

World Energy Outlook 2018

World Energy Outlook 2018 examines future patterns of a changing global energy system at a time of increasing uncertainties and finds that major transformations are underway for the global energy sector. Across all regions and fuels, policy choices made by governments will determine the shape of the energy system of the future.

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Oil

After the fallout from the 2014 oil price crash, the continued expansion of tight oil production in the United States and the prospect of major structural changes in oil consumption underpinned a view that the oil price was set to stay low for a very long time.

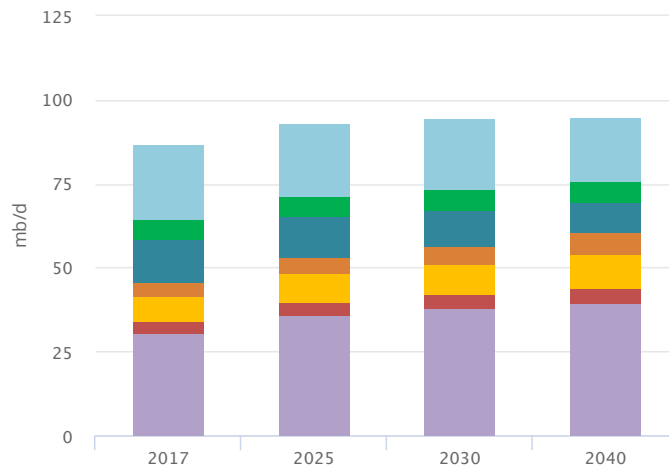
The reality has been different. On the supply side, while tight oil has proved remarkably resilient, geopolitical events, the slump in Venezuelan output, and decisions by major exporters have also weighed on production prospects. Meanwhile, on the demand side, lower prices have pushed up oil consumption. The oil price rose above \$80/barrel in September 2018 for the first time since 2014, although it has come down since.

Where do we go from here? The forces of change in oil markets remain strong. A maturing shale sector is now poised to become profitable; the cost of new upstream projects has come down; and sales of electric cars continue to break records. But elements of continuity are also formidable, and another boom and bust commodity price cycle cannot be ruled out. Volatility may be the new name of the game.

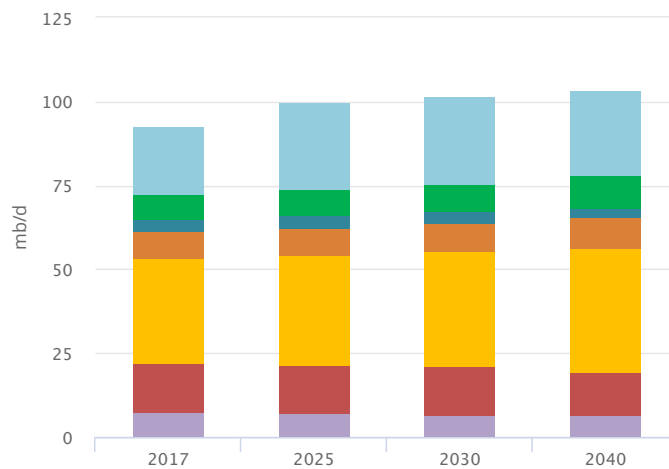
Outlook by scenario

[New Policies Scenario](#) [Sustainable Development Scenario](#)

Oil demand 2017-40, NPS



Oil production 2017-40, NPS



● North America ● Central and South America ● Europe ● Africa ● Middle East ● Eurasia ● Asia Pacific

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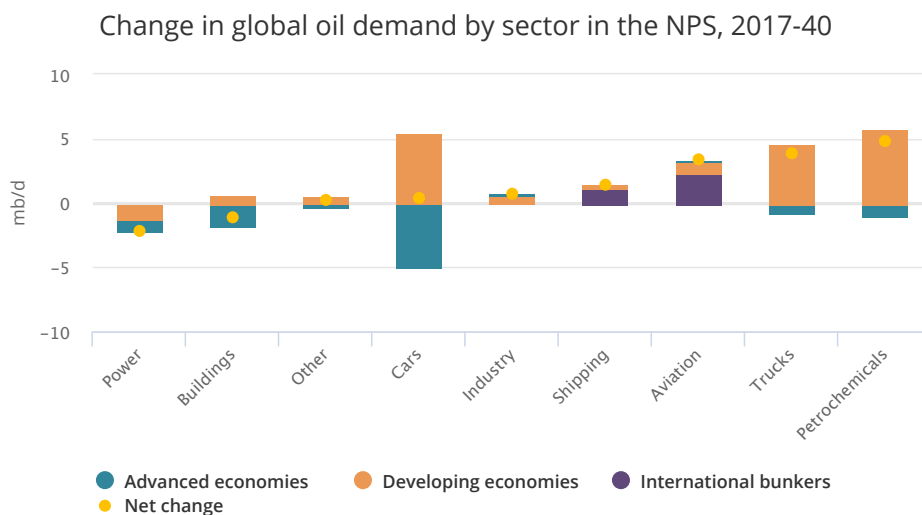
In the **New Policies Scenario (NPS)**, global oil demand growth slows but does not peak before 2040. Demand in 2040 is 106 mb/d, 11 mb/d greater than today. Demand in 2040 has been revised up by more than 1 b/d compared with last year's Outlook largely because of faster near-term growth and changes to fuel efficiency policies in the United States. China becomes the world's single largest consumer of oil in the 2030s and the largest net oil importer in history, importing over 13 mb/d in 2040. The United States dominates production growth to 2025: production increases by over 5 mb/d during that period to a peak of 18.5 mb/d. US production then starts to fall and OPEC steadily increases its share of total oil supply.

Key Trends

There is a major shift in the geography of oil demand in the NPS. Demand in developing economies grows by 18 mb/d to 2040 while demand in advanced economies drops by nearly 10 mb/d. There is also 3 mb/d growth in oil use in international aviation and shipping.

Oil use in cars peaks in the mid-2020s. Some 300 million electric cars on the road avoid 3.3 mb/d oil demand in 2040. Improvements in the efficiency of the non-electric car fleet are even more important to stemming demand growth: these avoid over 9 mb/d of oil demand in 2040.

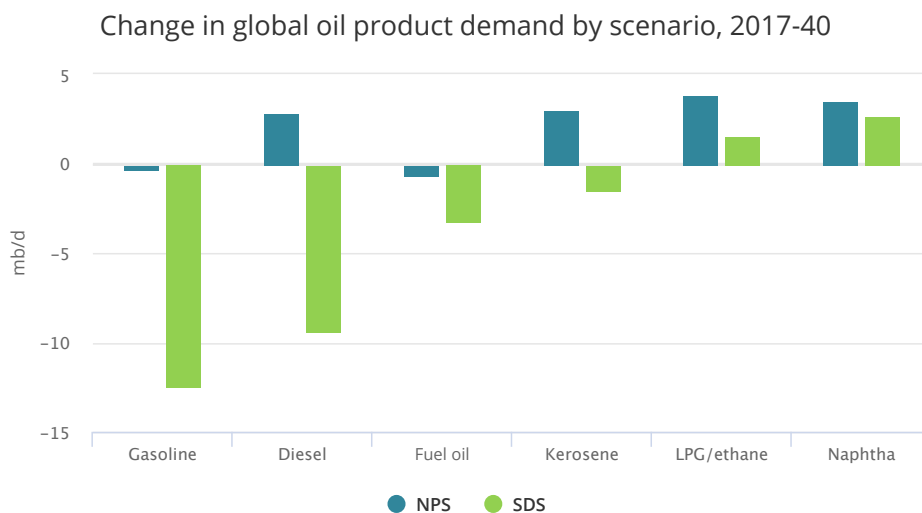
This pace of change is not matched elsewhere. Oil demand for trucks grows by 4 mb/d and oil use in petrochemicals sees the largest growth of any sector at 5 mb/d.



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The diverging sectoral oil demand outlook underpins a major shift in the composition of oil product demand towards lighter products. This move is amplified in the SDS.

Adapting to dramatic increases in the demand for lighter products would represent an unprecedented challenge for refiners, and would send ripples through the wider energy system.

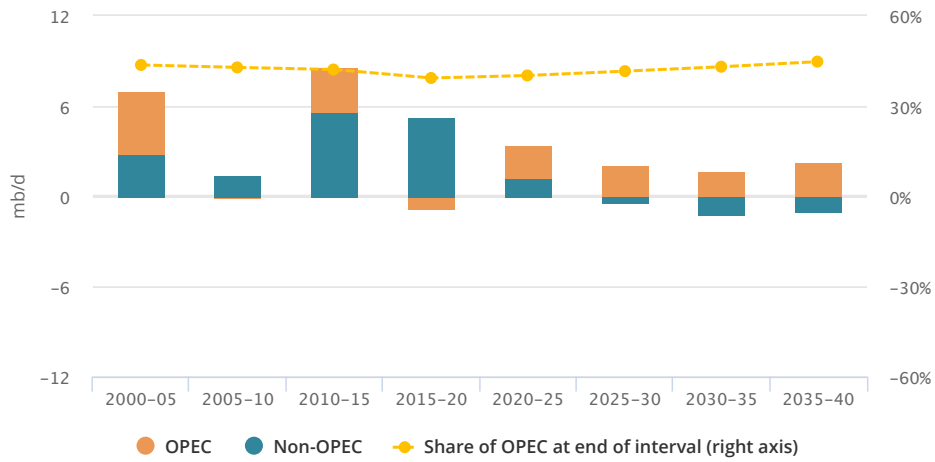


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The United States provides nearly 75% of the increase in global oil production to 2025 in the NPS.

After 2025, members of OPEC are central to meeting oil demand growth. US tight oil reaches 9.2 mb/d in the mid-2020s before declining slowly. But tight oil increases elsewhere, most notably in Argentina.

Change in global oil production in the NPS

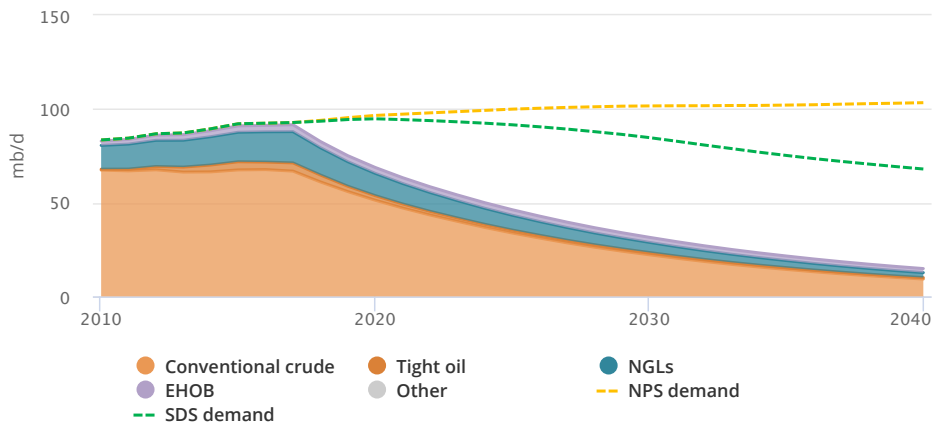


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The level of conventional crude oil resources approved for development in recent years is in line with the needs of the SDS but is only half of the level needed to meet demand growth in the NPS.

If these approvals do not pick up sharply from today's levels, US tight oil production would need to triple from today's level to over 15 mb/d by 2025 to satisfy demand in the NPS. With a sufficiently large resource base, this could be possible. But it would require levels of capital investment that would far surpass the previous peaks in 2014.

Oil production with no new investment from 2018 and demand in NPS and SDS



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Natural Gas

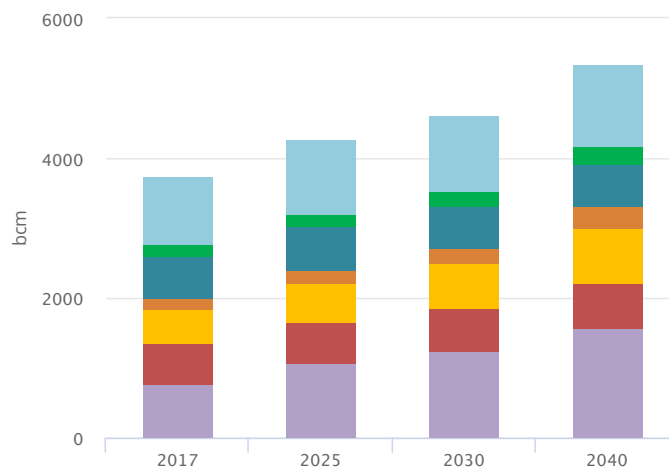
Surging growth in the global gas trade – underpinned by the shale revolution in the United States and the rise of liquefied natural gas (LNG) – continues to accelerate the transformation of global gas markets. Although talk of a global gas market similar to that of oil is premature, LNG trade has expanded substantially in volume since 2010.

As a result, gas is more accessible today to a variety of market players, and is more responsive to short-term changes in supply and demand across regions. In recent years, policy efforts to combat air pollution have been a key driver of natural gas demand growth in emerging economies in Asia.

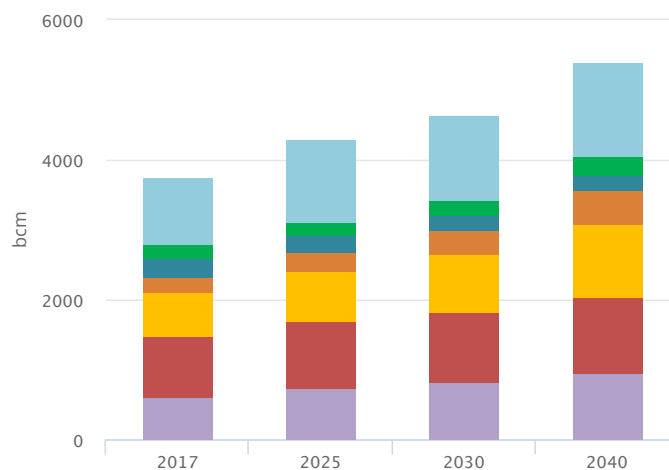
Outlook by scenario

New Policies Scenario Sustainable Development Scenario

Natural gas demand 2017-40, NPS



Natural gas production 2017-40, NPS



In the New Policies Scenario (NPS), natural gas demand in 2040 has been revised up by almost 100 billion cubic meters compared with last year’s outlook. The bulk of the revision is due to China, where gas demand grows rapidly, reflecting strong policy efforts to improve air quality. Developing economies in Asia account for half of the total demand growth through to 2040.

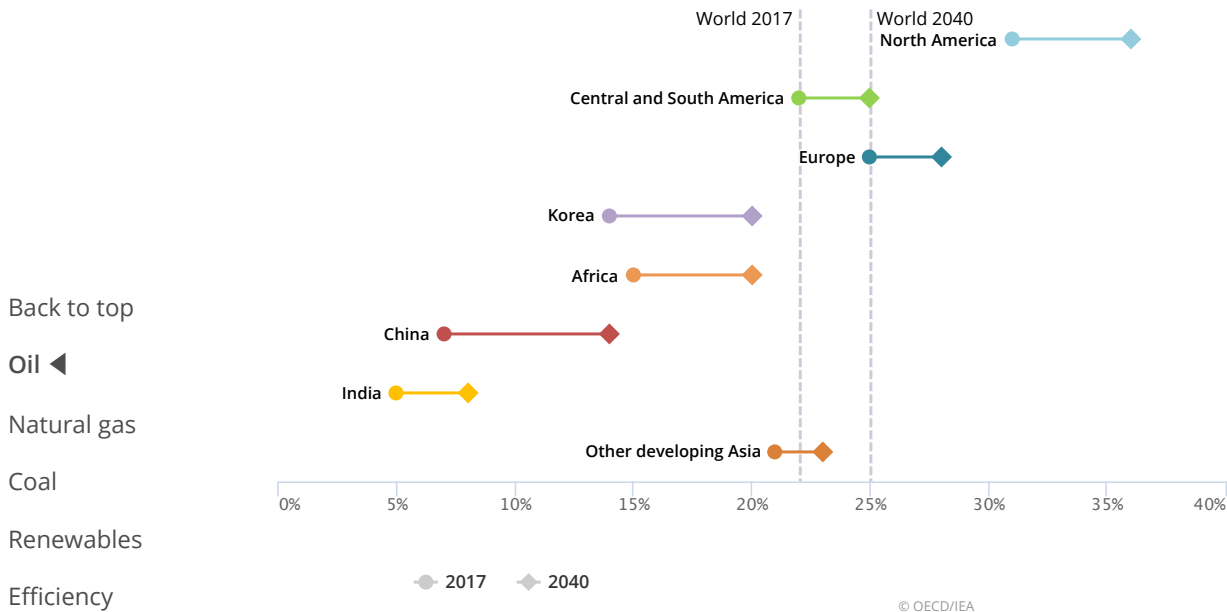
The United States accounts for 40% of total gas production growth to 2025, after which sources of growth become more diverse as US shale gas production flattens and unconventional gas production from other regions picks up. Low-cost US production keeps Henry Hub prices relatively low until the mid-2020s, but increasing levels of global LNG trade eventually begin to narrow the gap between regional prices.

Key Trends

Unlike other fossil fuels, natural gas continues to make inroads in almost all advanced economies.

In the United States, ample availability of gas at affordable prices fosters gas demand growth. In Korea, gas demand increases as the use of nuclear and coal in the power mix declines.

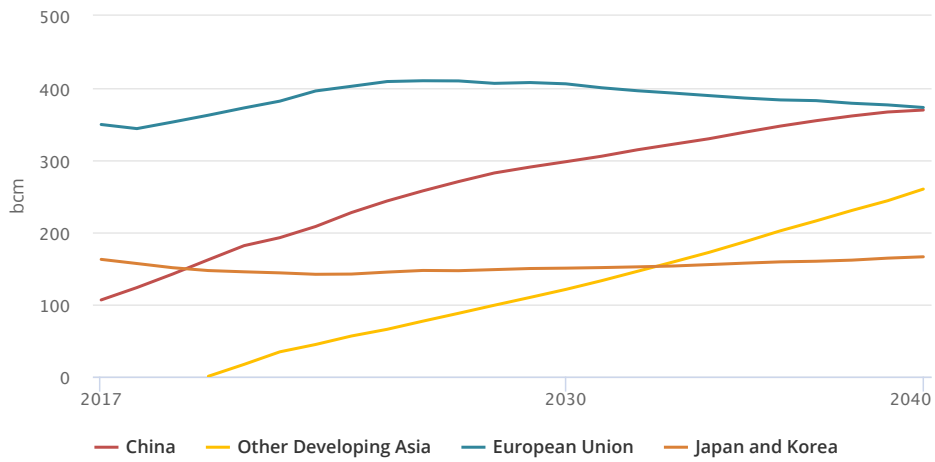
Share of gas in the energy mix by regions in the NPS



In the NPS, China soon becomes the world’s largest gas-importing country, with net imports approaching the level of the EU by 2040.

China today is also on the verge of surpassing Japan as the largest LNG importer.

Net gas imports by region

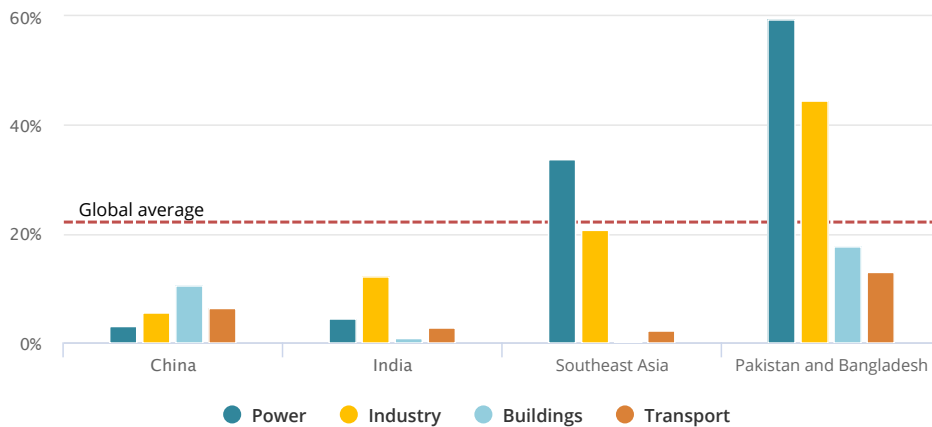


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Although the region is often dubbed “emerging Asia” as a whole, it is difficult to generalise about its gas demand.

Gas has been a niche fuel in some markets (such as India) while it is well established in some others (parts of Southeast Asia, Pakistan and Bangladesh).

Share of natural gas in the energy mix by sector in emerging Asian economies, 2017

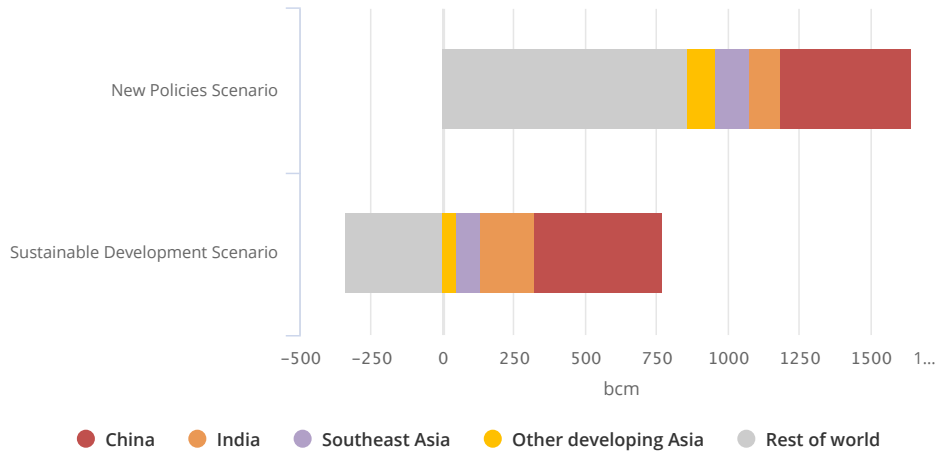


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Gas demand grows in most parts of the world in the NPS, but there are strong regional variations in the SDS.

While gas use comes under pressure from the expansion of renewables and from strong energy efficiency policies in many advanced economies, emerging Asia remains a key source of demand growth to 2040.

Changes in gas demand by region and scenario 2017-40

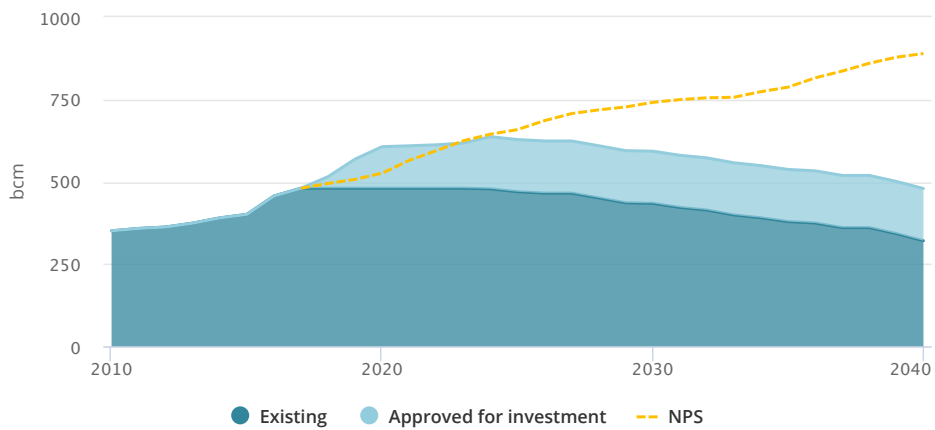


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The pickup in new LNG project approvals in the second half of 2018 suggests that the risk of an abrupt tightening in gas markets around the mid-2020s may be easing.

However a steady flow of additional projects would still be required to meet demand in the NPS.

Global liquefaction capacity, existing and approved, compared with requirements in the NPS



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Coal

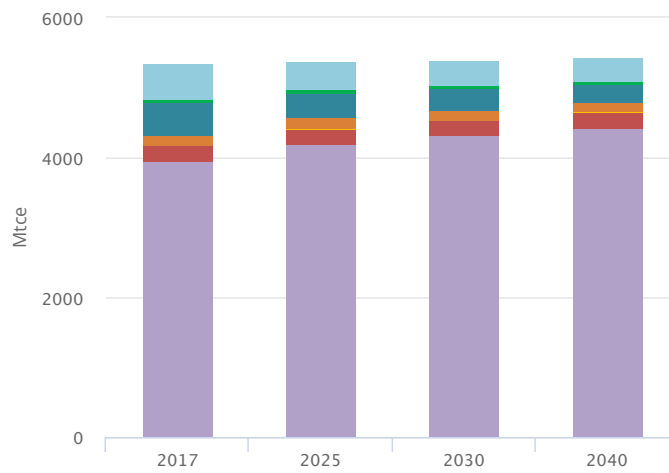
While both coal demand and prices declined after 2014, prices started to rebound in 2016 and coal demand made a comeback in 2017.

In Europe and North America, coal demand remains under pressure due to low electricity demand growth, strong uptake of renewables-based capacity and, in the United States, the availability of inexpensive natural gas. Nonetheless, elsewhere coal demand could be more resilient than some expect, especially among developing economies in Asia.

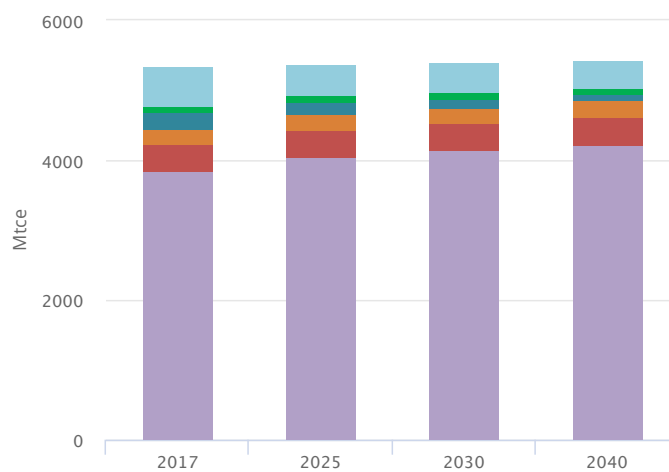
Outlook by scenario

New Policies Scenario Sustainable Development Scenario

Coal demand 2017-40, NPS



Coal production 2017-40, NPS



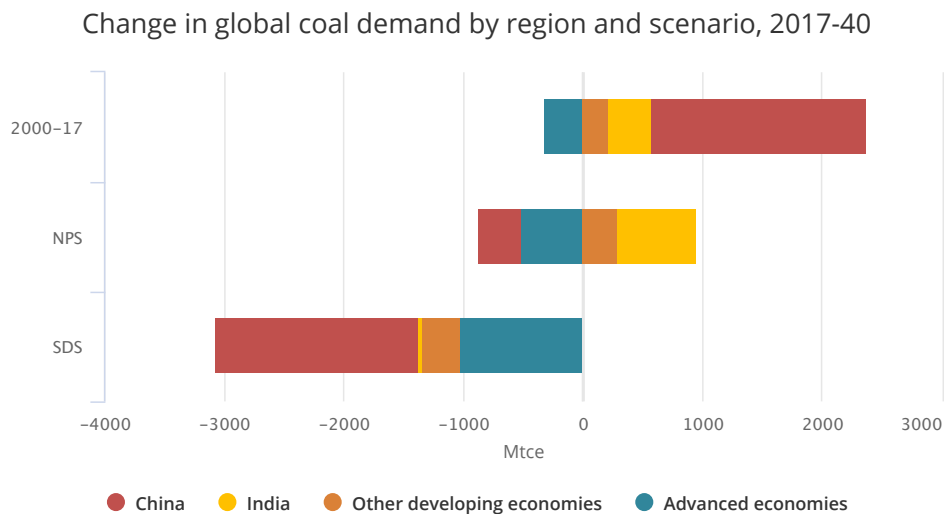
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Coal demand in 2040 in the **New Policies Scenario (NPS)** has been revised down by some 3% compared with last year's outlook. Downward revisions have been made for industrial coal use, as the shift from coal to alternative fuels in industry speeds up, and in the buildings sector where coal use almost disappears. Overall coal demand for power generation declines slightly in the NPS as moderate growth in coal-fired generation is offset by improvements in plant efficiencies. Modest growth in industrial coal consumption is due in part to rising use of coal as a feedstock for a range of conversion processes, notably coal-to-gas and coal-to-liquids projects in China. Overall coal consumption flattens around 5 400 million tonnes of coal equivalent (Mtce) and does not regain the peak seen in 2014.

The supply projections in the NPS mirror trends on the demand side, implying that global coal production peaked in 2014. However, there are stark regional differences in coal production prospects to 2040. Coal production in China, by far the world's largest coal producer, declines at an average rate of 0.4% per year over the outlook period. India overtakes Australia and the United States in the early 2020s to become the world's second-largest coal producer behind China. US coal production is projected to drop by 30% over the period to 2040, reflecting declining domestic demand and limited opportunities to tap into export markets.

Key Trends

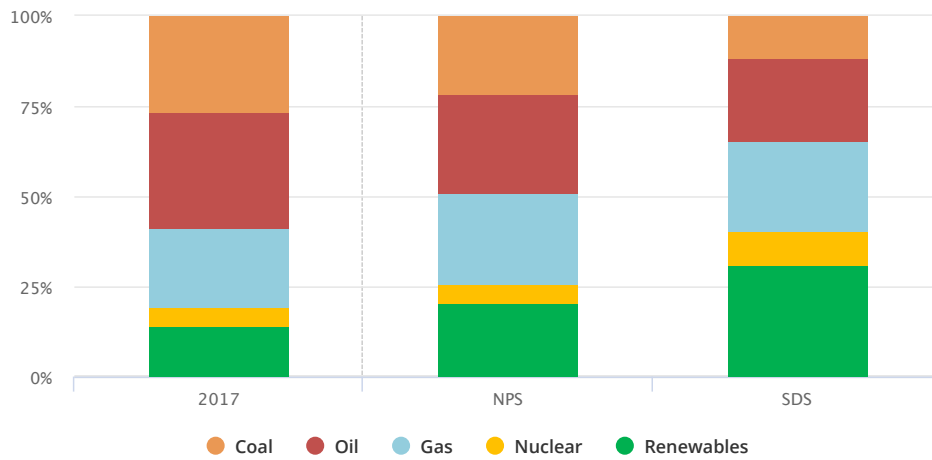
In the NPS, falling consumption in China, European Union and United States is balanced by rising demand in India and Southeast Asia.



In the NPS, the share of coal in global primary energy demand declines from 27% today to 22% in 2040, falling behind gas in the late 2020s.

In the SDS, coal consumption decreases steeply by 3.6% per year and coal's share in primary energy falls below 12% by 2040.

Shares of global primary energy, 2017 and 2040

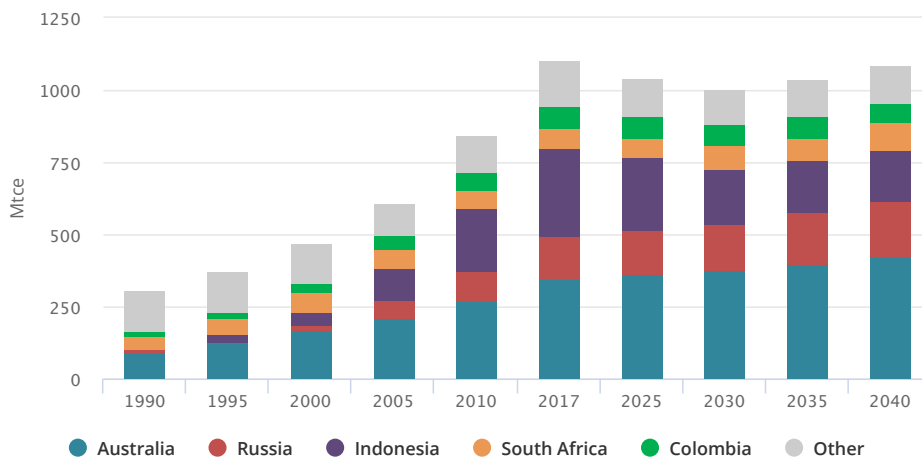


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Many coal exporters have emerged leaner and fitter from the recent coal market downturn, and competition promises to be strong in the uncertain import demand environment of the NPS, in which overall coal trade remains largely flat.

Australia, the world's largest exporter continues to be well positioned while Indonesian exports decline in the NPS due to increasing domestic coal demand in power generation. The fundamentals suggest that Russia has the potential to expand market share; it becomes the second-largest coal exporter in our projections, overtaking Indonesia by the mid-2030s.

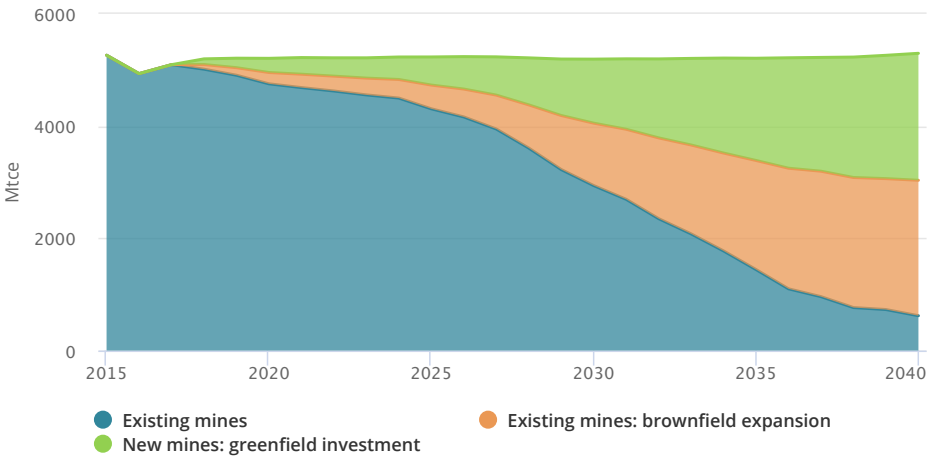
Major coal exporters in the NPS



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Coal prices have soared since early 2016 due to strong import demand and efforts to limit and restructure supply in China. Despite the resulting boost in profits for mining companies, investment in coal mining remains subdued, particularly among export-oriented companies. The New Policies Scenario implies \$1 trillion of investment to offset decreasing production from existing mines and to build new coal infrastructure, the majority of which is in China and India.

Global coal production by type in the NPS



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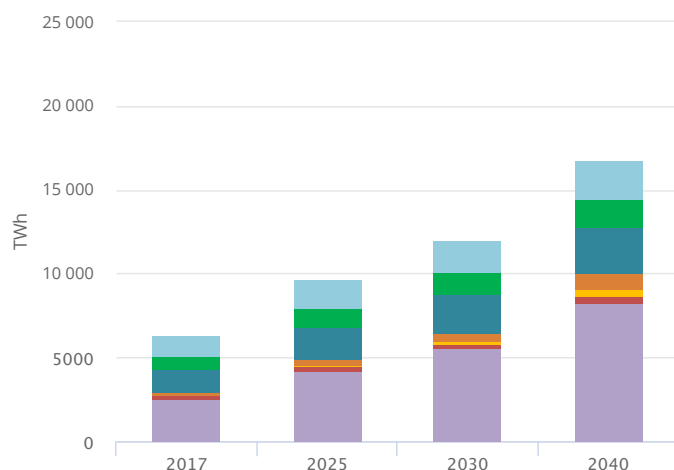
Renewables

Renewables have seen strong growth in recent years, with the power sector leading the way, and breaking records for levels of investment and deployment. But the uptake of renewables has been slower in industry, buildings and transport. Some renewable energy technologies such as solar PV and onshore wind are approaching competitiveness; others such as offshore wind are balancing between needing support and being competitive, while technologies such as tidal and wave energy still need support.

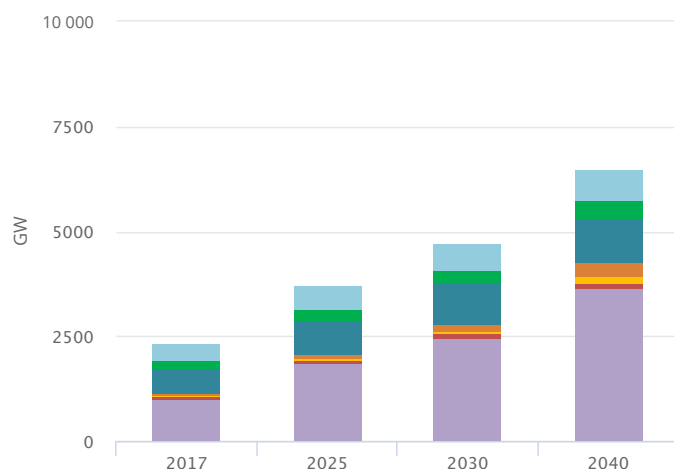
Outlook by scenario

New Policies Scenario Sustainable Development Scenario

Renewable power generation 2017-40, NPS



Renewable power capacity 2017-40, NPS



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 ● Central and South America
 ● Europe
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 ● Middle East
 ● Eurasia
 ● Asia Pacific

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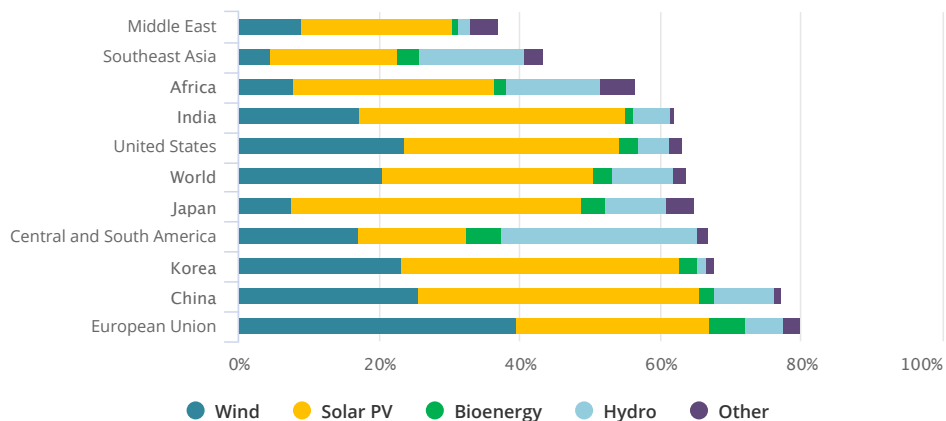
In the **New Policies Scenario (NPS)**, electricity generation from renewables nearly triples to 2040 and accounts for over 40% of overall generation. Direct use of renewables also grows in transport and heat applications, but their share remains more limited. The share of renewables in global heat supply increases in the NPS by five percentage points, to 15% in 2040. Around 60% of this increase is expected to take place in China, the European Union, India and the United States, which are today's largest consumers of renewables-based heat. In transport the share of direct and indirect renewables more than doubles to around 8%. Demand for biofuels is projected to increase to 4.7 mboe/d, accounting for 6% of renewables use in transport in 2040, with the remainder being EVs powered by renewables.

Key Trends

In the New Policies Scenario, renewables make up more than 60% of gross capacity additions to 2040 in most regions, reaching half of global power generation capacity by 2035. Solar PV is one of the fastest growing technologies, and is projected to become the second-largest installed capacity, with installed capacity overtaking wind in the next few years, hydropower within 15 years and coal before 2040.

China and India drive the global growth in solar PV; they are responsible for well over half of global solar PV capacity additions. Wind power deployment also grows rapidly, reaching 14% of global capacity by 2040, or around 1 700 GW. In terms of generation, electricity output from hydro remains the largest source of renewables-based generation.

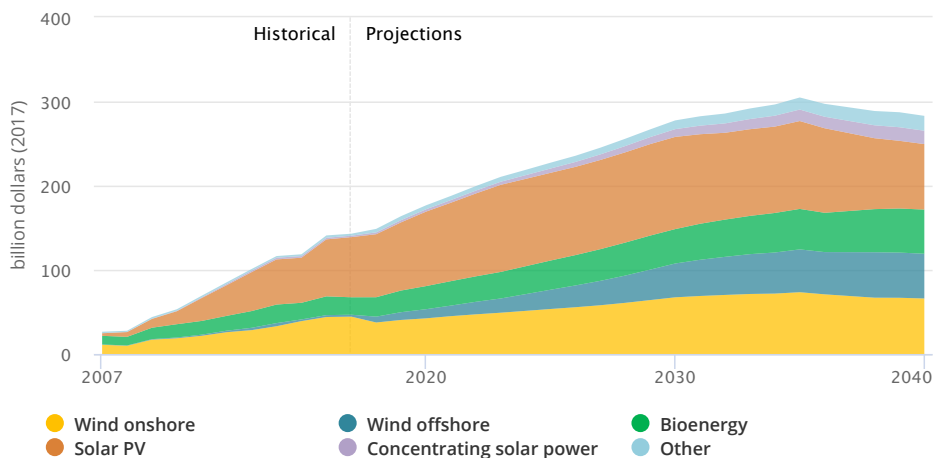
Share of renewables in total gross capacity additions by region in the NPS, 2018-2040



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Key drivers of the rise in renewables-based electricity include policy support and technology cost reductions. Stable support policy frameworks help drive down costs, in turn providing for increasing policy support while maintaining energy affordability. As a result by 2040, the global average support per unit of output for new solar PV projects declines almost 90%, and for new wind power projects it declines by almost 70%.

Global renewables-based electricity support in the NPS

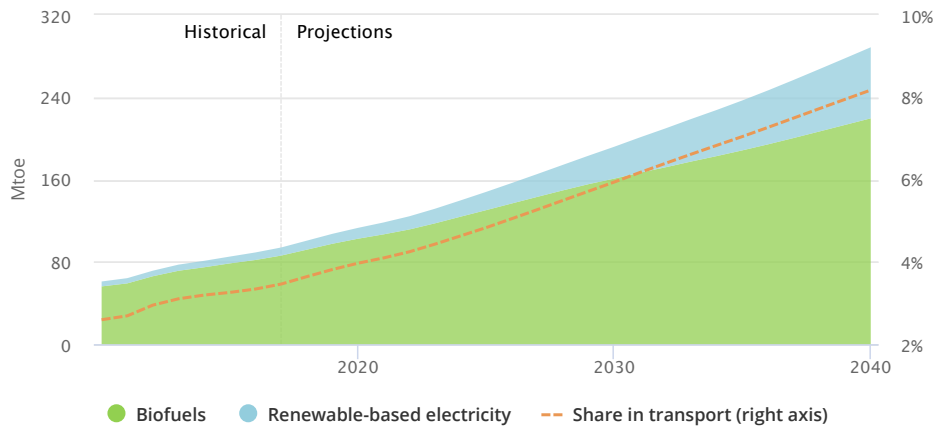


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In the NPS, road vehicles powered by renewables – cars, trucks, buses and two/three wheelers – more than double their share in road transport energy use to 9%, and they account for almost 15% of the total distance driven in 2040.

Renewable electricity represents one fifth of the direct and indirect renewable energy used in road transport in 2040, but accounts for more than a third of kilometres travelled on renewables thanks to the higher efficiency of electric engines.

Renewable energy consumption in the transport sector by source and share in the NPS

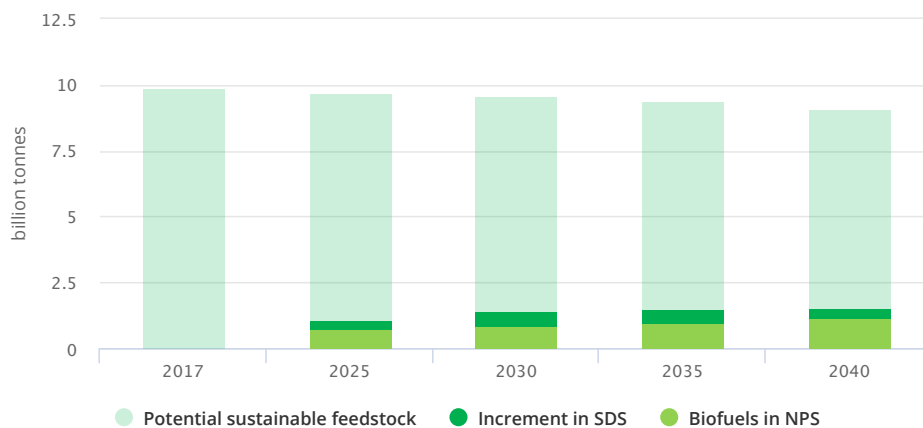


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Concerns have been raised about the sustainability of biofuels in some countries: the feedstocks required can compete with food production for agricultural land and there can be a large increase in CO₂ emission intensity associated with land clearing and cultivation. As a result, there is increased interest in advanced biofuels, which can avoid these concerns.

We estimate that today there are around 10 billion tonnes of lignocellulosic “sustainable” feedstock that could be used for biofuels production worldwide, much larger than the projected biofuel needs in our scenarios.

Sustainable feedstock available and levels needed to cover total biofuel consumption by scenario



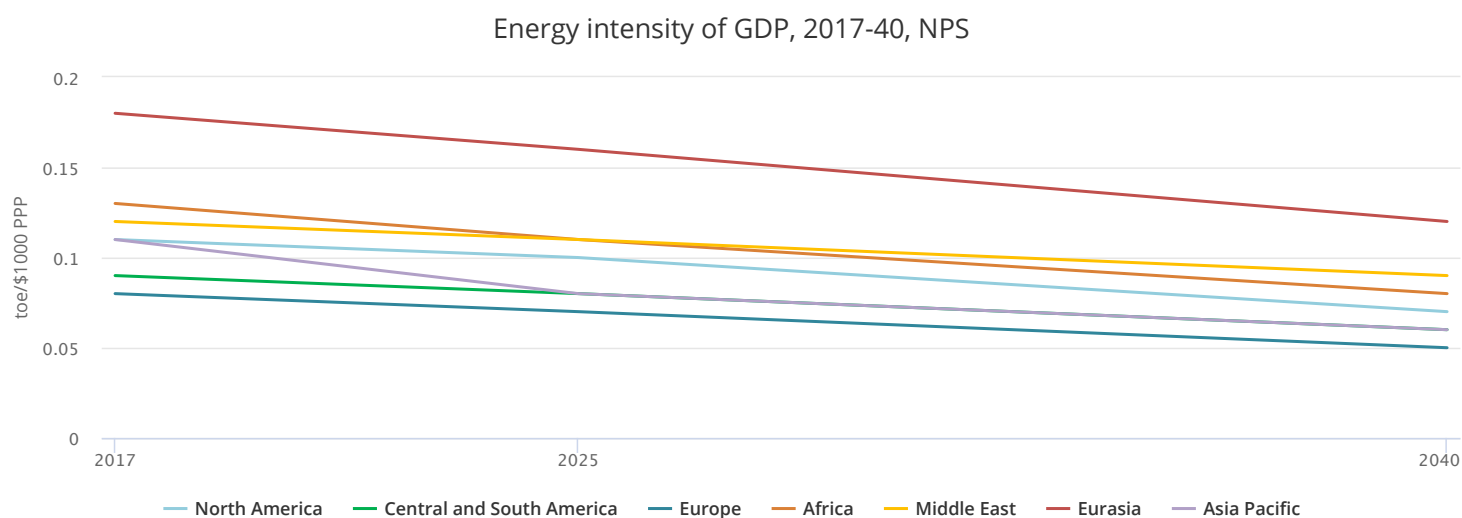
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Energy efficiency

Energy efficiency is one of the cornerstones of any strategy to guarantee sustainable and inclusive economic growth. It remains one of the most cost-effective ways to enhance security of energy supply, to boost competitiveness and welfare, and to reduce the environmental footprint of the energy system. Not only can the growth of carbon emissions be tempered by the more efficient use of energy but energy efficiency can also improve local pollution and contribute to reducing the millions of air-pollution related premature deaths each year, and keep consumers energy bills in check.

Outlook by scenario

New Policies Scenario Sustainable Development Scenario Efficient World Scenario

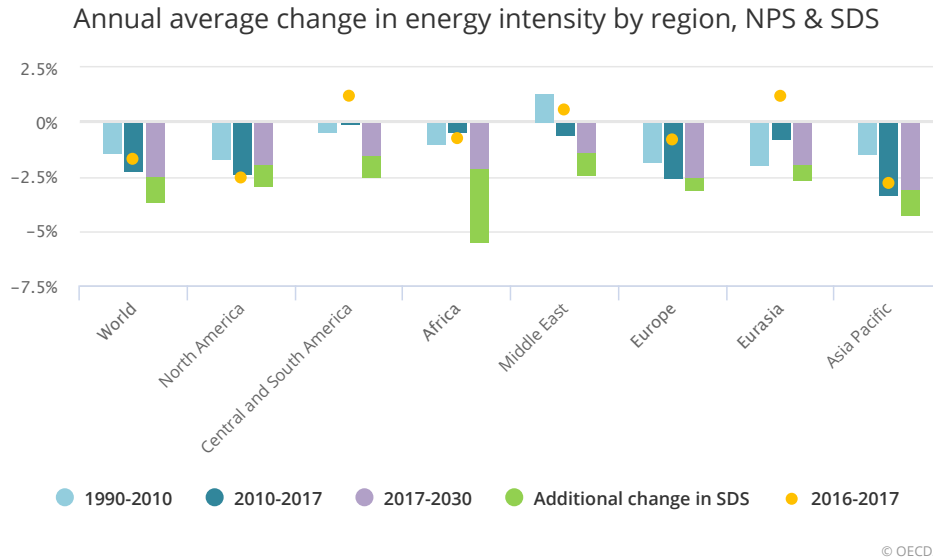


In the absence of existing and announced efficiency measures, global energy consumption in 2040 would be almost 30% higher than projected in the New Policies Scenario (NPS). Energy efficiency policies in developing economies account for 60% of the reduction in global energy consumption in 2040, but only in the European Union, Japan, and Korea do energy efficiency gains fully offset the increase in energy demand.

Key Trends

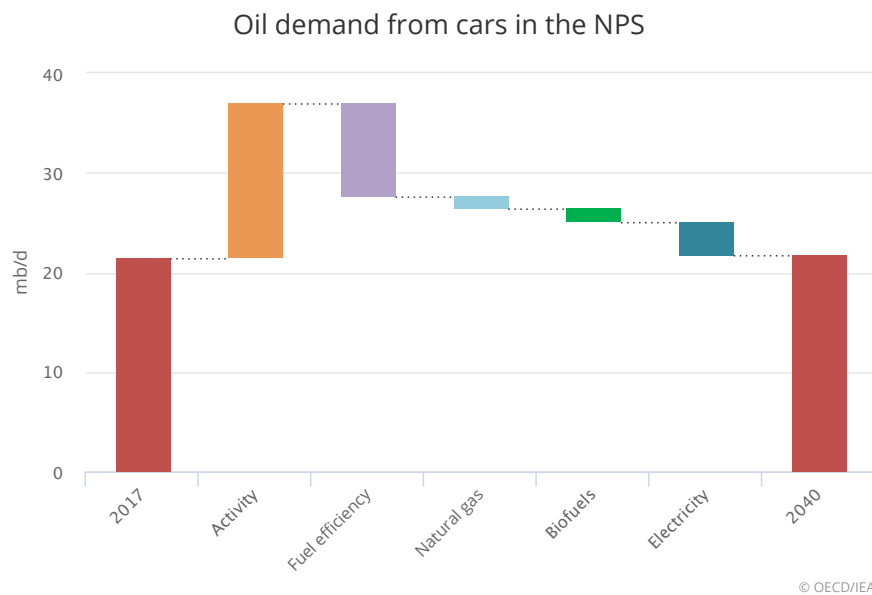
The United Nations Agenda for Sustainable Development (2030 Agenda) includes targets to improve energy efficiency (Sustainable Development Goal 7.3). Global energy intensity, defined as the ratio of primary energy supply to GDP, is the indicator used to track progress on global energy efficiency.

The original target was an annual reduction of 2.6% although the world has fallen short of this goal since it was announced: the annual reduction in 2017 was only 1.7%. This shortfall means that the required rate of intensity improvement has risen to 2.7% for the remaining years to 2030.



Improvements in fuel efficiency of the global car fleet are the single largest contributor to moderating oil demand growth in cars in the NPS. These measures avoid around 9 mb/d of oil demand in 2040.

Not all these savings are dependent on technological advances: for example, bringing the fuel efficiency of the global car fleet in line with that of cars in the European Union today (7.3 litres/100 km) would reduce global oil consumption by almost 6 mb/d.



In advanced economies, new sources of electricity demand growth such as digitalization and electrification of heat and mobility have been outpaced by savings from energy efficiency. In the absence of energy efficiency improvements, electricity demand in advanced economies would have grown at 1.6% per year since 2010, instead of 0.3%.

Energy efficiency measures adopted since 2000 saved almost 1 800 TWh in 2017 or the equivalent of around 20% of overall current electricity use.

