3,663	9	10	144	145
Middle East	2.8%	0.6%	6,069	6,108	10	10	242	246
Saudi Arabia	3.3%	-0.9%	1,734	1,719	21	20	32	33
Iran	1.8%	3.7%	1,581	1,640	6	6	80	81
Qatar	4.2%	1.6%	323	329	65	64	2,570	3
Africa	2.6%	3.3%	5,895	6,089	2	2	1,224	1,256
South Africa	1.6%	1.3%	730	740	6	6	56	57
World	**3.0%**	**3.7%**	**117,940**	**122,285**	**10**	**10**	**7,408**	**7,500**
OECD	**1.7%**	**2.5%**	**53,316**	**54,661**	**37**	**37**	**1,288**	**1,296**
Non OECD	**4.2%**	**4.6%**	**64,624**	**67,624**	**5**	**5**	**6,120**	**6,203**

***Compound annual growth rate.**

Source: Enerdata, Global Energy and CO_2 Data (2018)

World economy

Japanese economic growth faltered from 1.7% in 2017 to 1.1% in 2018 (it was 0.9% in 2016) on the back of another series of natural disasters. The labour market remains robust, with an unemployment rate of around 2.4%. The Japanese central bank's expansionary policy has weakened the yen and boosted export profits over the past few years. In a bid to tame the budget deficit (4.5% of GDP in 2017), VAT was raised from 8% to 10%. Prime minister Shinzo Abe is persisting with structural reforms ("Abenomics"); he intends to focus on social care in 2019 against a backdrop of a declining and ageing population (lengthening the social security contribution period plus a migration policy in favour of foreign workers).

China's economy remains dynamic, thanks to rapidly expanding domestic consumption. GDP rose by "only" 6.6% in 2018, its lowest rate for 28 years (6.9% in 2017 and 6.7% in 2016). Exports are a major contributor to Chinese activity and their share of GDP stabilised at 20% in 2017. The share of industrial production decreased, in line with the government's "economic rebalancing" policy.
In a bid to buoy domestic demand, the Chinese government is set to promote credit and foster investment through the introduction of financial instruments aimed at SMEs and private companies. It is also considering a range of tax measures, notably a cut in VAT, lower personal income taxes, tax exemptions for SMEs and leading technology firms. GDP growth is expected to stabilise to between 6% and 6.5% over the medium term.

The Indian economy remains buoyant. GDP rose 7.3% in 2018, driven by increases in private consumption, credit and investment. The country is benefiting from structural reforms such the harmonisation of goods and services taxation introduced in 2017 and the recapitalisation of the banking sector. Economic growth is swiftly reducing poverty: in 2018, 114 million people were living on less than $1.90 per day, 20 million fewer than in 2017.

Because of new tariffs, **countries exporting raw materials generally posted slower growth in 2018.**

Brazilian growth steadied at 1.4% in 2018, following an end to recession the year before (1% in 2017). But the economy remains fragile, with unemployment close to 12% and the budget deficit closing on 7% of GDP. The business community expects pension reform and a lower budget deficit from the new government headed by Jair Bolsonaro.

Russian GDP rose 1.7% in 2018, up from 1.5% in 2017. In addition to higher natural gas and oil revenues, the country benefited from policies that promoted stability and from the impact of the football world cup on domestic demand. Hydrocarbon production reached record levels (oil output peaked at 11.4mbbl/d) and exports expanded. The economy's lack of diversification is a risk factor, however. Oil and gas represent 59% of exports and account for a large proportion of investment, while other industries are suffering from chronic under-investment. Unemployment is still low (4.7%), and although wages and pensions are increasing in real terms, productivity is still far short of EU and US levels.

OPEC economies benefitted from higher oil prices in 2018 ($68/bbl on average, a 30% increase on 2017). This has eased budgetary pressures and social tensions in the Gulf states. But oil exporters that have failed to diversify, such as Bahrein and Oman, remain extremely vulnerable to the volatility of oil prices.

Energy reserves According to current estimates, fossil fuel reserves far exceed future needs

Réserves In 2017 In Gteo	Coal & Lignite		Crude oil & NGL				Natural gas				Uranium			Total
	Volume	Share in world total	Conventional volume	Non-conventional volume	Total volume	Share in world total	Conventional volume	Non-conventional volume	Total volume	Share in world total	Volume	Share in world total	Volume	Share in world total
Europe	66,7	10%	1,9	0	1,9	1%	3,2	0	3,2	2%	1,3	2%	73,0	6%
EU-28	50,9	7%	0,7	0	0,7	0%	1,2	0	1,2	1%	1,2	2%	54,0	5%
North America	171,7	25%	5,7	28,3	34	14%	6,8	5,2	12,1	6%	7,5	15%	225,3	19%
Canada	4,4	1%	0,7	26,7	27,4	11%	1,4	0,4	1,8	1%	5,8	11%	39,5	3%
United States	167,3	24%	5	1,6	6,6	3%	5,4	4,8	10,2	5%	1,7	3%	185,8	16%
Latin America	10,2	1%	15,7	30,8	46,5	19%	7	0	7	4%	2,2	4%	65,8	6%
Venezuela	0,5	0%	10,9	30,8	41,6	17%	5,1	0	5,1	3%	0	0%	47,3	4%
Asia	179,3	26%	6,1	0	6,1	3%	10,2	0,5	10,6	6%	4,4	9%	200,4	17%
China	90,6	13%	3,6	0	3,6	2%	2,2	0,3	2,5	1%	1,5	3%	98,2	8%
Inda	65,2	9%	0,6	0	0,6	0%	1,2	0,1	1,2	1%	1,5	3%	68,5	6%
Pacific	101,6	15%	0,6	0	0,6	0%	2,1	1	3,1	2%	13,8	27%	119,1	10%
Australia	96,5	14%	0,6	0	0,6	0%	1,9	1	2,9	2%	13,8	27%	113,8	10%
CIS	149	21%	20,5	0	20,5	9%	68	0	68,1	36%	10	19%	247,5	21%
Kazakhstan	17,1	2%	4,2	0	4,2	2%	1,7	0	1,7	1%	4,4	9%	27,3	2%
Turkmenistan	0	0%	0,1	0	0,1	0%	17,5	0	17,5	9%	0	0%	17,6	2%
Russia	106,9	15%	15,2	0	15,2	6%	45,5	0	45,5	24%	3,3	6%	170,8	15%
Middle East	0,8	0%	112,6	0	112,6	47%	72,1	0	72,1	38%	0	0%	185,4	16%
Saudi Arabia	0	0%	36,9	0	36,9	15%	7,8	0	7,8	4%	0	0%	44,7	4%
Iraq	0	0%	21,2	0	21,2	9%	3,4	0	3,4	2%	0	0%	24,5	2%
Iran	0,8	0%	21,9	0	21,9	9%	30,4	0	30,4	16%	0	0%	53,2	5%
Qatar	0	0%	3,5	0	3,5	2%	21,5	0	21,5	11%	0	0%	25,0	2%
Africa	22,3	3%	17,8	0	17,8	7%	12,1	0	12,1	6%	12,3	24%	64,5	6%
Namibia	0	0%	0	0	0	0%	0,1	0	0,1	0%	3,6	7%	3,6	0%
Niger	0	0%	0	0	0	0%	0	0	0	0%	3,8	7%	3,8	0%
World	**701,5**	**100%**	**180,9**	**59,1**	**240**	**100%**	**181,5**	**6,7**	**188,2**	**100%**	**51,4**	**100%**	**1181,1**	**100%**
OECD	**332**	**47%**	**9,1**	**28,3**	**37,5**	**16%**	**12,5**	**6,2**	**18,7**	**10%**	**22,6**	**44%**	**410,8**	**35%**
no-OECD	**369,5**	**53%**	**171,8**	**30,8**	**202,5**	**84%**	**169**	**0,5**	**169,5**	**90%**	**28,8**	**56%**	**770,3**	**65%**
Total years of production	**183**		**52**				**60**				**82**		**92**	

Source : Enerdata, Global Energy & CO_2 Data (2018)

Fossil fuel reserves will easily cover the consumption expected over the coming decades. Proven reserves* alone cover 52 years of oil consumption, 60 years of natural gas consumption and 183 years of coal consumption (at current production levels). **Above and beyond these conventional reserves, we can now add unconventional oil and gas,** for which reserves are far greater and where technical progress – notably in hydraulic fracturing – has made exploitation viable. This is subject to considerable economic and environmental constraints, however, which is why unconventional oil and gas production is still largely undeveloped outside North America. **Uranium reserves** are estimated to last another 82 years.

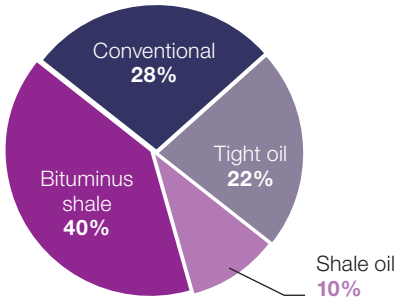
***Recoverable reserves are broken down by likelihood of production: 90% for proven reserves, 50% for probable reserves and 10% for possible reserves (see Reserves in the Glossary).**

Energy reserves: unconventional oil (tight oil / shale oil)

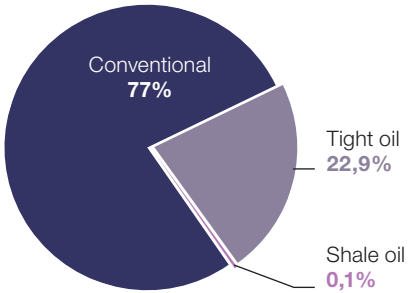
Shale oil (or light tight oil) refers to oil extracted directly from bedrock (shale) or from other rocks showing very low permeability (tight). Extraction involves horizontal drilling and hydraulic fracturing (fracking). This type of oil is usually of high quality (light, low sulphur content, etc.).

Exploitation of tight oil offers unrivalled flexibility compared to conventional oil (notably offshore), in terms of costs and both drilling and producing times. The plasticity of the production facility resulting from major technological advances is an important advantage in a highly volatile world. Close to null in 1990, the share of unconventional sources in world oil production is expected to reach 20% by 2035, according to PIRA's estimates.

WORLD OIL RESERVES IN 2017

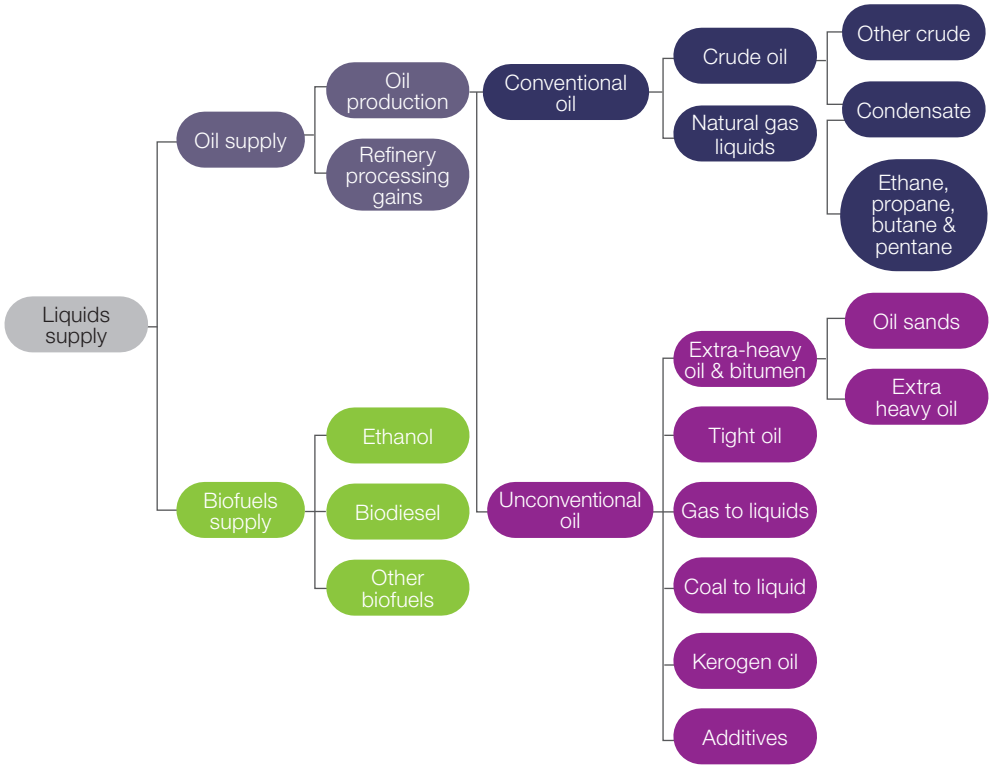


WORLD NATURAL GAS RESERVES IN 2017



Source: Enerdata, Global Energy & CO_2 Data (2018)

CONVENTIONAL AND UNCONVENTIONAL OIL CLASSIFICATION



Source: PIRA

Energy reserves: the world's unconventional and conventional gas resources

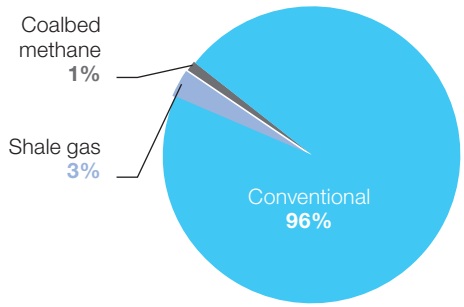
Unconventional natural gas comprises coal bed methane (CBM), tight gas and shale gas. Shale gas represents the largest share of unconventional resources (64%, compared with 23% for tight gas and 14% for CBM).
Exploitation of unconventional resources started with CBM at the end of the twentieth century. Shale and tight gas production is more complex and requires specific drilling technics (horizontal drilling and hydraulic fracturing).

Shale gas production is practically non-existent outside the USA and Canada. Australia produces CBM. Other regions intending to exploit shale gas are still in the exploration stage or produce only limited volumes (Asia-Pacific, China, India, Argentina, South Africa, Algeria, etc.). In Europe, disappointing initial drilling results in 2014-2015 combined with the energy transition programme have ended the development of unconventional gas.

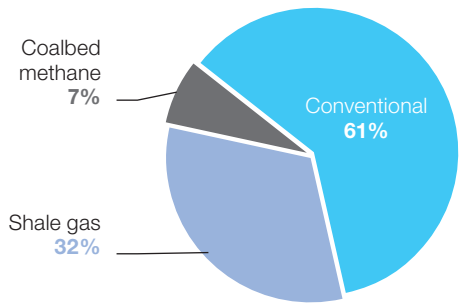
World unconventional gas accounts for 45% (364 Tm^3) of total recoverable gas reserves. The latter (conventional and unconventional) amount to 795 Tm^3 (+11 Tm^3 from 2017 estimates), enough to meet at least 220 years of consumption. Note that unconventional gas reserves are spread more evenly around the planet than conventional gas.

World conventional gas reserves lie mostly part in Eurasia (31%) and the Middle East (24%). The Middle East will have to develop its gas production capacity to satisfy growing domestic demand as well as export needs.

NATURAL GAS RESSOURCES IN 2017



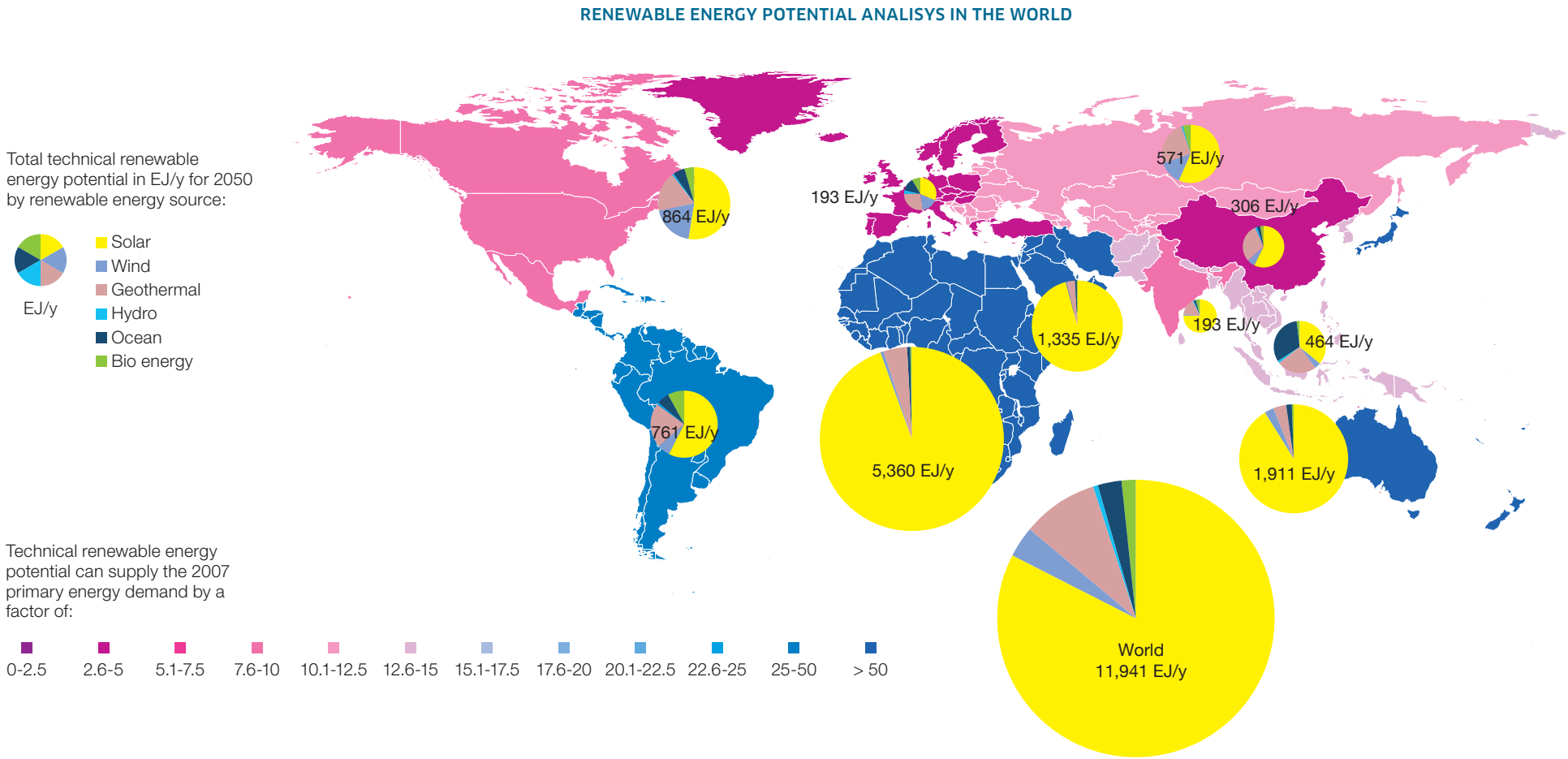
RESSOURCES DE NATURAL GAS EN 2017



Recoverable reserves are broken down by likelihood of production: 90% for proven reserves, 50% for probable reserves and 10% for possible reserves (see Reserves in the Glossary).

Source: Enerdata, Global Energy & CO_2 Data (2018)

Energy reserves: renewable energy sources



Source: IPCC/SRREN (2015)

Energy reserves: renewable energy sources

Renewable energy sources are sufficient to meet all world energy demand. The technical potential of renewable energies – in other words the achievable output, were the current techniques to be implemented with the greatest efficiency – is not a constraint to their expansion. It is even likely to increase as new technologies develop.

Solar power has the greatest technical potential and breakthroughs are regularly announced. One of them is the installation of solar panels on waterways or water bodies. This alternative combines the advantages of limiting both water evaporation and use of land.

Potential from hydro power is better known and exploited (48%). However, in this instance too, the available resources could be far greater with a wider use of small hydro, low head, and even very low head, turbines.

The technical potential of renewables is often difficult to measure precisely because of the sheer variety of assessment methods. It depends on many factors, but particularly on political will, technology's cost reduction, and economic and population growth.

Climate change will have an impact on the distribution and the availability of resources. Even if the overall impact of climate change on hydrology is limited (<0.1%), variations between regions will be substantial. Wind sources will also be affected. Bioenergy sources are also very sensitive to the consequences of climate change.

The challenge of metals in the energy transition

An obstacle to the transition process?

The technology behind energy transition (wind power, solar power, batteries) relies heavily on a variety of metals: aluminium, cobalt, chrome, copper, iron, lead, lithium, nickel, manganese, platinum, rare-earth elements (cadmium, molybdenum, neodymium, indium), silver, steel, titanium and zinc (World Bank classification). Lithium-ion battery manufacturing, for instance, requires lithium and cobalt. Energy transition technologies require a sharp increase not only in volumes but also in the variety of mined metals.
Considering what is at stake, the question of how critical they are – i.e. the reliability of their supply – is bound to arise. That reliability is by no means assured.

First and foremost, metals are exposed to price increases as a result of booming demand since the early 2000s. Supply and demand adjustment is not always automatic, as some rare metals are dependant on other materials. For example, cobalt is mined as a byproduct of copper and nickel.

Rare metal reserves and production are geographically concentrated. Australia and Chile produced three quarters of lithium in 2017, and the so-called lithium triangle – Chile, Argentina and Bolivia – accounts for 50% of known reserves (53 million tonnes).

China's dominant position in the value chains of several rare metals is of even more concern. Apart from their grip on the production of rare-earth elements (80% of world production in 2017), Chinese companies have a stranglehold on cobalt refining, which accounted for 80% of cobalt-bearing salts worldwide in 2017. Underpinned by its 'silk road' project, China's long-term strategy is to produce basic materials and set the standards for them. Given the political and economic risks inherent in China's monopoly position, importing countries are seeking to diversify their supplies. The problem is that it can take decades to develop new mines.

There are also several ethical issues around extraction practices. In DRC, where 60% of world cobalt is produced, child labour has been documented many times. The environmental costs of mining should not be ignored either.

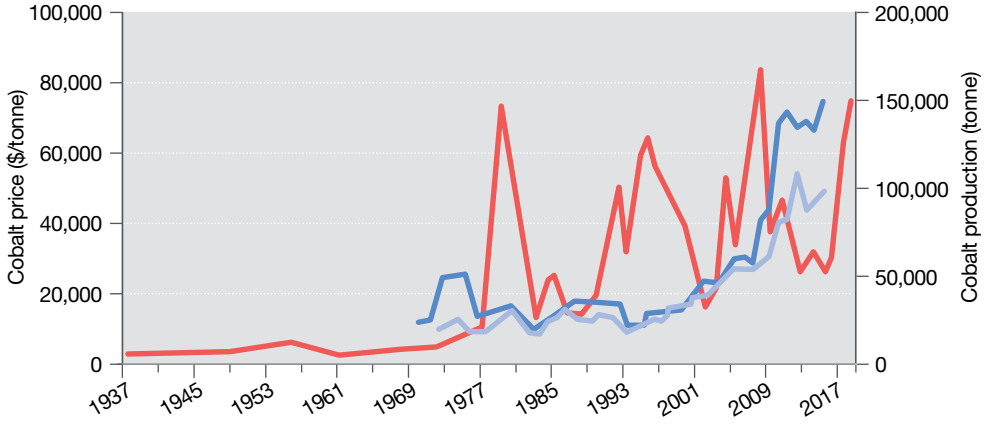
Lastly, there are serious concerns over the depletion of reserves. The issue is less critical when technological innovation is taken into account, however, notably improvements to metal intensity, technical diversity and technological substitution. Specific technology choices will have a major influence over the demand for particular metals, too. The manufacture of direct-drive wind turbines (permanent magnets) uses rare-earth elements, for example; geared turbines do not.

Recycling is a key consideration. Metals are currently recycled at very uneven rates (10% of world cobalt demand was recycled in 2017; lithium and rare-earth elements are hardly recycled at all). The EU is pushing recycling, however (cf. directives on battery and electronics recycling).

To summarise, the criticality of metals supply in energy transition is complex and relative: it depends on a whole 'ecosystem' shaped by environmental constraints, potential substitution, the efficiency of resource use, recycling, climate change and health issues, for example.
The issue does raise the paradox that RES sometimes requires more infrastructure that other energy sources, and therefore more raw material. Recycling is crucial; it is clearly insufficient at the moment and this means that additional raw materials are required.
Sustainable development urgently requires organised markets, more R&D, heightened substitution and recycling. Political risks are high and market solutions will not suffice on their own. If the above conditions are met, however, metals availability ought not hamper energy transition.

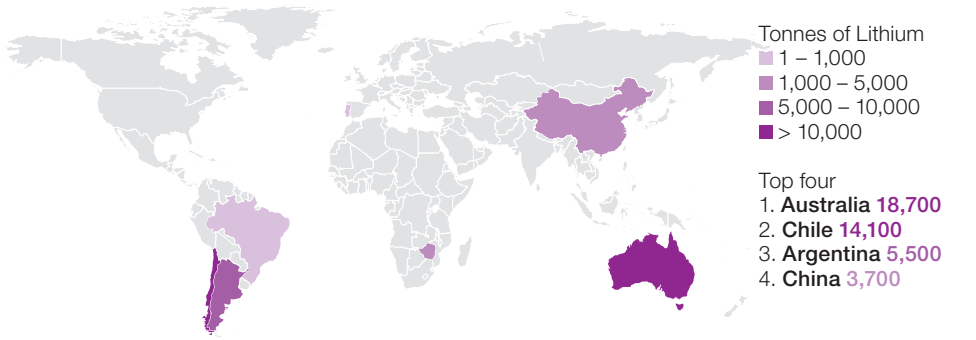
Metals for energy transition

EVOLUTION OF WORLD COBALT PRODUCTION AND PRICE

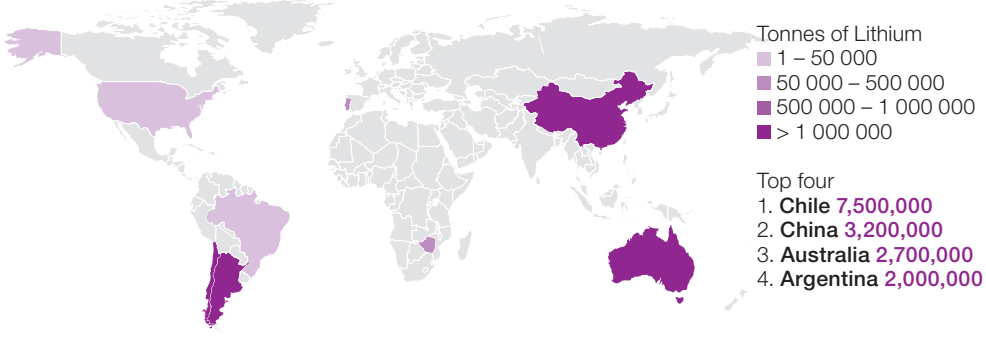


Source: European Commission, JRC Science for Policy report, Cobalt: demand-supply balances in the transition to electric mobility

LITHIUM PRODUCTION IN 2017



LITHIUM RESERVES



Source: CarbonBrief.org

Energy balance in 2018

World energy production is enjoying a period of dynamism that began in 2017 (+2.3%) and continued in 2018 with an increase in gas (+5%), oil (+2.4%) and coal (+1%) production, according to first estimates.
This is due to the strong health of the global economy, which resulted in a significant recovery in emerging countries' energy needs, and to a 2017 and 2018 rise in fossil fuel prices that boosted production.

Fossil fuels still dominate energy production with an 81% share, but the rapid growth of renewable sources to generate electricity (+6% per year on average since 2010) promises the market share of renewables to increase from 14% of the energy mix today to 20% by 2040 in the most moderate scenarios, and to 30% in the scenarios aligned with the Paris agreements.

World energy consumption has also been growing faster over the past two years; its 2018 increase is expected to be higher than in 2017 (+2.1% compared to an annual average of +1.3% over the 2010-2017 period).

Fossil energy consumption recovered strongly in 2018 due to emerging countries' appetite for coal, but also for gas, an alternative energy promoted by the energy transition. That did not prevent solar and wind energies from continuing their rapid breakthrough in the electricity sector.

Energy efficiency, close to its upward trend of +1% per year (+1.1% in 2017; excluding structural effect) remains largely insufficient to achieve environmental objectives. Meeting the latter requires an annual improvement of +3.4% to contain the temperature increase below 2°C.

Therefore, final energy demand* accelerated in 2017 (+2.5%) and 2018, after growing +1.1% in 2016.
Electricity plays an increasingly important role in end uses (+2.5% in 2017), its share in the final mix rising from 15% in 2000 to 19% in 2017 thanks to the increase in electricity uses and electrification rates across the world. As a result, the number of people lacking access to electricity decreased from 1.7 billion in 2000 to 1.1 billion in 2016 (last IEA survey).
The market share of oil (37%), although in continuous decline, is still dominant due to its captive use in transport. The share of gas is stable, at around 15%, with demand increasing (+4% in 2017) thanks to diversified uses for heating and the industry, and to a gradual development in transportation.
Coal as a final energy source is almost exclusively used in the steel industry, most of its consumption being devoted to electricity production. Final demand for coal is growing very slowly (+1% in 2017; 13% of the market share).
Finally, biomass, mainly wood, remains the main energy source for heating and cooking in many developing countries, although the emissions from its combustion cause serious health problems. Biomass accounts for 11% of global final energy demand but 80% in Sub-Saharan Africa.

*** Final demand refers to sectoral consumption (Industry, Residential & Tertiary, Agriculture, Transport, excluding consumption in the processing sector such as electricity production or refining).**

Primary energy production

Primary energy production in 2017 in Mtoe	Fossils									Biomass			Electricity			Heat			Total		
	Coal &Lignite			Crude oil & NGL			Natural gas			Biomass & wastes			Primary electricity			Geothermal & Solar					
	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total
Europe	175	6%	5%	175	-1%	4%	210	1%	7%	161	3%	12%	329	-1%	26%	7	4%	16%	1,058	1%	8%
EU-28	137	0.4%	4%	77	-2%	2%	101	-4%	3%	152	3%	11%	288	-2%	23%	3	3%	7%	757	-0.8%	5%
North America	418	7%	11%	843	6%	19%	793	2%	25%	116	2%	8%	349	3%	28%	3	17%	8%	2,522	4%	18%
Canada	29	-4%	0.8%	243	8%	6%	155	4%	5%	13	-5%	0.9%	65	3%	5%	0	-	0%	504	5%	4%
United States	389	8%	10%	601	6%	14%	638	1%	20%	103	3%	8%	284	3%	23%	3	21%	8%	2,018	4%	14%
Latin America	69	-3%	2%	498	-6%	11%	175	-0.9%	6%	147	2%	11%	84	2%	7%	1	9%	3%	973	-3%	7%
Brazil	3	-0.3%	0.1%	141	3%	3%	21	6%	0.7%	88	0.4%	6%	39	-1%	3%	0.9	13%	2%	292	2%	2%
Asia	2,439	4%	64%	362	0.2%	8%	385	3%	12%	559	4%	41%	352	8%	28%	31	6%	71%	4,129	4%	29%
China	1,833	3%	48%	194	-4%	4%	123	8%	4%	116	2%	8%	203	11%	16%	30	6%	68%	2,499	4%	18%
India	277	1%	7%	43	4%	1%	27	4%	0.9%	220	6%	16%	29	8%	2%	0.7	0%	2%	596	4%	4%
Indonesia	247	9%	7%	41	8%	0.9%	62	-4%	2%	56	-0.8%	4%	23	14%	2%	0	-	0%	429	6%	3%
Pacific	279	-5%	7%	18	-9%	0.4%	88	17%	3%	8	22%	0.6%	11	2%	0.8%	0.6	0%	1%	415	2%	3%
Australia	278	-5%	7%	16	-9%	0.4%	84	18%	3%	5	0%	0.4%	3	-7%	0.2%	0.4	0%	1%	386	-0.6%	3%
CIS	286	5%	8%	697	0.6%	16%	760	7%	24%	15	10%	1%	99	4%	8%	0	-	0%	1,858	4%	13%
Russia	220	6%	6%	550	0%	12%	571	8%	18%	9	6%	0.6%	70	3%	6%	0	-	0%	1418	4%	10%
Middle East	1	-1%	0%	1,467	-1%	33%	528	5%	17%	1	0.4%	0.1%	4	4%	0.3%	0.5	0%	1%	2,002	0.1%	14%
Qatar	0	-	0%	81	0.2%	2%	147	0.1%	5%	0	-	0%	0	-	0%	0	-	0%	228	0.1%	2%
United Arab Emirates	0	-	0%	179	-4%	4%	50	0.9%	2%	0	-	0%	0.2	154%	0%	0	-	0%	229	-3%	2%
Saudi Arabia	0	-	0%	572	-4%	13%	80	6%	3%	0	-	0%	0	-	0%	0	-	0%	652	-3%	5%
Iran	0.8	3%	0%	220	8%	5%	177	10%	6%	0.5	0%	0%	3	2%	0.2%	0	-	0%	401	9%	3%
Africa	156	2%	4%	392	4%	9%	183	6%	6%	371	0.7%	27%	20	4%	2%	0.2	0%	0.5%	1,122	3%	8%
Nigeria	0	0%	0%	100	2%	2%	36	12%	1%	113	0.7%	8%	0.4	-0.2%	0%	0	-	0%	250	3%	2%
World	**3,824**	**3%**	**100%**	**4,452**	**0.4%**	**100%**	**3,132**	**4%**	**100%**	**1,379**	**3%**	**100%**	**1,247**	**3%**	**100%**	**44**	**7%**	**100%**	**14,078**	**3%**	**100%**
OECD	**856**	**3%**	**22%**	**1,145**	**3%**	**26%**	**1,121**	**2%**	**36%**	**317**	**3%**	**23%**	**750**	**1%**	**60%**	**12**	**7%**	**27%**	**4,200**	**3%**	**30%**
no-OECD	**2,968**	**4%**	**78%**	**3,308**	**-0.5%**	**74%**	**2,011**	**6%**	**64%**	**1,062**	**3%**	**77%**	**497**	**6%**	**40%**	**32**	**7%**	**73%**	**9,878**	**3%**	**70%**

Source : Enerdata, Global Energy & CO_2 Data (2018)

Primary energy consumption

Primary energy consumption in 2017 in Mtoe	Fossils									Biomass			Electricity			Heat			Total		
	Coal &Lignite			Crude oil & NGL			Natural gas			Biomass & wastes			Primary electricity			Geothermal & Solar					
	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Évolution 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total
Europe	294	0.2%	8%	605	2%	13%	453	5%	15%	169	3%	12%	328	-2%	26%	8	2%	17%	1,857	2%	13%
EU-28	231	-4%	6%	532	2%	12%	397	4%	13%	159	3%	12%	288	-2%	23%	4	4%	8%	1,611	2%	11%
Germany	72	-6%	2%	105	3%	2%	76	6%	2%	31	0.8%	2%	30	0.1%	2%	0.8	5%	2%	314	0.8%	2%
France	9	7%	0.2%	68	-0.3%	2%	38	0.4%	1%	20	11%	1%	108	-2%	9%	0.2	2%	0.5%	243	0.9%	2%
North America	366	-0.5%	10%	913	1%	20%	745	-0.3%	24%	114	0.5%	8%	347	2%	28%	3	20%	7%	2,489	0.5%	18%
Canada	17	-2%	0.4%	97	2%	2%	102	7%	3%	12	-7%	0.9%	59	3%	5%	0	0%	0.1%	287	3%	2%
United States	349	-0.4%	9%	816	1%	18%	643	-1%	21%	102	2%	7%	288	2%	23%	3	20%	7%	2,201	0.2%	16%
Latin America	45	-1%	1%	367	0.2%	8%	205	0.2%	7%	145	1%	11%	84	2%	7%	1	12%	3%	847	1%	6%
Brazil	17	3.9%	0.4%	113	1%	3%	30	1%	1%	87	-0.2%	6%	43	-1%	3%	1	12%	2%	291	1.30%	2%
Asia	2,781	1%	73%	1,421	4%	32%	607	7%	20%	559	4%	41%	355	8.0%	29%	31	6%	68%	5,755	3%	41%
China	1,973	0.4%	52%	587	6%	13%	197	15%	6%	116	2%	8%	202	11%	16%	30	7%	65%	3,105	2%	22%
India	407	3%	11%	228	5%	5%	49	5%	2%	220	6%	16%	29	8%	2%	0.7	0%	1%	934	4%	7%
Indonesia	46	7%	1%	75	4%	2%	40	2%	1%	56	-0.8%	4%	23	14%	2%	0	-	0%	240	5%	2%
Japan	119	2%	3%	176	-2%	4%	102	0.6%	3%	10	11%	0.7%	21	21%	2%	0.4	-7%	0.8%	429	1%	3%
South Korea	82	6%	2%	112	1%	3%	42	4%	1%	19	16%	1%	40	-7.7%	3%	0.3	5%	0.6%	296	2%	2%
Pacific	43	-3%	1%	54	8%	1%	39	2%	1%	8	22%	0.6%	11	2%	0.8%	0.5	0.2%	1.2%	154	2%	1%
Australia	42	-3%	1%	44	4%	1%	35	2%	1%	5	0%	0.4%	3	-7%	0.2%	0.4	0.3%	0.8%	129	1%	1%
CIS	184	0.1%	5%	213	-0.3%	5%	527	5%	17%	15	10%	1%	97	4%	8%	0.7	0.4%	2%	1,037	4%	7%
Russia	122	4%	3%	160	-0.9%	4%	385	8%	12%	9	6%	0.6%	69	3%	6%	0	17%	0%	744	6%	5%
Middle East	9	-7%	0.2%	345	2%	8%	427	5%	14%	0.9	0.2%	0.1%	4	1%	0.4%	0.5	0%	1%	786	2%	6%
Iran	1	3%	0%	80	5%	2%	169	7%	5%	0.5	0%	0%	3	-2%	0.2%	0	-	-	255	3%	2%
Saudi Arabia	0	-	0%	144	-0.9%	3%	80	6%	3%	0	0%	0%	0	-	0%	0	-	-	212	1%	2%
Africa	106	-2%	3%	192	10%	4%	115	5%	4%	371	0.7%	27%	20	3%	2%	0.3	14%	0.6%	805	4%	6%
World	**3,827**	**0.8%**	**100%**	**4,507**	**12%**	**100%**	**3,117**	**4%**	**100%**	**1,382**	**3%**	**100%**	**1,247**	**3%**	**100%**	**46**	**6%**	**100%**	**14,126**	**2%**	**100%**
OECD	**901**	**0.6%**	**24%**	**1,940**	**0.9%**	**43%**	**1,439**	**1.3%**	**46%**	**324**	**3%**	**24%**	**747**	**0.7%**	**60%**	**13**	**6%**	**27%**	**5,363**	**1%**	**38%**
no-OECD	**2,927**	**0.9%**	**77%**	**2,170**	**4%**	**48%**	**1,678**	**6%**	**54%**	**1,057**	**3%**	**77%**	**500**	**6%**	**40%**	**33**	**7%**	**73%**	**8,366**	**3%**	**59%**

Source: Enerdata, Global Energy & CO_2 Data (2018)

Final energy consumption

Final energy consumption in 2017 Mtoe	Fossils									Biomass			Electricity			Heat			Total		
	Coal & Lignite			Crude oil & NGL			Natural gas			Biomass & wastes			Primary electricity			Geothermal & Solar					
	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total	Volume	Change 2016-2017	Share in world total
Europe	71	0.3%	6%	546	2%	15%	284	3%	20%	100	2%	10%	284	1%	16%	58	0.6%	16%	1,342	2%	14%
EU-28	54	0.3%	4%	481	2%	14%	255	2%	18%	93	3%	9%	241	0.7%	13%	51	0.4%	14%	1,175	2%	12%
Germany	14	2%	1%	95	3%	3%	58	7%	4%	15	-0.3%	1%	45	0.4%	2%	11	0.3%	3%	237	3%	3%
France	4	-3%	0.3%	67	2%	2%	30	-2%	2%	13	1%	1%	38	-0.2%	2%	4	0.2%	1%	154	0.3%	2%
North America	24	-0.7%	2%	845	1%	24%	370	2%	26%	91	1%	9%	362	-2%	20%	10	2%	3%	1,701	0.6%	18%
Canada	3	-1%	0.3%	93	1%	3%	43	3%	3%	10	5%	1%	41	2%	2%	1	-0.5%	0.2%	192	2%	2%
United States	21	-0.6%	2%	751	0.9%	21%	326	2%	23%	81	0%	8%	321	-2%	18%	9	2%	3%	1,509	0.4%	16%
Latin America	20	15%	2%	300	-1%	8%	72	-0.9%	5%	108	3%	10%	111	0.5%	6%	1	15%	0.3%	612	0.3%	6%
Brazil	11	7%	0.9%	103	1%	3%	12	2%	0.8%	63	3%	6%	43	1%	2%	0.8	10%	0.2%	232	2%	2%
Asia	1,062	0.7%	84%	1,242	4%	35%	295	9%	20%	447	3%	42%	825	5%	45%	139	7%	38%	4,010	4%	42%
China	822	0.4%	65%	516	4%	15%	134	15%	9%	89	5%	9%	475	7%	26%	131	7%	36%	2,166	4%	23%
India	117	4%	9%	193	6%	5%	33	3%	2%	167	2%	16%	101	5%	6%	0.8	7%	0.2%	611	4%	6%
Indonesia	9	-7%	0.7%	72	7%	2%	14	6%	1%	56	-0.2%	5%	19	3%	1%	0	-	0%	170	3%	2%
Japan	40	-2%	3%	149	-1%	4%	33	2%	2%	6	2%	0.6%	85	2%	5%	0.9	-0.9%	0.3%	314	0.1%	3%
South Korea	20	2%	2%	97	3%	3%	23	6%	2%	16	7%	2%	45	2%	3%	5	5%	1%	206	3%	2%
Pacific	4	5%	0.3%	52	2%	2%	16	2%	1%	8	5%	0.7%	22	0.1%	1%	0.6	0.9%	0.2%	103	2%	1%
Australia	3	6%	0.3%	44	2%	1%	14	4%	0.9%	5	7%	0.4%	18	0.1%	1%	0	6%	0.1%	84	2%	0.9%
CIS	60	2%	5%	180	0.3%	5%	187	7%	13%	8	10%	0.7%	93	2%	5%	155	21%	43%	681	7%	7%
Russia	37	4%	3%	135	0.4%	4%	132	9%	9%	4	3%	0.3%	64	2%	4%	131	24%	36%	503	9%	5%
Middle East	3	-14%	0.2%	235	0.5%	7%	183	1%	13%	0.8	0.5%	0.1%	82	3%	5%	0.6	0%	0.2%	503	1%	5%
Iran	0.9	-17%	0.1%	67	4%	2%	101	-0.2%	7%	0.5	0.4%	0%	22	7%	1%	0	-	0%	192	2%	2%
Saudi Arabia	0	-	0%	92	-3%	3%	24	12%	2%	0	14%	0%	25	0.3%	1%	0	-	0%	140	0.1%	2%
Africa	18	-3%	1.4%	158	2%	4%	39	6%	3%	294	0.7%	28%	56	2%	3%	0	6%	0%	563	2%	6%
World	**1,262**	**0.8%**	**100%**	**3,556**	**2%**	**100%**	**1,445**	**4%**	**100%**	**1,055**	**2%**	**100%**	**1.834**	**3%**	**100%**	**363**	**11%**	**100%**	**9,515**	**3%**	**100%**
OECD	**161**	**0.6%**	**13%**	**1,753**	**1%**	**49%**	**731**	**3%**	**51%**	**220**	**2%**	**21%**	**816**	**0.0%**	**45%**	**70**	**1%**	**19%**	**3,751**	**1%**	**39%**
no-OECD	**1,101**	**0.9%**	**87%**	**1,802**	**3%**	**51%**	**714**	**6%**	**49%**	**835**	**2%**	**79%**	**1.018**	**5%**	**56%**	**293**	**14%**	**81%**	**5,763**	**4%**	**61%**

Source: Enerdata, Global Energy & CO_2 Data (2018)

Energy efficiency

The path to achieve climate goals assumed a sharp drop in energy intensity and an energy mix based half on RES and half on gas

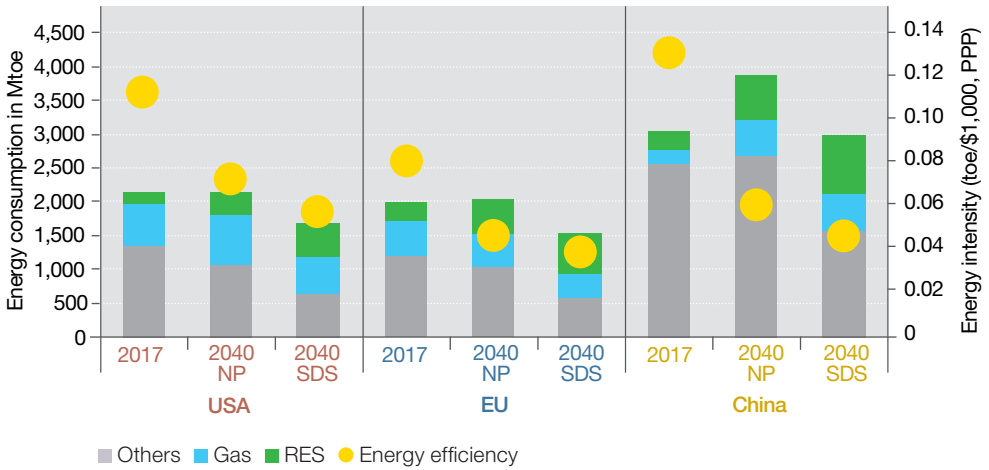
Energy efficiency, close to its trend of + 1% per year (+1.1% in 2017, excluding structural effect) remains largely insufficient to achieve environmental objectives. Indeed, these claim an annual improvement of +3.4% to maintain the rise in temperatures below 2°C.

Thus, the UN Sustainable Development Goals include doubling the rate of primary energy intensity improvement by 2030. The role of energy efficiency in curbing global CO_2 emissions, coupled with renewables, is one of the cornerstones of any strategy to guarantee sustainable and inclusive economic growth. Energy efficiency should improve by +2.4% per year in IEA New Policies Scenario, and by +3.4% in the Sustainable Development Scenario.

Policies requiring mandatory energy performance make their way: the European Union, where buildings represent nearly 40% of overall final consumption and generate 30% of its CO_2 emissions, approved in November 2018, as part of its Clean Energy Package, a non-binding commitment to advance its energy efficiency by 32.5% by 2030.

The increasing awareness of the benefits of energy efficiency has helped build support for more investments. Energy efficiency investments went up by +3% in 2017, to reach $236 billion. Buildings hold a big stake in energy efficiency efforts: about $140 billion flowed into the sector in 2017, representing almost 60% of total energy efficiency investments. Light-duty vehicles took up $33 billion of the $60 billion spent on improving energy efficiency in the transport sector in 2017, while global efficiency investment in transport increased by +11% in 2017.

PRIMARY CONSUPTION & ENERGY EFFICINECY IN LONG TERM SCENARIOS FOR USA, EU AND CHINA



Source: IEA – World Energy Outlook 2018; Scenario, NPS = New Policies Scenario, SDS = Sustainable Development Scenario

CO_2 & climate

CO_2 EMISSIONS

Worrying pick-up in CO_2 emissions

PARIS AGREEMENT

While governments are struggling to agree on more drastic measures, cities and civil society are taking the lead and imposing their own rules

CO_2 & climate: CO_2 emissions

Increase of CO_2 emissions in 2018

After 3 years of stability between 2014 and 2016, global anthropogenic CO_2 emissions have increased in 2017 (+1.6%) to accelerate further in 2018 (+2.7%). This bad news stems from the intensive use of highly polluting coal, mainly in China and India. In 2018, China's CO_2/capita emissions caught up with Europe's (7 tons/capita), but stayed well below those of the US (16.2 tons/capita).
However, on a longer trend, the pace of global CO2 emissions has substantially decreased, nearly halving between 2000/2010 (+2,7%/y) and 2010/2018 (+1.4%/y). This would lead to a global warming of 3°C by the end of the century.

China, the biggest polluter in the world (26% of global emissions), registered in 2018 an increase by +4.7% of CO_2 emissions; measures taken by Beijing to support the economy and the building sector explain this sharp upturn in emissions, as the continuous use of coal in power generation, coal being still the main source of energy. Despite this increase, the country respected its commitments made at the COP21 to curb emissions.

In India, the increase in CO_2 emissions (+6.3%) was supported by coal (+7.1%).

In the US (15% of global emissions) emissions resumed (+2.5% in 2018 versus -0.5% in 2017). This growth appears to be unrelated to D.Trump's pro-coal policy, but rather linked to meteorology. A cold winter followed by a very hot summer drove housing energy consumption up.

The EU, the 3rd polluter in the world (10% of the total), recovers at a virtuous pace, with a -0.7% decrease in emissions in 2018 after a +1.4% increase in 2017. Since 2010, its annual emissions pace has been -1.4%.

But there are strong disparities within Europe. The UK significantly reduced its CO_2 emissions (-3.7% in 2017) by replacing its coal power plants with gas and developing renewable energies. Germany is steady. In France, CO_2 emissions soften in 2018 after a conjunctural growth in 2017 (+2% due to higher fossils consumption in power generation and car fleet increase). However, the Hexagon is among the 19 countries in the world (along with Denmark, the US, Sweden and especially the UK), that cut emissions over the 2008-2017 decade while showing economic growth.

This trend is likely to continue in 2019 with the lasting use of coal, oil and natural gas.

Commitments made by the Paris Agreement signatory States (INDCs) will limit the increase in world CO_2 emissions to around 10% to 15% by 2040, depending on the reference scenario (Enerdata's Ener-Blue and IEA's New Policies).

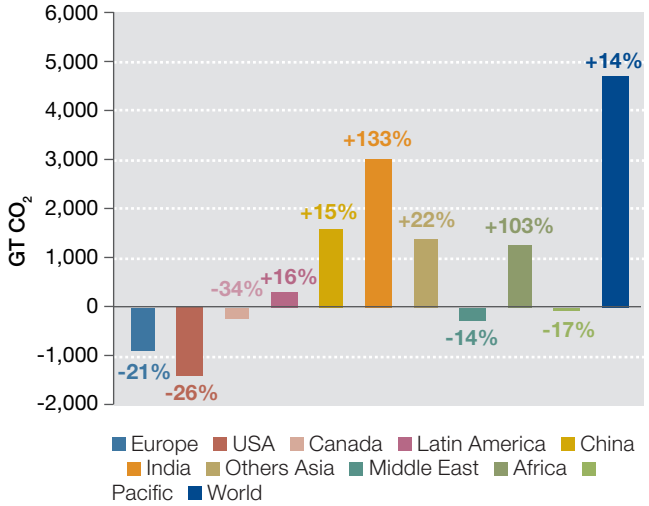
In order to restrict the temperature rise to 2°C by the end of the century, emissions will have to peak in the coming few years then decrease 25% by 2030 and 45% by 2040 (IEA's Sustainable Development and Enerdata's EnerGreen scenarios). A +1.5°C goal would require a 50% to 55% reduction by 2040. Note that these constraints take no account of direct emissions nor deforestation (5GtCO_2 equivalent per year) or of other powerful GHGs (methane, etc.).

CO_2 & climate: CO_2 emissions

Émissions de CO_2 (Mt)	1990	2000	2010	2015	2016	2017	Change 1990-2017	AAGR 1990-2017	Change 2016-2017	Share in world 2017
Europe	4,424	4,262	4,166	3,811	3,821	3,903	-12%	-1%	2%	12%
EU-28	4,121	3,906	3,730	3,325	3,308	3,352	-19%	-1%	1%	10%
Germany	956	833	780	754	760	763	-20%	-1%	0%	2%
North America	5,281	6,339	5,978	5,596	5,494	5,557	5%	0%	1%	17%
United States	4,851	5,809	5,430	5,034	4,927	4,975	3%	0%	1%	15%
Canada	430	529	548	562	567	582	36%	1%	3%	2%
Latin America	852	1,201	1,551	1,675	1,643	1,617	90%	2%	-2%	5%
Mexico	263	364	446	447	449	445	70%	2%	-1%	1%
Asia	4,768	6,773	12,657	14,736	14,827	15,328	222%	4%	3%	47%
China	2,261	3,144	7,763	9,061	9,003	9,179	306%	5%	2%	28%
India	522	909	1,575	2,013	2,057	2,194	320%	6%	7%	7%
Korea	244	435	594	639	656	681	179%	4%	4%	2%
Japan	1,049	1,134	1,100	1,146	1,143	1,142	9%	0%	0%	4%
Indonesia	148	273	381	466	466	496	236%	5%	6%	2%
Pacific	293	376	435	420	433	446	52%	2%	3%	1%
CIS	3,526	2,193	2,375	2,296	2,275	2,407	-32%	-1%	6%	7%
Russia	2,193	1,525	1,610	1,606	1,583	1,687	-23%	-1%	7%	5%
Middle East	589	961	1,608	1,870	1,902	1,948	231%	5%	2%	6%
Saudi Arabia	156	244	435	551	573	589	278%	5%	3%	2%
Iran	181	320	515	578	590	605	234%	5%	3%	2%
Africa	540	683	1,021	1,146	1,153	1,240	130%	3%	8%	4%
South Africa	254	300	416	418	423	422	66%	2%	0%	1%
World	**20,313**	**22,838**	**29,790**	**31,549**	**31,546**	**32,445**	**60%**	**2%**	**3%**	**100%**
OECD	**11,182**	**12,759**	**12,594**	**11,954**	**11,892**	**12,055**	**8%**	**0%**	**1%**	**37%**
no-OECD	**9,114**	**10,072**	**17,196**	**19,595**	**19,654**	**20,390**	**124%**	**3%**	**4%**	**63%**
BRICS	**5,422**	**6,176**	**11,739**	**13,559**	**13,494**	**13,912**	**157%**	**4%**	**3%**	**43%**

Source: Enerdata Global Energy & CO_2 Data (2018)

EVOLUTION OF CO_2 EMISSIONS BETWEEN 2015 AND 2040 WITHIN INDC



Source: Enerdata Global Energy & CO_2 Database, POLES-Enerdata model, EnerFuture scenarios

CO_2 & climate: CO_2 emissions by sector

The energy sector is responsible for nearly half of world CO_2 emissions associated with energy combustion

CO_2 EMISSIONS BY SECTOR, ACCORDING TO THE IEA'S CENTRAL SCENARIO (NEW POLICIES)

Nearly half of world CO_2 emissions come from the energy sector (mostly electricity production, but also refining and mining). Although power demand is expected to increase (up 60% by 2040), emissions from this sector should stabilise (up 2% by 2040), as the use of renewable sources will significantly reduce carbon intensity: from 485g of CO_2 per kWh in 2017 to 315g in 2040, according to the New Policies scenario. RES – solar energy, for the most part – will provide 75% of additional capacity and will represent half of the electricity mix in 2040. At the same time, the vast majority of new fossil fuel plants will be highly efficient CCG turbines.

Emissions from the industrial sector represented 23% of total emissions in 2017. They will rise another 20% over the period, as the reduction in energy intensity (>23%) will not be enough to offset higher production.

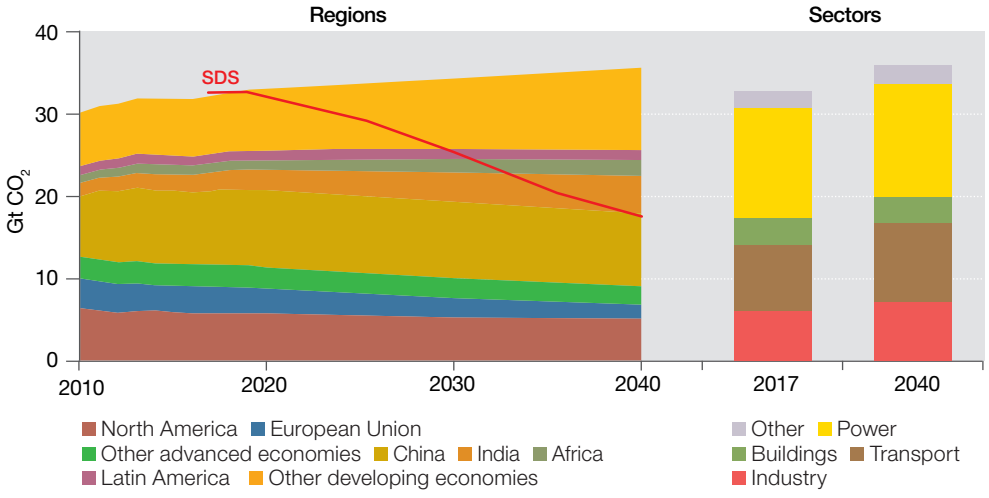
20% of global emissions come from transport. Oil dependency makes the sector's decarbonisation a difficult process. It is expected to produce a third of total emissions in 2040, as aviation and freight transport will expand, and even though car emissions should diminish from 2030 onwards. According to the New Policies scenario, CO_2 emissions from transport will rise 20% by 2040.

Emissions from the residential and service sector (10% share in 2017) declined slightly over the period (-3%), despite intensifying urbanisation. Better energy efficiency and electrification will offset the increase in energy demand.

All in all, world CO_2 emissions will increase 10% by 2040 in this scenario, from 32.5 Gt in 2017 to 36 Gt.

*** All forecasts are from the IEA's New Policies scenario (World Energy Outlook 2018).**

CO_2 EMISSIONS BY REGION AND SECTOR IN THE NEW POLICIES SCENARIO



Source: AIE, WEO 2018

CO_2 & climate: CO_2 emissions by sector

CO_2 emissions by sector	Energy (Mt)				Residential & Agriculture (Mt)				Industry (Mt)				Transport (Mt)				Total (Mt)			
	1990	2017	Change 1990-2017	Change 2016-2017	1990	2017	Change 1990-2017	Change 2016-2017	1990	2017	Change 1990-2017	Change 2016-2017	1990	2017	Change 1990-2017	Change 2016-2017	1990	2017	Change 1990-2017	Change 2016-2017
Europe	1,696	1,417	-17%	2%	865	702	-19%	2%	1,040	724	-30%	2%	822	1,060	29%	3%	4,424	3,903	-12%	2%
EU-28	1,592	1,191	-25%	1%	802	613	-24%	2%	967	620	-36%	1%	760	928	22%	2%	4,121	3,352	-19%	1%
Germany	352	301	-15%	-4%	212	142	-33%	6%	233	156	-33%	3%	159	165	3%	2%	956	763	-20%	0%
France	61	50	-17%	14%	96	80	-17%	-1%	94	62	-35%	0%	114	126	11%	2%	365	317	-13%	3%
North America	2,285	2,381	4%	1%	665	642	-3%	2%	807	670	-17%	1%	1,524	1,865	22%	1%	5,281	5,557	5%	1%
United States	2,140	2,153	1%	1%	584	548	-6%	2%	721	583	-19%	1%	1,406	1,691	20%	1%	4,851	4,975	3%	1%
Canada	145	228	57%	3%	81	94	17%	7%	86	87	1%	-3%	118	174	47%	3%	430	582	36%	3%
Latin America	237	485	105%	-5%	105	149	42%	-3%	223	379	70%	0%	288	604	110%	1%	852	1,617	90%	-2%
Mexico	94	172	82%	2%	26	27	4%	-15%	59	96	64%	4%	84	150	80%	-4%	263	445	70%	-1%
Asia	1,624	7,557	365%	4%	902	1,270	41%	4%	1,690	4,528	168%	2%	551	1,973	258%	4%	4,768	15,328	222%	3%
China	737	4,792	550%	2%	524	755	44%	4%	905	2,759	205%	2%	95	873	824%	4%	2,261	9,179	306%	2%
India	207	999	383%	5%	85	175	107%	5%	167	735	341%	9%	64	285	342%	8%	522	2,194	320%	7%
Korea	51	341	566%	5%	73	58	-20%	2%	76	179	136%	5%	44	103	136%	1%	244	681	179%	4%
Japan	396	515	30%	0%	137	135	-1%	-1%	313	281	-10%	-1%	203	210	4%	0%	1,049	1,142	9%	0%
Indonesia	48	169	253%	8%	23	32	38%	9%	45	149	235%	3%	32	146	353%	8%	148	496	236%	6%
Pacific	154	238	55%	2%	15	26	72%	2%	54	68	28%	9%	72	113	58%	2%	293	446	52%	3%
CIS	1,954	1,332	-32%	9%	625	319	-49%	5%	602	514	-15%	4%	345	241	-30%	-3%	3,526	2,407	-32%	6%
Russia	1,279	938	-27%	9%	382	185	-52%	8%	310	401	29%	5%	222	163	-27%	-5%	2,193	1,687	-23%	7%
Middle East	193	809	319%	4%	77	177	130%	1%	167	570	241%	2%	152	392	158%	0%	589	1,948	231%	2%
Saudi Arabia	53	226	324%	6%	3	5	80%	-1%	51	225	346%	2%	49	133	170%	-2%	156	589	278%	3%
Iran	40	201	407%	5%	53	147	178%	0%	49	139	183%	1%	40	119	200%	4%	181	605	234%	3%
Africa	243	614	153%	14%	50	114	127%	2%	135	184	37%	0%	113	328	191%	4%	540	1,240	130%	8%
South Africa	144	270	88%	-1%	14	29	101%	0%	67	64	-4%	-1%	29	59	103%	6%	254	422	66%	0%
World	**8,413**	**14,832**	**76%**	**4%**	**3,305**	**3,398**	**3%**	**3%**	**4,721**	**7,638**	**62%**	**2%**	**3,874**	**6,576**	**70%**	**2%**	**20,313**	**32,445**	**60%**	**3%**
OECD	**4,474**	**4,997**	**12%**	**2%**	**1,733**	**1,575**	**-9%**	**2%**	**2,251**	**1,999**	**-11%**	**1%**	**2,724**	**3,484**	**28%**	**1%**	**11,182**	**12,055**	**8%**	**1%**
no-OECD	**3,922**	**9,835**	**151%**	**3%**	**1,574**	**1,824**	**16%**	**5%**	**2,468**	**5,640**	**128%**	**7%**	**1,150**	**3,092**	**169%**	**4%**	**9,114**	**20,390**	**124%**	**4%**
BRICS	**2,395**	**7,070**	**195%**	**3%**	**1,033**	**1,179**	**14%**	**4%**	**1,503**	**4,081**	**171%**	**3%**	**491**	**1,581**	**222%**	**3%**	**5,422**	**13,912**	**157%**	**3%**

Source: Enerdata Global Energy & CO_2 Data (2018)

CO_2 & climate: GHG by process

CO_2 EMISSIONS BY SOURCE

CO_2 emissions - $MtCO_2$		UE	Germany	Belgium	France	Italy	United Kingdom	Russia	USA	Canada	Australia	Japan	Total appendix 1
Fuel combustion (sectoral approach)	1990	4,121	956	106	364	398	553	2,193	4,851	430	270	1,049	15,292
	2016	3,306	760	95	309	333	378	1,583	4,927	566	399	1,142	13,800
	AAGR	-0.8%	-0.9%	-0.4%	-0.6%	-0.7%	-1.5%	-1.2%	0.1%	1.1%	1.5%	0.3%	-0.4%
Fugitive emissions (including flaring)	1990	191	38	1	11	13	42	758	383	49	37	5	1,528
	2016	85	10	1	4	7	10	758	318	56	49	1	1,298
	AAGR	-3.1%	-5.0%	-2.5%	-3.6%	-2.2%	-5.4%	0.0%	-0.7%	0.5%	1.1%	-5.3%	-0.6%
Industrial processes	1990	518	97	26	67	40	67	283	342	57	26	110	1,635
	2016	377	62	20	44	32	31	218	362	53	34	96	1,330
	AAGR	-1.2%	-1.7%	-1.0%	-1.6%	-0.9%	-2.9%	-1.0%	0.2%	-0.2%	1.1%	-0.5%	-0.8%
Waste	1990	236	38	4	17	17	67	81	199	19	20	29	729
	2016	139	10	1	16	18	20	116	131	19	12	22	506
	AAGR	-2.0%	-4.9%	-4.0%	-0.2%	0.2%	-4.5%	1.4%	-1.6%	0.0%	-1.9%	-1.2%	-1.4%
Agriculture	1990	543	79	12	83	35	50	324	489	47	80	38	1,782
	2016	431	65	10	77	30	42	134	563	60	69	34	1,514
	AAGR	-0.9%	-0.8%	-0.8%	-0.3%	-0.5%	-0.7%	-3.3%	0.5%	0.9%	-0.6%	-0.4%	-0.6%
LULUCF (Land use, Land-use Change and Forestry)	1990	157	-2	-68	-250	-26	-31	-3	-62	159	-2	-820	-949
	2016	-24	-1	-28	-291	-37	-14	-30	-57	-634	-15	-717	-1,848
	AAGR	-	-2.8%	-3.4%	0.6%	1.3%	-2.9%	9.2%	-0.4%	-	7.7%	-0.5%	2.6%
Total (including LULUCF)	1990	5,403	1,220	144	523	515	798	3,893	5,536	536	577	1,204	20,349
	2016	4,007	895	117	429	398	472	2,009	5,795	676	525	1,248	16,570
	AAGR	-1.1%	-1.2%	-0.8%	-0.8%	-1.0%	-2.0%	-2.5%	0.2%	0.9%	-0.4%	0.1%	-0.8%

Source: Enerdata Global Energy & CO_2 Data (2018); UNFCCC Greenhouse Gas Inventory Data (2018)

CO_2 & climate: fuel emission factors

CO_2 EMISSION FACTOR OF CURRENT FUELS DATA FOR FRANCE (IN GRAM OF CO_2 EQUIVALENT/THERMAL KWH – PCI)

Combustibles	Direct emissions	LCA emissions
Coal	345	377
Heavy fuel	283	324
Domestic fuel	272	324
Diesel	256	323
Petrol (AVSR, unleaded 95 and 98)	253	314
LPG	233	260
Natural gas	204	243
Wood energy	18.8	29.5

Source: "Base Carbone de l'ADEME", January 2015

CO_2 content is estimated using one of two conventions:

- **Direct emissions:** emissions from energy use solely at the level of the consumer, or
- **Life Cycle Analysis (LCA):** emissions from extraction to final use: extraction, production, transport, distribution, use and even waste management.

CO_2 EMISSIONS FROM POWER GENERATION (IN GRAM OF CO_2 EQUIVALENT/KWH OF ELECTRICITY PRODUCED)

	Coal	Fioul	Gas combined cycle	Gas cogeneration	HWIP*	Nuclear	Wind	Hydro
Excluding life cycle analysis	915	676	404	from 230 to 380**	from 860 to 1,548	0	0	0
With a life cycle analysis	1,038	704	406			6	7.3	4

Source: "Base Carbone de l'ADEME", January 2015

*HWIP: Household Waste Inceneration Plant.
**Emission from gas cogeneration depend on yield and techniques used (turbine or motor).

CO_2 & climate: climate change

Climate change: signals and consequences are confirmed in 2018*

The long-term warming trend continues, 2018 being the 4th warmest year recorded. It corresponds to an average global temperature of 0.98±0.12°C above the pre-industrial baseline (1850-1900). 20 of the past 22 years have been the warmest ever, the last four years being at the top of the list. In France, 2018 is the hottest year since measurements began in 1900, ahead of 2014 (+1.2°C) and 2011 (+1.1°C). The average annual temperature, close to 14°C, is expected to be 1.4°C above the 1981-2010 reference average.

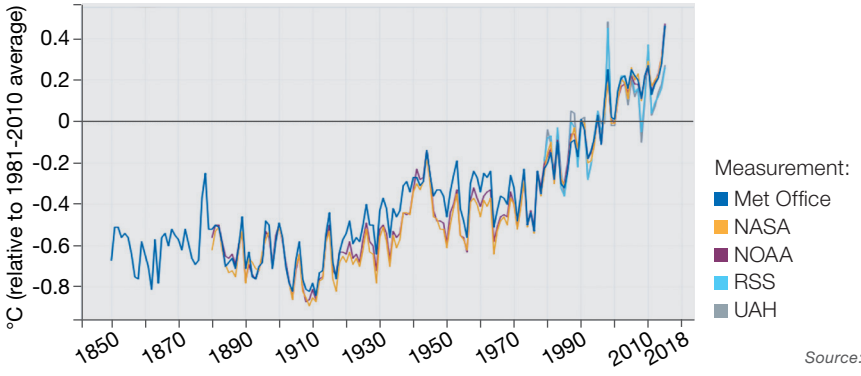
Ocean heat content was the highest in 2017, and the 2nd highest in 2018. More than 90% of the energy trapped by GHG goes into the oceans. The ocean heat content provides a direct measure of the energy accumulating in the upper layers of the ocean. The ocean heat contents in the upper 700m (data from 1955) and upper 2,000m (data from 2005) were the highest or 2nd highest on record in 2017 and 2018.

The Arctic sea ice extent was well below normal in 2018, with declining records in January and February. The annual maximum, observed in mid-March, ranks third among the lowest ever recorded (7% below the 1981-2010 average). As for the seasonal minimum of September, it ranks 6th among the lowest ever recorded (28% below average). The 12 lowest seasonal minimums coincide with those of the last 12 years. The 2018 extent of the Antarctic ice sheet is also much lower than usual. The seasonal minimum was reached at the end of February, and is one of the two lowest ever recorded.

Out of the 17.7 million Internally Displaced Persons (IDPs), 2.3 million people were displaced due to disasters linked to weather and climate events. Drought, floods and storms (including hurricanes and cyclones) are the events that led to the largest number of displacements caused by a disaster in 2018.

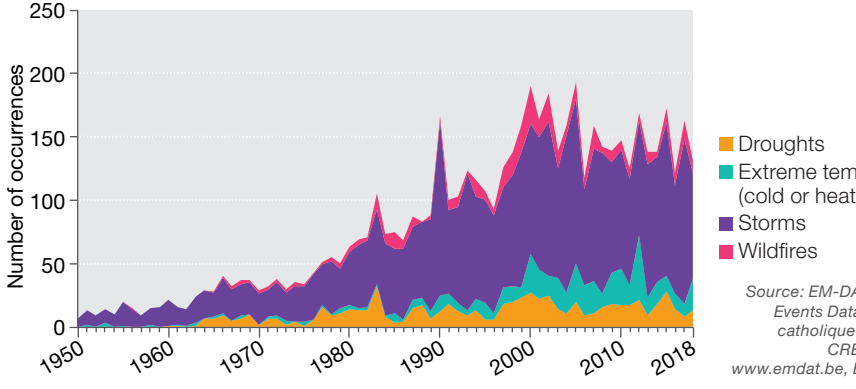
*** Source: World Meteorological Organization, "The State of Global Climate in 2018", Nov.2018; observations are made from January to October 2018.**

GLOBAL SURFACE TEMPERATURE (SATELLITE DATA)



Source: CarbonBrief.org

NATURAL DISASTER OCCURRENCES SINCE 1950



Source: EM-DA: The Emergency Events Database - Université catholique de Louvain (UCL) CRED, D. Guha-Sapir www.emdat.be, Brussels, Belgium

CO_2 & climate: carbon markets

CARBON MARKETS ACROSS THE WORLD

In 2018, 46 national and 26 local authorities - representing 60% of world GDP - have implemented explicit carbon pricing policies, covering approximately 20% of world GHG emissions (11 $GtCO_2e$), up from just 13% in 2016. This increase mainly reflects the Chinese Emission Trading Scheme (ETS) coming into force in December 2017.

The average carbon price is still too low. World carbon prices need to range between $40 and $80/$tCO_2$ by 2020 (and between $50 and $100/$tCO_2$ by 2030) to keep global warming to within the +2°C limit (recommendations of the High Level Commission on Carbon Prices). At present, over 75% of regulated emissions are priced at less than $10/$tCO_2$.

Carbon revenues increased to $32bn in 2017 (I4CE estimates), up from $22bn in 2016. At $21bn, carbon taxes generated 65% of total revenues, while emission trading schemes returned $11bn. The EU collected 67% of world carbon revenues. In contrast, the subsidies to fossil fuel consumption amounted to $260bn in 2016 (International Energy Agency estimates).

46% of world carbon revenues are used to finance low-carbon transition projects. 44% are allocated to general government budgets, 6% finance tax exemptions and the remaining 4% are transferred directly to companies and households.

THE EUROPEAN EMISSION TRADING SCHEME (EU-ETS)

Excess allowances on the EU-ETS stem largely from the 2008 economic crisis and **have driven carbon prices down since August 2008.** Carbon dioxide traded at between €5 and €10 per tonne between 2011 and 2017.

EU-ETS phase IV, which was approved by the European Council in early 2018, aims to restore a balance between allowance supply and demand in the 2021-2030 period and thereby boost carbon prices. Emission allowances are to decline 2.2% each year from 2021 (against 1.74% currently). Allowances withdrawn from the market and the 900 million tonnes in allowances left unsold at auction between 2014 and 2016 will be transferred to a Market Stability Reserve (MSR) that came into force in January 2019. The MSR allows supply and demand to be adjusted with a view to stabilising carbon prices over the long run, i.e. by freeing up allowances in case of insufficiency and withdrawing them in case of excess.

Carbon prices on the EU-ETS climbed from €8/t at end-2017 to a peak at €25/t in September 2018. The move anticipated the withdrawal of 1.4bn tonnes of carbon from the market by 2023. Carbon prices are forecast to reach €40/t by 2025.

CO_2 PRICES ON EU-ETS

CO_2 & climate: carbon markets

ETSs ELSEWHERE IN THE WORLD

2018 saw the introduction of China's ETS and new phases in the operation of the Australian and Kazakh ETSs.

Launched in 2017, the Chinese carbon market is to be fully operational in 2020. While 2018 focused on developing the market's infrastructures (monitoring, reporting, emissions verification, trading architecture), 2019 is a trial period. Allowances cover the power generation sector, which represents over 3.1 $GtCO_2$ per year, and 25% to 30% of Chinese CO_2 emissions. By comparison, the European market covers 1.8 $GtCO_2$ and the Californian market 400 $MtCO_2$. The extension of the Chinese carbon market to industrial sectors (aviation, construction materials, chemicals, iron and steel, non-ferrous metals, pulp and paper, and petrochemicals) will come at a later stage.

In Australia, the Emission Reduction Fund (ERF), along with the Safeguard Mechanism, make up a compensation system by which the regulator determines emission thresholds for a series of targeted businesses representing 50% of GHG emissions. Companies overstepping their thresholds are required to purchase carbon credits. GHG emissions have continued to rise, however, and the federal government is still promoting coal as durable resource.

The Kazakh carbon market covers 50% of the country's GHG. It applies to energy, mining, metallurgy, as well as the chemicals and transformation industries. This ETS aims to reduce GHG emissions by at least 15% from 1990 levels by 2030.

CARBON TAXES

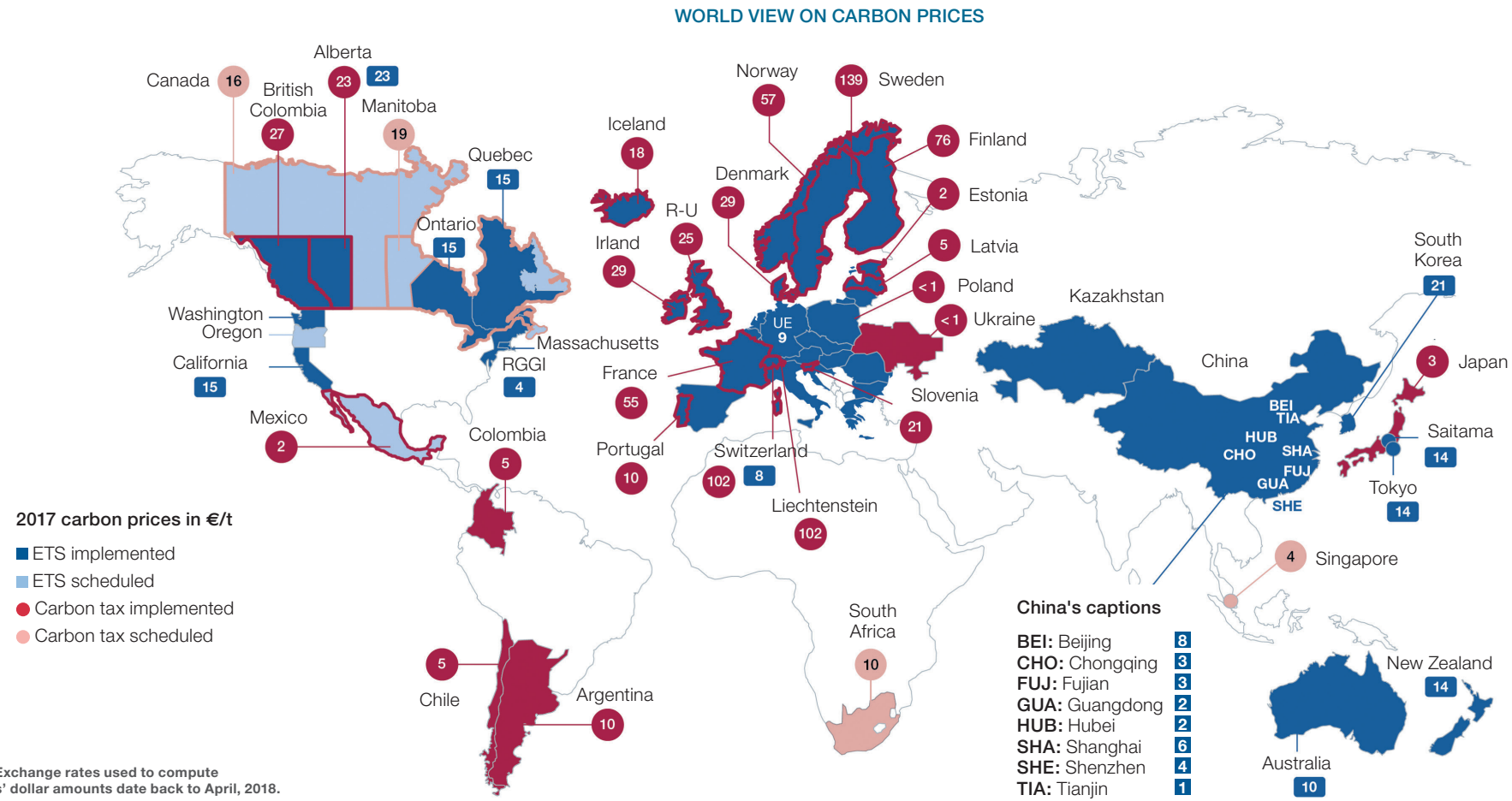
In 2018, more local authorities introduced carbon taxes to internalise pollution-linked costs. As of 1 January 2019, Canadian provinces that had not already imposed carbon taxes – or did so but at too low a rate – are taxing fossil fuels CAN$20/$tCO_2e$ (US$15/$tCO_2e$). Argentina also began taxing fossil energy consumption, at US$10/$tCO_2$. Although on a smaller scale (US$0.01/$tCO_2e$), Ukraine has also implemented a carbon tax, targeting the industrial, energy and construction sectors.

Nordic countries, Switzerland and Liechtenstein have the world's highest carbon taxes: US$127/$tCO_2e$ in Sweden, US$96/$tCO_2e$ in Liechtenstein, US$96/tCO2e in Switzerland, US$71/$tCO_2e$ in Finland and US$61/$tCO_2e$ in Norway. These taxes apply to individuals and companies emitting GHGs that are not subject to the EU-ETS.

France is the world's largest carbon tax revenue collector, with €6.9bn proceeds expected in 2018. Part of this revenue directly finances renewable energy sources via a special account dedicated to energy transition.

Currently set at 45€/tCO_2e (US$51/$tCO_2e$), the French carbon tax will remain frozen in 2019 following the fallout from the yellow jackets movement.

CO_2 & climate: prices on carbon markets



NB: Exchange rates used to compute taxes' dollar amounts date back to April, 2018.

Source: I4CE - Institute for Climate economics, d'après ICAP, Banque mondiale, sources gouvernementales et informations publiques (Avril. 2018)

CO_2 & climate: the Paris Agreement and the follow-up

The Paris Agreement negotiated at COP21 in 2015 came into force in November 2016. It establishes an international governance convention to keep the rise in global temperature from pre-industrial levels to "well below" 2°C by the end of the century. Each party committed to limit or reduce its greenhouse gas emissions and submitted National Determined Contributions (NDCs).

The Paris climate treaty did not set any implementation rules, however. Negotiations on such rules started at COP22 in Marrakech in 2016.

Reaching a consensus on this matter was one of the two main objectives of **COP24 in Katowice, Poland, last 3-14 December.** The other was to revise NDCs higher.

The Rulebook that has finally been approved allows the Paris Agreement to take full effect in 2024. It lays down in details how each country shall pilot and report GHG emissions, and defines control mechanisms. The Rulebook comprises a single framework but shows a degree of flexibility for signatories with limited technical and financial means (i.e. developing countries).

Despite the empty chair left by the USA, developed countries reiterated their financial commitments and decided to jointly mobilise $100bn per year from 2020 in support of poorer countries' efforts. Several specific financial promises were made: the Adaptation Fund will receive $129m, of which $80m from Germany; and the EU and Japan will make up the $3bn contribution promised by the USA to the Green Climate Fund before its withdrawal notification in August 2017. The final text of COP24 essentially provides for more ambitious financial objectives from 2025 onwards.

On the downside, delegations failed to agree on matters such as a world carbon market, carbon credits that would reward efforts to reduce GHG emissions, and carbon sinks. A Brazilian attempt to modify the carbon credit accounting mechanism that contradicted Article 6 of the Paris Agreement (a prohibition on double counting) brought discussions to a halt. Talks will resume at COP25, to be held in Chile in November 2019.

There is still no deal on making contributions mandatory (they will remain voluntary), or on funding climate change actions. Given insufficient public funds, delegations agreed to devise simplified financial instruments that could attract the private sector.

Most disappointingly for climate defenders, countries did not toughen GHG reduction objectives despite the recent IPCC (Intergovernmental Panel on Climate Change) warning of the disastrous consequences of a 2°C temperature rise relative to 1.5°C. Commissioned by the UN, the IPCC special report Global Warming of 1.5°C published in October 2018 highlights the necessity to cut GHG emissions by half of their 2010 levels by 2030 to maintain the global temperature increase below 1.5°C. The report states that 2015 commitments would mean a 3°C increase by the end of the century. Saudi Arabia, Kuwait, Russia and the USA have blocked a Katowice resolution intended at making this report a reference document for world climate action. The obligation for countries to revise their NDCs higher every five years is still in place, however, and 2020 is the next deadline. An inclusive and transparent platform, the so-called Talanoa dialogue (named after a Fijian term for free discussion), is still open to parties for the submission of new NDCs.

CO_2 & climate: the Paris Agreement and the follow-up

Global warming sceptics and fossil fuel industries' interests are returning to the fore, while the EU and poor countries insisted in Katowice that the situation is urgent. Alongside the climate sceptic US administration, the new Australian Prime Minister Scott Morrison firmly defended the coal industry and denigrated GHG reduction commitments made by Australia (26% to 28% off 2005 levels by 2030). Elected in November 2018, the new Brazilian president Jair Bolsonaro enjoys support from agribusiness lobbies and is threatening to revive large scale deforestation in Amazonia, the world's largest carbon sink (and home to many indigenous tribes).

The next climate conference will be the UN summit on climate change in New York in September 2019, chaired by Secretary-General Guterres. Its objectives will be to prompt national and local authorities, as well as companies and investors, to step up their efforts in energy and industry transition, climate project financing, carbon pricing and climate resilience.

CO_2 & climate: international regulatory and political environment

EUROPEAN UNION

In November 2018 the European Parliament adopted a Clean Energy Package (CEP) aimed at a 40% reduction of the EU's GHG emissions from 1990 levels by 2030. The EU has not only asserted its intention to comply with the Paris Agreement but is also demonstrating its leadership on renewables. The new directives give consumers a central role in energy transition, and prioritise energy efficiency.

Renewable energy sources (including biomass and biofuels) are to represent at least 32% of the energy mix by 2030, with an option to toughen this objective in 2023. Households and companies will be entitled to produce their own renewable electricity, to use it and sell any excess on the grid. RES made up 17.4% of EU energy primary consumption in 2017.

Energy efficiency is to improve by 32.5% by 2030, with possible upward revision in 2023. Tackling energy poverty also becomes mandatory.

To improve buildings' energy performance, member states have to come up with national renovation strategies to achieve carbon near-neutrality by 2050 (80% to 95% reduction in buildings' GHG emissions from 1990 levels). This sector is the EU's largest energy consumer (40%). The directive provides for the installation of building automation systems by 2025 as part of a bid to promote smart buildings, as well as the installation of recharging facilities for electric vehicles.

Member states also agreed on the governance of the energy union and climate action. The idea is to define cooperation between countries on energy projects, energy efficiency objectives and GHG reduction. Member states will have to submit Integrated National Energy and Climate Plans (NECPs) to the European Commission; the fist wave of plans are to cover the period 2021 to 2030.

The European Parliament will vote on a series of complementary measures in the first months of 2019 that will strengthen the regulation of the electricity market and the energy union (better national power grid connections, clarification of competition rules, consumer participation in electricity generation etc.).

According to the European Commission's estimates, the CEP could generate as much as 1% growth and create 900,000 jobs between 2021 and 2030. The package will cost €177bn per year to implement, and is to be financed via an increased EU energy union budget. The Commission also intends to attract private investors with specific financial and informational tools.

UNITED KINGDOM

The impact of Brexit on the European energy market remains uncertain. The UK is connected to the continental electricity and natural gas grids, which provide 4.2% of its electricity and 37% of its natural gas (2017). In the event of an exit from the internal energy market, electricity prices may rise in the UK because of higher import prices and less efficient trading; in contrast, continuing participation in the internal energy market would imply compliance with EU rules and related decisions by the EU Court of Justice. The UK also belongs to the EU-ETS carbon market and will continue to do so until 2020 at least.

We should bear in mind that the UK has adopted a climate change policy with its own robust legal framework. The Climate Change Act (2008) sets out an GHG emission reduction objective of 80% from 1990 levels by 2050 (excluding aviation and sea transport) and provides for the administrative and technical means to achieve this goal.

CO_2 & climate: international regulatory and political environment

UNITED STATES

Since the announcement of the America First Energy Plan in January 2017, the Trump administration has relentlessly supported fossil fuel industries. Through executive orders, the president has been unwinding Obama-era environmental regulations on the grounds that they hamper economic prosperity. These orders relate to the following:

> Dismantling the Clean Power Plan, notably rules limiting GHG emissions by gas and coal-fired power plants and by appliances (air conditioners and refrigerators),

> Freezing improvements in road vehicles' energy efficiency,

> Increasing the terrestrial and sea surface allowed to oil and gas companies for drilling. In 2017, the federal government auctioned off exploration and production rights covering over 4.8 million hectares of federal lands, a 500% increase from the previous year. In addition, the White House is currently considering the possibility of allowing drilling in protected lands such the Arctic National Wildlife Refuge.

The markets have effectively countered presidential enthusiasm for revived fossil fuel industries, however, and notably for coal. Gas-fired plants produce cheaper electricity than coal-fired plants (respectively $34.41/MWh and $36.70/MWh in 2018), and coal-fired plants are now competing with renewable energy plants, for which marginal costs are zero. Primary coal consumption has dropped by 40% over the last ten years in the USA and coal-fired power capacity has been trending lower since 2012 (down 12%).

The reality of climate change in the country underlines the inadequacy of Mr Trump's energy policy. The 2018 report on climate change warned of the already tangible consequences of higher temperatures: worsening air quality, fresh water scarcity, higher frequency of extreme weather events (droughts, heat waves, hurricanes and floods), soil and coastal erosion, ocean acidification etc.

At the same time, civil society is working through the separation of powers in the US political system to move the country in a different direction. The US Senate has passed the funding of the United Nations Framework Convention on Climate Change (UNFCCC) and the IPCC in 2018, with amounts similar to those of previous years.
The diverse "We are still in" coalition committed to the Paris Agreement claims the support of over half of the US population, and "America's pledge" is bringing together private and public players to meet American commitments made at COP21. Several multinational companies have committed to reduce GHG emissions; Apple now uses 100% renewable energy in its buildings, for example.

If fully implemented, policies agreed at US state and local levels could allow a 17% to 24% reduction in GHG emissions from 2005 levels by 2025. But that would fall short of COP21 commitments (26% to 28% reduction) and would fail to limit the rise in global temperatures to 2°C.

CHINA

Thanks to a proactive policy, China is about to fulfil its COP21 commitments and act as the planet's leader in this regard. The 13th five-year plan (2016-2020) and the Energy Supply and Consumption Revolution Strategy (out to 2030) set the country's energy and environmental goals, which include developing low-carbon energy, strengthening energy efficiency regulations and reducing CO_2 emissions.

Chinese CO_2 emissions are expected to peak before 2030. That said, and after stabilisation in 2013-2016, emissions rose in 2017 (+2.3%) and 2018 (+4.7%).

CO_2 & climate: international regulatory and political environment

The world's largest coal consumer (half of world consumption), China is to reduce the share of coal in its energy mix from 63% in 2017 to 58% by 2020. The country remains heavily dependent on coal, which accounted for 68% of national power generation in 2017 compared with 31% in the USA. Steps are being taken to enhance coal performance, however. Power plants consuming over 310g of coal per kW/h will be closed by 2020 at the latest (a tougher standard than in the USA), and new anti-pollution systems are to be installed (desulphurisation, denitrification and dust extraction).

China is also committed to raising the share of non-fossil energy (renewables, nuclear and biomass) in its national energy consumption to at least 20% by 2030. In 2017, carbon-free energy represented 12% of primary energy consumption (nuclear 2%, renewables 6%, of which 4% hydro, biomass 4%). To meet this goal, the country is investing massively in renewables. In 2017, $120bn were spent on solar and wind power, which is about double the amount spent in the USA. Chinese solar capacity is the largest in the world (78 GW in 2016), having increased by 53 GW in 2017 (+68%).

In addition, China sees energy transition technology as a promising strategic opportunity to modernise its economy. The country is striving to lead the world in battery and electric engine production. In 2019, car manufacturers will be required to produce electric vehicles amounting to at least 12% of their output; purchase subsidies for this type of car are bolstering the domestic market.

Many shortcomings persist, Chinese NDCs are not ambitious enough to limit the global rise in temperature to 2°C, and the country faces increasing demand for oil, gas and coal in line with growing electricity needs and expanding car ownership. In 2018, the Chinese government suddenly cut subsidies to solar projects – from 6.7% to 9% depending on the region – and lifted a ban on building new coal-fired power plants. Lastly, there are no provisions for reducing non-CO_2 GHG emissions (CH_4, N_2O, HFCs, etc.), which according to current estimates will represent between 23% and 25% of GHG emissions by 2030.

INDIA

India has taken on two energy challenges at once: to provide all households with access to electricity as soon as possible and to limit GHG emissions.

The so-called Saubhagya electrification plan aims to bring electricity to 25 million households by March 2019 that did not have access to it when the project was launched in September 2017. Because of rising energy demand (+3% per year on average over the last four years), and with a view to reducing energy dependency (64% in 2017), India plans to increase the share of domestic supply in its coal, oil and natural gas consumption. The country is promoting energy efficiency through such measures as the PAT (Perform, Achieve and Trade) plan, which focuses on the most energy-intensive industries. India did commit in the Paris Agreement to reduce its energy intensity by 33% to 35% from its 2005 levels by 2030.

Badly hit by the effects of climate change, the country is keen to restrain its CO_2 emissions. India's policy on renewable energy is particularly ambitious: 175 GW capacity (excluding hydro) by 2020 (of which 100 GW solar and 60 GW wind), rising to 275 GW by 2027. At end-2017, the country's renewable capacity was around 50 GW, or 13% of its total power capacity. To meet its Paris commitments, 40% of India's power capacity will have to come from non-fossil sources by 2030.

Efforts to decarbonise transport include subsidies for the purchase of electrical and hybrid vehicles, covering some 6 to 7 million cars per year. The country is also expected to launch a pilot carbon market for micro, small and medium enterprises and the waste sector in March 2019.

Doubts remain regarding the use of coal. India is now the world's second-largest coal producer and consumer, after China. In 2017, domestic coal consumption increased 5% (27 million tonnes), and the 2018 National Energy Policy (NEP) provides for new coal-fired plants over the next few years. This option had originally been rejected.

CO_2 & climate: international regulatory and political environment

WORLD

Legal proceedings against states have multiplied that cite constitutional and treaty-based fundamental rights to life, health and a sound environment. Some 900 environmentally-inspired legal proceedings have been initiated to date. US courts account for 667 suits; behind them figure the UK, the EU and Asia-Pacific countries. In the Juliana vs. US case, a group of 21 children and teenagers is accusing the US government, as a protector of natural resources, of discrimination in favour of fossil fuel companies. In France, four NGOs (Oxfam France, Nicolas Hulot Foundation, Greenpeace and Notre Affaire à Tous) are suing the state to hold it responsible in the event that it fails to meet its environmental commitments ("The legal battle of the century"). The petition they launched to support these proceedings had attracted over 2 million signatures by January 2019. Citizens, associations and NGOs are urging politicians to act faster and more vigorously on climate change.

2018 was a record year for civil mobilisation on climate change. A good example was the demonstration by thousands of Australian schoolchildren in November 2018 in support of the young Swedish activist Greta Thunberg. The "School Strike 4 Climate" movement is calling for an exit from fossil fuel energy by 2030 and plans more peaceful demonstrations in 2019.

Electricity

CONSUMPTION

In 2018 half of world electricity demand growth is based on renewable energies

PRICES

Electricity prices in Europe reflect the depth of environmental policies

Electricity: generating capacity

Strong growth in renewable capacity still fails to halt new coal plants in developing countries

World power generation capacity maintains a stable growth of +4% per year since 2000 (+3.6% in 2017), driven by Asia (+6,1%; +175 GW in 2017). Power capacities in Africa are growing (+6.5%; +13 GW in 2017) but they still lag far behind the other regions. New capacities in OECD have been steadily decreasing over the past decades, and are now around +1.5% per year (+1.1% and in North America and +1.7% in Europe in 2017).

Renewable capacities increased by +8% in 2017 and continue to lead as the largest source of additional capacity (65%), with solar alone representing 36% of the global additional capacities. China continues to dominate the market for solar PV, with 60% of the new capacities in 2017; by the way, China has already exceeded its 2020 target of installing 105 GW of solar capacity, and wind capacity reached 185 GW (+13%) in 2018 (Source: Energy Intelligence). In India, the aggressive drive to bring solar capacity up to 100 GW by 2022, has seen solar capacity more than triple since 2015 particularly due to government-backed auctions (PV reached 9.6 GW in 2017). But several factors could slow down this momentum, such as the 25% tariffs imposed since July 2018 on solar modules imported from China and Malaysia, coupled with growing concerns about weak grid connectivity and flexibility, and the lack of connections to the grid.
Turning over to Europe, one finds a picture of renewables glowing with solar (+9% in 2017) and wind (+7%) accounting for 27% of installed capacity in the EU. The UK's position as the world's biggest market for offshore wind was affirmed in 2018 when it added 2 GW of extra capacity.

Global gas capacity expanded by +2% in 2017 (+1% in 2016), with the US, Africa and the Middle-East having the strongest appetite (+6 GW each). The picture for gas-fired plants in Asia appears a bit bleak with a narrow rise by +1% in 2017 (+4.5% in 2016). Indeed, almost half of India's 24.2 GW gas capacity was mothballed due to the lack of sufficient natural gas in the domestic market and the high cost of imported gas.

Expansion of coal-fired generation continues with + 2% in 2017, albeit at a slower rate compared to the annual average since 2010 (+4%). Developing countries are largely responsible for the continued surge in coal-based electricity generation: +5% rise in China (+53 GW), +2% in India (4 GW), and +7% in Africa (+3 GW). Bold energy transition moves in Europe persistently lead to a push back on coal-fired plants which slumped by -3% in 2017. In the US, the twin of technology (ageing plants, reduced thermal efficiency) and economics (maintenance costs, competition from gas) have acted to suppress coal capacity: -13 GW in 2018 and a further -4.5 GW retirement scheduled for late 2019 (The US Energy Information Administration).

Nuclear capacity also expanded but is slowing down (+1.3% in 2017 compared to 2.6% in 2016) on the back of strong headwinds faced by the nuclear industry in the US and South Korea. China remains the main engine with 4 of the 6 GW new nuclear reactor connected to the grid in 2017.

Electricity: generating capacity by power station type

Installed Electricity Generation Capacity (GW)	Total capacity			Hydro capacity			Nuclear capacity			Thermal capacity			Wind capacity			Solar capacity			Geothermal capacity		
	2000	2017	Évolution 2016-2017	2000	2017	Change 2016-2017	2000	2017	Change 2016-2017	2000	2017	Change 2016-2017	2000	2017	Change 2016-2017	2000	2017	Change 2016-2017	2000	2017	Change 2016-2017
Europe	804	1,183	1.7%	203	243	0.4%	141	123	-0.8%	447	523	-0.5%	12	177	9.3%	0.2	107	7%	1	3	10%
European Union	712	1,016	1.1%	140	155	0.1%	138	120	-0.9%	421	463	-1.3%	12	169	9.0%	0.2	104	4%	1	1	-6%
Germany	122	203	0.2%	10	11	0%	22	11	0%	85	83	-7.6%	5	56	12.1%	0.1	41	3%	0	0	0%
France	114	137	-0.6%	25	26	0.2%	63	63	0%	25	26	-9.8%	0.08	14	12.4%	0	7	7%	0	0	0%
North Amercia	980	1,353	1.1%	167	184	0.4%	118	118	0.1%	688	901	-0.1%	3	100	7.1%	0.4	37	23%	3	4	-1%
Canada	111	145	1.1%	67	81	0.7%	10	14	0%	33	35	1.2%	0.1	12	2.9%	0	3	10%	0	0	-
United States	869	1,207	1.2%	100	103	0.2%	108	105	0.1%	655	866	-0.1%	2	88	7.7%	0.4	35	24%	3	4	-1%
Latin America	222	414	2.5%	123	187	2.1%	4	5	0%	93	193	0.5%	0.10	21	17.9%	0	3	67%	1	2	2%
Brazil	74	158	4.8%	61	100	3.5%	2	2	0%	10	42	1.4%	0.02	12	21.4%	0	0	1271%	0	0	-
Asia	934	3,035	6.1%	185	520	3.3%	66	111	4.3%	678	1987	3.3%	2	204	10.8%	0.4	138	51%	3	4	4%
China	336	1,821	7.9%	79	341	2.7%	2	36	14.1%	254	1150	4.8%	0.3	164	10.1%	0.1	78	68%	0.03	0.03	0%
South Korea	49	106	1.1%	3	6	0.1%	14	23	-2.5%	32	72	2.2%	0.01	1	9.9%	0	4	0%	0	0	-
India	115	370	6.8%	24	49	14.4%	3	7	17.3%	87	265	2.0%	1	33	14.5%	0	9	78%	0	0	-
Japan	258	371	1.8%	46	50	0%	42	40	-1.3%	169	228	0%	0.1	3	5.5%	0.3	42	17%	0.5	0.5	0%
CIS	329	405	1.6%	64	74	1.0%	31	41	3.5%	234	287	1.3%	0.002	1	25.6%	0	1	34%	0.02	0.10	0%
Russia	211	265	2.0%	44	49	0.7%	20	28	5.4%	147	188	1.7%	0.002	0	0%	0	0.1	142%	0.02	0.10	0%
Middle East	118	309	2.4%	7	16	1.9%	0	1	0%	111	290	2.3%	0.001	0	0%	0	1	29%	0	0	-
Saudi Arabia	31	84	0%	0	0	-	0	0	-	31	83	0%	0	0	-	0	0	20%	0	0	-
Iran	33	76	3.2%	2	12	2.7%	0	1	0%	31	63	3.3%	0	0	0%	0	0	213%	0	0	-
Africa	101	210	6.5%	21	36	3.8%	2	2	0%	78	163	6.5%	0.1	5	20.3%	0	3	22%	0.07	0.68	1%
North-Africa	33	89	8.6%	5	5	0%	0	0	-	28	82	9.0%	80	2	6.3%	0	1	44%	0	0	-
Egypt	15	45	15.9%	3	3	0%	0	0	-	12	42	17.3%		1	0%	0	0	81%	0	0	-
Sub-saharan Africa	69	120	5.0%	17	31	4.4%	2	2	0%	50	81	4.2%	3	3	34.1%	0	3	18%	0.07	0.68	1%
South-Africa	41	54	7.5%	2	4	16.5%	2	2	0%	37	44	5.5%		2	42.2%	0	2	14%	0	0	-
Pacific	55	77	-1.2%	15	15	0.1%	0	0	-	40	49	-3.2%	0.07	5	4.9%	0	6	8%	0.37	1.00	-4%
Australia	46	66	-1.4%	9	9	0%	-	-	-	37	46	-3.3%		5	5.7%	0	6	7%	0	0	-
World	**3,544**	**6,984**	**3.6%**	**785**	**1,275**	**2.0%**	**363**	**402**	**1.3%**	**2,368**	**4,393**	**1.9%**	**17**	**514**	**9.8%**	**1**	**297**	**30%**	**9**	**14**	**0**

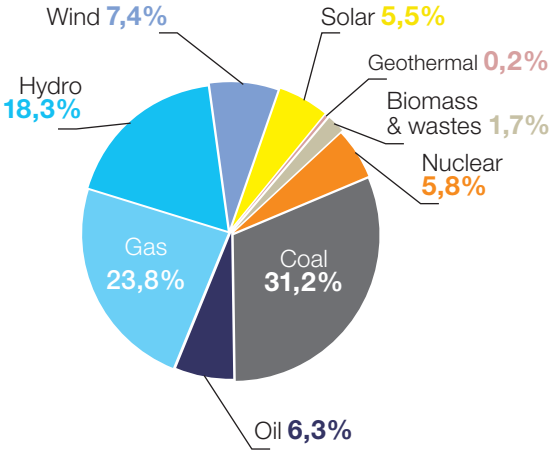
Source: Enerdata Global Energy & CO_2 Data (2018)

Electricity: detail of thermal capacities

Details of Installed Thermal Capacity (GW)	Thermal capacity Oil			Thermal capacity Natural gas			Thermal capacity Coal & lignite			Thermal capacity Biomass & waste		
	2000	2017	Change 2016-2017	2000	2017	Change 2016-2017	2000	2017	Change 2016-2017	2000	2017	Change 2016-2017
Europe	804	43	-8.3%	203	252	1.9%	216	190	-2.7%	10	38	4.4%
European Union	712	41	-8.4%	140	222	1.3%	201	162	-3.8%	9	37	4.2%
Germany	122	2	-12.1%	10	22	-10.5%	54	49	-8.9%	2	9	10.2%
France	114	8	-30.7%	25	12	4.5%	8	5	0.0%	0	2	1.7%
North Amercia	980	44	-1.6%	167	539	1.2%	345	297	-2.1%	14	21	0.8%
Canada	111	2	-0.4%	67	18	2.4%	18	9	0.0%	1	5	0.0%
United States	869	41	-1.7%	100	520	1.2%	327	288	-2.2%	13	16	1.1%
Latin America	222	57	0.5%	123	97	0.8%	11	20	-1.8%	3	20	1.7%
Brazil	74	9	1.0%	61	13	0.1%	2	5	2.3%	2	15	2.6%
Asia	934	121	-1.9%	185	292	1.0%	416	1,540	4.1%	5	34	11.0%
China	336	15	0.0%	79	47	0.0%	225	1,080	5.1%	0	9	0.0%
South Korea	49	3	0.0%	3	33	0.0%	14	32	0.0%	1	4	58.4%
India	115	4	-1.8%	24	29	-0.5%	72	222	1.8%	0	10	18.6%
Japan	258	56	0.0%	46	62	-0.1%	63	103	0.0%	3	8	1.1%
CIS	329	26	-1.4%	64	178	2.3%	78	81	0.0%	1	1	0.4%
Russia	211	16	0.0%	44	128	2.5%	42	43	0.1%	1	1	0.0%
Middle East	118	88	0.5%	7	197	3.1%	4	5	0.0%	0	0	0.0%
Saudi Arabia	31	45	0.0%	0	38	0.0%	0	0	-1	0	0	-
Iran	33	15	2.6%	2	48	3.5%	0	0	-1	0	0	0.0%
Africa	101	25	3.1%	22	90	7.3%	40	47	6.9%	0	1	6.2%
North-Africa	33	11	0.0%	5	68	10.5%	1	3	12.5%	-	-	-
Egypt	15	5	0.0%	3	37	20.1%	-	-	-1	-	-	-
Sub-saharan Africa	69	14	5.6%	17	22	-1.1%	39	44	6.6%	0	1	6.2%
South-Africa	41	0	0.0%	2	3	0.0%	37	41	6.0%	0	0	0.0%
Pacific	55	3	0.9%	15	19	-0.2%	28	26	-5.8%	0	1	-0.7%
Australia	46	2	0.0%	9	17	0.0%	27	26	-5.9%	0	1	0.0%
World	**3,544**	**407**	**-1.4%**	**785**	**1,664**	**1.9%**	**1,139**	**2,206**	**2.3%**	**34**	**116**	**4.9%**

Source: Enerdata Global Energy & CO_2 Data (2018)

WORLD INSTALLED ELECTRICITY CAPACITY BY SOURCE 2017 (TOTAL: 6,984 GW)



Source: Enerdata Global Energy and CO_2 Data (2018)

Electricity: generating capacity – long series

In MW	2000	2005	2010	2015	2016	2017	Change 2016-2017	AAGR 2000-2017	AAGR 2010-2017	Market Share 2017
Europe	804,465	870,476	1,016,161	1,152,332	1,163,033	1,182,695	1.7%	2.3%	2.2%	16.9%
European Union	712,115	765,623	894,643	999,577	1,004,765	1,016,124	1.1%	2.1%	1.8%	14.5%
Germany	122,115	130,966	163,755	200,611	202,374	202,738	0.2%	3%	3.1%	2.9%
Spain	55,112	76,626	101,593	107,314	106,714	106,792	0.1%	4%	0.7%	1.5%
France	113,565	115,762	125,244	135,934	137,671	136,886	-0.6%	1.1%	1.3%	2%
Italy	77,223	85,279	107,256	116,825	115,283	116,081	0.7%	2.4%	1.1%	1.7%
United Kingdom	78,394	81,976	93,525	97,314	97,872	103,555	5.8%	1.7%	1.5%	1.5%
North America	979,857	1,187,544	1,268,686	1,316,543	1,337,289	1,352,651	1.1%	1.9%	0.9%	19.4%
Canada	110,825	121,921	130,615	140,527	143,588	145,191	1.1%	1.6%	1.5%	2.1%
United States	869,031	1,065,623	1,138,071	1,176,016	1,193,701	1,207,460	1.2%	2%	0.8%	17.3%
Latin America	221,814	262,970	314,488	383,291	403,364	413,608	2.5%	3.7%	4%	5.9%
Brazil	73,533	92,998	112,889	143,271	150,411	157,583	4.8%	4.6%	4.9%	2.3%
Mexico	41,456	52,355	61,603	66,623	69,320	68,906	-0.6%	3%	1.6%	1%
Asia	933,951	1,225,882	1,833,228	2,636,828	2,860,284	3,035,385	6.1%	7.2%	7.5%	43.5%
China	336,120	530,590	1,012,023	1,564,438	1,687,609	1,821,392	7.9%	10.5%	8.8%	26.1%
South Korea	48,869	63,490	76,962	96,149	104,967	106,072	1.1%	4.7%	4.7%	1.5%
India	114,814	143,479	201,318	317,509	346,271	369,970	6.8%	7.1%	9.1%	5.3%
Japan	258,487	273,105	283,295	320,794	364,445	371,084	1.8%	2.1%	3.9%	5.3%
Pacific	55,011	59,996	71,759	78,598	77,539	76,603	-1.2%	2%	0.9%	1.1%
Australaia	46,204	50,142	61,132	67,730	66,807	65,887	-1.4%	2.1%	1.1%	0.9%
Middle East	117,703	147,521	217,273	296,754	301,755	308,910	2.4%	5.8%	5.2%	4.4%
Saudi Arabia	31,078	39,058	59,851	81,603	83,503	83,503	0%	6%	4.9%	1.2%
Iran	33,338	44,033	61,220	73,183	73,197	75,560	3.2%	4.9%	3.1%	1.1%
CIS	329,355	336,544	357,402	395,206	398,402	404,777	1.6%	1.2%	1.8%	5.8%
Russia	210,888	215,941	230,927	258,561	259,867	264,938	2%	1.4%	2%	3.8%
Africa	101,388	115,943	141,079	183,983	196,967	209,750	6.5%	4.4%	5.8%	3%
North Africa	32,749	40,896	56,208	75,950	82,308	89,415	8.6%	6.1%	6.9%	1.3%
Egypt	14,830	19,637	26,490	35,629	39,079	45,278	15.9%	6.8%	8%	0.6%
Subsaharan Africa	68,639	75,047	84,871	108,033	114,659	120,335	5%	3.4%	5.1%	1.7%
South Africa	41,308	42,069	44,256	47,565	50,669	54,459	7.5%	1.6%	3%	0.8%
World	**3,544,816**	**4,206,876**	**5,220,076**	**6,443,536**	**6,738,633**	**6,984,379**	**3.6%**	**4.1%**	**4.2%**	**100%**

Source : Enerdata Global Energy & CO_2 Data (2018)

Electricity: forecast of electricty generating capacity

GENERATING CAPACITY FORECAST BY SOURCE (GW)

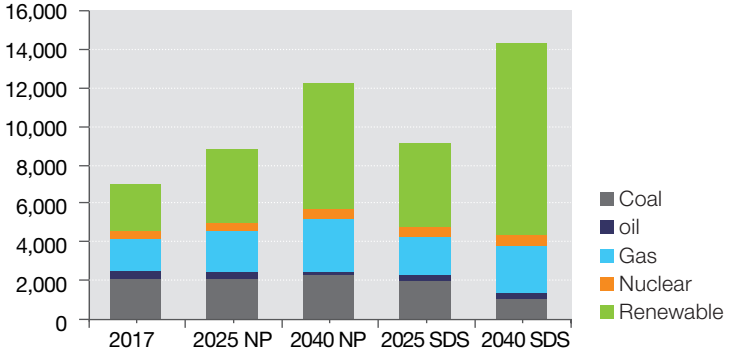
	2017	New Policies Scenario				Sustainable Development Scenario			
		2025	2040	AAGR 2017-2040	Share in 2040	2025	2040	AAGR 2017-2040	Share in 2040
Coal	2,067	2,130	2,238	0%	18%	1,945	1,119	0%	8%
Oil	447	350	246	-1%	2%	339	228	-1%	2%
Gas	1,695	2,113	2,740	1%	22%	1,996	2,406	1%	16%
Nuclear	412	448	518	0%	4%	467	678	1%	5%
Renewables	2,337	3,744	6,504	2%	52%	4,385	9,914	3%	68%
o/w hydropower	1,270	1,462	1,839	1%	15%	1,531	2,096	1%	14%
o/w bioenergy	136	186	278	1%	2%	213	379	2%	3%
o/w wind power	515	953	1,707	3%	14%	1,122	2,819	3%	19%
o/w geothermal	14	20	51	2%	0%	26	82	3%	1%
o/w solar PV	398	1,109	2,540	5%	20%	1,472	4,240	6%	29%
o/w CSP	5	13	68	4%	1%	20	267	6%	2%
o/w marine energy	1	1	21	0%	0%	2	31	3%	0%
Total capacity	**6,961**	**8,845**	**12,466**	**1%**	**100%**	**9,187**	**14,655**	**1.2%**	**100%**

GENERATING CAPACITY FORECAST BY REGION (GW)

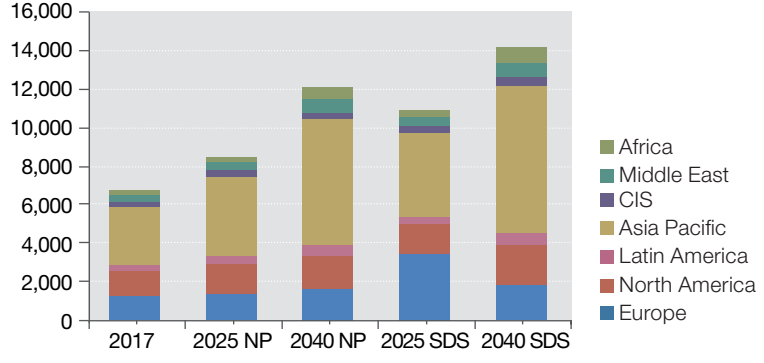
	2017	New Policies Scenario				Sustainable Development Scenario			
		2025	2040	AAGR 2017-2040	Share in 2040	2025	2040	AAGR 2017-2040	Share in 2040
Europe	1,284	1,445	1,701	1%	14%	3,549	1,951	5%	13%
North America	1,409	1,567	1,788	0%	14%	1,576	2,120	0%	14%
Latin America	345	419	622	1%	5%	433	610	1%	4%
Asia-Pacific	3,052	4,305	6,676	2%	54%	4,581	7,924	2%	54%
CIS	327	348	409	0%	3%	342	434	0%	3%
Middle East	318	408	648	1%	5%	437	772	1%	5%
Africa	226	334	622	2%	5%	359	844	2%	6%
OECD	**3,121**	**3,501**	**4,070**	**1%**	**33%**	**3,473**	**4,772**	**0%**	**33%**
non-OECD	**3,840**	**5,344**	**8,396**	**1%**	**67%**	**5,637**	**9,883**	**2%**	**67%**
Total capacity	**6,961**	**8,845**	**12,466**	**1%**	**100%**	**9,187**	**14,655**	**1.2%**	**100%**

Source: World Enregy Outlook Outlook 2018© OECD/IEA 2018

FORECAST OF GENERATING CAPACITIES BY SOURCE IN THE IEA SCENARIO (GW)



FORECAST OF GENERATING CAPACITIES BY REGION IN THE IEA SCENARIO (GW)



Source: World Enregy Outlook 2018© OECD/IEA 2018

Electricity: generation

RE and coal were the two main drivers of world electricity generation growth in 2017 and 2018

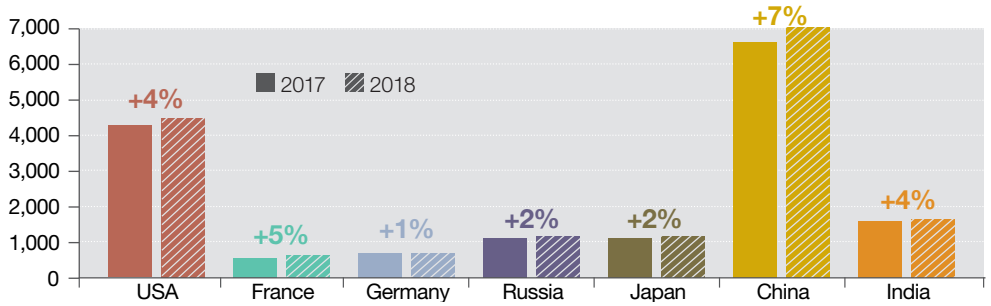
In 2018 world power generation accelerated in major producing countries, while 2017 was in line with the trend of the past few years (+2.5% in 2017): production records of 2018 in China, the US and France beats output of the previous year: +7% in China, +5% in US, +4% in France and +4% in India.

Renewables accounted for more than 50% of the increase in global electricity generation in 2017, against 39% for coal and 7% for natural gas. RES have reached a quarter of world electricity generation.

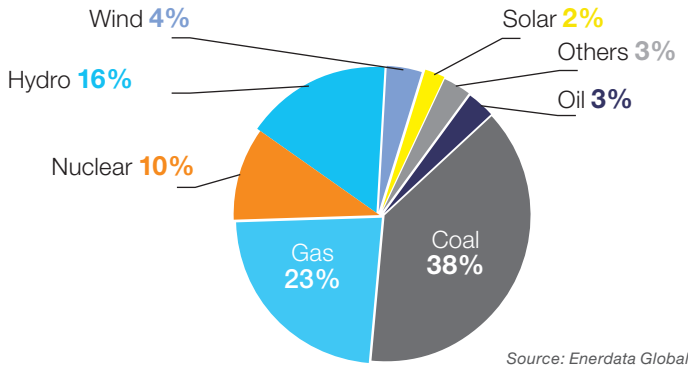
Natural gas in power generation has benefited in recent years from better price competitiveness and environmental measures compared to coal (+8% in 2015 and +4.5% in 2016). The pace has however slowed down in 2017 (+1%) largely because of a reduced production in the US (-8%) where gas prices climbed (the US accounted for 22% of worldwide electricity production from gas).

In 2018 gas fired power plants witnessed a down tide in Europe with a fall by -5% (35 TWh), mainly due to climate factors (wetter weather and increased hydro generation in France, Italy and Spain). But it gained speed in the US and Asia with additional gas-fired power plants and continued coal-to-gas switching.

2017 AND 2018 ELECTRICITY PRODUCTION BY COUNTRY (IN TWH) AND YEAR-TO-YEAR CHANGE IN %



WORLD ELECTRICITY PRODUCTION IN 2017 BY SOURCE (25,628 TWH)



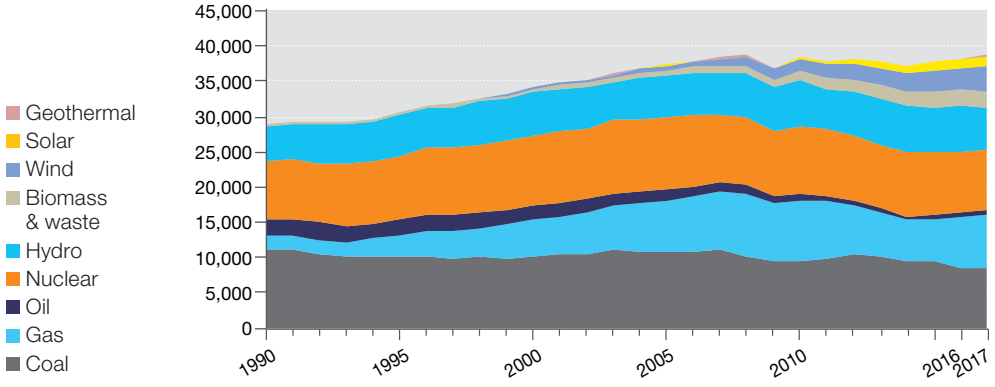
Source: Enerdata Global Energy & CO_2 Data (2018)

Electricity: generation

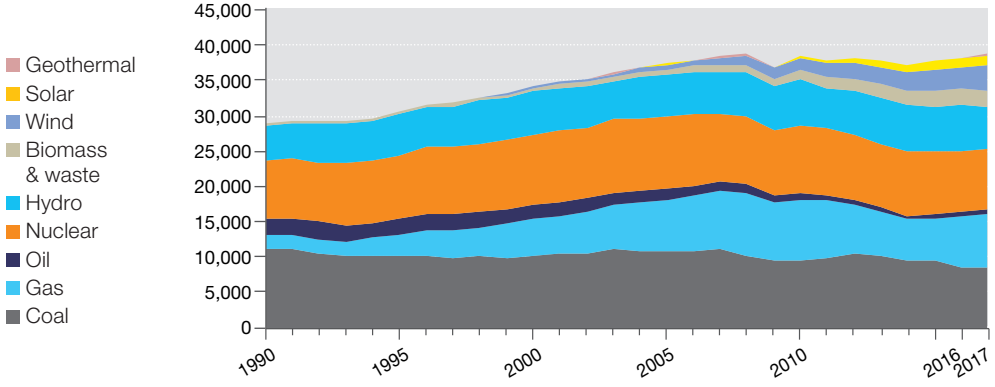
Coal in power generation picked up in 2017 and 2018 after 3 years of stagnation. This is largely due to a recovery in Asia's demand (+5%, an extra 323 TWh in 2017) where China holds sway with additional 203 TWh (+4.8%) and India follows quickly with an extra 52 TWh (+4%). In contrast North America's power production from coal decreased by -2.7%.
In the European Union, coal generation slumped by as much as -2.6% in 2017 and up to -6% in 2018 owing to increasing rates of coal capacity retirements and rising waves of renewable electricity generation (Agora Energiewende and Sandbag 2019).

Nuclear generation has risen consecutively since 2013, but is still below 2010 level. Most of the increase in 2017 (+1.1%) came from Asia where China expanded production by +16% and Japan ramped up about +82% following the restart of nuclear plants that were closed after the Fukushima accident. Financial constraints, supply chain glitches and competent workforce deficit all seem to be hurting India's ability to meet its 2032 target of generating 63 TWh of nuclear electricity.

WORLD ELECTRICITY PRODUCTION BY SOURCE BETWEEN 1990 AND 2017 IN TWH



EUROPEAN ELECTRICITY PRODUCTION BY SOURCE BETWEEN 1990 AND 2017 IN TWH



Source: Enerdata Global Energy & CO_2 Data (2017)

Electricity: production by power station type

Electricity Prodcution in TWh	Total production			Hydro production			Nuclear production			Thermal production			Wind production			Solar production			Geothermal production			Others		
	2016	2017	Change 2016-17	2016	2017	Change 2016-17	2015	2017	Change 2016-17	2016	2017	Change 2016-17	2016	2017	Change 2016-17	2016	2017	Change 2016-17	2016	2017	Change 2016-17	2016	2017	Change 2016-17
Europe	3,846	3,900	1.4%	673	597	-11.3%	861	851	-1.2%	1,857	1,922	3.5%	321	384	19.6%	113	124	9.9%	17	18	9.6%	4	5	2.2%
European Union	3,260	3,295	1.1%	382	332	-13.3%	840	830	-1.1%	1,613	1,640	1.7%	303	362	19.5%	111	120	8.1%	7	7	-0.7%	4	4	-0.9%
Germany	649	655	0.9%	26	26	0.1%	85	76	-9.8%	420	404	-3.7%	79	107	35.6%	38	40	4.7%	0.2	0.2	5.7%	2	2	2.1%
France	556	554	-0.4%	65	54	-16.2%	403	398	-1.2%	57	67	16.4%	21	24	13.6%	8	9	12.3%	0.004	0.0086	115%	1	1	-0.8%
North America	4,989	4,928	-1.2%	679	721	6.2%	941	940	-0.1%	3,031	2,877	-5.1%	260	288	10.5%	53	77	44.3%	19	19	0.9%	6	6	-1.4%
Canada	667	671	0.6%	387	397	2.4%	101	101	0%	145	140	-3.8%	31	31	-0.4%	3	3	0.9%	0	0	-	0	0	56.7%
United States	4,322	4,256	-1.5%	292	325	11.2%	840	839	-0.1%	2,886	2,737	-5.2%	229	257	12%	50	74	46.9%	19	19	0.9%	6	5	-2.9%
Latin America	1,584	1,582	-0.1%	718	728	1.4%	35	33	-5.6%	760	734	-3.4%	55	68	22.3%	5	9	71.1%	10	10	-0.8%	0	0	-
Brazil	579	579	0%	381	371	-2.6%	16	16	-0.8%	149	149	0.3%	33	42	26.5%	0.09	0.83	878.8%	0	0	-	n.d.	n.d.	-
Asia	10,779	11,310	4.9%	1,629	1,647	1.1%	472	503	6.7%	8,184	8,513	4%	295	371	25.8%	153	227	48.9%	24	26	5.1%	23	23	1%
Chia	6,218	6,585	5.9%	1,193	1,199	0.5%	213	248	16.3%	4,499	4,711	4.7%	237	302	27.3%	75	124	64.5%	0.1	0.1	0%	0.00	0.00	-
South Korea	563	576	2.4%	7	7	5.4%	162	148	-8.4%	386	410	6.2%	2	2	28.3%	5	7	36.2%	0	0	-	1	1	26.1%
India	1,478	1,558	5.4%	138	142	3.1%	38	38	0.9%	1,243	1,297	4.3%	45	54	21.1%	14	26	86.2%	0	0	-	n.d.	n.d.	-
Japan	1,058	1,085	2.6%	85	88	3.8%	18	33	82.2%	874	873	-0.2%	6	6	6.2%	51	61	20.2%	3	2	-2.3%	21.448	21.385	-0.3%
Pacific	306	306	0.2%	43	43	0.5%	0	0	-	234	232	-0.7%	15	15	1.1%	6	8	30.1%	8	8	0.2%	0.1	0.1	3.2%
CIS	1,561	1,587	1.7%	262	266	1.7%	280	291	4.1%	1,016	1,026	1%	1	1	1.7%	1.1	1.3	17.7%	0.4	0.4	-2.5%	n.d.	n.d.	-
Russia	1,091	1,110	1.7%	187	187	0.3%	197	203	3.3%	707	718	1.7%	0.1	0.139	-6.1%	0.5	0.5	17.7%	0.4	0.4	-2.5%	n.d.	n.d.	-
Middle Esat	1,143	1,188	3.9%	22	21	-1.8%	7	7	7.5%	1,112	1,155	3.9%	0.6	1	20.3%	3	3	26.9%	0	0	-	0	0	-
Saudi Arabai	340	345	1.4%	0	0	-	0	0	-	340	345	1.4%	0	0	-	0.001	0.001	0%	0	0	-	n.d.	n.d.	-
Iran	289	312	7.8%	16	16	-4.7%	7	7	7.5%	266	289	8.5%	0.3	0	13.1%	0.004	0.016	300%	0	0	-	n.d.	n.d.	-
Africa	808	827	2.4%	121	127	4.8%	15	15	-0.8%	653	665	1.8%	10	11	4.1%	4	5	20.2%	4	5	11.8%	n.d.	n.d.	-
North Africa	361	n.d.	-	15	n.d.	-	0	0	-	339	n.d.	-	6	6	1.5%	1	n.d.	-	0.0	0.0	-	n.d.	n.d.	-
Egypt	194	200	2.7%	13	14	0.5%	0	0	-	179	184	2.8%	2	2	0.2%	0	0	74.4%	0.0	0.0	-	n.d.	n.d.	-
Sub-sahara Africa	447	n.d.	-	106	n.d.	-	15	15	-0.8%	314	n.d.	-	5	5	7.1%	3	n.d.	-	4.4	5.0	11.8%	n.d.	n.d.	-
South Africa	253	255	0.9%	4	5	23.8%	15	15	-0.8%	227	228	0.4%	4	4	9.3%	3	3	11.9%	0.0	0.0	-	n.d.	n.d.	-
World	**25 015**	**25 628**	**2.5%**	**4 146**	**4 151**	**0.1%**	**2 610**	**2 640**	**1.2%**	**16 846**	**17125**	**1.7%**	**958**	**1,137**	**18.7%**	**338**	**455**	**34.5%**	**83**	**86**	**4.2%**	**33**	**33**	**0.8%**

Source: Enerdata Global Energy & CO_2 Data (2018)

Electricity: detail of thermal electricity production

Detail of thermal electricity production in TWh	Thermal production Oil			Thermal production Natural gas			Thermal production Coal & lignite			Thermal production Biomass & waste		
	2016	2017	Change 2016-2017	2016	2017	Change 2016-2017	2016	2017	Change 2016-2017	2016	2017	Change 2016-2017
Europe	62	73	19.0%	705	778	10.4%	877	854	-2.6%	210	212	1.4%
European Union	59	61	2.7%	611	662	8.3%	734	707	-3.8%	204	207	1.1%
Germany	6	6	-0.1%	82	87	5.7%	273	252	-7.6%	58	59	0.8%
France	3	4	43.2%	35	40	13.8%	11	14	31.2%	10	10	2.6%
North America	43	38	-10.5%	1,480	1,366	-7.7%	1,416	1,378	-2.7%	92	95	3.1%
Canada	8	8	-0.4%	62	56	-9.4%	62	61	-1.5%	13	14	9.6%
United States	35	30	-12.9%	1,418	1,310	-7.7%	1,354	1,317	-2.8%	79	81	2.1%
Latin America	156	149	-4.4%	424	418	-1.5%	108	94	-12.4%	72	73	1.4%
Brazil	15	16	4.1%	56	58	2.9%	26	23	-9.5%	51	51	1.2%
Asia	235	241	2.7%	1,335	1,328	-0.5%	6,438	6,762	5.0%	176	182	3.3%
Chia	10	11	3.6%	170	177	3.6%	4,242	4,445	4.8%	76	79	3.6%
South Korea	18	12	-29.8%	127	126	-0.6%	235	263	12.1%	6	8	27.4%
India	23	25	6.0%	71	73	2.0%	1,105	1,156	4.7%	44	43	-1.1%
Japan	84	77	-8.7%	406	400	-1.6%	349	361	3.4%	34	34	2.0%
Pacific	8	8	3.2%	57	58	1.8%	164	161	-1.9%	4	4	1.9%
CIS	17	14	-21.0%	680	698	2.6%	315	311	-1.4%	3	3	6.3%
Russia	11	11	-0.9%	522	533	2.2%	171	172	0.3%	2	3	5.0%
Middle Esat	280	271	-3.3%	806	861	6.8%	25	23	-7.6%	0.1	0.1	3.7%
Saudi Arabai	141	140	-0.5%	200	205	2.7%	0	0	-	0	0	-
Iran	32	26	-17.4%	233	262	12.1%	0	0	-3.3%	0	0	14.2%
Africa	90	76	-15.4%	308	332	8.0%	252	253	0.3%	1	1	2.7%
North Africa	58	n.d.	-	263	n.d.	-	17	18	3.8%	0	0	-
Egypt	38	30	-21.8%	140	154	9.5%	0	0	-	0	0	-
Sub-sahara Africa	32	n.d.	-	45	n.d.	-	235	n.d.	-	1	n.d.	-
South Africa	0	0	6.4%	0	0	-	226	227	0.3%	0	0	2.7%
World	**890**	**870**	**-2.2%**	**5,795**	**5 840**	**0.8%**	**9 596**	**9 836**	**2.5%**	**558**	**571**	**2.3%**

Source: Enerdata Global Energy & CO_2 Data (2018)

Electricity: generation forecast

The landscape of electricity in 2040 New Policies Scenario (NPS) of the IEA sees low-carbon generation account for 50% of production, taking over from carbon-intensive coal that today accounts for 40% of total generation but will only wield 26%. Specifically, renewables will by 2040 generate 41% of total electricity (25% today), while natural gas retains third place with about 22%.

In the more ambitious Sustainable Development Scenario (SDS), where 66% of total production are garnered from renewable sources, wind moves up 21% and overtakes hydropower (19%) ahead of solar PV (17%). Comparing IEA scenarios of 2017 and 2018, the weight attached to renewables in the global power mix even becomes more evident, while coal's fate is the reverse.

Regional projection pictures: Asia, dominated by China and India, as the largest production zone in the 2040 NPS and the SDS, way ahead of North America and Europe. The average rate of growth in the OECD remains steady, close to 0,5%/y going into 2040 in both scenarios, but for non-OECD production moves at 3%/y in the NPS but slows to 2% in the SDS.

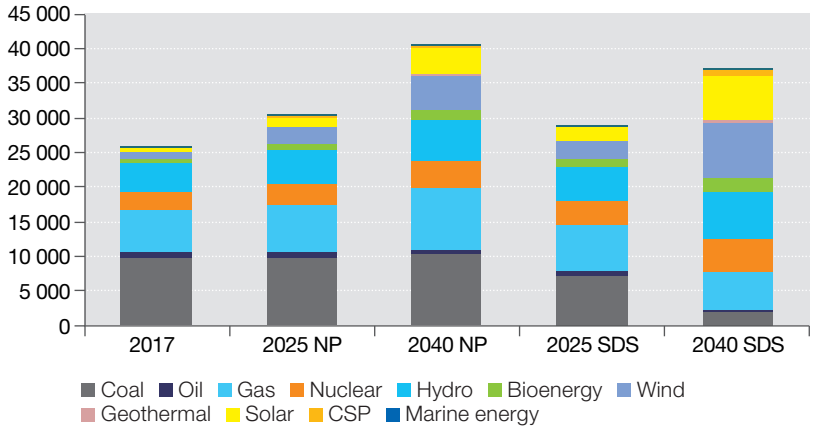
NB: See appendix for a description of these scenarios.

ELECTRICITY PRODUCTION FORECAST BY SOURCE IN IEA SCENARIOS (TWH)

	2017	New Policies Scenario				Sustainable Development Scenario			
		2025	2040	AAGR 2017-2040	Share in 2040	2025	2040	AAGR 2017-2040	Share in 2040
Coal	9,858	9,896	10,335	0%	26%	7 ,193	1,982	-1%	5%
Oil	940	763	527	-1%	1%	605	197	-2%	1%
Gas	5,855	6,829	9,071	1%	22%	6,810	5,358	1%	14%
Nuclear	2,637	3,089	3,726	1%	9%	3,303	4,960	1%	13%
Renouvelables	6,351	9,645	16,753	2%	41%	10,917	24,585	2%	66%
o/w hydro	4,109	4,821	6,179	1%	15%	5,012	6,990	1%	19%
o/w bioenergy	623	890	1,427	2%	4%	1,039	1,968	2%	5%
o/w wind	1,085	2,304	4,690	3%	12%	2,707	7,730	4%	21%
o/w geothermal	87	129	343	2%	1%	162	555	3%	1%
o/w solar PV	435	1,463	3,839	5%	9%	1,940	6,409	7%	17%
o/w CSP	11	34	222	5%	1%	54	855	7%	2%
o/w marine energy	1	3	52	5%	0%	4	78	6%	0%
Total Production	**25,679**	**30,253**	**40,443**	**0.7%**	**100%**	**28,859**	**37,114**	**0.5%**	**100%**

Source: World Enregy Outlook 2018© OECD/IEA 2018

FORECAST OF ELECTRICTY PRODUCTION BY SOURCE IN IEA NEW POLICY & SUSTAINABLE DEVELOPMENT SCENARIOS (TWH)



Source: World Enregy Outlook 2018© OECD/IEA 2018

Electricity: consumption World electricity consumption continues mounting owing to rising incomes and burgeoning electrification in developing countries, while digitalization and extended use are the major drivers in advanced economies

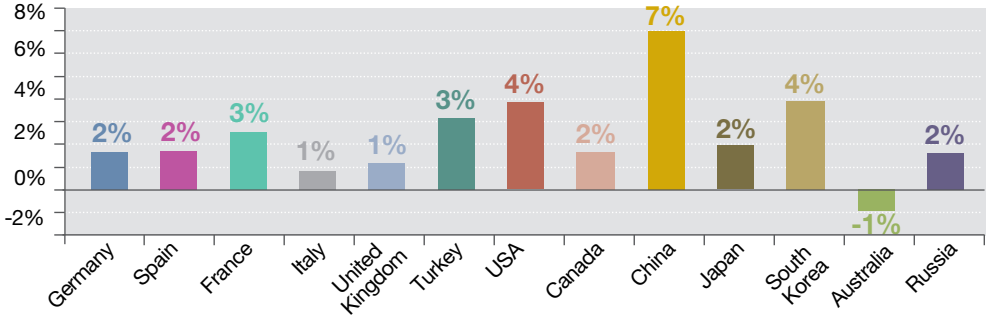
2018 saw a recovery of electricity demand in all regions compared to the slow trend over the decade (+2%/y since 2010). Developing countries worldwide continue to fire up demand, which has grown by about three-fold since 2000, thanks to surging industrial capacity, higher incomes and wider access to electricity. China tops the chart again in total consumption, which grew by +7% in 2018. Consumption in the US picked up in 2018 by +4% after the -2% fall in 2017.

Energy efficiency measures pursued in advanced economies have wiped out about 20% (1800 TWh) of their consumption between 2000 and 2017 (IEA 2018). Even though new demand was added due to growing digitalization and electrification of transport and heat, this was not sufficient enough to undo the gains of energy efficiency.

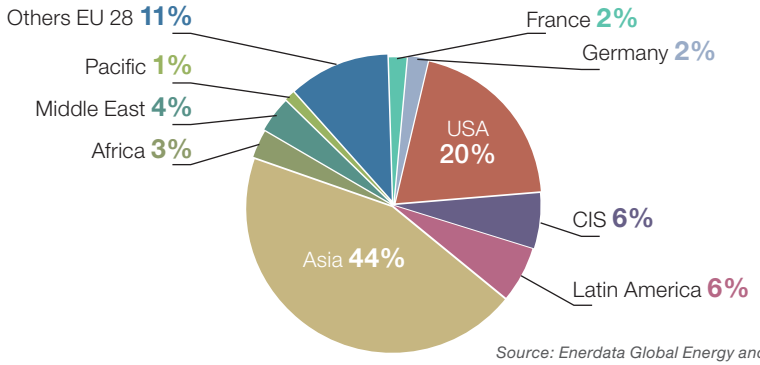
More and more consumers are yearning for green electricity. An interesting development is the powerful momentum witnessed in corporate sourcing of renewable energy, which grew by +41% in 2017, compared to 2016 (Source: RE100, 2019). The movement is gaining weight across regions and sectors: Apple now runs 100% on clean energy and in 2018 Exxon became the 1st oil major to sign a long-term clean energy contract to power its operation and is now the 7th largest buyer of clean energy.

Electricity in Transport (2% of the total) is driven mostly by rail consumption (2/3 of the sector demand), but the road sector has the fastest growth rate owing to rising purchase of electric vehicles. The 3rd quarter of 2018 recorded 72% increase in the sales of electric vehicles.

ELECTRICITY CONSUMPTION GROWTH BETWEEN 2017-2018



2017 WORLD ELECTRICTY CONSUMPTION (22, 114 TWH)



Source: Enerdata Global Energy and CO_2 Data (2018)

Electricity: consumption – long series

in TWh	2000	2005	2010	2015	2016	2017	2018	Change 2016-2017	AAGR 2010-2017	AAGR 2016-2017
Europe	2,952	3,264	3,377	3,310	3,358	3,392	n.a.	1.0%	0.8%	-0.1%
European Union	2,637	2,901	2,949	2,837	2,869	2,878	n.a.	0.3%	0.5%	-0.4%
Germany	501	539	547	528	530	532	541	0.3%	0.3%	-0.4%
Spain	195	248	250	239	240	243	247	1.1%	1.2%	-0.6%
France	410	451	472	441	449	449	460	-0.2%	0.5%	-0.7%
Italy	279	310	310	297	296	301	304	2.0%	0.3%	-0.7%
United Kingdom	340	357	338	311	311	307	311	-1.2%	-0.5%	-1.2%
North Amercia	4,093	4,349	4,439	4,396	4,422	4,352	n.a.	-1.6%	0.5%	-0.1%
Canada	503	537	544	501	506	520	528	2.7%	0.0%	-1.0%
United States	3,590	3,811	3,894	3,895	3,916	3,833	3,980	-2.1%	0.5%	0.1%
Latin America	788	939	1,129	1,290	1,307	1,303	n.a.	-0.3%	3.0%	2.1%
Brazil	329	371	459	514	513	509	n.a.	-0.7%	2.6%	1.6%
Mexico	148	195	221	262	274	272	279	-0.8%	3.7%	3.1%
Asia	3,344	4,783	6,843	8,869	9,367	9,829	n.a.	4.9%	6.2%	4.6%
China	1,138	2,126	3,626	5,103	5,407	5,726	6,127	5.9%	9.6%	5.9%
South Korea	263	358	458	507	530	543	564	2.4%	4.2%	2.1%
India	376	489	728	1,038	1,115	1,175	n.a.	5.4%	6.6%	6.3%
Japan	957	999	1,009	967	982	1,005	1,025	2.3%	0.2%	-0.4%
Middle East	400	528	742	913	958	993	n.a.	3.6%	5.3%	3.7%
Saudi Arabia	114	153	212	305	307	311	n.a.	1.4%	6.0%	5.4%
Iran	96	137	188	214	244	261	n.a.	7.3%	5.6%	3.8%
CIS	1,000	1,086	1,203	1,227	1,253	1,286	n.a.	2.6%	1.3%	0.6%
Russia	709	760	851	871	896	915	930	2.2%	1.4%	0.7%
Africa	379	472	554	639	654	668	n.a.	2.2%	3.3%	2.4%
North Africa	118	170	218	271	280	n.d.	n.a.	-	5.2%	3.6%
Egypt	64	92	124	157	164	169	n.a.	2.9%	5.7%	4.1%
Sub-saharan Africa	261	302	336	369	373	n.d.	n.a.	-	2.1%	1.5%
Sout Africa	190	204	214	206	206	207	n.a.	0.5%	0.5%	-0.5%
Pacific	218	241	265	270	273	274	n.a.	0.2%	1.3%	0.5%
Australia	180	199	221	225	229	230	228	0.2%	1.4%	0.5%
World	**13 172**	**15 662**	**18 551**	**20 914**	**21 593**	**22 097**	**n.a.**	**2.3%**	**3.0%**	**2.2%**

Source: Enerdata Global Energy & CO_2 Data (2018)

Electricity: consumption in Europe

Electricity consumption TWh	Total consumption								Residential		Services		Industry		Transport	
	2000	2010	2016		2017		AAGR 2000-2017	Change 2016-2017	2017		2017		2017		2017	
				EU market share		EU market share ↓				Share in country total ←		Share in country total ←		Share in country total ←		Share in country total ←
Germany	501	547	530	18%	532	18%	0%	0%	128	24%	141	27%	232	44%	12	2%
Austria	53	63	65	2%	62	2%	1%	-4%	n.d.	-	n.d.	-	n.d.	-	n.d.	-
Belgium	79	86	83	3%	84	3%	0%	1%	19	23%	22	26%	38	46%	2	2%
Bulgary	25	28	30	1%	31	1%	1%	4%	n.d.	-	n.d.	-	n.d.	-	n.d.	-
Cyprus	3	5	4	0%	4	0%	2%	2%	2	36%	2	49%	0	11%	0	0%
Croatia	12	16	13	0%	12	0%	0%	-7%	n.d.	-	n.d.	-	n.d.	-	n.d.	-
Denmark	33	33	32	1%	32	1%	0%	0%	10	32%	10	32%	8	26%	0	1%
Spain	195	250	240	8%	243	8%	1%	1%	71	29%	75	31%	79	33%	5	2%
Estonia	5	7	8	0%	7	0%	2%	-7%	2	27%	3	38%	2	31%	0	1%
Finland	77	85	83	3%	80	3%	0%	-3%	n.d.	-	n.d.	-	n.d.	-	n.d.	-
France	410	472	449	16%	449	16%	1%	0%	159	35%	146	33%	117	26%	10	2%
Greece	45	55	55	2%	56	2%	1%	2%	20	36%	20	35%	11	21%	0	0%
Hungary	31	36	38	1%	39	1%	1%	3%	11	29%	8	21%	16	42%	1	3%
Irland	20	26	26	1%	26	1%	1%	2%	n.d.	-	n.d.	-	n.d.	-	n.d.	-
Italy	279	310	296	10%	301	10%	0%	2%	66	22%	94	31%	116	38%	11	4%
Latvia	4	6	6	0%	6	0%	2%	-1%	2	26%	3	43%	2	28%	0	1%
Lithuania	7	9	11	0%	11	0%	3%	0%	3	27%	3	31%	4	34%	0	0%
Luxembourg	6	7	6	0%	6	0%	1%	0%	1	14%	2	30%	3	53%	0	2%
Malta	2	2	2	0%	2	0%	3%	13%	n.d.	-	n.d.	-	n.d.	-	0	0%
Netherlands	99	112	110	4%	109	4%	1%	-1%	23	21%	36	33%	37	33%	2	2%
Poland	109	129	144	5%	146	5%	2%	2%	29	20%	48	33%	54	37%	3	2%
Portugal	39	51	47	2%	49	2%	1%	3%	12	25%	18	37%	16	33%	0	1%
Czech Republic	52	56	57	2%	58	2%	1%	2%	15	26%	16	27%	24	41%	2	3%
Roumania	41	46	49	2%	48	2%	1%	-1%	12	24%	10	20%	21	44%	1	2%
United Kingdom	340	338	311	11%	307	11%	-1%	-1%	105	34%	94	30%	93	30%	5	2%
Slovakia	23	25	26	1%	26	1%	1%	1%	5	20%	7	27%	12	47%	1	2%
Slovenia	11	12	13	0%	14	0%	1%	4%	3	24%	4	26%	6	47%	0	2%
Sweden	135	137	134	5%	134	5%	0%	0%	44	33%	29	21%	51	38%	2	2%
European Union	**2,637**	**2,949**	**28,69**	**100%**	**2,878**	**100%**	**1%**	**0%**	**806**	**28%**	**839**	**29%**	**1,034**	**36%**	**62**	**2%**
Norway	111	121	123		123		1%	1%	39	31%	27	22%	46	38%	1	1%
Turkey	98	172	231		248		6%	7%	55	22%	69	28%	114	46%	1	0%
Europe	**2,952**	**3,380**	**3,358**		**3,392**		**1%**	**1%**	**949**	**28%**	**965**	**28%**	**1,245**	**37%**	**67**	**2%**

NB: Total electricity consumption: Final consumption (Residential, Services, Industry, Transort and Agriculture not shown here) plus energy sector's own consumption (not shown here).

Source: Enerdata Global Energy & CO_2 Data (2018)

Investments in the power sector

Investment in the power sector dropped by 6% to $750 billion in 2017, lower than records seen in 2016. While investment in power generation capacity slumped by 10%, investment in power networks rose slightly by 1% to $300 billion.

The fall seen in generation capacity is explained by the fewer number of coal-fired power plants brought on board in India and China; final investment decisions (FIDs) for additional coal plants might have peaked in 2015 even as the number of retirements level off the effect of new coal capacities. **For gas on the other hand, 40% growth in new capacity was registered in 2017:** the United States together with the Middle East and the North Africa region fuelled this surge. But FIDs in the sector only brought on an additional 50 GW of power in 2017, a reflection of trying times in the United States and Middle East. As regards nuclear, there has been increasing spending on lifetime extensions of existing plants as opposed to green field plants (-70%); this resulted in a 45% decline in investments in 2017 when total investment was $17 billion.

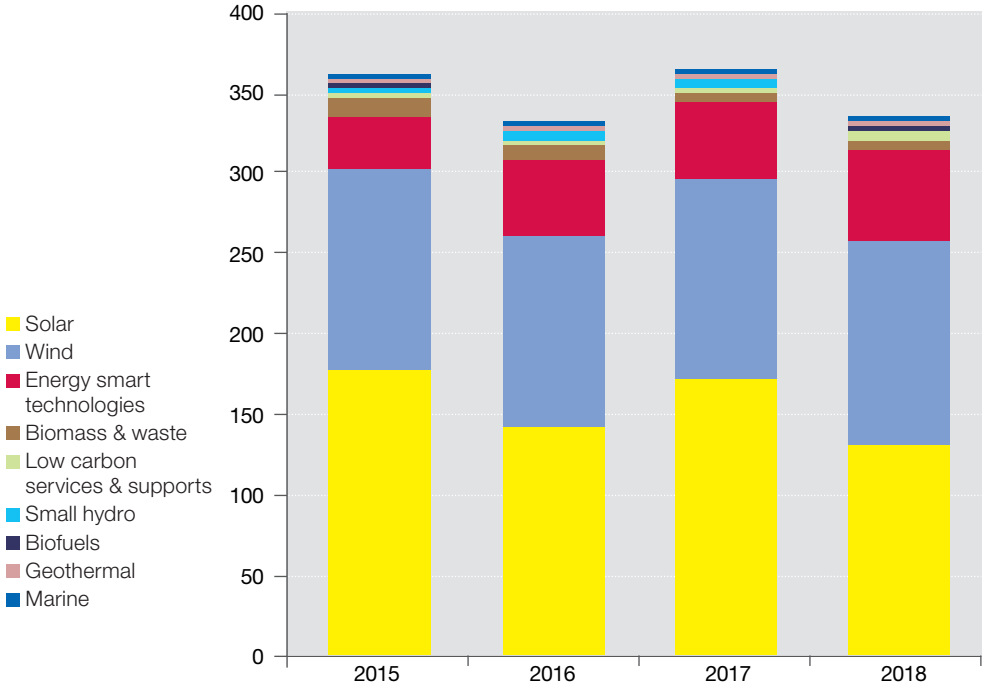
Over two-thirds of global investments in power plants came from low carbon sources, including nuclear and renewables (IEA 2017 figures). **Solar still controls the largest share of investments in renewable energy,** a position it has held since 2010 when it overtook wind. Even though solar investments rose by +21% in 2017, like the set of renewables sources, they registered a 24% drop in 2018 (source BNEF).

Although investments in renewable energies remain high, they have stabilized in recent years, and even decreased by -8% in 2018 (to $332 billion compared to $362 billion in 2017, source BNEF).
The main reason of fading investments in renewable is that prices of inputs, especially PV materials, have been falling globally thus reducing the costs of installing new capacities. Continuing technology developments are also exerting some downward pressure on costs in the renewable sector. Investment costs for solar PV for instance plummeted by almost 15% in 2017 while for onshore wind, costs fell by as much as one-third per MW (IEA, 2018). Over the 2009-2018 period the average cost of photovoltaic PV in the world decreased from $300/MWh to nearly $50.

Developing countries, led by China, continue to account for the largest share of new investments in clean energy (64% in 2017). In 2017, investments in Europe fell to $41 billion (-36%) with investors uncertain about the impact of Germany's switch to auctions from feed-in tariffs, and the phase-out of subsidies for onshore wind and utility-scale solar in the UK.

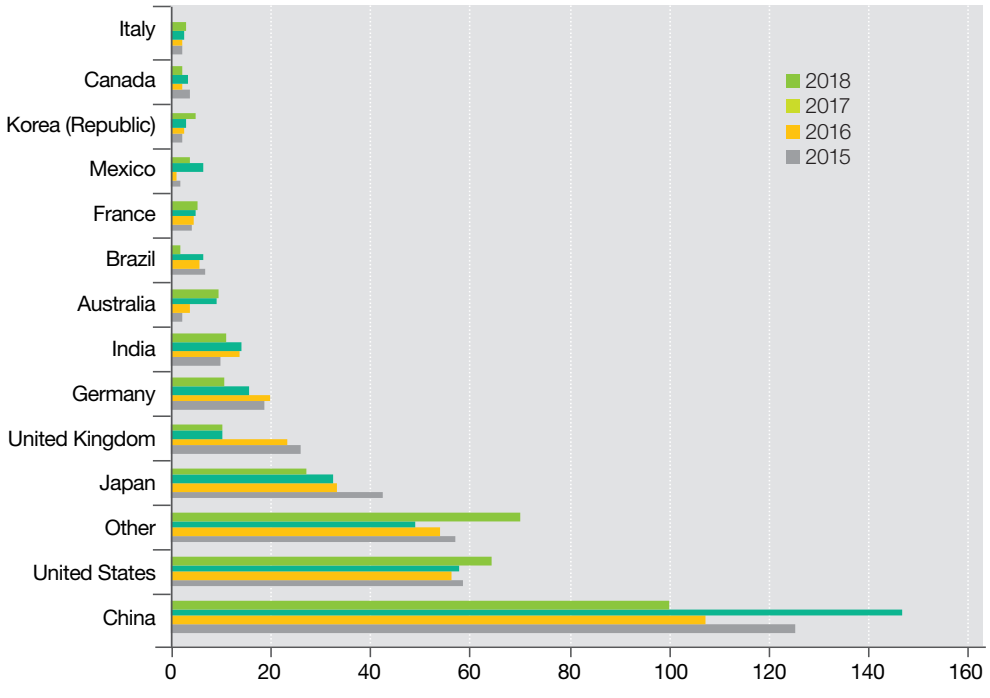
Investments in the power sector

NEW INVESTMENTS IN CLEAN ENERGY ($BN)



Source: Bloomberg New Energy Finance 2018

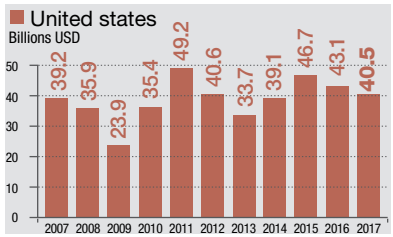
CLEAN ENERGY INVESTMENTS IN TOP COUNTRIES ($BN)

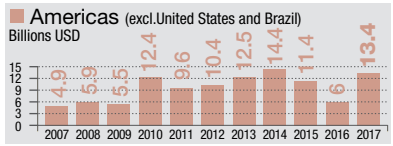


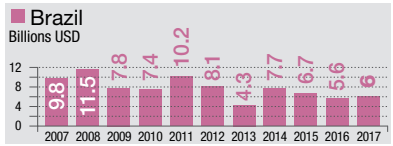
Source: Bloomberg New Energy Finance 2018

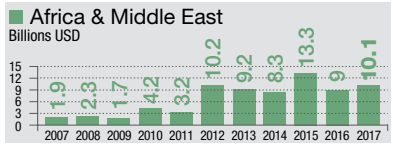
Renewables Electricity investments by region

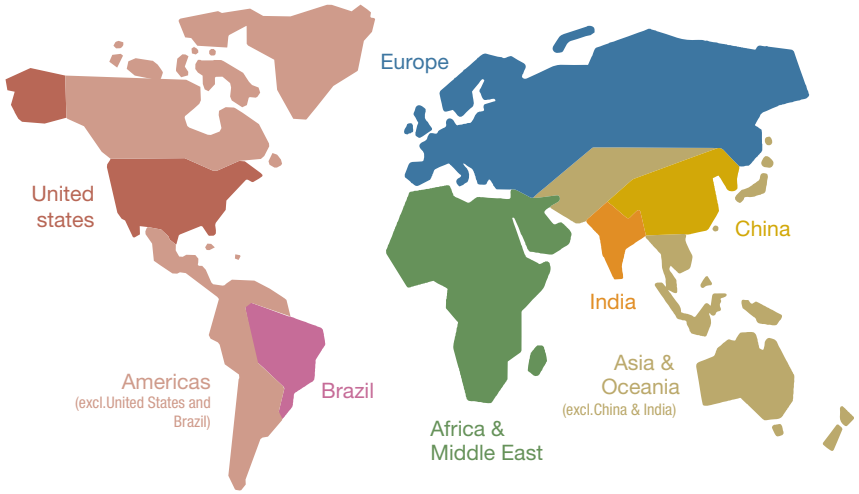
NEW INVESTMENTS IN POWER RES AND BIOFUELS BETWEEN 2007 AND 2017 ($BIILION)

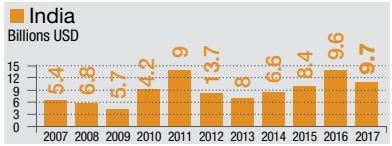


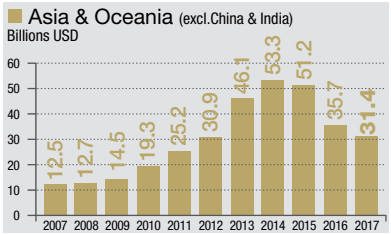


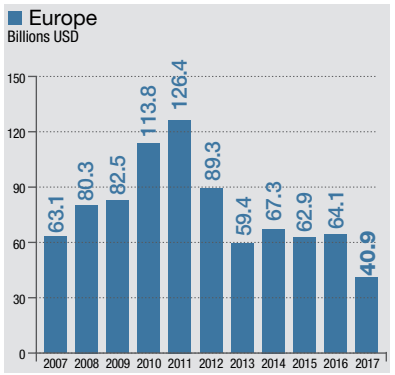


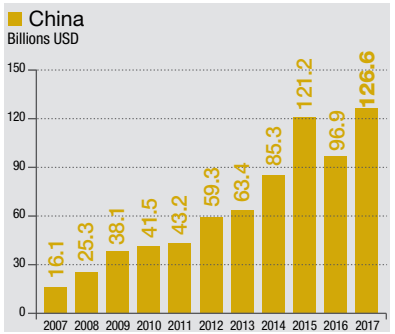












Source: REN 21 Renewable 2017 Global Status Report (2018)

Electricity: prices

Environmental policies had a strong impact in 2018 on electricity prices and market design in Europe

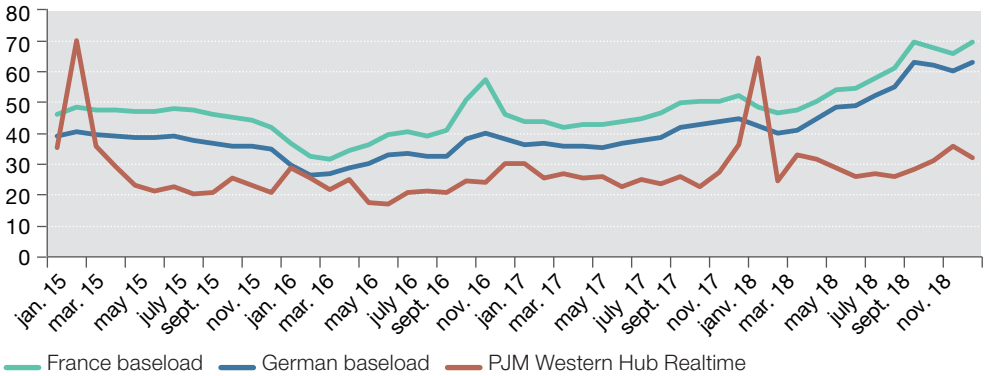
Wholesale prices in Europe reached high levels in 2018 with rising commodities and CO_2 prices, whereas prices remained relatively stable in the US, widening the price gap between both regions.

Generally, the frequency of negative hourly wholesale prices have increased in Germany, Denmark and the Czech Republic, an occurrence more common in Europe than in any other region due to very high rates of wind and solar penetration. New year's day in 2018 for example saw daily average electricity prices in Germany slump below zero with many other markets in the CWE region also recording negative hourly prices. This trend of negative prices signals the need for enhanced integration of renewables and better infrastructure that permits more cross-border trade.

Residential electricity prices in Europe have over the years increased with renewable supports. Prices in Germany rose from 257€/MWh in 2010 to 298€/MWh in 2017, while in France the increase was from 131€/MWh to 165€/MWh within the same period. For the whole of EU-28 an average yearly 1.7% increase drove prices up from 182€/MWh in 2010 to 204€/MWh in 2017.

Taxes also account for the divergence in prices among EU countries. In the first half of 2018, the proportion of tax as a composition of tariffs in Malta was only 5%, whereas in Denmark, which has the highest consumer tariff in the EU, 68% of household prices amounted to taxes.

ELECTRICITY PRICES IN FRANCE, GERMANY AND USA (IN $2018/MWH)



Source: ENGIE, Global Energy Market

ELECTRICITY PRICES FOR CONSUMER IN EUROPE

Electricity Prices in €2005/MWh	Residential Prices in €2005/MWh					Industrial Prices in €2005 05/MWh				
	2000	2010	2016	2017	AAGR 2010-2017	2000	2010	2016	2017	AAGR 2010-2017
European Union	147	182	205	204	1.7%	71	109	109	108	-0.1%
Germany	163	257	296	298	2.1%	55	110	127	124	1.8%
Belgium	191	202	259	272	4.4%	69	116	116	116	0.0%
Spain	178	190	243	255	4.3%	65	107	105	101	-0.8%
France	138	131	164	165	3.3%	69	79	93	94	2.6%
Italy	196	215	250	226	0.7%	128	163	167	160	-0.3%
United Kingdom	134	183	202	209	1.9%	69	121	127	129	0.9%
United States	102	113	112	112	-0.1%	57	67	60	60	-1.4%
Japan	173	165	181	176	1.0%	116	110	132	123	1.7%

Source: Enerdata Global Energy & CO_2 Data (2018)

Natural gas

PRODUCTION

2018 gas production hits record highs in the U.S. and Russia

CONSUMPTION

IEA's forecasts confirm once again the prominence of gas in the 2040 energy mix

Natural gas: production

Higher prices and good demand prospects are boosting natural gas production in the major basins

After a vigorous 4% increase in 2017, world natural gas output is expected to have jumped 5% in 2018* (ENGIE estimates).

Production in the USA hit a new record at 845 bcm (up 9% or +70 bcm compared to 2017). The country remains the world's leading producer ahead of Russia, accounting for 20% of world output in 2017 and probably the same in 2018. The rig count more than doubled between 2008 and 2018, and this has created problems in distributing output to customers. Substantial investment in pipelines and infrastructure amounting to around $32bn will be required in the next few years (Wells Fargo Securities analysis).

Russian production also set new highs in 2018 (up 5% to 723 bcm), to 18% of world production. This rise stemmed from record exports to Europe totalling almost 200 bcm, close to the 205 bcm maximum contractual capacity. Mothballed Russian gas capacity declined (150 bcm/year in 2017, 80 bcm in 2018).

European gas production is structurally depleting. It inched higher in 2017 (up 0.4%, thanks to Norway) **but declined again in 2018** (down 9 bcm, or by 3.7%). The Netherlands is producing less and less because of the dangerous seismic profile of its largest field in Groningen. Output from this field dropped from 55 bcm in 2013 to just 21 bcm in 2018, and is likely to contract further to 5 bcm by 2023. In the UK, where several small fields discovered in 2014-15 have come on stream, gas production increased slightly to 42 bcm in 2016 and 2017 but eased to 40 bcm in 2018. It is expected to stabilise at this level.

Iranian production is on the rise: 224 bcm in 2017, 230 bcm in 2018, of which 71% from the world's largest gas field of South Pars, shared with Qatar. Betting on gas only, Qatar has pulled out of OPEC. Its LNG production is set to increase from 77 Mtpa at the moment to 110 Mtpa in 2020.

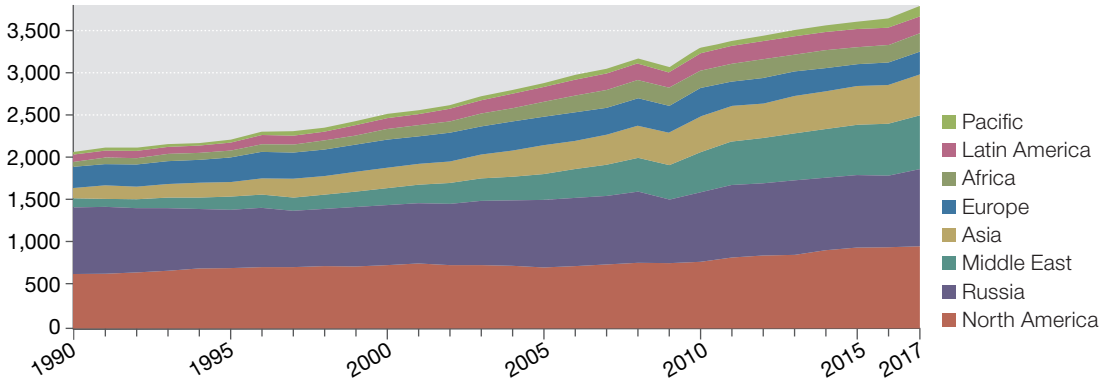
In China, natural gas production has increased rapidly over the past decade and posted a new high in 2018 at 159 bcm (up 7.5%). This is almost the equivalent of Norwegian and Dutch production combined.

Shale gas production is essentially limited to the USA, Canada and Australia. The Chinese government has reiterated its intention to produce 30 bcm of shale gas in 2020 and 100 bcm in 2030, but current output falls well short of these levels (10 bcm in 2018). In January 2019, Chinese scientists at the State Key Laboratory of Controlled Shock Waves claimed to have developed a new process for extracting shale gas at great depth (over 3 km) without water. Unlike hydraulic fracturing, this so-called "exothermic non hydraulic extraction" process, or "dry fracking", uses a high electric current to generate controlled and concentrated shock waves for a similar result. This technology is still in early stages, but if it proves viable on a large scale it could redesign the world's energy map. China's shale gas reserves are estimated at 31,000 bcm and are mostly 3.5km underground.

*** ENGIE – Strategy department 2018 estimates, based on IEA, IHS and Enerdata 2019 sources.**

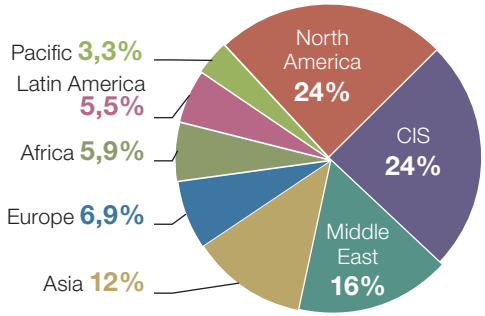
Natural gas: production

NATURAL GAS PRODUCTION BY REGION IN BCM



Source: Enerdata Global Energy and CO_2 Data (2018)

NATURAL GAS PRODUCTION IN THE WORLD IN 2017 (BCM)
TOTAL: 3,782.4 BCM

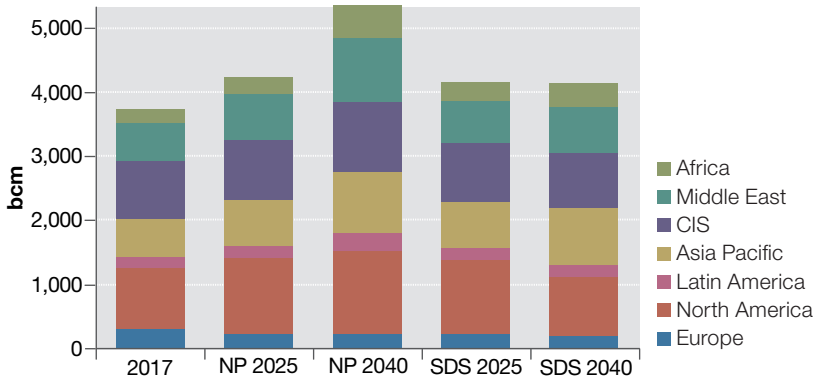


Source : Enerdata Global Energy and CO_2 Data (2018)

FORECASTS OF NATURAL GAS PRODUCTION IN NEW POLICIES AND SDS SCENARIOS FROM IEA

IEA production forecast in Bcm	2017	New Policy Scenario				Sustainable Development Scenario			
		2025	2040	AAGR 2017-2040	Share in 2040	2025	2040	AAGR 2017-2040	Share in 2040
Europe	291	227	203	-1.6%	3.8%	226	197	-1.7%	4.7%
North America	976	1185	1328	1.3%	24.6%	1161	916	-0.3%	21.9%
Latin America	183	189	293	2.1%	5.4%	183	196	0.3%	4.7%
Asia Pacific	596	730	950	2.0%	17.6%	730	919	1.9%	22.0%
CIS	886	974	1104	1.0%	20.4%	941	858	-0.1%	20.5%
Middle-East	620	709	1025	2.2%	19.0%	673	727	0.7%	17.4%
Africa	216	280	498	3.7%	9.2%	274	372	2.4%	8.9%
World	**3,769**	**4,293**	**5,399**	**1.6%**	**100%**	**4,189**	**4,184**	**0.5%**	**100%**
Conventional gas	**2,918**	**3,064**	**3,654**	**1.0%**	**67.7%**	**3,006**	**2,899**	**0.0%**	**69.3%**
Tight gas	**273**	**238**	**293**	**0.3%**	**5.4%**	**313**	**195**	**-1.4%**	**4.7%**
Shale gas	**495**	**884**	**1,267**	**4.2%**	**23.5%**	**752**	**919**	**2.7%**	**22.0%**
Coalbed methane & Other	**84**	**108**	**184**	**10.8%**	**3.4%**	**118**	**171**	**10%**	**4.1%**

WORLD NATURAL GAS CONSUMPTION FORECASTS UNDER THE IEA'S NEW POLICIES AND SUSTAINABLE DEVELOPMENT SCENARIOS (WEO 2018)



Source: World Energy Outlook 2018 © OECD/IEA, 2018

Natural gas: production

In bcm	Natural gas production						Change 2016-2017	AAGR 2000-2017	AAGR 2010-2017
	2000	2005	2010	2015	2016	2017			
Europe	320	329	317	261	260	260	0.3%	-2.8%	7%
EU-28	265	241	206	139	138	131	-4.9%	-6.2%	4%
Norway	53	87	110	121	121	128	6.3%	2.2%	3%
Netherlands	74	78	90	55	53	46	-12.8%	-9.1%	1%
United Kingdom	115	93	58	41	42	42	0.3%	-4.6%	1%
North America	726	699	764	932	929	945	1.7%	3.1%	25%
United States	544	512	604	767	755	764	1.2%	3.4%	20%
Canada	182	187	160	165	174	181	4%	1.8%	5%
Latin America	138	179	211	216	212	208	-1.6%	-0.2%	6%
Asia	251	335	426	453	456	475	4.1%	1.6%	13%
China	27	49	96	135	137	148	8.2%	6.4%	4%
Indonesia	70	75	86	75	74	74	0.1%	-2.1%	2%
Malaysia	50	66	61	69	68	72	6%	2.5%	2%
Pacific	39	40	58	82	102	125	21.8%	11.7%	3%
Australia	33	36	53	67	87	109	25%	10.9%	3%
CIS	709	799	828	861	858	915	6.7%	1.4%	24%
Russia	573	628	657	638	644	694	7.7%	0.8%	18%
Turkmenistan	47	63	45	84	80	81	2%	8.7%	2%
Middle East	196	302	467	587	609	632	3.7%	4.4%	17%
Saudi Arabia	38	56	73	87	91	95	4.8%	3.8%	3%
Iran	59	99	144	184	200	214	7%	5.8%	6%
Qatar	25	45	121	167	169	169	0.1%	5%	5%
Africa	124	187	210	198	204	222	9%	0.8%	6%
Algeria	82	89	85	84	95	96	1.5%	1.8%	3%
World	**2,504**	**2,869**	**3,280**	**3,590**	**3,629**	**3,782**	**4.2%**	**2.1%**	**100%**
OECD	1,110	1,103	1,185	1,305	1,319	1,353	2.6%	1.9%	36%
no-OECD	1,393	1,766	2,095	2,284	2,310	2,430	5.2%	2.1%	64.20%

Source: Enerdata Global Energy and CO_2 Data (2018)

Natural gas: consumption

Economic factors and environmental choices have revived the attractiveness of natural gas and driven two years of solid growth

Natural gas consumption is expected to have remained dynamic in 2018, increasing 4%* after a 3.8% gain in 2017, driven by North America and Asia. World demand will have amounted to 3,950 bcm in 2018. A stronger world economy in 2018 and environmental policies have favoured natural gas, but particularly high temperatures over the last four years have had the opposite effect.

In Europe, gas demand weakened 1.4%* in 2018 (-7 bcm) to an expected 520 bcm after two rising years (up 6% in 2016 and up 5% in 2017). Mild weather, a sluggish economy and less use of gas in power generation to the benefit of renewables (due in part to high water levels available to French, Italian and Spanish hydro plants) explain this decline.

Following a 1.2% dip in 2017, US demand rebounded 7.6%* and set a historical record at 826 bcm (+58 bcm) in 2018. Natural gas continues to squeeze coal out of power generation and is reinforcing the development of renewables in the USA. In addition, low Henry Hub prices are promoting natural gas as a raw material for fertilisers. Economic recovery is also raising demand for gas from industry.

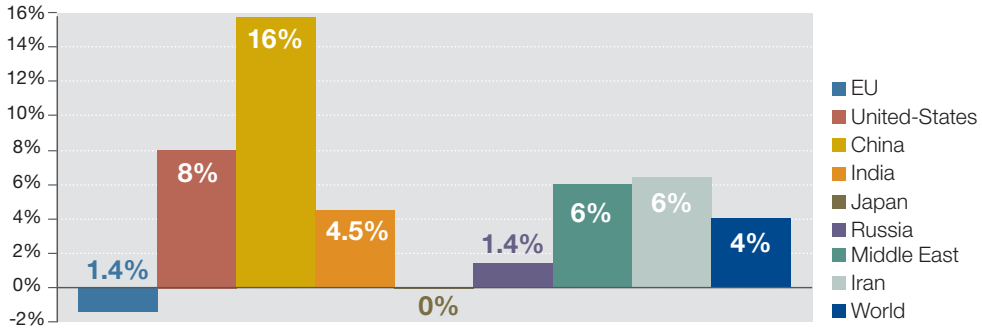
In Asia, after a 9.3% increase in 2017, gas consumption progressed again 10%* in 2018. In China, the third largest consumer of natural gas after the USA and Russia and the second largest LNG importer behind Japan, demand rose 16% in 2018. This reflected the authorities' new environmental focus and their albeit painstaking efforts to curb the country's use of coal. In India, after a 3% rise in 2017, natural gas consumption increased by 5% in 2018 to 55 bcm. Gasification policies and anti-pollution measures are likely to maintain pressure on demand in 2019. In Japan, the world's largest LNG importer, natural gas demand declined 0.7% in 2018 because of the resumption of nuclear power generation at nine reactors and higher output from renewables.

IEA forecasts published in the 2018 World Energy Outlook confirm the prominence of natural gas: it is the only fossil energy whose share in the energy mix is set to increase (from 22% in 2017 to 25% in 2040) in all three scenarios**, New Policies (reference scenario), Current Policies (Business as usual) and Sustainable Development ("2°C"). These scenarios assume an average rise in natural gas demand of 1.6%, 1.9% and 0.4% per year, respectively. In the New Policies scenario, world gas demand surges from 3,752 bcm in 2017 to 5,399 bcm in 2040, of which China consumes 700 bcm.

*** ENGIE – Strategy department 2018 estimates, based on IEA, HIS and Enerdata 2019 sources.**
**** See appendix for a description of these scenarios.**

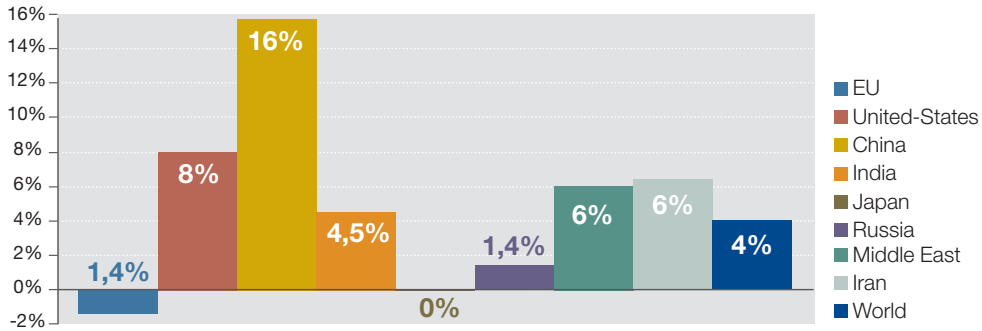
Natural gas: consumption

CHANGE IN PRIMARY CONSUMPTION OF NATURAL GAS IN 2017



Source: Enerdata, Global Energy and CO_2 Data, 2019

CHANGE IN PRIMARY CONSUMPTION OF NATURAL GAS IN 2018*

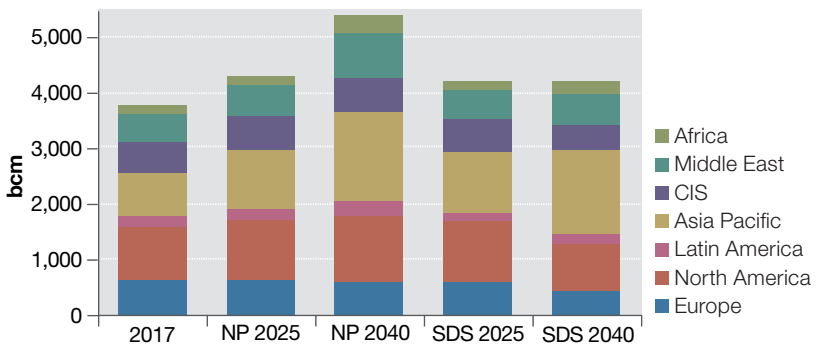


Source: Enerdata, Global Energy and CO_2 Data, 2019
** Estimates by Group Strategy Department based on IEA, IHS, Enerdata sources*

FORECASTS OF NATURAL GAS CONSUMPTION IN NEW POLICIES AND SDS SCENARIOS FROM IEA

IEA consumption forecast in Bcm	2017	New Policies Scenario				Sustainable Development Scenario			
		2025	2040	AAGR 2017-2040	Share in 2040	2025	2040	AAGR 2017-2040	Share in 2040
Europe	613	622	592	-0.1%	11%	596	450	-1.3%	11%
North America	969	1,078	1,170	1%	22%	1,066	814	-0.8%	19%
Latin America	174	183	271	2%	5%	170	184	0.2%	4%
Asia Pacific	775	1,073	1,579	3%	29%	1,081	1,491	2.9%	36%
CIS	575	592	635	0.4%	12%	574	485	-0.7%	12%
Middle East	501	560	794	2%	15%	528	545	0.4%	13%
Africa	145	175	308	3%	6%	166	201	1.4%	5%
OECD	1,723	1,823	1,906	0.4%	35%	1,784	1,349	-1.1%	32%
non OECD	2,028	2,460	3,444	2%	64%	2,396	2,821	1.4%	67%
Bunkers	0	10	49	33%	1%	9	15	25.9%	0%
World	3,752	4,293	5,399	1.6%	100%	4,189	4,184	0.5%	100%

WORLD NATURAL GAS CONSUMPTION FORECASTS UNDER THE IEA'S NEW POLICIES AND SUSTAINABLE DEVELOPMENT SCENARIOS



Source: World Energy Outlook 2017 © OECD/IEA, 2018

Natural gas: primary consumption

	Primary gas consumption						Change 2016-2017	AAGR 2000-2017	AAGR 2010-2017
In bcm	2000	2005	2010	2015	2016	2017			
Europe	507	575	597	498	526	550	4.6%	-1.2%	15%
EU-28	483	536	545	437	467	485	3.8%	-1.7%	13%
Germany	88	91	94	81	89	94	5.7%	0.0%	3%
Italy	71	86	83	68	71	75	6.0%	-1.4%	2%
United Kingdom	103	100	99	73	81	79	-2.4%	-3.1%	2%
North America	753	722	780	877	887	882	-0.6%	1.8%	23%
United States	661	623	683	767	777	766	-1.4%	1.7%	20%
Canada	92	99	97	110	110	116	5.7%	2.6%	3%
Latin America	136	177	222	243	240	243	1.4%	1.3%	7%
Argentina	37	41	47	51	53	53	0.7%	1.9%	1%
Mexico	40	53	70	75	76	78	2.5%	1.6%	2%
Asia	284	389	548	661	690	732	6.2%	4.2%	20%
China	25	46	104	188	204	234	14.8%	12.2%	6%
India	28	38	64	50	55	56	2.4%	-1.9%	2%
Japan	83	87	108	126	131	130	-0.8%	2.6%	3%
Pacific	29	32	40	45	50	50	1.0%	3.4%	1%
CIS	568	624	655	614	606	653	7.6%	-0.1%	17%
Russia	391	426	466	445	441	481	9.1%	0.5%	13%
Moyen Orient	175	256	376	477	497	516	3.7%	4.6%	14%
Saudi Arabia	38	56	73	87	91	95	4.8%	3.8%	3%
Iran	62	99	144	184	197	205	4.0%	5.1%	5%
United Arab Emirates	30	42	61	71	72	71	-0.4%	2.3%	2%
Africa	57	89	107	129	131	139	6.6%	3.9%	4%
World	**2,507**	**2,864**	**3,323**	**3,544**	**3,626**	**3,765**	**3.8%**	**1.8%**	**100%**
OECD	**1,406**	**1,477**	**1,621**	**1,655**	**1,708**	**1,729**	**1.2%**	**0.9%**	**46%**
no-OECD	**1,101**	**1,387**	**1,703**	**1,889**	**1,919**	**2,037**	**6.1%**	**2.6%**	**54%**

Source: Enerdata Global Energy and CO_2 Data (2018)

Natural gas: consumption by sector

Consumption by sector in 2017 In bcm	Power stations		Industry		Transport		Services, Residential & Agriculture		Non-energy uses		Total	
	2017	Change 2016/2017	2017	Change 2016/2017	2017	Change 2016/2017	2017	Change 2016/2017	2017	Change 2016/2017	2017	Change 2016/2017
Europe	206	8%	112	3%	2	2%	211	3%	19.0	4%	550	5%
EU-28	176	7%	98	3%	2	2%	191	1%	18	5%	485	4%
Germany	24	3%	25	5%	0	-16%	42	8%	3.4	7%	94	6%
Italy	33	10%	11	3%	1	3%	30	3%	0.8	3%	75	6%
United Kingdom	35	-2%	9	3%	0	NA	35	-4%	0.4	-3%	79	-2%
North America	438	-3%	167	2%	1	-1%	249	3%	27	2%	882	-1%
United States	374	-5%	151	2%	1	-1%	217	2%	23	2%	766	-1%
Canada	65	8%	16	-4%	0	2%	32	7%	4	3%	116	6%
Latin America	157	3%	47	0%	7	-2%	18	-5%	14	1%	243	1%
Argentina	30	7%	8	-4%	3	-10%	11	-7%	1.7	-8%	53	1%
Mexico	60	3%	16	3%	0	0%	1	3%	0.6	3%	78	3%
Asia	384	4%	135	10%	35	11%	120	10%	59.1	6%	732	6%
China	79	15%	58	15%	24	15%	59	15%	14.1	15%	234	15%
India	18	2%	9	3%	3	3%	2	3%	24.1	3%	56	2%
Japan	91	-2%	13	2%	0	3%	25	2%	0.4	37%	130	-1%
Pacific	30	0%	11	4%	0	-8%	7	1%	2.5	1%	50	1%
CIS	429	8%	62	8%	1	7%	110	5%	50.3	9%	653	8%
Russia	324	9%	47	9%	0	9%	66	9%	44.2	9%	481	9%
Moyen Orient	296	5%	124	2%	8	0%	60	0%	27.6	4%	516	4%
Saudi Arabia	66	2%	22	12%	0	NA	0	NA	7.3	12%	95	5%
Iran	85	11%	40	0%	8	-0.2%	60	-0.2%	12.7	-0.2%	205	4%
United Arab Emirates	38	-0.4%	33	0%	0	NA	0	NA	0.3	-0.3%	71	-0.4%
Africa	95	7%	21	9%	0	9%	12	7%	10.7	-1%	139	7%
World	2,034	4%	680	4%	54	7%	787	4%	210.1	5%	3,765	4%
OECD	850	0%	325	2%	5	0.3%	502	3%	46.9	3%	1,729	1%
no-OECD	1,185	6%	355	6%	49	7%	285	6%	163.2	5%	2,037	6%

Source,: Enerdata, Global Energy and CO_2 Data (2018)

Natural gas: green gases

Biogas from methanisation is taking off and will pave the way for other green gas technologies

Green gases can be produced from three different sources:

> Anaerobic digestion or methanisation is a biological process using micro-organisms to decompose organic matter in the absence of oxygen. This process produces biogas (methane, CO_2 and other gases) and a digestate that can be used as fertiliser. The organic matter may come from crop residues, agricultural wastes or agri-food industries. Biogas can be used directly in cogeneration or purified to produce so-called biomethane, which is of similar quality to that of natural gas.

> Pyrogasification or gasification is a thermo-chemical process that produces a gaseous fuel, called syngas, from lignocellulosic material (wood, straw, etc.). Syngas mainly consists of methane, hydrogen, carbon monoxide and carbon dioxide. It can be used directly in cogeneration or purified to produce biomethane.

> Power-to-gas is a process that allows the conversion of electricity to synthesise methane. The first step consists of producing hydrogen by water electrolysis (power-to-H_2). This hydrogen is then used directly as fuel or injected into the gas grid within a certain limit. The second step involves converting hydrogen into synthesis methane by adding CO_2 (methanation).
This biomethane or synthesis methane can be injected into the gas grid or used to power NGV vehicles.

Most of today's green gases are biogases from methanisation, with heat and electricity produced through cogeneration engines.
Pyrogasification and power-to-gas have not yet reached the technological maturity of methanisation, and their share of production remains limited compared to methanisation.

Biogas is developing rapidly in Europe because of environmental policies. It represents 8% of European natural gas production (20 bcm out of 260 bcm in 2017). Its production capacity has tripled over the last 5 years, but 70% of it is concentrated in just three countries: Germany (10 bcm), UK (3 bcm) and Italy (3 bcm). Biogas has been the most rapidly expanding form of bioenergy since 2010, overtaking biofuel production.
80% of biogas is used for power generation, 14% in the residential/agricultural sectors, 2% in industry and 1% in transport.

The introduction of repurchasing policies, as for electricity RES, should lead to improved productivity in methanisation units and heightened industry professionalisation through operational consolidation and standardisation. The objective is to reduce biomethane production costs by a third by 2030, to €65-85/MWh in nominal value depending on the type of installation.

Green gases offer substantial potential, but the sector needs to consolidate.

Within Europe, green gas potential by 2050 is estimated at 20% to 40% of gas consumption (or 70-140 Mtoe).

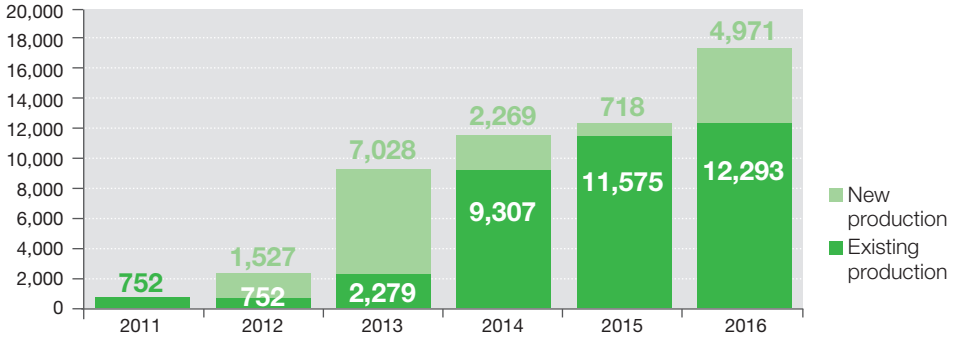
Biogas production, according to Eurogas, could reach around 10% of European gas consumption (or 25-30 Mtoe) by 2030. This share is equal to that set in French energy transition law (10% by 2030). After 2030, the development of biogas is set to stabilise, reflecting limited further potential (around 50 Mtoe in 2050).

The conversion of electricity into hydrogen and methane will be competitive alternatives from 2030 onwards and ensure greater use of green gases. According to Greenpeace estimates ([R]Evolution scenario 2016), hydrogen could reach substantial volumes by 2050, at 165 Mtoe. But according to Eurogas, the real potential of green gases lies in power-to-gas, which could represent 51% of gas consumption by 2050 (Innovative Gas scenario 2016).

Natural gas: green gases across the world

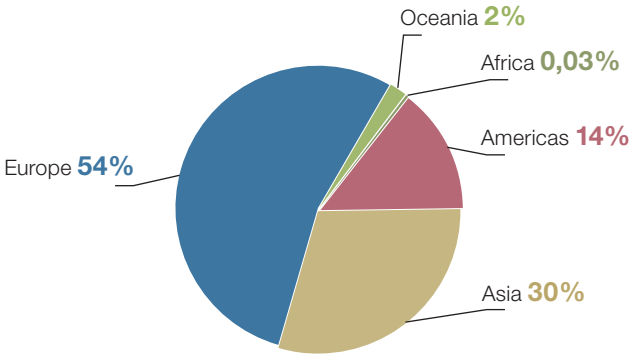
	Biogas (bcm)	Biogas (EJ)	Biogas (TWh)
2000	13.2	0.28	78
2005	23.1	0.5	139
2010	38.7	0.84	233
2015	60	1.3	361
2020	60.8	1.31	364

EUROPE'S BIOMETHANE PRODUCTION (GWH)



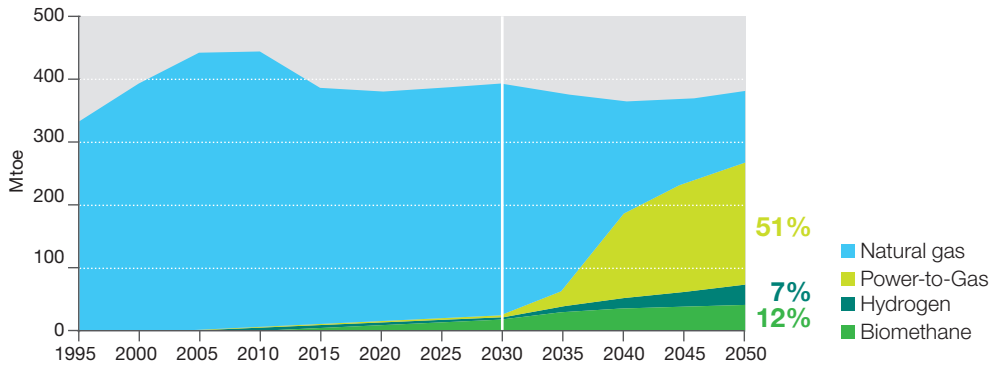
Source: European Biogas Association, Statistical Report (2017)

WORLD BIOGAS PRODUCTION



Source: IEA, Key World Energy Statistics

PROJECTION OF GREEN GAS PRODUCTION IN EUROPE ACCORDING TO EUROGAS' INNOVATIVE GAS SCENARIO



Source: Eurogas, Gas Roadmap (2016)

Natural gas: hydrogen

Green hydrogen as the “missing link” of energy transition

Hydrogen (dihydrogen molecule H_2) is the most widespread chemical element in the world (it can be found notably in water (H_2O) and in hydrocarbons: oil, natural gas).

> The molecule has a particularly high energy content: 1kg of hydrogen generates roughly three times more energy than 1kg of gasoline. It can be transported and stored, but while the hydrogen atom is very abundant on earth, it cannot be easily found in a pure form; hence H_2 has to be produced.

> Grey hydrogen is produced through the Steam Methane Reforming (SMR) method, which uses natural gas. Currently the cheapest solution available, it is also the most carbon intensive: 1kg of H_2 produced generates at least 11kg of carbon dioxide (CO_2). 49% of grey hydrogen is produced from natural gas, 29% from liquid hydrocarbons and 18% from coal.

> Blue hydrogen is derived from SMR grey hydrogen, completed by carbon capture and storage (CCS). From 60% to 90% of the CO_2 emitted during the production process is captured and stored underground. Huge storage capacity are needed and the price surplus is not very well established.

> Green hydrogen is the only fully decarbonized solution, that produces hydrogen through the electrolysis of water by using renewable electricity (such as hydraulic, solar or wind), without CO_2 emissions or polluting particles.

> Hydrogen is used as a feedstock, in large scale industrial processes: the chemical industry and refining account for 94% of world consumption (world consumption: 67Mt/y).

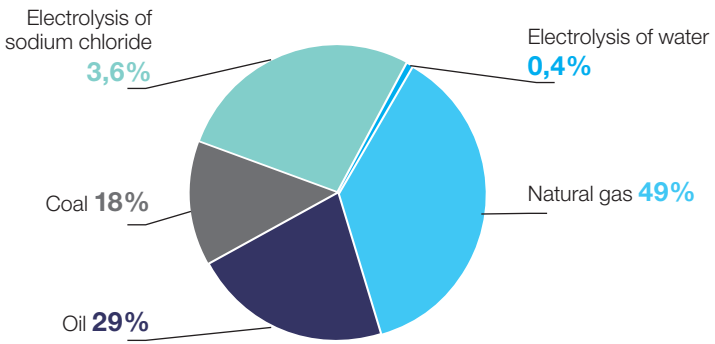
Today, hydrogen is mainly “grey” (produced from fossil fuels), due to the context of low carbon price that allows its competitiveness (production cost around $2/kg). Water electrolysis generates only 0.4% of global H_2, at a production cost of less than twice that of grey hydrogen.

But green hydrogen's competitivity is expected to evolve with carbon pricing. A large panel of experts expect green hydrogen to be competitive by 2025-30, with promising market prospects. The Hydrogen Council forecasts that the global market size of hydrogen will increase tenfold by 2050, driven by renewable hydrogen and its new usages, and that hydrogen will account for about 20% of final energy demand by that year.

In most energy transition scenarios, green hydrogen (produced by electrolysis) is the link to drive carbon-free energy solutions and to unlock the full potential of renewables: it can decarbonize several energy uses, be easily transported from production to consumption areas, and can also be stored to meet seasonal demand (heating and cooling) and to cope with intermittent renewable energies.

Natural gas: hydrogen

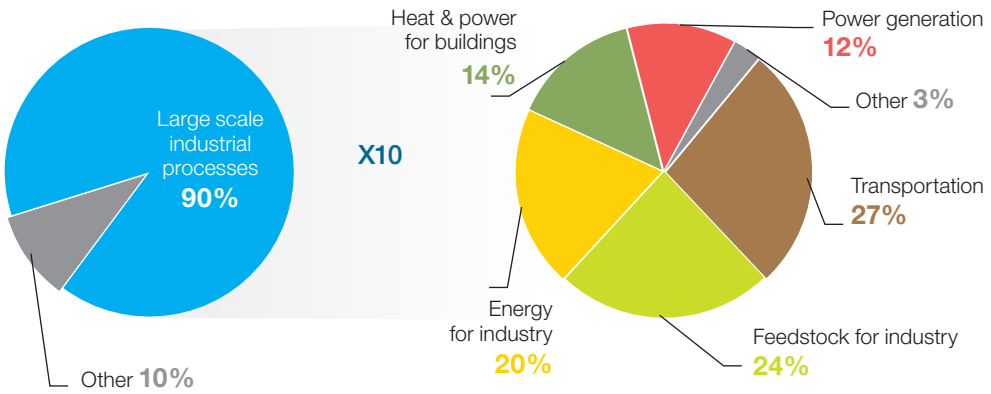
WORLD HYDROGEN PRODUCTION (2014)



Source : IHS, 2014

H_2 MARKET IN 2017
67 MTPA
2,642 TWH PCS/YEAR

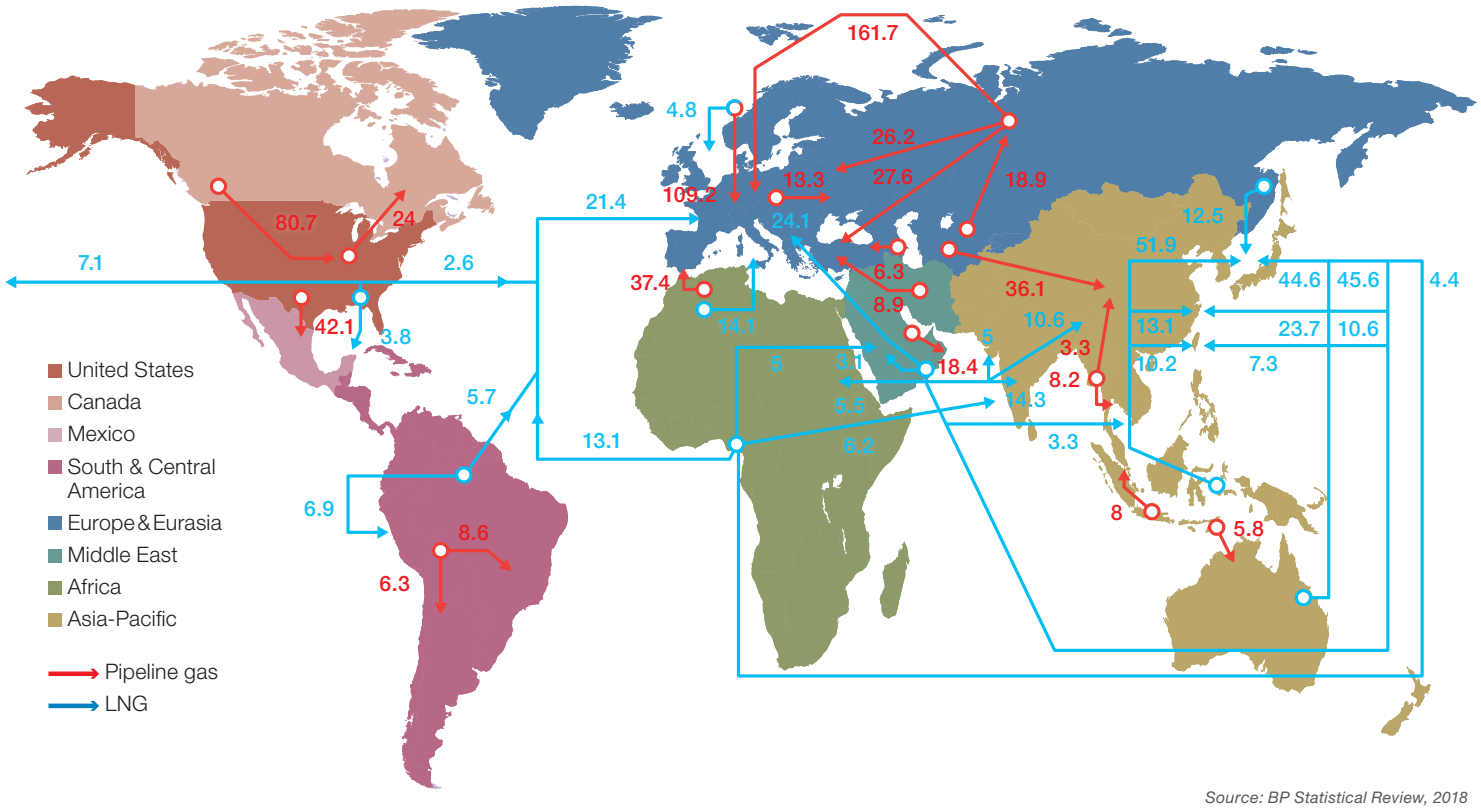
H_2 MARKET IN 2050
550 MTPA
21,692 PCS/YEAR



Source: Hydrogen Council

Natural gas: world trade flows

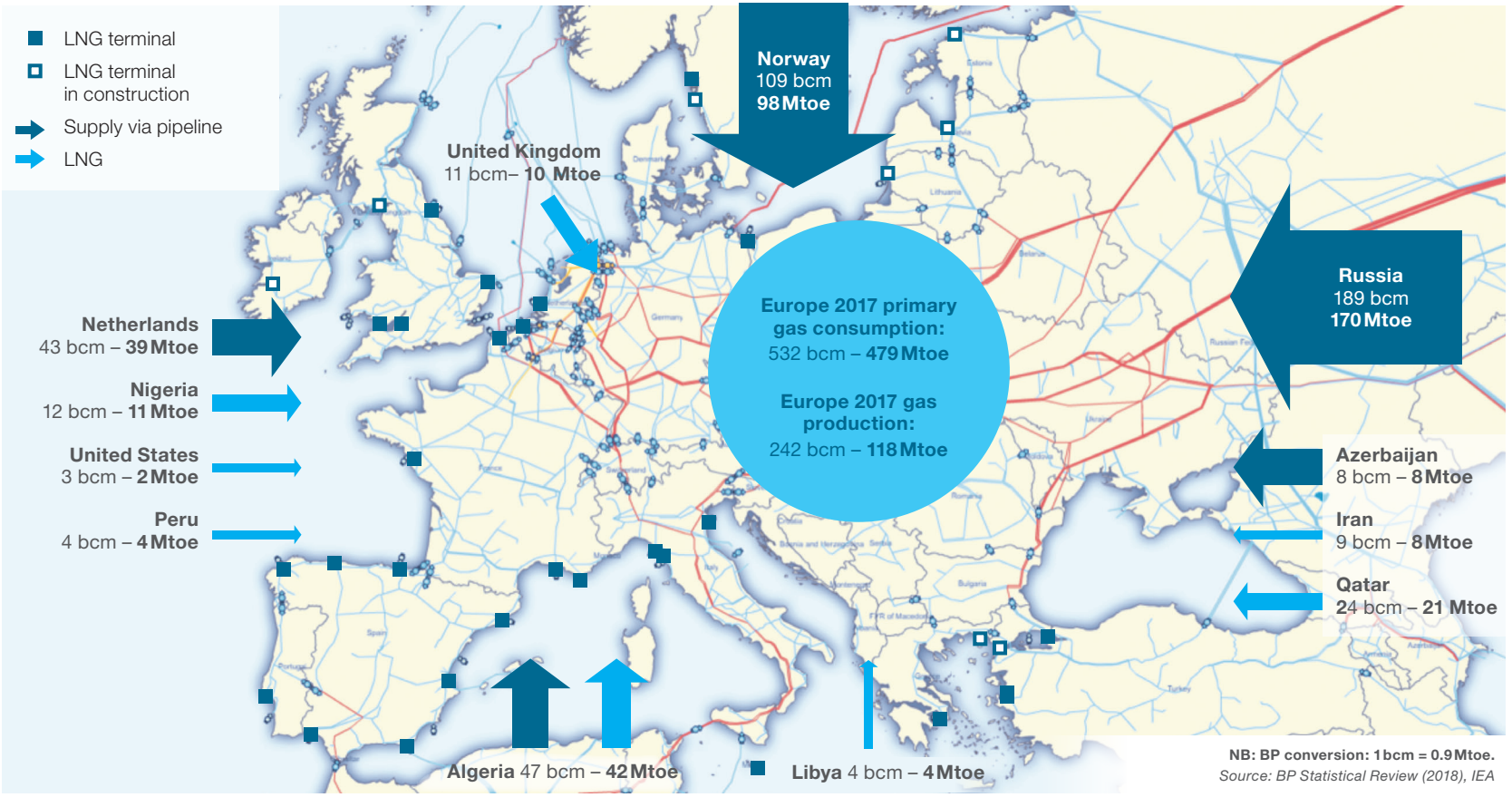
MAIN NATURAL GAS TRADE FLOWS IN 2017 (BCM)



Source: BP Statistical Review, 2018

Natural gas: focus on Europe

NATURAL GAS SUPPLY OF EUROPE IN 2017



NB: BP conversion: 1 bcm = 0.9 Mtoe.

Source: BP Statistical Review (2018), IEA

Natural gas: world trade flows

LNG gets a boost from growing demand on Asian markets and the USA's rapid advance among major exporters

NATURAL GAS TRADE

After a 11.3% rise in 2017, LNG world trade expanded another 9.6% in 2018, boosted by demand from all regions except Latin America and MENA. Planned and actual new capacity reinvigorated the LNG market in 2018: an additional 35 Mtpa is expected in 2019 and 29 liquefaction projects are at final investment decision (FID) stage.

Natural gas imports to Europe via pipelines increased 1.5% in 2018 after an impressive 7% rise in 2017. Russia supplied almost 200 bcm of this 252 bcm, amounting to 38% of total European demand. The country remains the world's leading gas exporter, ahead of Qatar.

Asia is the largest gas importer at 409 bcm in 2018, of which 329 bcm in liquid form, **followed by Europe.** Cross-border trade represented 33% of gas market production in 2018, of which 37% was LNG. LNG is increasingly predominant in long-distance flows.

China was the main engine of growth for LNG imports, which climbed from 53 bcm in 2017 to 75 bcm in 2018. It has overtaken South Korea to take second place behind Japan in the world ranking. In coastal regions and nationally, and following switching from coal to natural gas, LNG has a competitive advantage over pipeline gas. **LNG flows into Europe expanded 7.3% from their 2017 level to 68 bcm.** Imports into the UK, Belgium and the Netherlands doubled.

LIQUEFACTION

Australia sold 93 bcm of LNG in 2018, a 22% rise on the previous year, and lies second behind Qatar (107 bcm). Qatar intends to expand capacity to 150 bcm per year in order to retain its leadership position. In the USA, liquefaction capacity is now 43 bcm per year. The Sabine Pass and Cove Point terminals supplied 30 bcm in 2018, of which 12 bcm were exported to Asia. US liquefaction capacity is set to rise to 81 bcm in 2019, behind only Qatar and Australia. There were 21 exporter countries at end-2018.

REGASIFICATION

Regasification capacity expanded further in 2018, to 435 bcm in total and 303 bcm in Asia. The vigour of Asian markets is stimulating the development of new capacity. Having reported their first imports in 2018, Bangladesh and Panama have lifted the number of LNG importing countries to 42, of which 15 are European. The 24 FSRUs (Floating Storage and Regasification Units) worldwide, representing 130 bcm total capacity, supplied 40% of import flows. Since 2014, six countries have joined the LNG markets via FSRUs; another two, Gibraltar and Russia (via its Kaliningrad enclave) will follow suit in 2019.

NB:Conversion: 1 bcm = 0.7245 Mt of LNG // 1 Mt of LNG = ~1.38 bcm.

Natural gas: natural gas trade flows (Pipeline gas and LNG)

Trade flows, bcm	Via pipelines						Via tankers						Total						Trade balance*		
	Exportations			Importations			Exportations			Importations			Exportations			Importations					
	2016	2017	Change	2016	2017	Change	2016	2017	Change	2016	2017	Change	2016	2017	Change	2016	2017	Change	2016	2017	Change
Europe	208	193	-7%	416	423	2%	11	8	-21%	56	66	16%	218	201	-8%	472	489	4%	-254	-288	13%
Germany	9	7	-22%	96	95	-1%	0	0	-	0	0	-	9	7	-22%	96	95	-1%	-86	-88	1%
Netherlands	52	43	-17%	38	41	8%	0.9	0.8	-5%	1.3	1.6	24%	53	44.1	-17%	39	43	8%	14	1	-89%
Norway	110	109	-0.5%	0	0	-	6	6	-9%	0	0	-	116	115	-1%	0	0	-	116	115	-1%
North America	143	147	3%	143	147	3%	4	17	295%	8.7	9.2	5%	147	164	12%	151	156	3%	-4	8	-289%
United States	60	66	9%	82	81	-2%	4	17	295%	2.5	2.2	-12%	65	83	29%	85	83	-2%	-20	1	-103%
Canada	82	81	-2%	22	24	10%	0	0	-	0.3	0.4	21%	82	81	-	22	24	10%	60	56	-7%
Latin America	17	15	-8%	17	15	-8%	20	19	-6%	16	14	-11%	37	35	-7%	32	29	-10%	4.9	5.4	10%
Argentina	0	0	-	6	7	8%	0	0	-	5.2	4.8	-9%	0	0	-	11	11	0%	-11	-11	0%
Brazil	0	0	-	10	9	-18%	0.6	0.1	-	3	2	-38%	0.6	0.1	-76%	13	10	-22%	-13	-10	-20%
Trinidad & Tobago	0	0	-	0	0	-	14	13	-6%	0	0	-	14	13	-6%	0	0	-	14	13	-6%
Asia-Pacific	31	27	-15%	66	63	-4%	129	155	20%	242	284	17%	161	182	13%	307	346	13%	-146	-165	12%
Australia	0	0	-	8	6	-30%	57	76	34%	0.1	0	-100%	57	76	34%	8	6	-31%	48	70	45%
China	0	0	-	38	39	4%	0	0	-	34	53	53%	0	0	-	72	92	27%	-72	-92	27%
Japan	0	0	-	0	0	-	0	0	-	108	114	5%	0	0	-	108	114	5%	-108	-114	5%
Indonesia	9	8	-9%	0	0	-	21	22	2%	0	0	-	30.0	29.7	-1%	0	0	-	30.0	29.7	-1%
South Korea	0	0	-	0	0	-	0.09	0.08	-15%	44	51	17%	0.1	0	-15%	44	51	17%	-44	-51	17%
CIS	265	283	7%	61	62	3%	14	16	11%	0	0	-	279	299	7%	61	62	3%	218	236	8%
Russia	191	215	13%	22	19	-13%	14	16	11%	0	0	-	205	231	13%	22	19	-13%	183	212	16%
Turkmenistan	37	34	-10%	0	0	-	0	0	-	0	0	-	37	34	-10%	0	0	-	37	34	-10%
Middle East	28	31	9%	27	22	-17%	123	122	-0.05%	14	13	-8%	151	153	2%	41	35	-14%	110	118	8%
United Arab Emirates	0	0	-	18	16	-8%	7	8	6%	3	2	-35%	7	8	4%	21	19	-13%	-14	-11	-21%
Iran	8	12	50%	7	3	-57%	0	0	-	0	0	-	8	12	50%	7	3	-57%	1	9	554%
Qatar	20	18	-8%	0	0	-	104	103	-1%	0	0	-	124	122	-2%	0	0	-	124	122	-2.2%
Africa	46	45	-1.2%	9	8	-13%	46	55	22%	10	8	-20%	91	100	10%	19	16	-17%	72	85	17%
Algeria	37	36	-1.9%	0	0	-	16	17	4%	0	0	-	53	53	0%	0	0	-	53	53	0%
Nigeria	0.1	1.1	954%	0	0	-	24	28	17%	0	0	-	24	29	21%	0	0	-	24	29	21%
World	**738**	**741**	**0.4%**	**738**	**741**	**0.4%**	**347**	**393**	**14%**	**347**	**393**	**14%**	**1,084**	**1,134**	**5%**	**1,084**	**1,134**	**5%**	**0**	**0**	**-**

*** The trade balance is the difference between exports and imports. A positive balance (trade surplus) means a net exporting country while a negative balance (trade deficit) means a net importing country.**

Conversion: 1 Gm³ ~ 0,7245 Mt of LNG // 1 Mt of LNG ~1,38 Gm³.

Source: BP Statistical Review, 2018

Natural gas: liquefaction and regasification capacity worldwide

Liquefaction capacities (Mt/yr)	2016	2017
United Arab Emirates	5.8	5.8
Oman	10.4	10.4
Qatar	77.4	77.4
Yemen	6.7	6.7
Total Middle East Basin	100.3	100.3
Algeria	25.3	25.3
Angola	5.2	5.2
Egypt	12.2	12.2
Equatorial Guinea	3.7	3.7
Libya	0.6	0.0
Nigeria	22.0	22.0
Total Africa	69.0	68.4
Norway	4.2	4.2
Total Europe	4.2	4.2
United States	10.5	19.5
Peru	4.5	4.5
Trinidad and Tobago	15.3	15.3
Total America	30.3	39.3
Atlantic-Mediterranean basin (Africa, Europe, America)	103.5	111.9

Liquefaction capacities (Mt/yr)	2016	2017
Russia	10.8	16.3
Total CIS	10.8	16.3
Autralia	60.6	70.3
Brunei	7.2	7.2
Indonesia	31.8	31.8
Malaysia	26.2	31.0
Papua New Guinea	6.9	6.9
Total Asia-Pacific	65.2	70.0
Pacific basin (America, Asia-Pacific)	67.5	77.2
World	**347.3**	**375.6**
OPEC	168.1	167.5
Non OPEC	179.2	208.1

Sources: Enerdata, Global Energy and CO_2 Data, 2018

Regasification capacities (Mt/yr)	2016	2017
Belgium	6.7	6.7
Spain	44.5	44.5
France	15.8	25.5
Greece	3.9	3.9
Italy	11.3	11.3
Netherlands	8.9	8.9
Poland	3.7	3.7
Portugal	5.9	5.9
United Kingdom	36.0	36.0
Turkey	15.1	15.1
Other European countries	3.7	5.1
Total Europe	155.4	166.5
Canada	7.6	7.6
United States	136.5	136.5
Mexico	17.2	17.2
Argentina	7.6	9.2
Brazil	11.6	11.6
Chile	5.5	5.5
Colombia	3.8	3.8
Other American countries	2.1	2.1
Total America	192.0	193.6
Egypt	9.5	9.5
Total Africa	9.5	9.5
Total Atlantic basin (Europe, America, Africa)	356.9	369.6

Regasification capacities (Mt/yr)	2016	2017
China	49.6	55.7
South Korea	103.6	103.6
India	30.0	30.0
Indonesia	8	8
Japan	206.7	206.7
Pakistan	3.5	9.1
Taiwan	14.0	14.0
Thailand	5.0	5.0
Other Asian countries	9.8	13.3
Total Asie	430.2	445.4
Total Asia-Pacific basin (America, Asia)	622.2	639.0
United Arab Emirates	9.9	9.9
Israel	3.8	3.8
Jordan	3.8	3.8
Kuwait	5.9	5.9
Total Middle East basin	23.4	23.4
World	**810.5**	**838.3**

Sources: Enerdata, Global Energy and CO_2 Data, 2018

Natural gas: prices

Bolstered by buoyant energy markets, natural gas prices rose on the three main regional markets in 2018

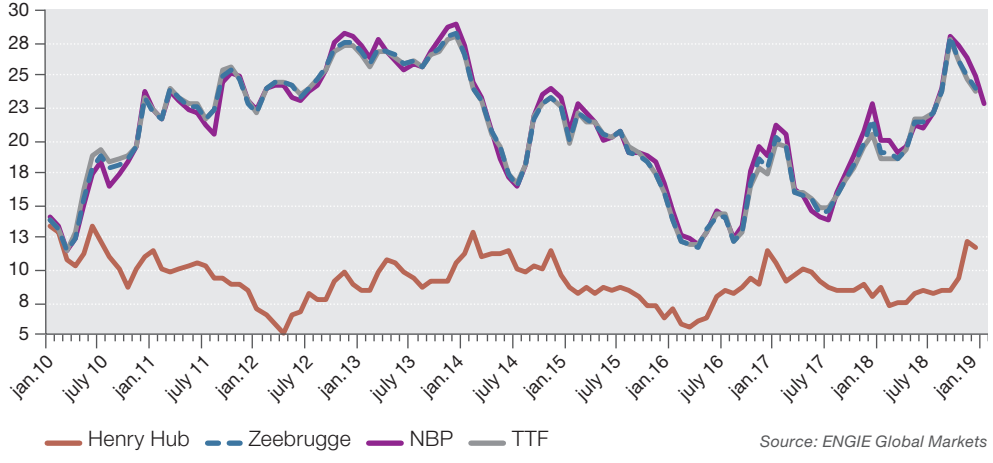
In Europe, natural gas prices surged 30% in 2018. Factors behind this move included intense stockbuilding after an unusually cold first quarter, a continuing contraction in domestic production and soaring oil and coal prices, together with higher carbon prices on the EU ETS. Prices eased in the last quarter of the year, however, when softer Asian demand triggered record inflows of LNG into European ports and numerous liquefaction trains came on stream in the USA, Russia and Australia.
All in all, after an average of €17/MWh in 2017, the TTF month-ahead price peaked at €30/MWh in September 2018 and ended the year at around €22/MWh. The 2018 average was €22.20/MWh.

In the USA, the long downtrend in spot prices that started in January 2014, when Henry Hub was at $4/MMBtu, or €11/MWh, appears to have bottomed out at $2/Mbtu in 2016. Henry Hub prices have stabilised at around $3/MMBtu since then, averaging $3.02 in 2017 and $3.07 in 2018. These levels favour switching from coal to gas in US electricity generation.

In Asia, higher oil prices lifted the Japan-Korea Marker (JKM) index 25% in 2018. It averaged $9.70/MMBtu in 2018, up from $7.30 in 2017.

LNG prices are continuing to converge between the different regions. This reflects a more fluid market and increasingly abundant supply. Moreover, the price differential between long term contracts and spot prices has become much less of an issue, regardless prices convergence between long and short term.. Two thirds of LNG trade flows are oil-indexed. In December 2018, the volume of long term contracts had expanded 38% and the number of newly signed 20 or 25 year contracts also progressed.

NATURAL GAS MARKET PRICES IN €/MWH (MONTH AHEAD)



Source: ENGIE Global Markets

Oil

PRODUCTION

The oil market remains a battleground between the major players

PRICES

OPEC is struggling to maintain prices in line with its objective of around €90/bbl

Oil: production

The oil market is being transformed by US overproduction of shale gas, OPEC's loss of influence and Asian attempts to move away from dollar-denominated oil trading

World oil production confirmed a strong recovery in 2018 with a 2.4% rise. Particularly robust gains in Iraq, the USA (shale oil) and Canada (Alberta oil sands) were partially offset by cuts in production in OPEC and several non-OPEC partners, including Russia, who were seeking to steady prices at higher levels. Oil prices averaged $71/bbl in 2018, up from $54/bbl in 2017, but plummeted almost 30% in less than two months at end-2018 to average just $57.40/bbl in December (see details in the Prices section).

Oil extraction picked up sharply in the USA, climbing 15% to 15.4 Mbd in 2018. The country has been the world's leading producer since 2017, swiftly outpacing Russia, Saudi Arabia and Iran. This surge mostly results from lower production costs in shale oil, which have encouraged drilling in unconventional basins such as Permian, Bakken and Eagle Ford.

The share of conventional oil in US production has contracted considerably. According to IEA forecasts it will fall below 50% before 2025.

At the same time, ironically, US influence on the world oil market is gradually waning as Asian and emerging countries step up their own ambitions. We note the opening of a yuan-denominated oil market in China, for example, and talks between India, Russia and the UAE to drop US$ trade for direct exchange rates. These developments highlight a trend towards national interests as well as the trade war against China.

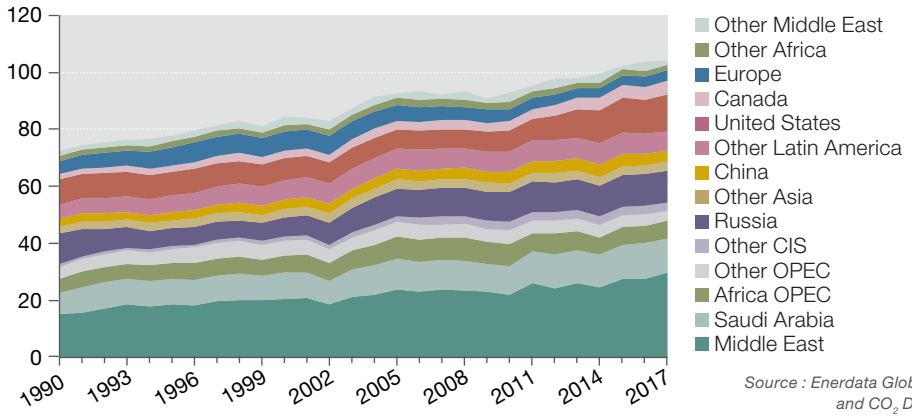
The expansion in US and Canadian production calls OPEC's influence into question. The cartel appears to have less and less influence over oil prices, despite severe restrictions on its output. Already forced to turn to Russia and its 11.5 Mbd to support prices, OPEC's share of world production has dropped below 40% (39.3 Mbd in 2018 against 39.5 Mbd in 2017). Given the cartel's flagging effectiveness, some members are thinking of leaving it, just as Qatar did following political disagreement. After the deal that was struck in December 2018, OPEC and its partners are to meet again in the spring of 2019 to assess the results of their efforts and to decide on their approach in the following months.

Oil: production

Crude Oil, NGL production, LNG (mbl/d)	2000	2005	2010	2015	2016	2017	Change 2016-2017	AAGR 2000-2017	AAGR 2010-2017
European union	3.5	2.7	2.0	1.6	1.6	1.5	-2.7%	-4.8%	-4.0%
Germany	0.1	0.1	0.1	0.1	0.1	0.1	-21.3%	-1.1%	-0.5%
Unitek Kingdom	2.6	1.8	1.3	0.9	1.0	1.0	-1.7%	-5.7%	-4.3%
North America	10.3	9.7	10.6	16.8	16.3	17.7	9.1%	3.2%	7.6%
Canada	2.7	3.0	3.4	4.5	4.6	5.0	6.9%	3.7%	5.5%
United States	7.6	6.7	7.2	12.2	11.6	12.8	9.9%	3.1%	8.5%
Latin America	10.5	11.4	10.7	10.7	10.2	9.5	-7.1%	-0.6%	-1.7%
Brazil	1.3	1.7	2.1	2.6	2.7	2.7	1.9%	4.6%	3.6%
Mexico	3.5	3.9	3.0	2.6	2.5	2.3	-9.6%	-2.6%	-4.0%
Venezuela	3.4	3.5	3.1	2.8	2.6	2.2	-14.7%	-2.5%	-4.8%
Asia	7.0	7.3	7.7	7.9	7.6	7.4	-3.3%	0.3%	-0.6%
China	3.3	3.6	4.1	4.4	4.1	3.9	-3.7%	1.1%	-0.6%
India	0.8	0.8	0.9	0.9	0.8	0.8	0.1%	0.5%	-0.8%
Indonesia	1.5	1.1	1.0	0.8	0.9	0.8	-5.6%	-3.2%	-2.4%
Pacific	0.8	0.6	0.6	0.4	0.4	0.4	-2.5%	-4.8%	-6.4%
CIS	8.0	11.7	13.4	13.9	14.1	14.2	0.6%	3.4%	0.8%
Russia	6.6	9.6	10.3	11.0	11.2	11.3	0.1%	3.2%	1.2%
Kazakhstan	0.7	1.3	1.6	1.6	1.6	1.8	9.7%	5.5%	1.1%
Middle East	23.5	25.7	25.5	28.8	30.7	31.1	1.0%	1.6%	2.9%
Saudi Arabia	9.1	10.8	9.9	12.1	12.8	12.0	-5.6%	1.6%	2.9%
United Arab Emirates	2.6	2.9	2.8	3.5	3.6	3.9	7.2%	2.3%	4.5%
Iraq	2.6	1.9	2.4	3.6	3.9	4.0	1.6%	2.5%	7.5%
Iran	4.1	4.4	4.5	3.3	4.0	4.9	22.5%	1.1%	1.3%
Kuwait	2.1	2.7	2.5	3.2	3.3	3.0	-8.4%	2.2%	2.9%
Africa	8.2	10.0	10.4	8.3	8.0	8.1	2.1%	0.0%	-3.4%
Nigeria	2.4	2.7	2.7	2.4	2.2	2.0	-8.0%	-1.0%	-3.9%
World	**75.2**	**81.9**	**83.1**	**90.3**	**90.9**	**91.9**	**1.1%**	**1.2%**	**1.4%**

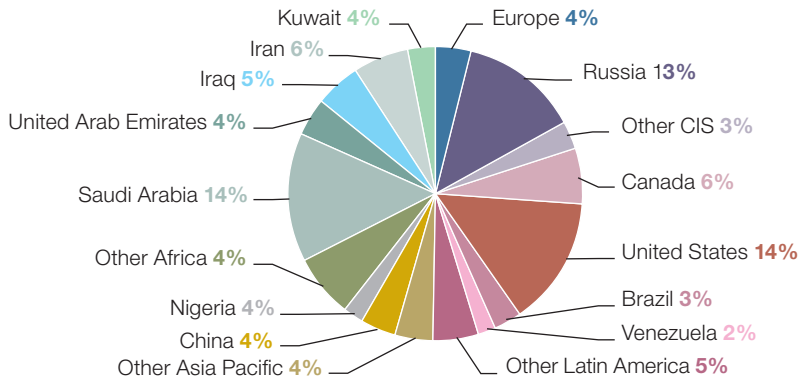
Source: Enerdata Global Energy and CO_2 Data (2019)

OIL PRODUCTION IN THE WORLD (1990-2017) IN MBL/D, OPEC AND THE WORLD



Source : Enerdata Global Energy and CO_2 Data (2019)

OIL PRODUCTION SHARES IN THE WORLD, 2017 – TOTAL 91,9 MBL/D



Source : Enerdata Global Energy and CO_2 Data (2019)

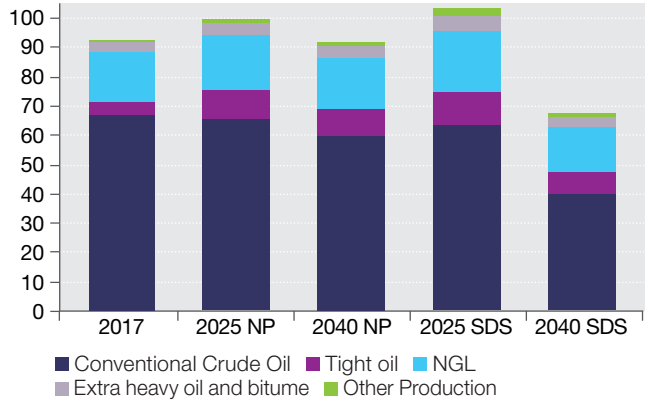
Oil: production forecasts

OIL PRODUCTION FORECASTS IN NEW POLICIES ANS SUSTAINABLE DEVELOPMENT SCENARIOS FROM IEA

Forecast of oil production in IEA scenarios in mb/d		2025		2040		New Policies		Sustainable development	
	2017	NP	SD	NP	SD	AAGR 2017-2040	Share in 2040	AAGR 2017-2040	Share in 2040
Conventional Crude Oil	66.9	65.6	59.8	63.8	40.2	-0.2%	62%	-2%	59%
Tight oil	4.8	9.8	9.1	11.0	7.3	4%	11%	2%	11%
NGL	16.7	19.0	17.5	21.1	15.6	1%	20%	0%	23%
Extra heavy oil and bitume	3.7	4.2	3.9	5.5	3.5	2%	5%	0%	5%
Other Production	0.7	1.3	1.2	2.1	1.4	5%	2%	3%	2%
Total	**92.8**	**99.9**	**91.6**	**103.4**	**68.0**	**0.5%**	**100%**	**-1.3%**	**100%**

Source : World Energy Outlook 2018 c OECD/IEA, 2018

FORECAST OF OIL PRODUCTION IN IEA NEW POLICIES AND SUSTAINABLE DEVELOPMENT SCENARIOS IN MB/D



Source: World Energy Outlook 2018 c OECD/IEA, 2018

Oil: consumption Oil demand rebounded in 2018, in line with the development of the transport and petrochemicals sectors in Asia and abundant supply in North America

Boosted by economic expansion and growing Asian requirements, world oil demand rose 1.6% in 2018 (ENGIE estimate), close to the 1.7% recorded in 2017. The USA remains the world's leading oil consumer (19 Mbbl/d), ahead of China (12 Mbbl/d), but increasing demand in both China and India is gradually reducing that lead.

China (up 4% in 2018) and India are the main drivers of oil demand because of their booming transport and petrochemical sectors. In contrast, three OECD countries in the Asia-Pacific region – Japan, South Korea and Australia – are reporting decreasing consumption as a result of new environmental policies such as the decommissioning of oil-fired plants, as well as slower economic growth.

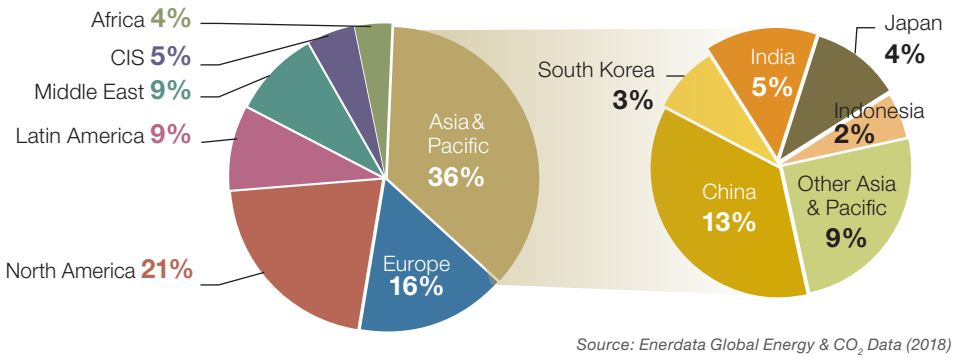
After 20 years of steady decline, US oil demand rose 1.7% in 2017 amid abundant domestic supply. The country has also become a net exporter of oil: imports contracted sharply in 2018 and exports jumped by almost 2 Mbbl/d in May 2018, compared with an average 1.4 Mbbl/d in 2017 (up 66% on 2016). Asia and Europe were the main destinations for this output.

Oil consumption is gradually focusing around petrochemicals and transport. The US lead in petrochemicals sector is being challenged by China, where demand continues to rise (540,000 bbl/d in 2017, up from 310,000 bbl/d in 2016). Oil demand is still rising in the residential-services sector (up 2% in 2017) but is disappearing almost entirely from electricity generation.

By 2040, according to the IEA's New Policies reference scenario, oil demand in passenger transport will stabilise with the development of electric vehicles, biofuels and more efficient engines, and despite a doubling in the size of the car fleet. On the other hand, oil demand from terrestrial and maritime freight, airlines and petrochemicals will accelerate strongly. Demand for power generation and from the residential sector will continue to fall.

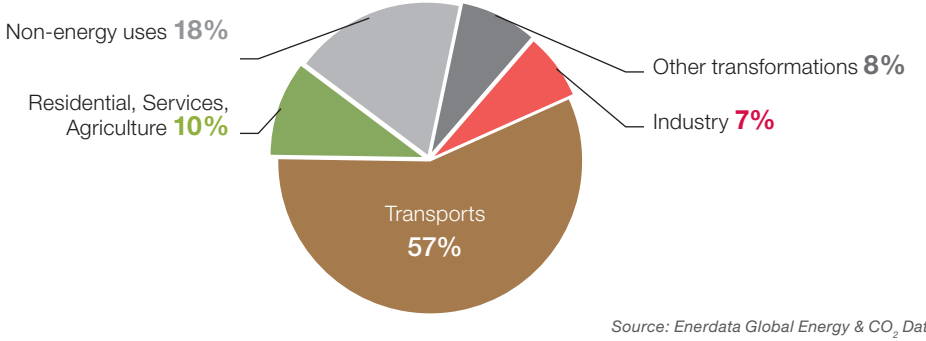
Oil: consumption

GLOBAL OIL DEMAND BY SECTOR IN 2017 – TOTAL 93 MBL/D



Source: Enerdata Global Energy & CO_2 Data (2018)

GLOBAL OIL DEMAND BY SECTOR – TOTAL 93 MBL/D



Source: Enerdata Global Energy & CO_2 Data (2018)

Oil demand worldwide, Mbl/d	2000	2010	2015	2016	2017	Change 2016-2017	AAGR 2000-2017	AAGR 2010-2017
European Union	12.8	11.6	10.4	10.6	10.8	1.8%	-1.0%	-0.9%
Germany	2.5	2.1	2.0	2.1	2.1	1.9%	-1.0%	-0.1%
United Kingdom	1.5	1.3	1.1	1.2	1.2	-2.3%	-1.3%	-0.9%
North America	19.8	18.6	18.9	18.9	19.0	0.7%	-0.2%	0.3%
Canada	1.9	2.2	2.3	2.4	2.3	-4.4%	1.0%	0.4%
United States	17.9	16.4	16.6	16.5	16.7	1.4%	-0.4%	0.2%
Latin America	6.3	7.4	7.8	7.5	7.4	-2.5%	0.9%	-0.1%
Brazil	1.8	2.1	2.4	2.3	2.2	-2.8%	1.2%	0.8%
Mexico	2.0	2.0	2.0	1.9	1.9	-0.6%	-0.5%	-0.8%
Venezuela	0.4	0.8	0.7	0.6	0.5	-15.6%	1.2%	-4.8%
Asia	18.2	23.3	27.1	27.9	28.8	3.2%	2.6%	2.7%
China	4.4	8.6	10.9	11.3	11.8	4.1%	5.6%	4.1%
South Korea	1.9	1.9	2.0	2.2	2.2	0.9%	0.8%	1.9%
India	2.2	3.1	4.0	4.2	4.4	5.8%	3.8%	4.3%
Japan	1.1	1.5	1.6	1.6	3.5	125.6%	6.5%	11.3%
Indonesia	5.0	4.0	3.7	3.6	1.7	-53.0%	-5.9%	-10.2%
Pacific	0.9	1.0	1.2	1.2	1.2	1.1%	1.5%	1.6%
CIS	3.7	4.0	4.6	4.7	4.7	1.6%	1.5%	2.3%
Russia	2.7	3.0	3.6	3.6	3.7	1.0%	1.8%	2.6%
Middle East	4.6	7.1	8.2	8.3	7.9	-4.5%	3.0%	1.4%
Saudi Arabia	1.5	2.7	3.4	3.5	3.3	-6.0%	4.4%	2.8%
United Arab Emirates	0.1	0.3	0.4	0.5	0.5	-2.8%	6.5%	3.8%
Iraq	0.5	0.7	0.9	0.9	0.9	3.5%	3.6%	3.3%
Iran	1.4	1.8	1.9	1.9	1.9	-2.0%	1.4%	0.6%
Kuwait	0.2	0.4	0.4	0.4	0.4	-9.9%	3.7%	-1.6%
Africa	2.4	3.4	3.5	3.6	3.7	4.7%	2.5%	1.4%
Nigeria	0.2	0.3	0.2	0.3	0.3	5.5%	1.2%	-0.3%
World	**75.2**	**84.6**	**90.4**	**91.7**	**93.0**	**1.5%**	**1.2%**	**1.2%**

Source: Enerdata Global Energy and CO_2 Data (2019)

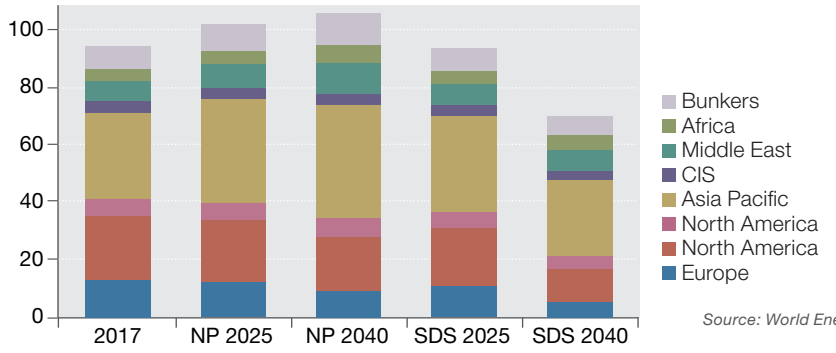
Oil: consumption

OIL CONSUMPTION FORECASTS IN NEW POLICIES ANS SUSTAINABLE DEVELOPMENT SCENARIOS FROM IEA

Forecast of oil consumptionn in IEA scenarios in mb/d		New Policies				Sustainable development			
	2017	2025	2040	AAGR 2017-2040	Share in 2040	2025	2040	AAGR 2017-2040	Share in 2040
Europe	13.2	12.1	8.7	-2%	8%	11.1	5.1	-4%	7%
North America	22.3	22.0	19.3	-1%	18%	20.2	12.1	-3%	17%
Latin America	5.8	5.9	6.3	0.4%	6%	5.4	4.0	-2%	6%
Asia Pacific	30.5	35.9	39.5	1%	37%	33.4	26.7	-1%	38%
CIS	3.7	4.1	4.2	1%	4%	3.9	3.4	-0.3%	5%
Middle East	7.4	8.4	10.6	2%	10%	7.6	7.2	-0.1%	10%
Africa	4.0	4.8	6.3	2%	6%	4.6	5.0	1%	7%
Bunkers	8.0	9.2	11.4	2%	11%	7.7	6.4	-1%	9%
World	**94.8**	**102.4**	**106.3**	**0.5%**	**100%**	**93.9**	**69.9**	**-1%**	**100%**

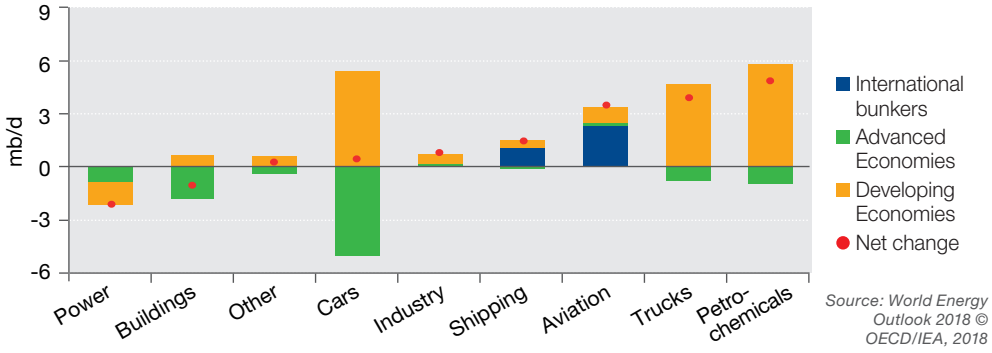
Source: World Energy Outlook 2018 © OECD/IEA, 2018

CHANGE IN OIL DEMAND IN THE NEW POLICIES AND SUSTAINABLE DEVELOPMENT SCENARIOS, IAE 2018 (MBL/D)



Source: World Energy Outlook 2018 © OECD/IEA, 2018

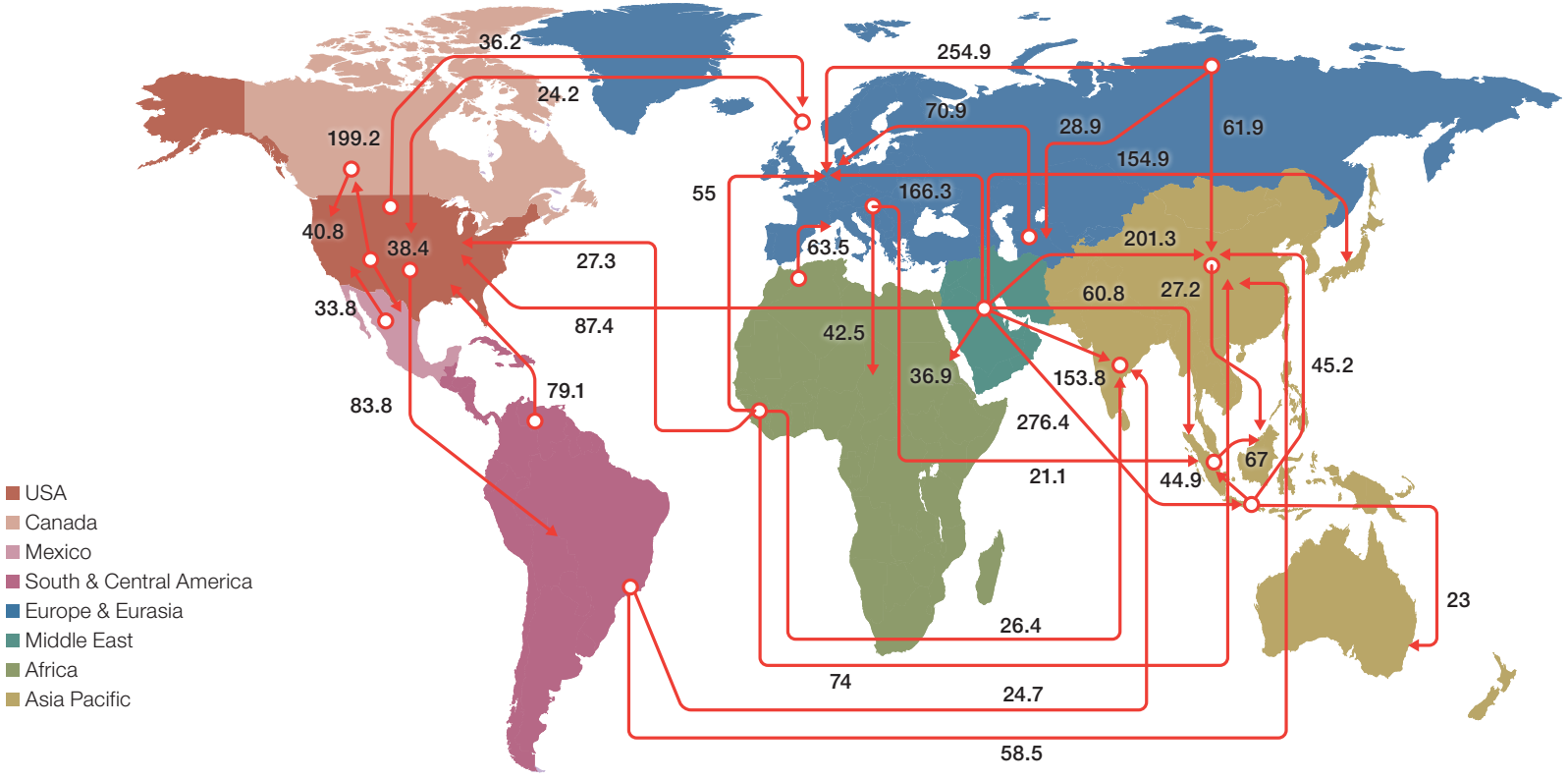
CHANGE IN GLOBAL OIL DEMAND BY SECTOR IN THE NEW POLICIES SCENARIO, 2017-2040 – IEA, 2018



Source: World Energy Outlook 2018 © OECD/IEA, 2018

Oil: international trade

MAIN OIL TRADE FLOWS IN 2017 (MILLIONS OF TONNES)



Source: BP Statistical Review, 2018

Oil: international trade in 2017

Oil exports	2000	2016		2017		Change 2016-2017	AAGR 2000-2017
	mbl/day	mbl/day	World Share	mbl/day	World Share		
Europe	5.4	2.7	6%	2.7	6%	1.0%	-3.7%
European Union	2.4	1.1	2%	1.2	2%	5.0%	-4.0%
North America	1.8	4.4	9%	5.8	12%	32.0%	6.7%
Canada	1.6	3.3	7%	3.7	8%	11.6%	4.7%
United States	0.2	1.0	2%	2.0	4%	98.2%	15.5%
Latin America	5.0	4.7	10%	4.8	10%	2.1%	-0.2%
Mexico	1.9	1.3	3%	1.3	3%	-0.3%	-2.1%
Venezuela	2.2	1.6	3%	1.5	3%	-6.2%	-2.0%
Asia	1.7	1.6	3%	1.1	2%	-32.3%	-2.6%
Pacific	0.5	0.2	1%	0.2	1%	-2.1%	-3.7%
CIS	3.7	7.3	16%	7.4	16%	1.0%	4.0%
Russia	2.9	5.2	11%	5.2	11%	0.5%	3.3%
Middle East	16.1	19.3	42%	19.5	41%	0.8%	1.1%
Saudi Arabia	6.3	7.2	15%	7.0	15%	-2.9%	0.6%
United Arab Emirates	1.9	2.7	6%	2.4	5%	-11.0%	1.1%
Iraq	2.1	3.5	7%	3.3	7%	-3.8%	2.7%
Iran	2.4	1.9	4%	2.8	6%	47.5%	1.0%
Kuwait	1.2	2.3	5%	2.1	4%	-7.0%	3.1%
Africa	6.2	6.2	13%	5.8	12%	-7.6%	-0.4%
Angola	0.8	1.6	4%	1.5	3%	-5.9%	4.1%
Nigeria	2.3	2.2	5%	1.8	4%	-16.0%	-1.3%
OPEC	**21.9**	**26.2**	**56%**	**24.7**	**52%**	**-5.6%**	**0.7%**
Non OPEC	**18.4**	**20.2**	**44%**	**22.4**	**48%**	**11.1%**	**1.1%**
World in mbl/d	**40.3**	**46.4**	**100%**	**47.2**	**100%**	**1.7%**	**0.9%**

Crude Oil imports Worldwide (mbl/d)	2000	2016		2017		Change 2016-2017	AAGR 2000-2017
	mbl/day	mbl/day	World Share	mbl/day	World Share		
Europe	13.3	12.4	25%	13.0	26%	4%	-0.2%
European Union	12.7	11.8	24%	12.3	25%	4%	-0.2%
Germany	2.1	1.8	4%	1.8	4%	-1%	-0.7%
Netherlands	1.3	1.3	3%	1.3	3%	2%	0.0%
North America	11.4	9.6	20%	9.7	20%	1%	-0.9%
Canada	0.9	1.1	2%	1.1	2%	-2%	0.8%
United States	10.4	8.5	17%	8.6	18%	1%	-1.1%
Latin America	1.2	0.8	2%	0.9	2%	7%	-1.7%
Asia	13.1	22.2	45%	23.3	48%	5%	3.3%
China	1.4	7.6	16%	8.4	17%	10%	10.4%
South Korea	2.5	3.0	6%	3.1	6%	2%	1.2%
India	1.5	4.4	9%	4.5	9%	4%	6.3%
Japan	4.4	3.3	7%	3.2	6%	-4%	-1.8%
Pacific	0.5	0.5	1%	0.5	1%	-15%	-0.9%
CIS	0.5	0.4	1%	0.4	1%	3%	-0.9%
Middle East	0.4	0.5	1%	0.5	1%	-4%	1.5%
Africa	0.8	0.8	2%	0.7	1%	-9%	-0.7%
World	**41.3**	**47.4**	**100%**	**49.0**	**100%**	**3.3%**	**1%**

Solde du commerce extérieur en mbl/j	2000	2016	2017	Change 2016-2017	AAGR 2000-2017
Europe	7.9	9.7	10.2	5.3%	1.4%
European Union	10.3	10.7	11.1	4.0%	0.4%
North America	9.6	5.3	3.9	-25.6%	-4.9%
United States	10.3	7.5	6.6	-12.4%	-2.5%
Latin America	-3.8	-3.8	-3.9	1.1%	0.2%
Brazil	0.4	-0.7	-0.9	29.4%	/
Asia	11.4	20.7	22.2	7.6%	3.8%
China	1.2	7.6	8.3	9.7%	11.3%
India	1.5	4.4	4.5	4.0%	6.3%
Japan	4.4	3.3	3.2	-4.0%	-1.8%
Pacific	0.1	0.3	0.2	-25.9%	7.8%
Australia	0.1	0.2	0.1	-46.6%	3.3%
CIS	-3.2	-6.9	-6.9	0.9%	4.5%
Russia	-2.8	-5.2	-5.2	0.5%	3.5%
Middle East	-15.7	-18.8	-19.0	0.9%	1.0%
Saudi Arabia	-6.3	-7.2	-7.0	-2.9%	0.6%
United Arab Emirates	-1.9	-2.7	-2.4	-11.0%	1.1%
Iraq	-2.1	-3.5	-3.3	-3.8%	2.7%
Iran	-2.3	-1.9	-2.8	48.2%	1.0%
Kuwait	-1.2	-2.3	-2.1	-7.0%	3.1%
Africa	-5.3	-5.4	-5.0	-7.3%	-0.3%
OPEC	**-21.9**	**-**	**-**	**-**	**-**
World	**0.9**	**1.0**	**1.8**	**76%**	**0.6%**

Source: Enerdata Global Energy and CO_2 Data (2018)

Oil: prices

Oil prices recovered strongly over the course of 2018, with OPEC and Russia resolved to restrain production. But oil prices fell back towards $50bbl late in the year with signs of faltering world economic activity and the US push to produce shale

Brent	1970	1975	1980	1985	1990	1995	2000	2005	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Brent Dated in $/bl (nominal)	2	12	37	28	24	17	28	55	97	62	79	111	112	109	99	52	44	54	71
Brent Dated in €/bl (nominal)	2	8	24	37	20	13	31	44	66	44	60	78	87	82	74	48	40	48	60

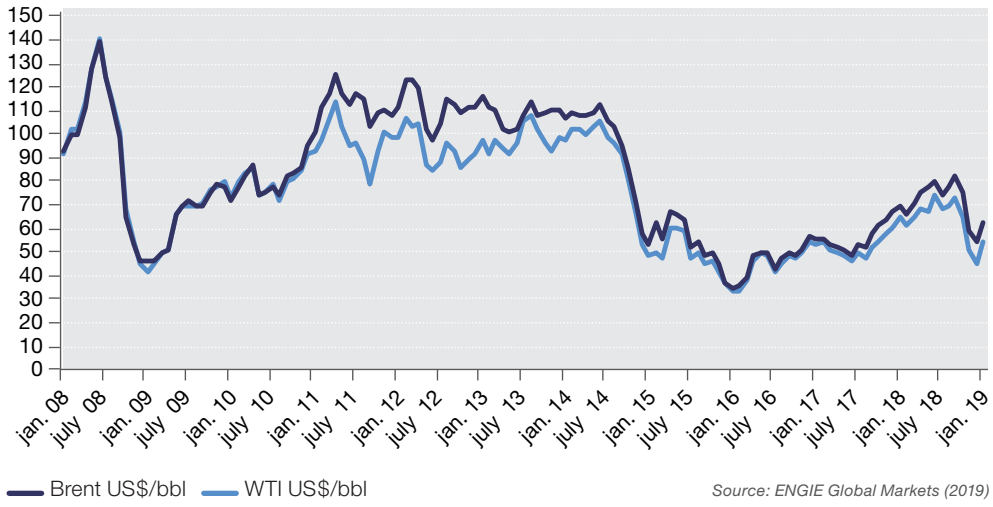
Source : Enerdata Global Energy and CO_2 Data (2018)

Oil prices rose steadily through the first three quarters of 2018, in response to production cuts decided by OPEC and Russia aimed at absorbing oversupply dating back to 2015. Brent crude hit $85/bbl at end-October, its highest level since 2014. The more than $20 increase since the beginning of the year reflected the extended cartel's ability to pursue its quota policy, US sanctions against Iran and strong demand. The US production boom (+2 Mbd in 2018, with a record high at 11.5 Mbd) had not yet countered these trends.

A rapid inversion occurred in the fourth quarter however. Prices fell dramatically and Brent crude closed the year at $50/bbl. Signs of a weaker world economy, highlighted in disappointing European and Chinese data, together with the development of American shale gas production and US sanctions that proved softer than first announced, convinced financial markets that supply was sufficient. **Brent crude averaged $71/bbl in 2018.**

The market rebounded early 2019, however, lifting prices to $65/bbl in February, mainly due to OPEC production cuts, the Venezuelan crisis and the decline in production in Iran.

BRENT AND WTI PRICES (CURRENT US$) / BARREL



Source: ENGIE Global Markets (2019)

Coal

PRODUCTION

Successful Chinese efforts to boost prices reinvigorated coal production in 2017 and 2018 in Asia, Russia and the USA

CONSUMPTION

Asia’s reliance on coal boosted world demand in 2017 and 2018

Coal: production

World economic growth and China's price support policy has imparted fresh impetus to global coal production.

The recovery in coal production proved stronger than expected (up 2.9% in 2017) after a contraction in 2016 orchestrated by a Chinese government keen to address persistent overproduction. Benefiting from higher prices and very low local production costs, China, India, Russia and the USA all increased their output significantly.

In the USA, coal output bucked a 10-year downtrend to gain 6.3% in 2017, reflecting both a more relaxed regulatory regime under the Trump administration and a growing economy. Currently the world's third-largest producer, the USA may soon be overhauled by Australia, which is Asia's main supplier. Strong Asian demand, relaxed environmental policies and low operating costs explain the renewed attractiveness of Australian coal.

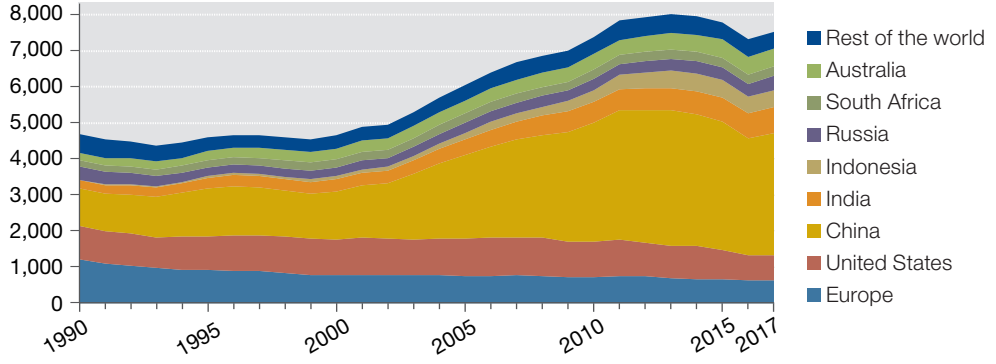
Against all expectations, the recovery also spread to Europe, where coal output rose 2% overall in 2017. Production declined in Poland and Germany but increased in Estonia, Greece and Romania.

Increased production reflects both heightened coal requirements as a result of world economic growth and a new market equilibrium after the marked shortfall in output in 2016. The reduction in stocks in 2017 was particularly obvious in China, where they reached their lowest level since 2012. Stocks were reconstituted in 2018, however, to over 80Mt in China, 15 Mt in India and nearly 7Mt in Western Europe by December.

China has become coal market's price maker by tightly controlling drastically its own production, which represents almost 45% of world output. Prices have stayed high, averaging close to $100 per tonne on the spot market and nearly $85 on the CIF ARA market in 2017. The uptrend continued in 2018, when the CIF ARA average price was $91.90.

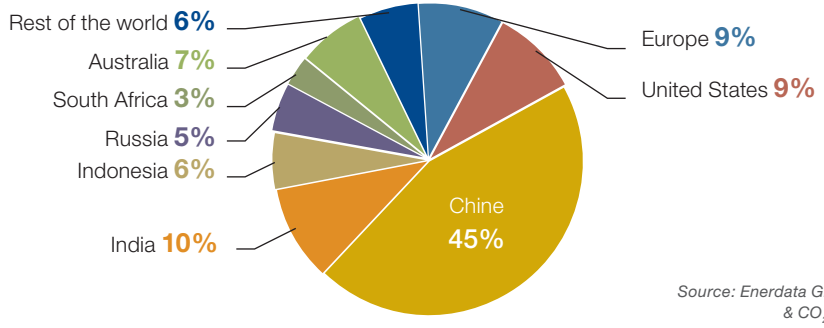
Medium-term forecasts are more cautious. Slower world economic growth, an expected end to the production cycle and declining production costs for renewables all tend to limit interest in coal. Investment in coal mines dropped 16% in 2017, and China slashed its investment in coal-fired power capacity by more than half that same year, to its lowest level in 10 years.

EVOLUTION OF WORLD COAL PRODUCTION (1990 - 2017), IN MT



Source: Enerdata Global Energy & CO_2 Data (2019)

TOTAL SHARE OF COAL PRODUCTION WORLDWIDE (7,537 MT IN TOTAL)



Source: Enerdata Global Energy & CO_2 Data (2019)

Coal: production

	Coal and Lignite production in the World												
MT	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Change 2016-2017**	**AAGR 2000-2017**	**AAGR 2010-2017**
Europe	778	758	705	740	732	690	664	653	640	634	-1.0%	-1.1%	-1.3%
European Union	657	639	564	591	592	559	540	527	500	491	-1.7%	-1.6%	-1.7%
Germany	205	206	184	189	197	191	187	184	177	175	-0.9%	-0.9%	-0.6%
Poland	163	160	133	139	144	143	137	136	131	127	-3.1%	-1.4%	-0.6%
Turkey	63	58	73	76	71	60	65	58	71	74	4.7%	0.9%	0.1%
North America	1,041	1,109	1,064	1,073	999	973	987	876	734	763	4.0%	-1.7%	-4.1%
United States	972	1,039	996	1,006	932	904	918	814	672	702	4.5%	-1.8%	-4.3%
Latin America	65	87	99	114	114	114	118	113	119	110	-7.3%	3.0%	1.4%
Colombia	38	59	74	86	89	85	89	86	94	90	-3.7%	4.9%	2.5%
Asia	1,851	3,035	4,349	4,741	4,862	4,981	4,914	4,865	4,533	4,721	4.2%	5.3%	1.0%
China	1,355	2,317	3,316	3,608	3,678	3,749	3,640	3,563	3,242	3,376	4.1%	5.2%	0.2%
India	336	437	570	582	603	610	657	683	708	731	3.3%	4.4%	3.1%
Indonesia	79	171	325	405	446	490	485	488	459	469	2.1%	10.4%	4.7%
Pacific	310	376	441	420	440	463	493	516	512	502	-2%	3%	2%
Australia	307	371	436	415	435	458	489	512	509	499	-2%	3%	2%
CIS	388	439	476	492	528	525	513	498	506	534	5.5%	1.8%	1.4%
Kazakhstan	77	87	111	116	121	120	114	107	102	106	3.1%	1.7%	-0.6%
Russia	242	285	300	297	331	328	334	348	359	388	8.1%	2.7%	3.3%
Middle East	2	2	2	2	1	2	1	1	1	2	6.0%	0.1%	0.3%
Africa	231	250	259	258	268	267	275	265	264	272	2.9%	0.9%	0.6%
South Africa	224	245	255	253	259	256	261	251	250	256	2.4%	0.7%	0.1%
World	**4,665**	**6,055**	**7,394**	**7,839**	**7,943**	**8,014**	**7,965**	**7,788**	**7,309**	**7,537**	**3.1%**	**2.7%**	**0.2%**

Source: Enerdata Global Energy & CO_2 Data (2019)

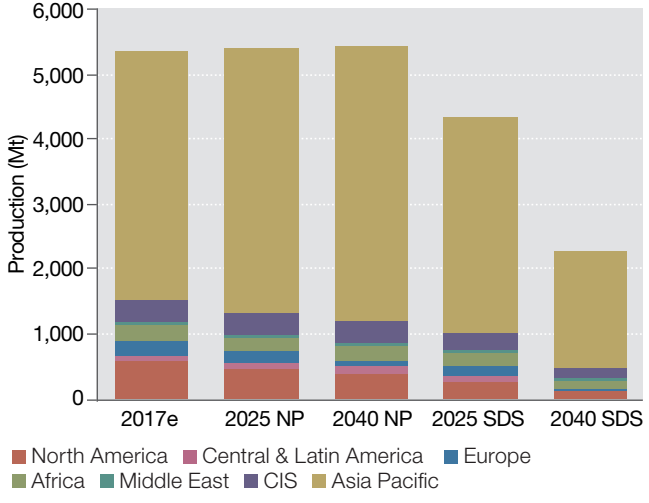
Coal: production forecasts

COAL PRODUCTION FORECASTS IN NEW POLICIES AND SDS SCENARIOS FROM IEA (WEO 2018) IN MILLION TONS

Mt	2017	New Policies Scenario				Sustainable Development Scenario			
		2025	2040	AAGR 2017-2040	Share in 2040	2025	2040	AAGR 2017-2040	Share in 2040
Europe	237	176	93	-4.0%	2%	138	31	-8.5%	1%
North America	582	465	406	-1.6%	7%	284	99	-7.4%	4%
Latin America	88	85	88	0.0%	2%	67	14	-7.6%	1%
Asia Pacific	3,844	4,049	4,217	0.4%	78%	3,320	1,799	-3.2%	79%
CIS	384	390	408	0.3%	8%	334	210	-2.6%	9%
Middle East	1	1	1	1.0%	0%	1	1	0.4%	0%
Africa	224	218	228	0.1%	4%	207	128	-2.4%	6%
OECD	**1,185**	**1,011**	**936**	**-1.0%**	**17%**	**704**	**351**	**-5.2%**	**15%**
Non-OECD	**4,175**	**4,372**	**4,505**	**0.3%**	**83%**	**3,646**	**1,930**	**-3.3%**	**85%**
World	**5,360**	**5,383**	**5,441**	**0.1%**	**100%**	**4,350**	**2,282**	**-3.6%**	**100%**
Steam coal	**4,134**	**4,201**	**4,412**	**0.3%**	**81%**	**3,313**	**1,609**	**-4.0%**	**71%**
Coking coal	**960**	**918**	**806**	**-0.8%**	**15%**	**837**	**579**	**-2.2%**	**25%**

Source: International Energy Agency (2018), World Energy Outlook 2018, OECD/IEA, Paris

COAL CONSUMPTION FORECASTS IN NEW POLICIES & SUSTAINABLE DEVELOPMENT SCENARIOS FROM IEA (WEO 2018)



Source: International Energy Agency (2018), World Energy Outlook 2018, OECD/IEA, Paris

Coal: consumption

World economic growth in 2017 and 2018 reinvigorated demand for coal, temporarily dampening environmental hopes

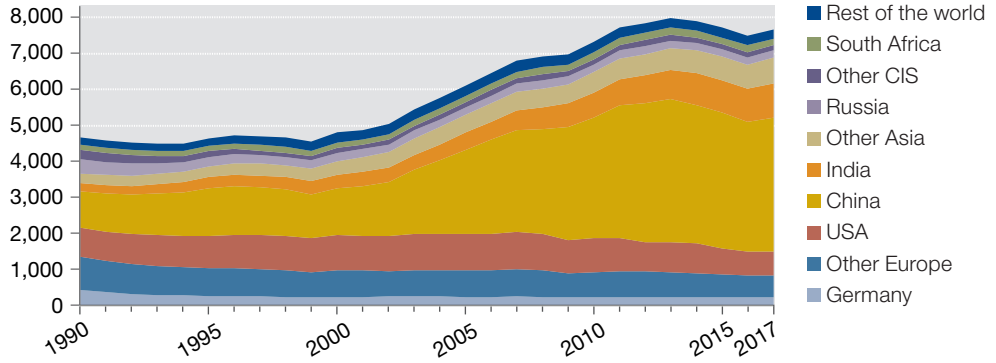
World coal demand has proven more resilient than expected: consumption increased 1% in 2017 and appears to have risen further in 2018 after 4 years of decline (-1% per year in 2013-2017).

Chinese and Indian economic expansion underpins increased requirements in Asia. Coal consumption rose 15 Mt (4.5%) in China and 41 Mt (0.4%) in India in 2017; in these two countries representing 61% of world coal consumption. Coal-fired thermal power plants lost some ground in China however, dropping from 72% to 70% of the power mix.

In the USA, coal consumption has been relentlessly diminishing for over 10 years now and dropped another 2% in 2017, despite growing output. This situation bolstered exports towards India, South Korea and the Netherlands. Trump administration's policies had little impact on coal domestic demand nor on the power industry's withdrawal: the number of coal power plant shutdowns doubled between 2017 and 2018.

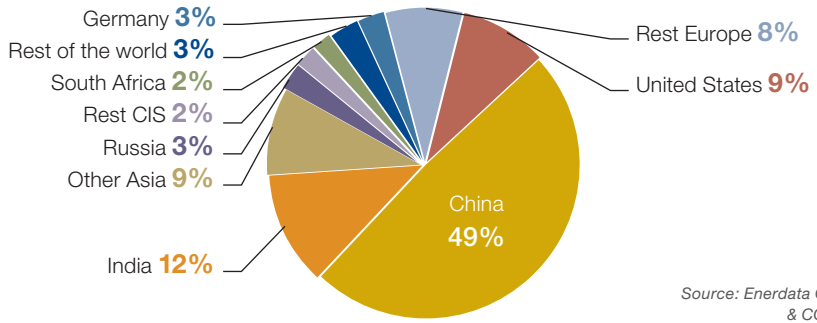
In Europe, coal consumption is declining on trend (-1% per year since 2000). The EU's Large Combustion Plant Directive of 2000 provides for the gradual shutdown of polluting power plants. EU consumption is now declining by 2% per year; the UK is taking the lead with a nearly 70% drop in coal demand since 2010. In contrast, Turkish coal consumption jumped 5% in 2017 on the back of low local production costs, growing needs in Turkish industry and national economic expansion. All in all, European consumption picked up slightly in 2017 (+0.5%).

EVOLUTION OF COAL AND LIGNITE CONSUMPTION WORLDWIDE, 1990-2017 IN MT



Source: Enerdata Global Energy & Co2 Data (2018)

SHARE OF WORLD COAL CONSUMPTION IN 2017 (7,668 MT TOTAL)



Source: Enerdata Global Energy & CO_2 Data (2019)

Coal: consumption

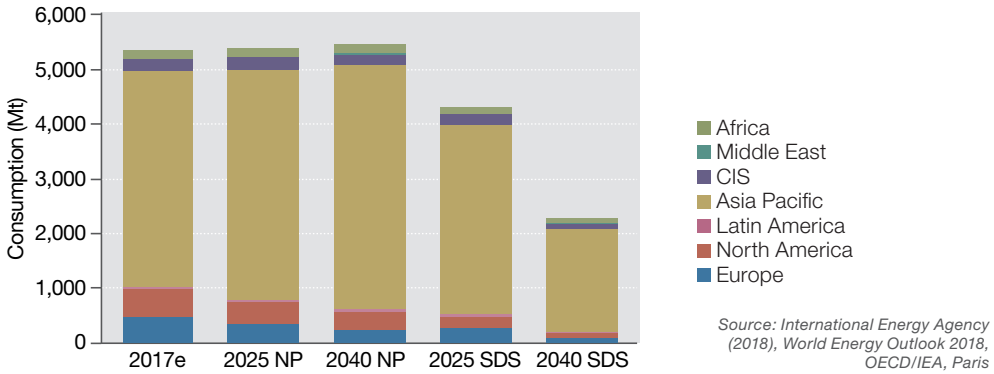
MT	Domestic coal and lignitie consumption										Change 2016-2017	AAGR 2000-2017	AAGR 2010-2017
	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017			
Europe	973	972	915	959	968	921	889	877	835	844	1.1%	-0.8%	-1.0%
European union	832	833	749	781	796	765	731	715	658	660	0.2%	-1.3%	-1.6%
Germany	244	244	232	236	247	247	239	236	226	225	-0.5%	-0.5%	-0.4%
Poland	141	137	134	137	135	137	130	127	124	128	2.9%	-0.6%	-0.6%
Turkey	81	77	96	101	101	85	97	93	106	112	5.3%	1.8%	2.0%
North America	1,046	1,078	1,005	959	851	880	873	764	700	689	-1.5%	-2.3%	-4.6%
United-States	983	1,018	954	910	807	837	831	722	660	650	-1.5%	-2.3%	-4.7%
Latin America	47	56	65	71	70	75	75	77	70	74	6.3%	2.5%	1.8%
Colombia	5	4	4	5	4	5	5	6	3	6	105.8%	0.9%	3.9%
Asia	2,062	3,300	4,602	4,982	5,198	5,383	5,361	5,307	5,180	5,376	3.8%	5.5%	2.0%
China	1,304	2,345	3,350	3,695	3,832	3,969	3,837	3,770	3,593	3,732	3.9%	6.0%	1.4%
South Korea	72	83	120	130	128	126	131	131	126	143	13.4%	3.9%	2.2%
India	375	466	684	715	777	808	892	892	931	946	1.6%	5.3%	4.1%
Indonesia	25	41	51	51	61	66	79	89	100	101	1.5%	8.1%	8.9%
japan	151	180	178	172	179	191	190	189	191	193	0.6%	1.4%	1.0%
Pacific	130	142	136	131	130	119	114	117	116	118	1.9%	-0.5%	-1.7%
Australia	128	138	133	128	127	116	111	114	114	116	2.0%	-0.6%	-1.7%
CIS	356	350	369	390	404	378	355	346	351	355	1.3%	0.0%	-0.5%
Kazakhstan	50	65	83	90	91	90	84	77	75	78	4.1%	2.5%	-0.8%
Russia	232	213	212	221	232	207	199	207	210	225	7.1%	-0.2%	0.7%
Middle East	13	16	16	18	20	17	17	16	14	14	-4.5%	0.4%	-2.1%
Africa	170	192	203	194	199	205	216	207	211	198	-6.4%	0.9%	-0.3%
South Africa	157	179	193	182	187	193	201	190	194	182	-5.9%	0.8%	-0.7%
World	**4,798**	**6,106**	**7,310**	**7,704**	**7,841**	**7,978**	**7,901**	**7,711**	**7,477**	**7,668**	**2.6%**	**2.6%**	**0.6%**

Source: Enerdata Global Energy & Co2 Data (2018)

Coal: consumption forecasts

COAL CONSUMPTION FORECASTS IN NEW POLICIES & SDS SCENARIOS FROM IEA (WEO 2018)

Mt	2017e	New Policies Scenario				Sustainable Development Scenario			
		2025	2040	AAGR 2017-2040	Share in 2040	2025	2040	AAGR 2017-2040	Share in 2040
Europe	475	363	240	-2.9%	4%	276	112	-6.1%	5%
North America	513	396	341	-1.8%	6%	204	64	-8.7%	3%
Latin America	48	52	54	0.5%	1%	43	28	-2.3%	1%
Asia Pacific	3,948	4,186	4,439	0.5%	79%	3,470	1,884	-3.2%	83%
CIS	224	228	211	-0.3%	4%	183	105	-3.3%	5%
Middle East	5	8	13	4.5%	0%	7	7	1.9%	0%
Africa	145	150	142	-0.1%	3%	128	83	-2.4%	4%
OECD	**1,258**	**980**	**853**	**-1.7%**	**15%**	**642**	**245**	**-6.9%**	**11%**
Non-OECD	**4,099**	**4,403**	**4,760**	**0.7%**	**85%**	**3,709**	**2,037**	**-3.0%**	**89%**
World	**5,357**	**5,383**	**5,613**	**0.2%**	**100%**	**4,350**	**2,282**	**-3.6%**	**100%**



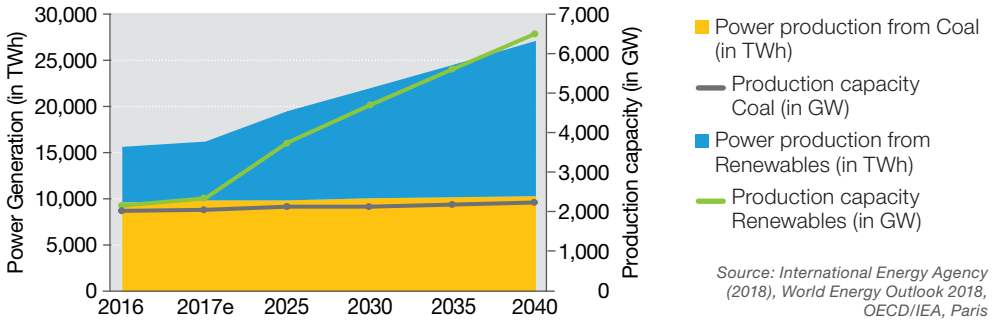
Source: International Energy Agency (2018), World Energy Outlook 2018, OECD/IEA, Paris

Targeted by environmental policies, coal is losing ground in long-term forecasts. Its competitiveness is also deteriorating amid increasingly cheap renewable alternatives. Coal has almost disappeared from new buildings and is giving way to other energy sources in the industrial sector. Competition with natural gas and RES in power generation will at worst stabilise coal power capacity at current levels (New Policies scenario) and would eliminate it in a +2°C scenario.

Regulations are helping to improve coal power plants' energy efficiency by promoting ultra-supercritical units that reject less CO_2 and fine particles than standard units.

Carbon capture, utilisation and storage (CCUS) technology is spreading too slowly to meet climate constraints and still raises many questions. Some assert that the implementation of CCUS in power plants that participate in the Capacity Mechanism is an investment that will never be worthwhile and that the money would be better spent elsewhere. Others argue that efficient CCUS could make coal-fired power plants carbon-neutral or even negative.

EVOLUTION OF TOTAL POWER PRODUCTION AND PRODUCTION CAPACITY WORLDWIDE (NEW POLICY SCENARIO)



Source: International Energy Agency (2018), World Energy Outlook 2018, OECD/IEA, Paris

Coal: world trade flows

Coal and Lignite exports (Mt)	Exports					
	2000	2016	2017	Share (world) 2017	Change 2016-2017	AAGR 2000-2017
	Mt	Mt	Mt			
Europe	54	58	50	3.6%	-15.1%	-0.5%
European Union	53	56	48	3.5%	-14.2%	-0.6%
Poland	27	17	14	1.0%	-14.5%	-3.7%
North America	86	82	120	8.7%	47.2%	2.0%
Canada	32	27	31	2.2%	16.6%	-0.2%
United States	54	55	89	6.5%	62.0%	3.0%
Latin America	44	92	90	6.5%	-3.0%	4.3%
Colombia	36	91	88	6.4%	-3.3%	5.5%
Asia	135	426	437	31.6%	2.6%	7.2%
China	70	24	18	1.3%	-27.7%	-7.8%
Indonesia	57	363	372	26.9%	2.5%	11.7%
Pacific	189	397	381	27.5%	-4.1%	4.2%
Australia	187	396	379	27.4%	-4.1%	4.3%
CIS	78	204	223	16.1%	9.0%	6.4%
Russia	40	173	193	13.9%	11.2%	9.7%
Kazakhstan	34	27	28	2.1%	4.0%	-1.1%
Middle East	0.1	0.2	0.2	0.0%	11.1%	7.4%
Africa	71	74	84	6.1%	14.6%	1.0%
South Africa	70	69	77	5.5%	11.5%	0.5%
World	**657**	**1,359**	**1,385**	**100%**	**1.9%**	**4.5%**

Source: Enerdata Global Energy & CO_2 Data (2018)

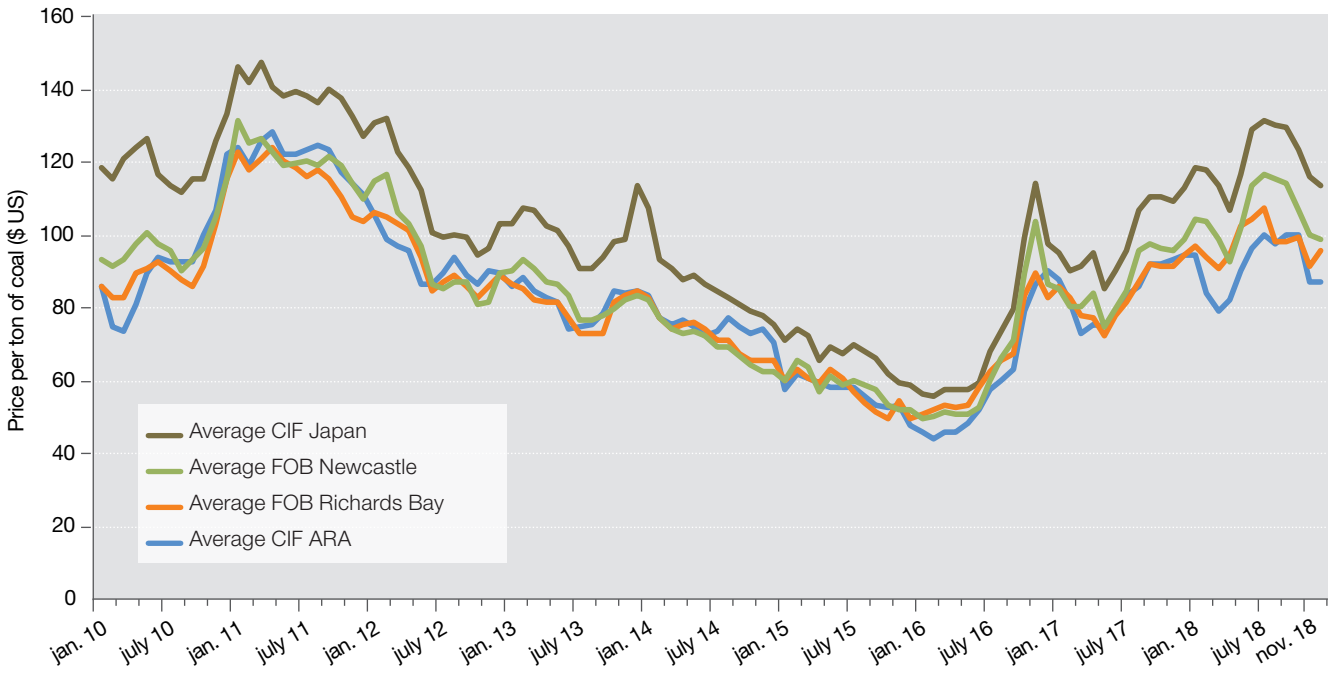
Coal / Lignite Imports in Mt	Imports					
	2000	2016	2017	Share (world) 2017	Change 2016-2017	AAGR 2000-2017
	Mt	Mt	Mt			
Europe	225	254	253	18.2%	-0.3%	0.7%
European union	209	210	209	15.0%	-0.3%	0.0%
Germany	36	57	53	3.8%	-8.4%	2.3%
Netherlands	23	49	41	3.0%	-15.9%	3.5%
North America	39	16	16	1.1%	-0.4%	-5.2%
United States	15	9	7	0.5%	-19.8%	-4.1%
Latin America	25	44	51	3.7%	16.0%	4.4%
Brazil	15	20	22	1.6%	9.3%	2.3%
Asia	313	969	998	71.7%	2.9%	7.1%
China	3	256	271	19.5%	6.0%	31.3%
South Korea	65	133	136	9.8%	2.3%	4.5%
India	23	220	212	15.2%	-3.8%	13.8%
Japan	153	191	189	13.6%	-1.4%	1.2%
Taiwan	46	65	68	4.9%	4.4%	2.4%
Pacific	0.02	1	1	0.1%	0.6%	25.4%
CIS	36	47	50	3.6%	7.3%	1.9%
Russia	26	24	29	2.1%	20.6%	0.8%
Middle East	11	14	11	0.8%	-22.2%	-0.2%
Africa	8	13	13	0.9%	0.8%	2.8%
World	**657**	**1,357**	**1,392**	**100%**	**2.6%**	**4.5%**

Source: Enerdata Global Energy & Co2 Data (2018)

Coal: prices

Coal prices rose in 2017 and 2018 and averaged $92 per tonne in 2018 (ARA CIF)

INTERNATIONAL COAL PRICES 2010-2018



NB: CIF = Costs, Insurance&Freight - FOB = Free on board.

Source: ENGIE Global Markets, February 2019

Controlled Chinese production boosted prices and kept them at high levels. But the gradual reopening of some Chinese mines is likely to halt the rally and bring prices back to the $65-75 range, which is the target that the Chinese government – effectively the market leader – set in 2017.

Appendix 1: energy scenarios and sources

World scenarios' positioning

	Business as usual	Central	Environmental
IEA	**Current Policies**	**New Policies**	**Sustainable Development Scenario**
WEO 2018 Horizon 2040	**Current Policies:** this conservative scenario only takes into account implemented energy policies through mid-2018. Where existing policies target a range of outcomes, it is assumed that the lower end of the range is achieved. As a consequence, this scenario assesses the consequences of inaction. The COP21's commitments that haven't been followed by concrete measures are downplayed.	**New Policies:** the IEA's central scenario incorporates implemented policies along with the effects of announced policies through mid-2018, as expressed in official targets and plans. It takes into account the states' commitments made at the COP21 but adjusts for the degrees of achievement depending on the country.	**Sustainable Development Scenario:** the Sustainable Development scenario is a "dream scenario", consistent with the realization of the Paris Agreement's objectives. It also factors in the achievement of the UN Sustainable Development Goals (SDGs) for energy. It is designed as a comparative tool to measure the progress already made and the efforts that are still required.
Carbon prices ($\$_{2017}$/tonne)	Canada: $35 by 2025, $39 by 2040; Chile: $5 by 2025, $5 by 2040; China: $15 by 2025, $31 by 2040; European Union: $22 by 2025, $38 by 2040; South Korea: $22 by 2025, $39 by 2040.	Canada: $35 by 2025, $39 by 2040; Chile: $8 by 2025, $20 by 2040; China: $17 by 2025, $36 by 2040; European Union: $25 by 2025, $43 by 2040; South Korea: $25 by 2025, $44 by 2040; South Africa: $11 by 2025, $24 by 2040.	Advanced economies: $63 by 2025, $140 by 2040; Selected developing economies: $43 by 2025, $125 by 2040.
Macroeconomic assumptions	Economic growth: an average of +3.4% per year between 2017 and 2040 (North America: +2.1%; Central and South America: +2.9%; Europe: +1.8%; Africa: +4.3%; Middle East: +3.4%; Eurasia: +2.4%; Asia Pacific: +4.5%) – World population: from 7.5 billion in 2017 to 9.2 billion people in 2040.		
Enerdata	**Ener-Brown**	**Ener-Blue**	**Ener-Green**
Global Energy Forcasting 2018 Horizon 2040	In the wake of the shale oil and gas revolutions, the Ener-Brown scenario assumes fossil consumption increases, buoyed by strong fossil fuel technological improvements. The scenario posits energy intensity improvements are limited and energy prices decrease, although energy demand rises both in developed and developing countries.	The Ener-Blue scenario takes into account current trends and policies assuming that energy commitments will translate into actions. This scenario predicts that energy demand increases in developing countries, while remaining stable in OECD countries. Energy prices rise and renewable energies diversify the energy mix.	The Ener-Green scenario assumes strict climate policies are implemented (greater energy efficiency, priority to RES, etc.). Fossil fuel subsidies are phased out. The increase in energy prices results from GHG emission constraints, as global energy demand stabilizes.
Macroeconomic assumptions	Economic growth: an average of +2.6% a year in GDP per capita between 2017 and 2040 (OECD: +1.6%; non OECD: +3.6%). World population: from 8.6 billion in 2030 to 9.2 billion people in 2040.		

Climate consequences by type of scenarios			
Rise in temperatures	From +5 to +6°C	From +3 to +4°C	From +1.5 to +2°C
Environmental objectives (NDCs)	Not met	Met in 2030	Regularly reviewed upwards
CO_2 emissions	Sharp increase	Slight increase	Decrease

Sources

ENERGY CONTEXT
Enerdata
AIE – WEO 2018

CO_2 & CLIMAT
Enerdata
UNFCCC
ADEME

ELECTRICITY
Enerdata
AIE – WEO 2018
BNEF
REN21 : Renewables 2018
GIEC
Greenpeace (R)évolution scenario
ENGIE Global Markets

NATURAL GAS
Enerdata
AIE – WEO 2018
Cedigaz
BP statistical review 2018
IHS
ENGIE Global Markets

OIL
Enerdata
AIE – WEO 2018
BP statistical review 2018
ENGIE Global Markets

COAL
Enerdata
IHS

Enerdata methodology

Primary energy data comes from the International Energy Agency (IEA). It is completed with data from regional organizations (EUROSTAT, OLADE, ADB, OPEC) or specialized institutions (Cedigaz), as well as by data from national sources (national statistics or data specially prepared by local correspondents with more than 100 partners in around 60 countries). This complementary data is used for the assessment and correction of primary data, and for the quick update of our own data.

The methodology and definitions used by Enerdata are the same as that of IEA and Eurostat.

Energy statistics in physical units are converted into energy units (ktoe or Mtoe) on the basis of the following coefficients:

- Crude oil: fixed coefficient for most countries: 1.02 toe/ton
- Oil products: fixed coefficient for all countries - same as EUROSTAT or IEA
- Natural gas: national coefficients for key countries and fixed coefficients for the other countries (0.82 toe/1000 m^3); the national coefficients are indicated in the database
- Coal, Lignite: fixed coefficient for coke; national coefficient for production, imports and exports for key producers or importers; the national coefficients are indicated in the database.
- Electricity:
  - nuclear: 1 TWh = 0.26 Mtoe
  - hydroelectricity: 1 TWh = 0.086 Mtoe
  - geothermal: 1 TWh = 0.86 Mtoe
  - total production: 1 TWh = 0.086 Mtoe
  - imports, exports: 1 TWh = 0.086 Mtoe
  - consumption: 1 TWh = 0.086 Mtoe

Geographic scope of the sources

Enerdata	
Europe region	
Europe	European Union (28), Albania, Bosnia-Herzegovina, Croatia, Iceland, Macedonia, Norway, Serbia and Montenegro, Switzerland, Turkey.
UE-28	European Union (25), Bulgaria, Romania, Croatia.
America region	
America	North America, Mexico, Central America, South America, Caribbeanv
Latin America	Central America, Mexico, South America, Caribbean.
North America	Canada, USA.
Central America and Mexico	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama.
South America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela.
Caribbean	Bahamas, Barbados, Bermuda, Cuba, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Netherlands Antilles and Aruba, Saint Vincent and the Grenadines, Saint Lucia, Trinidad and Tobago.
Asia region	
Asia	ASEAN, Afghanistan, China, Hong Kong, Japan, Macao, Mongolia, North Korea, South Asia (Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka), Soth Korea, Taiwan.
ASEAN	Association of Southeast Asian Nations (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam).
Pacific region	
Pacific	Australia, Pacific Islands, New Zealand.

Enerdata	
Africa region	
Africa	North Africa, Sub-Saharan Africa.
North Africa	Algeria, Egype, Libya, Morocco, Tunisia.
Sub-Saharan Africa	Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, DR Congo, Ivory Coast, Djibouti, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Equatorial Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe.
Middle East region	
GCC	Gulf Cooperation Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates).
OPEC Middle East	Iran, Iraq, Kuwait, Qatar, Saudi Arabia, UAE.
OAPEC	Organization of Arab Petroleum Exporting Countries (Algeria, Bahrain, Egypt, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, Syria, Tunisia, UAE).
CIS region	
CIS	Commonwealth of Indiapendent States (former USSR, excluding Baltic countries).
Soviet Union (former)	Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan.

Source: Enerdata

Geographic scope of the sources

International Energy Agency	
Europe region	
European Union	UE 28
Eastern Europe/Eurasia	Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, the former Yugoslav, Republic of Macedonia, the Republic of Moldova, Romania, Russian Federation, Serbia (incl Montenegro until 2004 and Kosovo until 1999, Slovenia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. For statistical reasons, this region also includes Cyprus, Gibraltar and Malta.
OECD Europe	Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.
America region	
OECD North America	Canada, Mexico and the United States.
OECD Latin America	Chile.
Latin America	Antigua and Barbuda, Aruba, Argentina, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, the British Virgin Islands, the Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, the Dominican Republic, Ecuador, El Salvador, the Falkland Islands, French Guyana, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Montserrat, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, Saint Lucia, Saint Pierre et Miquelon, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, the Turks and Caicos Islands, Uruguay and Venezuela.
Asia-Pacific region	
China	Refers to the People's Republic of China, including Hong Kong.
ASEAN	Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.
OECD Asia	Japan and Korea.
Non-OECD Asia	Afghanistan, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, Chinase Taipei, the Cook Islands, East Timor, Fiji, French Polynesia, India, Indonesia, Kiribati, the Democratic People's Republic of Korea, Laos, Macau, Malaysia, Maldives, Mongolia, Myanmar, Nepal, New Caledonia, Pakistan, Papua New Guinea, the Philippines, Samoa, Singapore, Solomon Islands, Sri Lanka, Thailand, Tonga, Vietnam and Vanuatu.
Other Asia	Non-OECD Asia regional grouping excluding China and India.

International Energy Agency	
OECD Oceania	Australia and New Zealand.
OECD Pacific	Includes OECD Asia and Oceania.
Africa region	
Africa	Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Democratic Republic of Congo, Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, United Republic of Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe.
North Africa	Algeria, Egypt, Libyan Arab Jamahiriya, Morocco and Tunisia.
Sub-Saharan Africa	Africa regional grouping excluding South Africa and North Africa regional grouping.
Middle East region	
Middle East	Bahrain, the Islamic Republic of Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, the United Arab Emirates and Yemen. It includes the neutral zone between Saudi Arabia and Iraq.
CIS region	
OECD	Includes OECD Europe, OECD Latin and North America and OECD Pacific regional groupings.
OECD+	OECD regional grouping and those countries that are members of the European Union but not of the OECD.
Other Major Economies	Brazil, China, Russia, South Africa and the countries of the Middle East.
Other Countries	Comprises all countries not included in OECD+ and Other Major Economies regional groupings, including India, Indonesia, the African countries (excluding South Africa), the countries of Latin America (excluding Brazil), and the countries of non-OECD Asia, (excluding China) and the countries of Eastern Europe/Eurasia (excluding Russia).
Organization of the Petroleum Exporting Countries	Algeria, Angola, Ecuador, the Islamic Republic of Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates and Venezuela.

Geographic scope of the sources

BP Statistical Review	
North America	US (excluding Puerto Rico), Canada, Mexico.
South and Central America	Caribbean (including Puerto Rico), Central and South America
Europe	European members of the OECD plus Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Former Yugoslav Republic of Macedonia, Gibraltar, Malta, Romania, Serbia and Montenegro, Slovenia.
Former Soviet Union	Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan.
Europe and Eurasia	All countries listed above under the headings Europe and Former Soviet Union.
Middle East	Arabian Peninsula, Iran, Iraq, Israel, Jordan, Lebanon, Syria.
North Africa	Territories on the north coast of Africa from Egypt to western Sahara.
West Africa	Territories on the west coast of Africa from Mauritania to Angola, including Cape Verde, Chad.
East and Southern Africa	Territories on the east coast of Africa from Sudan to Republic of South Africa. Also Botswana, Madagascar, Malawi, Namibia, Uganda, Zambia, Zimbabwe.
Asia Pacific	Brunei, Cambodia, China, China Hong Kong SAR*, Indonesia, Japan, Laos, Malaysia, Mongolia, North Korea, Philippines, Singapore, South Asia (Afghanistan, Bangladesh, India, Myanmar, Nepal, Pakistan, Sri Lanka), South Korea, Taiwan, Thailand, Vietnam, Australia, New Zealand, Papua New Guinea, Oceania. * Special Administrative Region.
Australasia	Australia, New Zealand.
OECD members	Europe: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Republic of Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, UK. Other member countries: Australia, Canada, Israel, Japan, Mexico, New Zealand, South Korea, US.
OPEC members	Middle East: Iran, Iraq, Kuwait, Qatar, Saudi Arabia, United Arab Emirates. North Africa: Algeria, Libya. West Africa: Angola, Nigeria. South America: Ecuador, Venezuela.

BP Statistical Review	
European Union members	Austria, Belgium, Bulgaria, Cyprus, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Republic of Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, UK.
Other EMEs (Emerging Market Economies)	South and Central America, Africa, Middle East, non-OECD Asia, non-OECD Europe.
Methodology	The primary energy values of both nuclear and hydroelectric power generation have been derived by calculating the equivalent amount of fossil fuel required to generate the same volume of electricity in a thermal power station, assuming a conversion efficiency of 38% (the average for OECD thermal power generation).
Percentages	Calculated before rounding of actuals. All annual changes and shares of totals are on a weight basis except on pages 6, 14, 18, 20 and 22.
Rounding differences	Because of rounding, some totals may not agree exactly with the sum of their component parts.
Tonnes	Metric equivalent of tons.
Disclosure	Statistics published in this Review are taken from government sources and published data. No use is made of confidential information obtained by BP in the course of its business.

Country groupings are made purely for statistical purposes and are not intended to imply any judgement about political or economic standings.

Appendix 2: conversions & Glossary

Conversions

Weight	kilograms
1 pound	0.453
1 American ton (short ton)	907
1 British ton (long ton)	1,016

Denominations in the American system	
10^{0}	unit
10^{1}	tens
10^{2}	hundreds
10^{3}	thousands
10^{6}	millions
10^{9}	billions
10^{12}	trillions
The French billion is 10^{12}	

Multiples and decimal sub-multiples of the units of measurement			
Abbreviation	Name	Value	Power
P	peta	1,000,000,000,000,000	10^{15}
T	tera	1,000,000,000,000	10^{12}
G	giga	1,000,000,000	10^{9}
M	mega	1,000,000	10^{6}
k	kilo	1,000	10^{3}
h	hecto	100	10^{2}
da	deca	10	10^{1}
unité	unit	1	10^{0}
da	deci	0.1	10^{-1}
c	centi	0.01	10^{-2}
m	milli	0.001	10^{-3}
µ	micro	0.000 001	10^{-6}

Other energies						
	Heavy fuel	Super fuel	Dry wood	Household waste	Paper waste	Natural uranium
Physical unit	1 ton	1 000 liters	1 ton	1 ton	1 ton	1 ton
Tons of oil equivalent	0.95	0.79	0.33	0.18	0.33	12,000
MWh	11	9.1	3.9	2.1	3.9	140,280
GJ	40	33	14	7.6	14	505,000

Source: Joint report by the OECD Nuclear Energy Agency and the International Atomic Energy Agency – Uranium 2005: Resources, Production and Demand

Volume unit					
From	To				
	m^3	liters	ft^3	US gallon	barrel
	multiply by				
m^3	1	1 000	35.32	264	6.28
liters	0.001	1	0.0353	0.264	0.00629
ft^3	0.0283	28.3	1	7.47	0.178
US gallon	0.00379	3.79	0.134	1	0.0238
Barrel	0.159	159	5.62	42	1

Energy unit					
From	To				
	MWh	toe	GJ	MMBtu	Therm
	multiply by				
MWh	1	0.0860	3.6	3.412	34.12
toe	11.63	1	41.9	39.68	396.8
GJ	0.2778	0.0239	1	0.948	9.48
MMBtu	0.293	0.0252	1.055	1	10
Therm	0.0293	0.00252	0.105	0.1	1

Conversions

Crude oil						
From	To					
	Tonnes	1,000 liters	Barrels	US Gallons	MWh	GJ
	Multiply by					
Tons (Metric)	1	1.212	7.6	320	12.1	43.5
1,000 liters	0.825	1	6.290	264.17	10.0	35.9
Barrel	0.132	0.159	1	42	1.587	5.710
US Gallons	0.00313	0.0038	0.0238	1	0.0378	0.136
MWh	0.0827	0.100	0.630	0.630	1	3.60
GJ	0.0230	0.028	0.028	7.35	0.278	1

Coal					
From	To				
	Short ton	Metric ton	Ton of oil equivalent	MWh	GJ
	Multiply by				
Short ton	1	0.9071847	0.6248	7.560	27.22
Metric ton	1.102	1	0.6887	8.333	30
Ton of oil equivalent	1.601	1.452	1	12.1	43.5
MWh	0.1323	0.1200	0.08264	1	3.6
GJ	0.03674	0.03333	0.02299	0.278	1

Natural gas (GN) & liquefied natural gas (LNG)									
From	To								
	Bcm	Gft³	Mtoe	Million tons of LNG	Millions of m³ of LNG	TBtu	Million barrels of oil equivalent	TWh	PJ
	Multiply by								
1 billion cubic meter NG (1 Bcm)	1	**35.3**	0.93	0.739	1.63	37.0	6.37	10.8	**39.0**
1 billion cubic feet NG	0.0283	1	0.026	0.0209	0.0460	1.05	0.18	0.307	1.10
1 million tons of oil equivalent	1.07	37.9	1	0.794	1.74	39.69	6.84	**11.6**	41.9
1 million tons of LNG	1.35	47.7	1.26	1	2.20	50.0	8.62	14.7	**52.7**
1 million cubic meter of LNG	0.615	21.7	0.573	**0.455**	1	22.8	3.92	6.67	24.0
1 trillion British thermal units	0.0270	0.955	0.0252	0.0200	0.0440	1	0.17	**0.293**	1.05
1 million barils of oil equivalent	0.157	5.54	0.146	0.116	0.255	**5.8**	1	1.70	6.12
TWh	0.0923	3.258	0.0860	0.0683	0.150	3.41	0.588	1	**3.6**
PJ	0.0256	0.905	0.0239	0.0190	0.0417	0.948	0.163	0.278	1

1 m³ NG: 0.9 of crude oil – 1 m³ NG: 10,000 kcal – 1 m³ NG: 41.860 kJ
NB: These conversions are based on eight assumptions identified by the figures in bold.

The change from cubic meters to kWh and more generally from volume units to energy units depends on the quality of the gas. We speak of HHV and LHV depending on whether we use the lower or higher estimate of the heating value of the gas. The HHV estimate includes heat recoverable from steam (including energy recoverable from condensation). In a gas context, we generally speak of HHV. We speak of LHV in domestic inter-energy reports, for example.

1 kWh LHV . . . . . = 0.9 kWh HHV
1,000 m³ of HHV Natural Gas = 0,9 toe
1,000 m³ of LHV Natural Gas. = 0,81 toe
1 toe (HHV context) . . . . . = 1,111 m³ of Natural Gas
1 toe (LHV context) . . . . . = 1,234 m³ of Natural Gas
1 m³ of HHV Natural Gas . . . = standard of 42 MJ (HHV) (between 38 and 42 MJ)
. . . . . standard of 11.7 kWh (HHV) (between 9 and 12 kWh)
. . . . . European conversion: 39 MJ (HHV)
. . . . . European conversion: 10.8 kWh (HHV)
. . . . . conversion in France: 11.5 kWh (HHV)
1 Tcf PCS. . . . . = 25,48 Mtoe
1 tonne of LNG. . . . . = 1,320 – 1,380 m³ of gas

Glossary

Added value: Usual method for measuring the net production of a branch or a sector in monetary units; added value is equal to the difference between the gross production and intermediate consumption; added value can be measured at the cost of the factor or at the market price. Added value of agriculture measures the activity of farming, fishing and forestry. Added value of industry measures mining, manufacturing and construction activities, and electricity, gas and water. Added value of services or of the tertiary sector measures the activity of all services, both public and private: retail and wholesale commerce, banking, and public administration.

Annex I: UN Convention on Climate Change Annex I countries: Germany, Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Denmark, Spain, Estonia, United States of America, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, New Zealand, Norway, Netherlands, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Switzerland, Czech Republic, Turkey, Ukraine, United Kingdom.

ATEE: Association Technique Énergie Environnement, a French association of energy and environmental operators (institutional, private, etc…).

Aviation and marine bunker oils: Marine bunker oils are the duty-free fuels for ocean vessels and aviation bunker oils are the aircraft fuels consumed for international transport. At country level, they are excluded from primary consumption and are considered to be exports. At global level, they are included in primary consumption.

Biogas: a gas resulting from the fermentation, also called methanisation, of organic matter (animal or plant) in the absence of oxygen. It consists primarily of methane (from 50% to 70%), but usually also carbon dioxide, water vapour, hydrogen sulphide, etc. The energy produced by biogas solely comes from methane.

Biomethane: a biogas whose undesired components have been removed (carbon dioxide, water vapour, hydrogen sulphide, etc.), so that methane only remains. Methane's properties are similar to those of natural gas. Biomethane can be handled in natural gas distribution and transport networks.

Bituminous coal: Type of coal transformed into coke.

CAPEX-OPEX: Operating expense (often abbreviated as OPEX) is the ongoing cost for running a product, business, or system. Its counterpart, capital expenditure (CAPEX), is the cost of developing or providing non-consumable parts for the product or system.

CEA: Commissariat à l'énergie anomique (French Atomic Energy Commission)

Cedigaz: International association of manufacturers for gas (GDF SUEZ is a member).

CERA: Cambridge Energy Research Associates.

CH_4: Methane, a hydrocarbon with a global warming potential 25 times greater than that of CO_2.

Change in inventories: In principle, these are the changes in inventory levels between two identical dates one year apart. The inventories are those of the energy producers and generally exclude consumer inventories. However, depending on the measurement methods adopted by each country, these changes in inventories represent real data or may include statistical deviations or non-metering between the primary supply and the inputs transformed or consumed. The + sign indicates a decrease in inventories during the year; the - sign indicates an increase in inventories during the year. Changes in inventories that systematically have the same sign are an indication of accounting distortions or poor allocation.

CI: Cost Insurance Freight. CIF price, in contrast to FOB price, includes shipping costs, and the various taxes and insurance; the seller is responsible for the merchandise up to the port of arrival.

CIS: Community of Indiapendent States, composed of 11 of the 15 former Soviet Republics: Armenia, Azerbaijan, Belarus, Georgia, Kyrgyzstan, Kazakhstan, Moldavia, Russia, Federation of Tajikistan, Turkmenistan (Associate State), Ukraine, Uzbekistan - Mongolia as an observer.

Coke: Transformed coal used primarily in making steel.

Coking plants and blast furnaces: The inputs of coking plants are the coking coal consumed by coking plants. The inputs of blast furnaces are the coke consumed.

Coking plants, briquette plants: The inputs of coking plants are the coking coal consumed by coking plants. The inputs of blast furnaces are the coke consumed. The outputs of coking plants are coke and coking gas. The outputs of the blast furnaces are the blast furnace gases.

DEP: Department of Exploration Production.

DGEMP: Department of Energy and Raw Materials (Direction Générale de l'Énergie et des Matières Premières).

DFO: Domestic fuel oil (home heating oil).

Domestic consumption: Domestic consumption, for each energy product, is the balance of the total production, foreign trade, air and marine bunker oils (for oil) and changes in inventories.

EIA-DOE: Energy Information Agency - Department of Energy (USA).

Electric power plants: The inputs of electric power plants correspond (for thermal plants) to the consumption of fuels by the power plants. The production of the electric power plants corresponds to the gross production.

Glossaire

Electric power plants (thermal): The inputs of electricity power plants are the fuels consumed by public plants and by self-producers (including co-generation).

Electricity production: Gross electricity production including public production (private and public power companies) and the self-producers, by any type of power plant (including co-generation).

Electricity production from co-generation: Gross production of electricity by power plants that produce electricity and heat (power companies and self-producers).

Energy sector self-consumption: Consumption to run energy transformation units (power plants, refineries).

ENTSO-E: European Network of Transmission System Operators for Electricity.

EU: The European Union has since 1 July 2013 28 Member States: Austria, Belgium, Bulgaria, Cyprus, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Czech Republic, Romania, United Kingdom, Slovakia, Slovenia, Sweden. The accession of Croatia is effective July 1, 2013 and confirms the prospects of enlargement in the Balkans started nine years earlier. The EU has a total of over 500 million people and covers an area of 3,930,000 km^2.

Exploration and development cost: The average cost of exploration and development represents the dollar cost per barrel equivalent of additional reserves of a country coming from exploration activities, discoveries, improved recovery or update assessments. This cost does not include the licensing of proven reserves

Exports: Exports are the volumes of energy product exported from the national territory to another country, minus simple transit volumes and volumes “custom” processed on behalf of a third party country. In the case of geographic or geopolitical regions, exports are the aggregates of national exports, including those that are part of flows within the region. For accounting consistency, exports appear with a negative sign.

Final consumption: Final consumption is the balance between the interior consumption and consumption from the energy transformations and various losses. It measures the needs of the end consumers in the country. They are broken down by category as follows: industry, transport, residential, services, agriculture and non-energy uses. Final consumption of industry is broken down by business line or sector: steel, chemical, non metallic minerals (construction materials), and so on.

Final consumption for non-energy uses: This is the consumption of the products intended for petrochemicals (naphtha), the fabrication of ammonia (natural gas), use in electrode (carbon) form and the use of all products used for their physical-chemical properties (bitumen, paraffins, motor oils, etc.). They are divided into chemicals and other.

FOB: Free On Board. FOB price, in contrast to CIF price, does not include any transport cost, tax or insurance.

Forward price: Forward = forward price - given for different expirations.

Fugitive emissions: Intentional and non-intentional greenhouse gas emissions, from the extraction of a fossil fuel up to the point of use.

GDP: Gross Domestic Product: Measurement of the economic activity of a country; it is currently measured at market prices. GDP at market price is the sum of the value added to the cost of factors, plus indirect taxes, minus subsidies.

GHG: Greenhouse Gases.

Henry Hub: Point of determination of the prices of the gas traded on the NYMEX (New York Mercantile Exchange).

HFC: Hydrofluorocarbon (a category of fluorinated gases that actively contribute to the deterioration of the ozone layer, with a global warming potential 3,000 times greater than that of CO_2).

IEA: International Energy Agency.

IIASA: International Institute for Applied Systems Analysis.

Imports: Imports are the volumes of energy product imported from another country into the national territory, minus the volumes that are transiting to a third party country and the quantities intended to be “custom” processed on behalf of a third party country. In the case of geographic or geopolitical regions, imports are the aggregates of the national imports, including those that are flows within the region.

Industry final consumption: Industry final consumption includes the consumption of the mining, manufacturing and construction sectors. They exclude the consumption of fuel for transport activities, even when the means of transport belong to the industrial companies, and the consumption of fuels for the self-production of electricity. The energy products used as raw materials or maintenance products are in general separate, or at least identified under the name “non-energy uses.”

LNG: Liquefied Natural Gas.

Light Tight Oil (Tight Oil): Light tight oil or tight oil is a type of oil present in relatively impermeable, non-porous layers and requires extraction techniques similar to those of shale gas. Tight oil primarily differs from shale oil in its degree of viscosity and is found in particular in the Niobrara and Eagle Ford formations in the United States.

Glossaire

Lignite: A type of low-carbon coal with a low calorific value.

Liquefaction (of gas): The inputs of gas liquefaction plants are natural gas consumptions. The production of liquid gas is the output.

LPG: Liquefied Petroleum Gas.

ULUCF: Land Use, Land Use Change and Forestry, with implications for CO_2, CH_4 and N_2O emissions and capture. The notion covers tree felling and planting, woodland conversion (clearing) and prairies as well as soils whose carbon content is sensitive to the use to which it is put (forest, prairie, cultivated).

Marginality: In the production of electricity, the duration of marginality represents the time when the production method used is the one with the lowest marginal cost (cost of an additional unit).

Mbl: Million barrels.

MMBtu: 1,000,000 Btu (1 million Btus).

NBP: National Balancing Point is a virtual trading location for the sale and purchase and exchange of UK. It serves as a reference for forward contracts.

Net production (electricity): The net production of electricity is the balance between gross production and the auto-consumption of electric power plants.

Nitrogen oxide: NO, nitrogen oxide.

NO_2: Nitrogen dioxide.

N_2O: Nitrogen protoxide (also known as nitrous oxide) with the chemical formula N_2O is a powerful greenhouse gas that remains in the atmosphere for a long time (about 120 years). It is partially responsible for the destruction of the ozone. The soil and oceans are the principal natural sources of this gas, but it is also produced by the use of nitrogen fertilizers, the combustion of organic matter and fossil fuels, the production of nylon, etc. In France, farming contributes to the 3/4 of N_2O emissions that essentially come from the transformation of nitrogen products (fertilizer, manure, liquid manure, crop residues) in farm land. N_2O is a colorless and non-flammable gas, stable in the lower levels of the atmosphere, but it decomposes in the higher levels (stratosphere) through chemical reactions involving sunlight.

Non-conventional gases: Like the gas known as "conventional", "non-conventional gases" are essentially composed of methane, but are trapped in relatively impermeable rock, which until recently had limited their development. In fact, extraction requires production technologies that are much more complex than for traditional reservoirs.

Non-conventional oils: Oil extracted by methods other than from a well (in oil sands, for example).

OECD: Organization of Economic Cooperation and Development. Member countries: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Germany, Finland, France, Greece, Hungary, Ireland, Iceland, Israel, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, South Korea,,Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

Particulate Matter: Particles in suspension (PM 2.5 corresponds to the fine particles that can enter the pulmonary alveoli).

PFC: Perfluorocarbon (category of fluorinated gases, with a global warming power on average 7500 times greater than that of CO_2).

Primary consumption: Primary consumption is the balance from primary production, foreign trade, bunker oils, and changes in inventories. Primary consumption aggregated over all products measures the country's total energy consumption, including all losses and self-consumption during transformations. For primary energies, primary consumption = domestic consumption.

Primary production: Primary production measures the quantity of natural energy resource extracted and produced for the purpose of consumption as is, on the production site or elsewhere, or for subsequent transformations. It excludes the quantities not use for energy or transformation purposes, particularly for natural gas, the quantities flared, reinjected into wells or discharged as is. On the other hand, it includes auto-consumption on the production sites (electricity generation, auxiliary motors, for example). The production of hydraulic, geothermal, wind and nuclear electricity is considered to be primary production.

Private consumption: Total consumption of goods and services in monetary units by households.

Production: Energy production corresponds to gross domestic production. It measures the volume of energy product produced directly or resulting from a transformation process, including the volume reused in the transformation process itself (hence the concept of gross production).

Production cost: The average production cost is the average lifting cost of oil and gas from the reservoir to the shipping interface towards the processing center.

Power generation from cogeneration: Gross production of electricity by power plants that produce electricity and heat (power companies and self-producers).

Public production (electricity): The public production of electricity is the gross production of electricity production companies, whatever their status (public or private).

Pumping: Pumping station inputs are their electricity consumption. The output is the gross production of hydroelectricity.

RES: Renewable energy sources.

Glossaire

Residential-services-agriculture consumption: This includes all the final consumptions from energy products used for energy purposes, excluding the consumption of industry and transport. They are divided into three categories: residential, services, agriculture (including fishing).

Reserves: oil reserves are termed possible, probable or proven, according to the degree of certainty of their existence in the light of geological and technical data and interpretations for each location. Oil reserves derive primarily from a measure of geological risk, i.e. the probability of oil being present and of its exploitation in current economic and technical conditions.

Proven reserves: gas and oil resources whose extraction is "reasonably certain" using existing techniques, at current prices and under current trade and government agreements. In the industry they are known as 1P. Some specialists refer to them as P90, as they have a 90% probability of being put into production.

Probable reserves: gas and oil resources whose extraction is "reasonably probable" using existing techniques, at current prices and under current trade and government agreements. In the industry they are known as 2P. Some specialists refer to them as P50, as they have a 50% probability of being put into production.

Possible reserves: gas and oil resources with a chance of extraction in favourable circumstances. In the industry they are known as 3P. Some specialists refer to them as P10, as they have a 10% probability of being put into production.

Self-production (electricity): Self-production of electricity is the gross production of businesses whose main activity is not electricity production.

SF_6: Sulfur hexafloride (greenhouse gas with a global warming potential 22,800 times greater than that of CO_2). SF_6 is used in metallurgy for the production of aluminum and magnesium, in the fabrication of semi-conductors (because of its inert character and its density, which maintain the purity of the medium against dust and oxidizing elements), in electric construction (electric stations (Gas Insulated Substation) and high-voltage electrical equipment because of its high dielectric rigidity and its good stability in electric arc), in particle accelerators, and in medical applications (for example, for disinfecting respiratory equipment against aerobic microbes).

SO_2: Sulfur dioxide. Sulfur dioxide is used as a disinfectant, antiseptic and antibacterial as well as a coolant gas, a whitening agent and food preservative (particularly for dry fruits), in the production of alcoholic beverages and, more specifically, in oenology and wine making.

Spot price: Spot prices are prices negotiated the day before for delivery the following day. They reflect the short-term balance between supply and demand.

Sulfur dioxide: In industry, sulfur dioxide is used particularly for the production of sulfuric acid. Sulfuric acid has numerous applications and is the most-used chemical product. Atmospheric pollution by sulfur dioxide from industry is mainly the result of fossil fuel combustion.

Sulphur dioxide: Sulfur dioxide.

Trade balance: Marine bunker oils are the duty-free fuels for ocean vessels and aviation bunker oils are the aircraft fuels consumed for international transport. At country level, they are excluded from primary consumption and are considered to be exports. At global level, they are included in primary consumption.

Transport/Distribution losses: Quantity of energy lost during transport and distribution.

Toe: Ton of oil equivalent.

Transport final consumption: Transport final consumption is the consumption by all transport methods, whatever the ownership status or type of use. However, it excludes "air and marine bunker oils." Generally, transport consumption includes the consumption of infrastructures (railway stations, airports, etc.), pleasure boats and consumption by port maChinary. They are divided into the four main infrastructures: road transport, rail transport, inland waterways, air transport.

Refineries: Refinery inputs are crude oil, natural gas liquids, and various products to be refined. The outputs are the refined products. The production from refineries is the gross production (including the uses made by the refineries).

Troll-Zeebrugge: LNG terminal and the connection point for European gas infrastructures where a spot price for the gas is set.

WEO: World Energy Outlook, a forward-looking report on energy in the world; annual publication of the IEA.

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