

BP Energy Outlook 2035



Focus on North America, February 2014

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Disclaimer

This presentation contains forward-looking statements, particularly those regarding global economic growth, population growth, energy consumption, policy support for renewable energies and sources of energy supply. Forward-looking statements involve risks and uncertainties because they relate to events, and depend on circumstances, that will or may occur in the future. Actual outcomes may differ depending on a variety of factors, including product supply, demand and pricing; political stability; general economic conditions; legal and regulatory developments; availability of new technologies; natural disasters and adverse weather conditions; wars and acts of terrorism or sabotage; and other factors discussed elsewhere in this presentation.



Introduction

- This edition updates our view of the likely path of global energy markets and extends it to 2035. The underlying methodology remains unchanged – we make assumptions on changes in policy, technology and the economy, based on extensive internal and external consultations, using a range of analytical tools to build a single “most likely” view.
- We focus on these “most likely” numbers, to provide a basis for discussion. Of course the future is uncertain, and in the process of building the Outlook we explore the impact of alternative assumptions. While we do touch on some of the key uncertainties, the treatment of energy market risks here is by no means exhaustive.
- Unless noted otherwise, data definitions are based on the *BP Statistical Review of World Energy*, and historical energy data through 2012 is consistent with the 2013 edition of the *Review*. Gross Domestic Product (GDP) is expressed in real Purchasing Power Parity (PPP) terms and rescaled from 2005 to 2012 prices using a simple across-the-board increase for exposition purposes.



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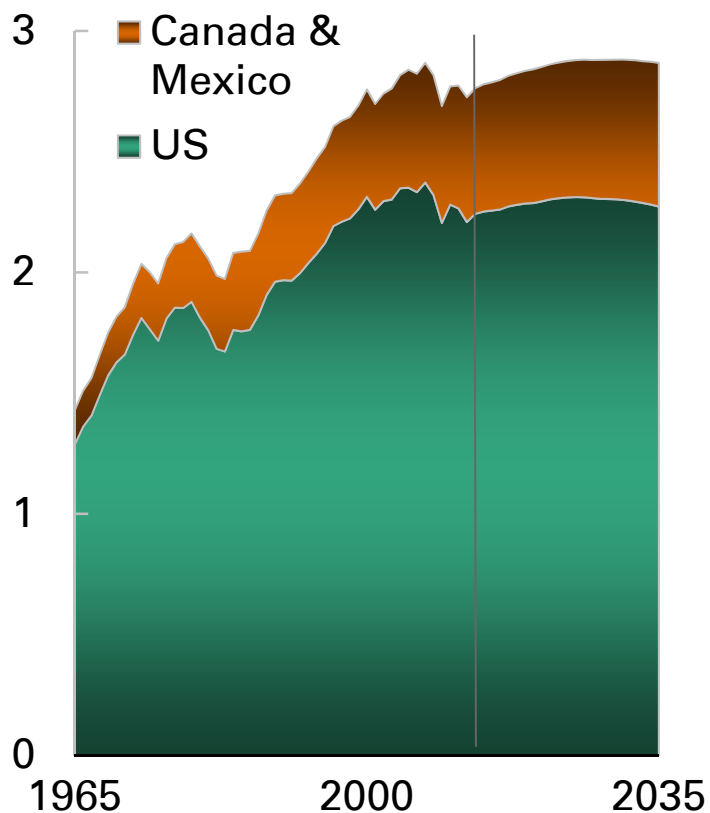
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North American energy use rises slowly from today's levels...

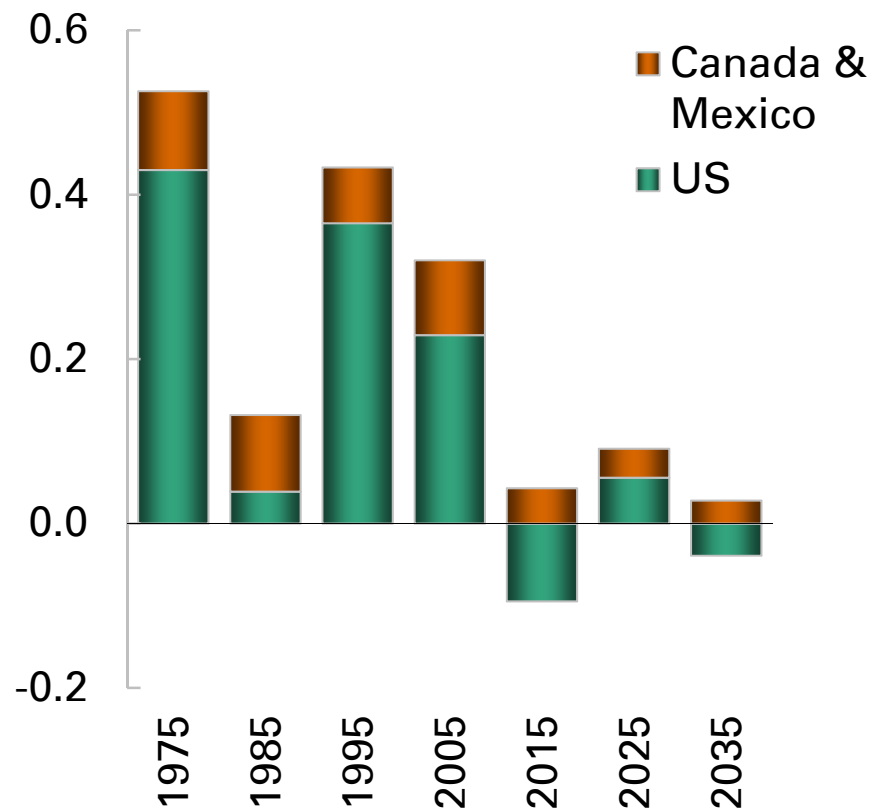
Consumption by region

Billion toe



Ten year increments by region

Billion toe





...but peaks in 2030 as US demand begins to contract

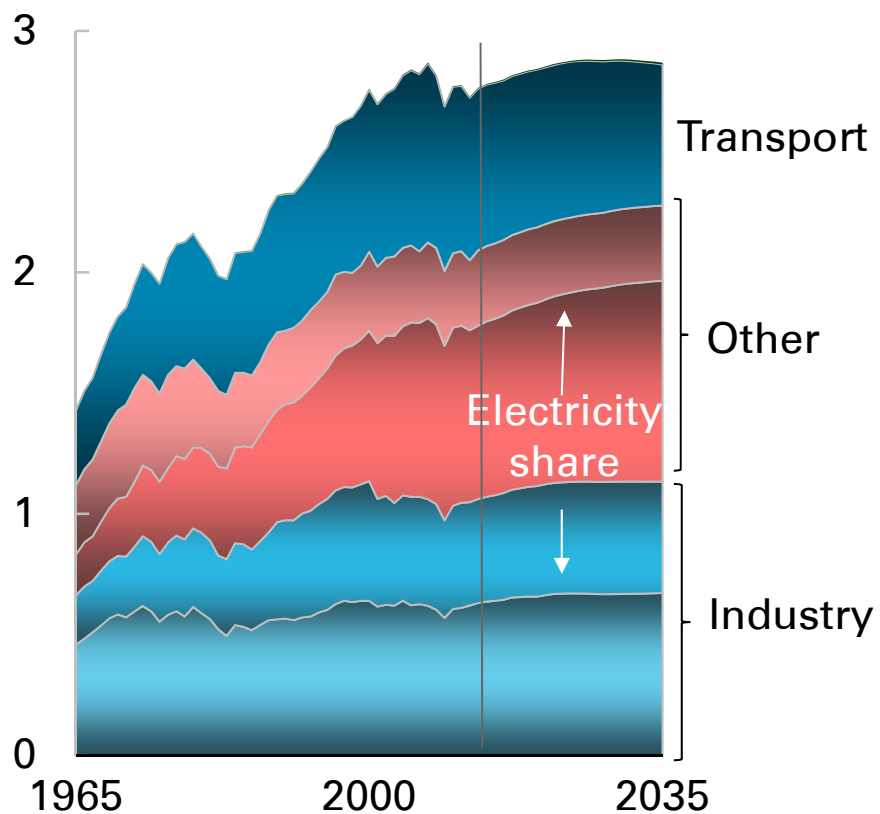
- North American energy demand increases by 5% between 2012 and 2035, with growth averaging 0.2% per annum (p.a.). Energy use contracts by 0.2% p.a. during 2005-15, but growth returns at 0.3% p.a. during 2015-25. Energy use is virtually flat the final 10 years of the outlook.
- This compares to global growth of 41% between today and 2035 and an average growth of 1.5% p.a.. As a result, North America's share of global demand drops from 22% today to 16% by the end of the outlook.
- Regional demand growth comes primarily from Canada & Mexico, which will expand by 15% or 0.6% p.a. compared to the US, where energy use grows by just 3% or 0.1% p.a. from 2012 to 2035. Demand in Canada & Mexico expands throughout the outlook, whereas US demand begins to contract after 2025.
- As a result, regional energy use will not return to the previous peak (2007) until 2023, and demand declines after 2030. In 2035 energy demand has returned to the 2007 level. The US, however, will never return to its peak, with 2035 demand 4.2% below 2007 levels.



Falling transport demand is offset by the 'other' sector...

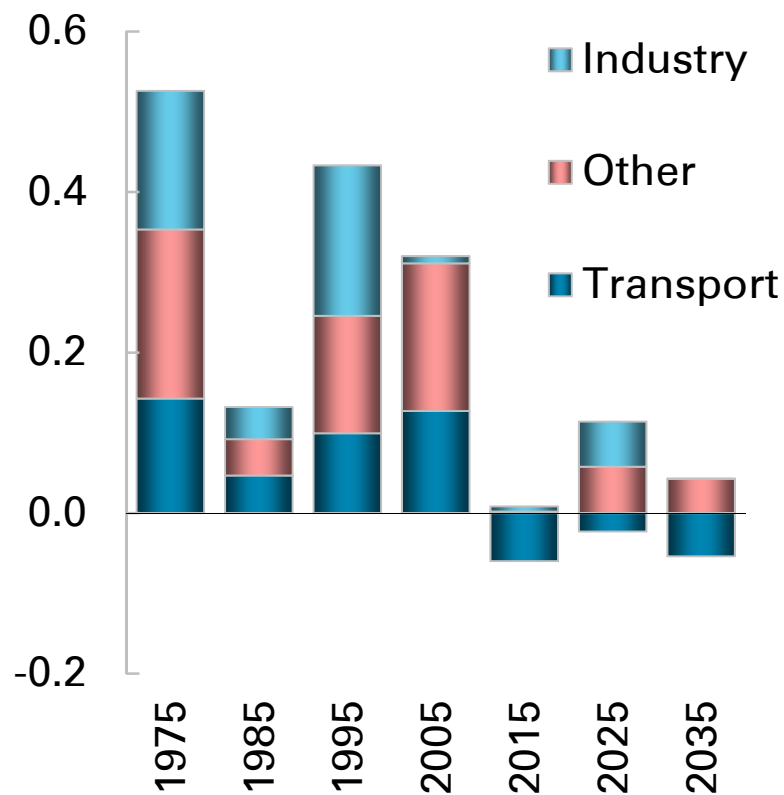
Consumption by sector

Billion toe



Ten year increments by sector

Billion toe





...as electrification of the economy continues

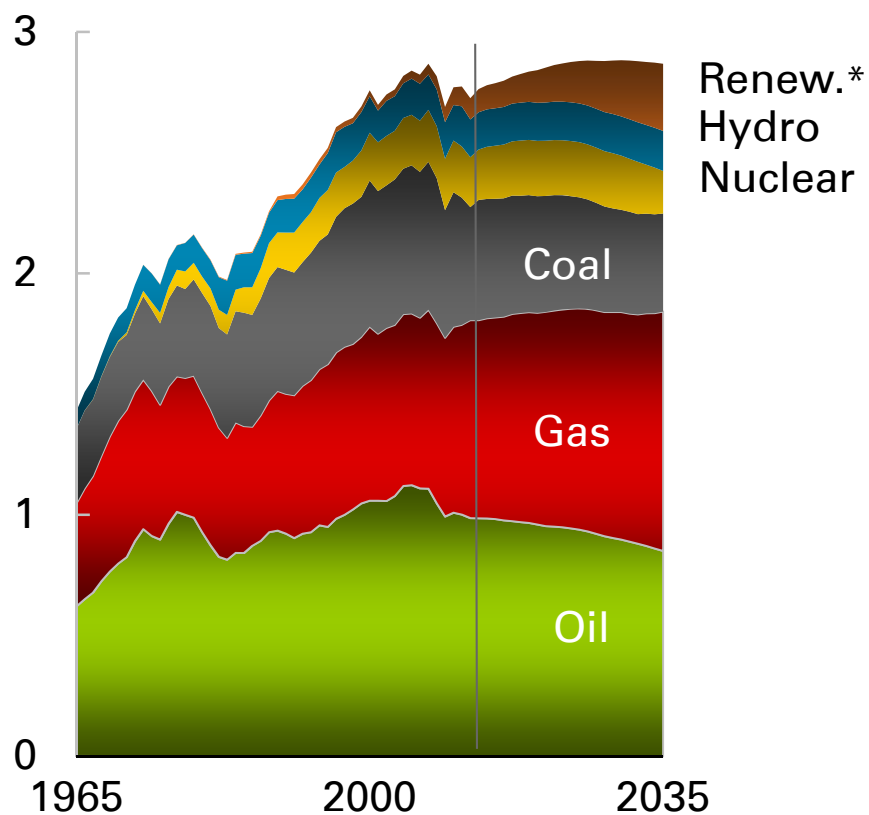
- Energy use in the transport sector contracts by 12% from 2012 to 2035, declining steadily throughout the outlook. Regional demand in 2035 will be the lowest since 1993. Declines are driven by the US, where transport demand declines by 18% as the country ends the outlook with the lowest transport demand since the late 1980s and 28% below its peak (2007).
- The 'other' sector (residential/commercial, services, and agriculture) more than compensates for falling transport demand with a 14% expansion, remaining the dominant source of energy demand growth, both directly and indirectly (in the form of electricity). 'Other' accounts for 99% of regional growth in final energy consumption from 2012-35.
- The growth in 'other' is predominantly in the form of electricity, which accounts for 84% of the sector's growth. The industrial sector expands by 8% with electricity playing a key role as well, contributing 38% to the sector's growth.
- The result is that 'other' overtakes industry as the largest source of sectoral energy demand in North America by the end of the outlook.



The slowdown in transport curtails oil demand...

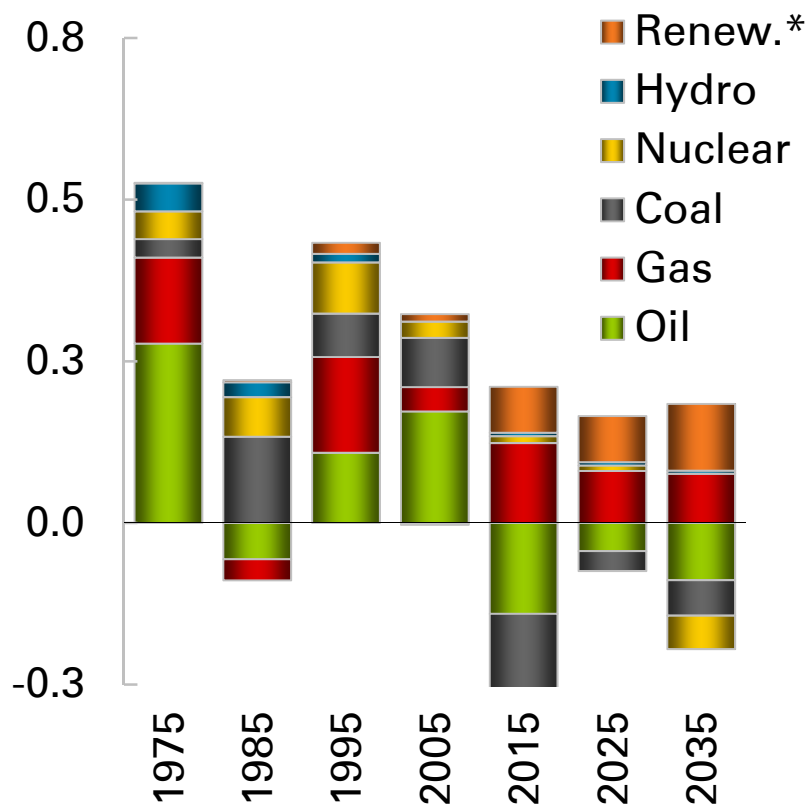
Consumption by fuel

Billion toe



Ten year increments by fuel

Billion toe



*Includes biofuels



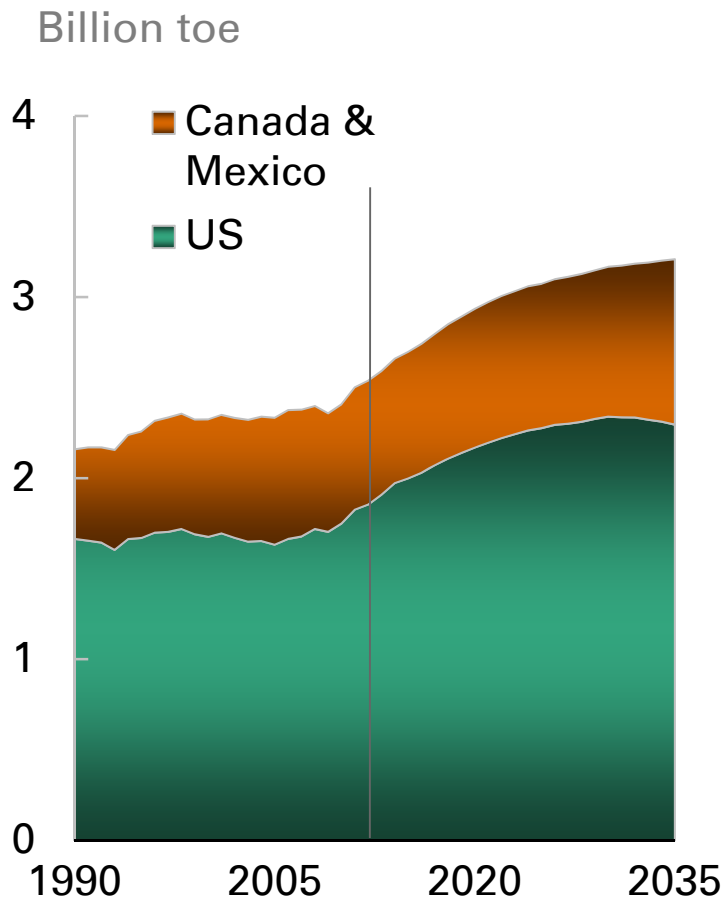
...while natural gas and renewables gain market share

- The fuel outlook is mixed, with declines in oil (-0.6% p.a.), coal (-0.6% p.a.), and nuclear (-0.7% p.a.) more than offset by gains in natural gas (0.8% p.a.), hydro (0.2% p.a.), and renewables (5.2% p.a.). Growth in renewables and natural gas account for more than double the net increase in regional demand.
- This changing composition of the fuel mix reflects falling transport demand (driven by rising efficiency) and increasing power demand. Reductions in coal use and growth of renewables are supported by market forces and policy measures.
- The outlook for North American demand has some similarities to world averages but also some significant contrasts. At a global level, as in North America, renewables (6.4% p.a.) grow the fastest followed by natural gas (1.9% p.a.). However, all fuels show global growth over the forecast period, including oil (0.8% p.a.), coal (1.1% p.a.), and nuclear (1.9% p.a.).

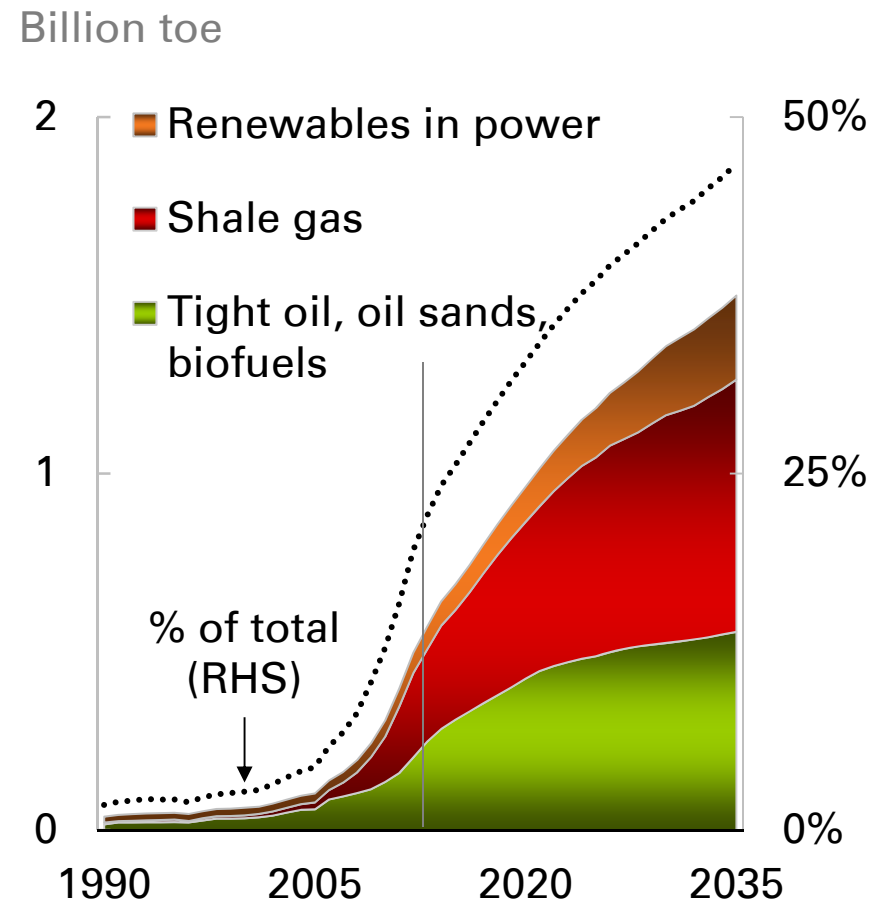


North American production continues to expand...

Production by region



New energy forms





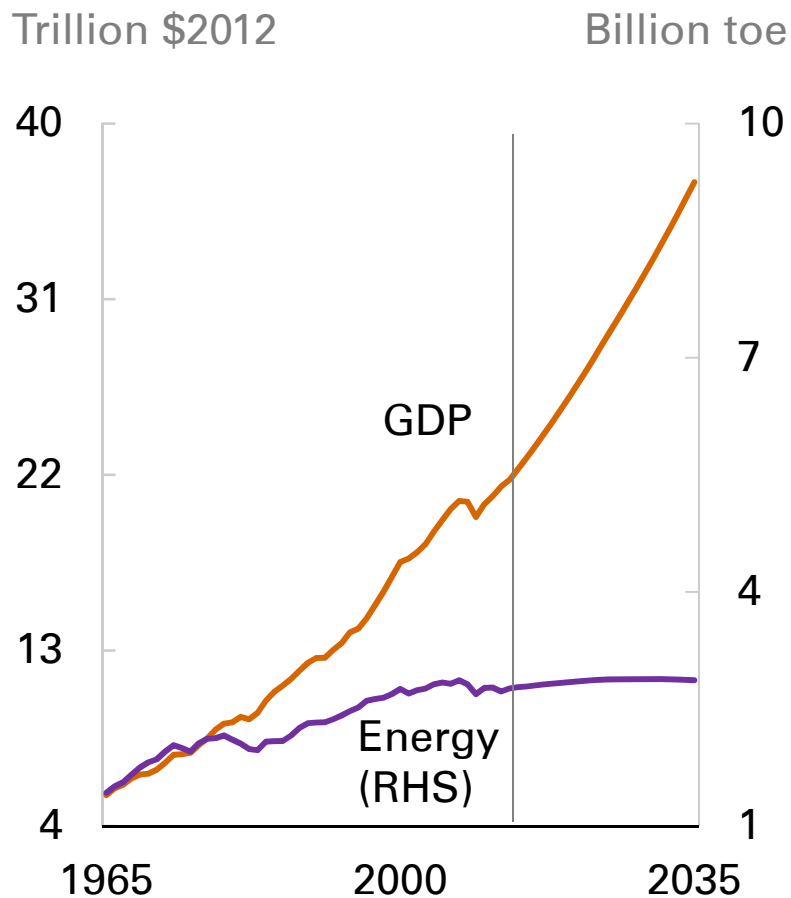
...led by unconventional oil & gas and renewables

- North American energy production grows by 1% p.a. from 2012 to 2035, compared to a global average of 1.5% p.a. Production by 2035 will rise by 26% from today's already-record levels, allowing the region to become energy self-sufficient.
- The US will account for 66% of regional production growth and output will expand by 24% to 2035. This expansion is in stark contrast to growth of just 5% between 1990 and 2010.
- The reason for the region's production renaissance is the emergence of unconventional oil and natural gas, plus increasing production of renewables. These new supplies will account for 150% of the region's net growth and reach a market share of nearly 50% by 2035, compared to just 20% today and 3% a decade ago.
- The US will lead the growth in unconventional production, with tight oil production increasing from 1.6 Mb/d in 2012 to 4.5 Mb/d in 2035, and shale gas output rising from 24.7 Bcf/d to 65.1 Bcf/d. Meanwhile, Canadian oil sands will increase from 1.8 Mb/d to 5.1 Mb/d.

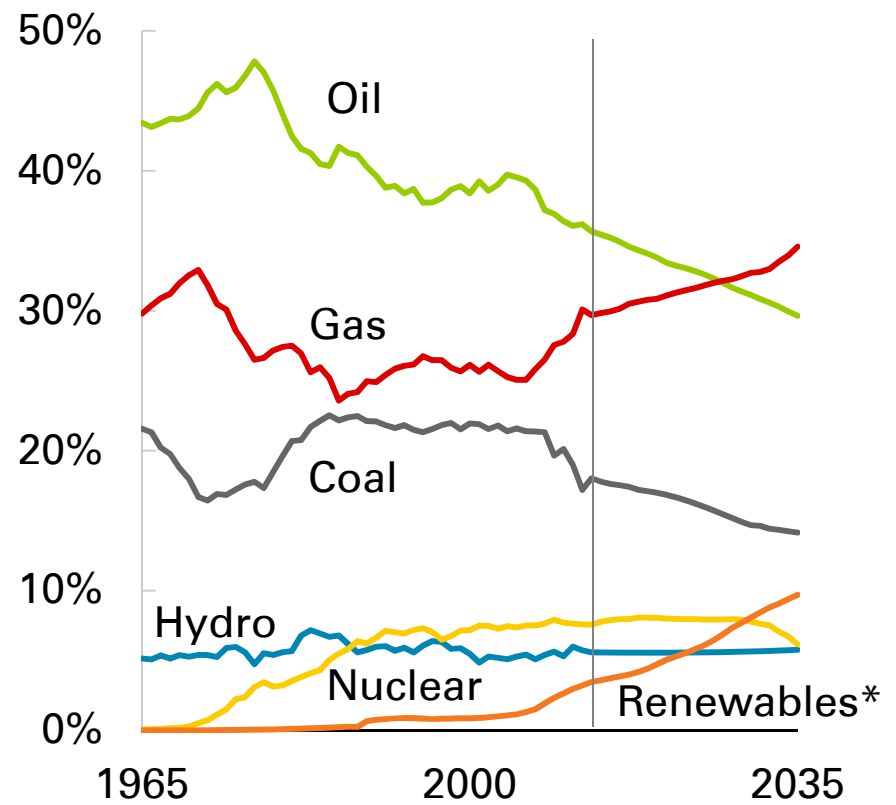


Energy is decoupling from economic growth...

GDP and energy



Shares of primary energy



*Includes biofuels



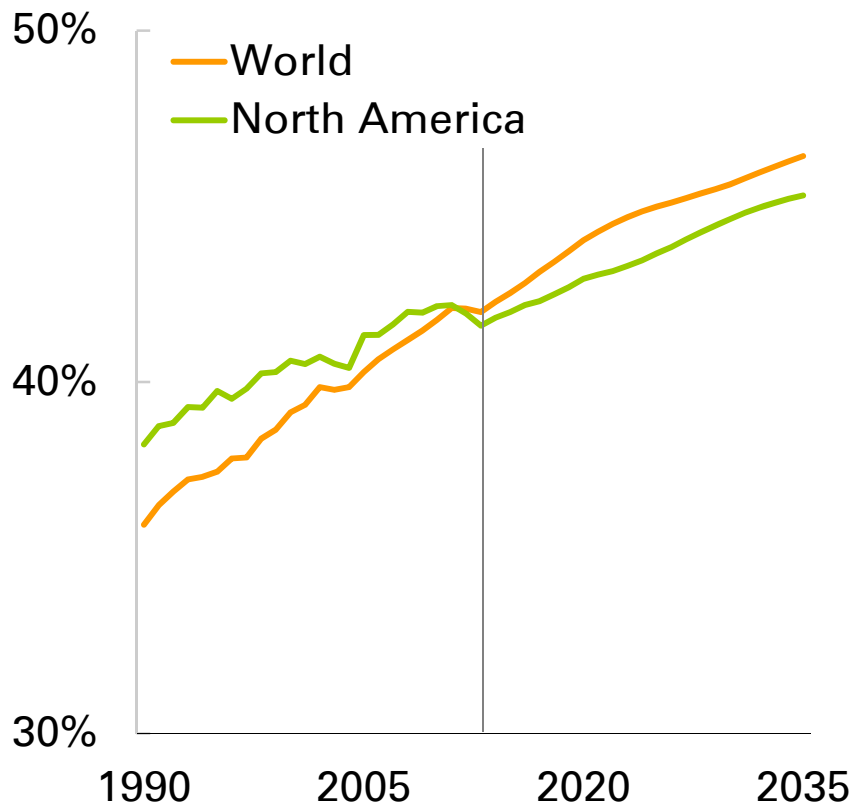
...and the fuel mix is slowly shifting away from fossil fuels

- Energy consumption grows less rapidly than the regional economy, with GDP growth averaging 2.4% p.a. 2012-35. As a result energy intensity, the amount of energy required per unit of GDP, declines by 39% (-2.1% p.a.). The decline in energy intensity accelerates; the expected rate of decline post 2020 is 50% higher than the decline rate achieved from 1990-2010.
- Fuel shares evolve slowly. Market shares for coal and oil experience a marked decline, with the latter's position as the leading fuel overtaken by natural gas by 2027. Renewables continue to expand, surpassing both hydro (2024) and nuclear (2030).
- Oil will end the outlook with a 30% market share, the lowest on record, and down from a high of 48% in 1977. Coal's share will drop to just 14%, also the lowest on record. Natural gas will capture 35% of the regional market by 2035, surpassing its previous high from 1971.
- Fossil fuels will account for 78% of demand in 2035, down from today's 83%. The renewables share will rise from 3% today to 10% in 2035, while hydro remains stable and nuclear loses share late in the outlook.

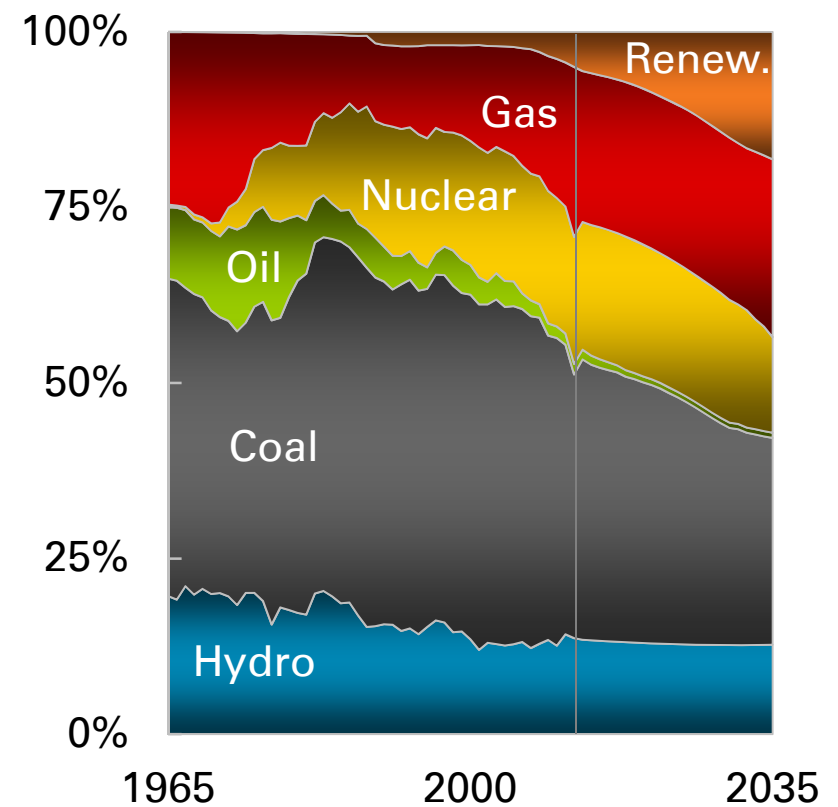


The power sector takes an increasing share of energy...

Inputs to power as a share of total primary energy



Primary inputs to North American power





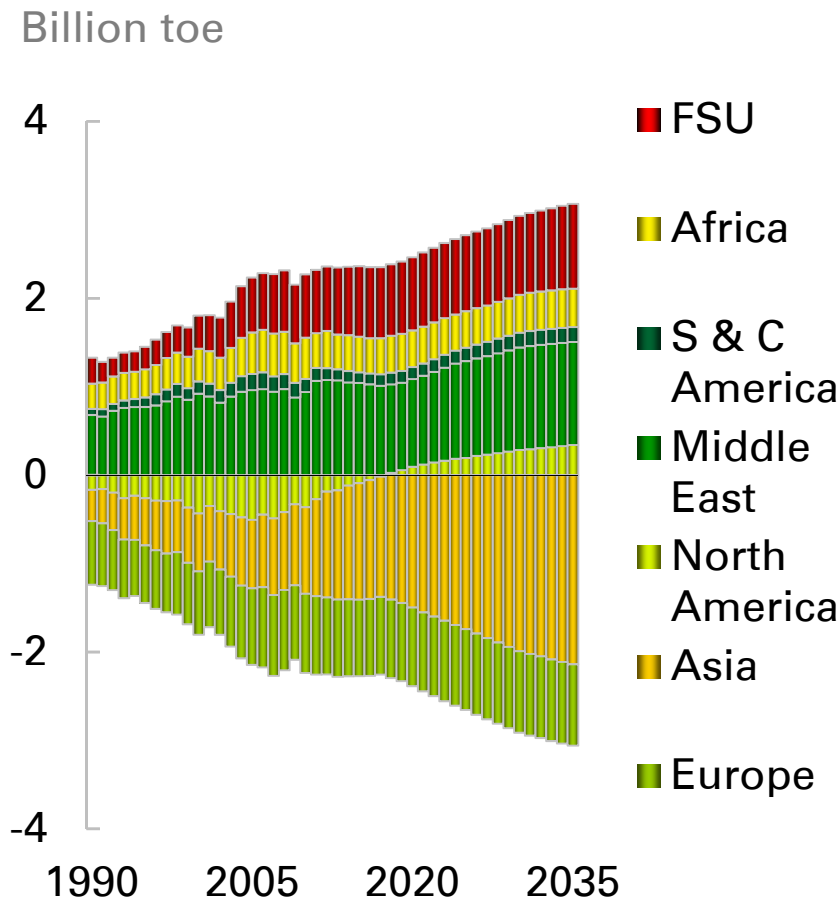
...and plays a key role in shaping the fuel mix

- One of the longest established trends in energy is the increasing role of the power sector. The share of primary energy devoted to power generation rises in industrializing as well as in mature economies like North America, where growth is dominated by the service sector.
- In 2012, 42% of North American primary energy was converted into electricity, up from 38% in 1990. By 2035 that share will rise to 45%. Fuels for power generation account for 110% of net regional growth in energy consumption from 2012-35.
- Coal remains the largest source of power generation through 2035 with a 29% market share, but it loses share (down from today's 38%) largely due to displacement by renewables.
- Carbon-free sources (renewables, hydro and nuclear) increase their combined share of power generation from 37% in 2012 to 44% by 2035. Renewables overtake both hydro (2028) and nuclear (2033) as a source of power generation, increasing their share of power generation from 5% today to 18% in 2035.

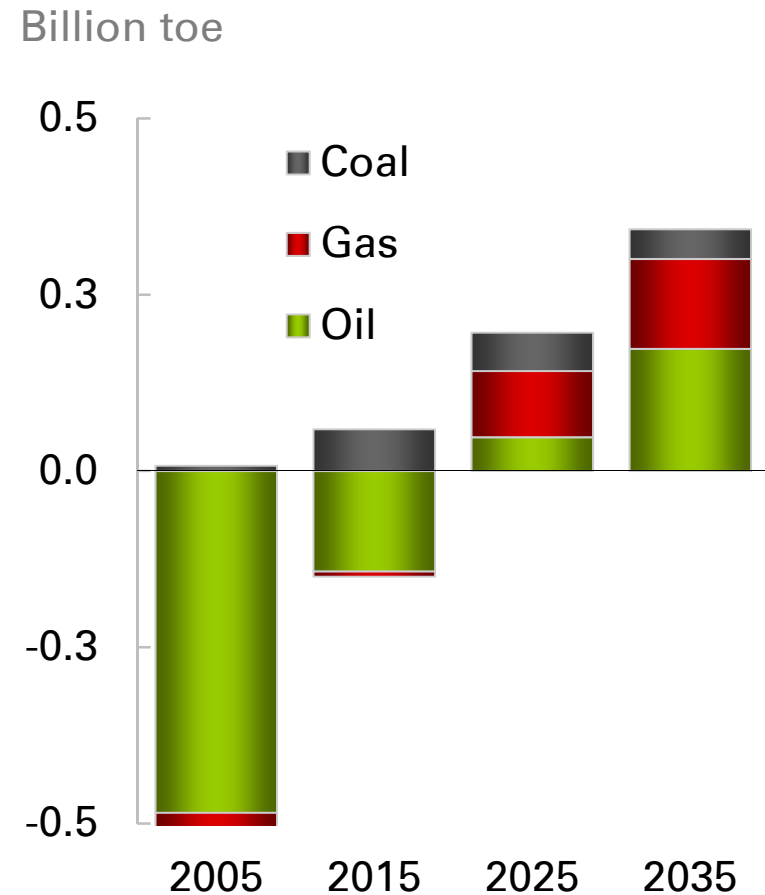


North America is unique among regions...

Primary energy net balances



Regional fossil fuel balances





...in that it switches from being a net importer to exporter

- Regional energy imbalances suggest that trading relationships will change significantly by 2035. North America switches from being a net importer of energy to a net exporter around 2018. Meanwhile, Asia's need for imported energy continues to expand; by 2035 Asia accounts for 70% of inter-regional net imports, and nearly all of the growth in trade.
- Among exporting regions, the Middle East remains the largest net regional energy exporter, but its share falls from 46% in 2012 to 38% in 2035. Russia remains the world's largest energy exporting country.
- In 2005, North America's oil imports accounted for 23% of the world's net inter-regional energy imports. By 2035, the region will be a net oil exporter, which will account for 6% of global energy exports.
- In addition, the region will continue exporting coal and become a net exporter of natural gas after 2015. All told, by 2035 the region's exports will account for 11% of the inter-regional total, compared to 2005 when North America accounted for 24% of the world's imports.

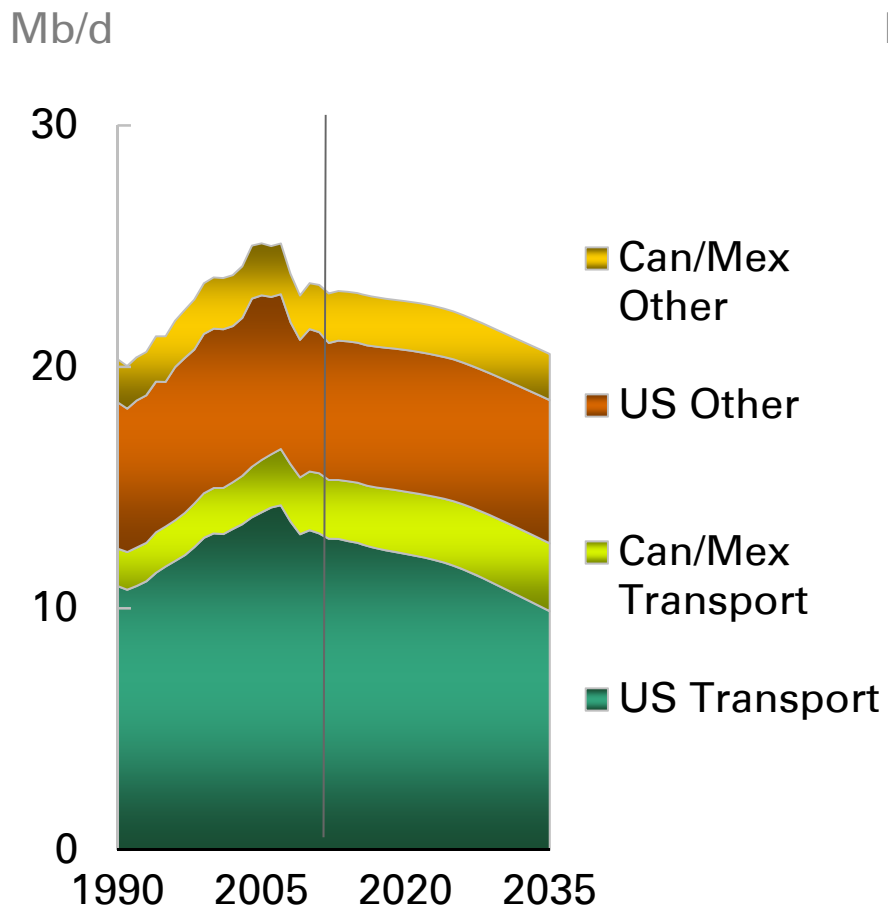


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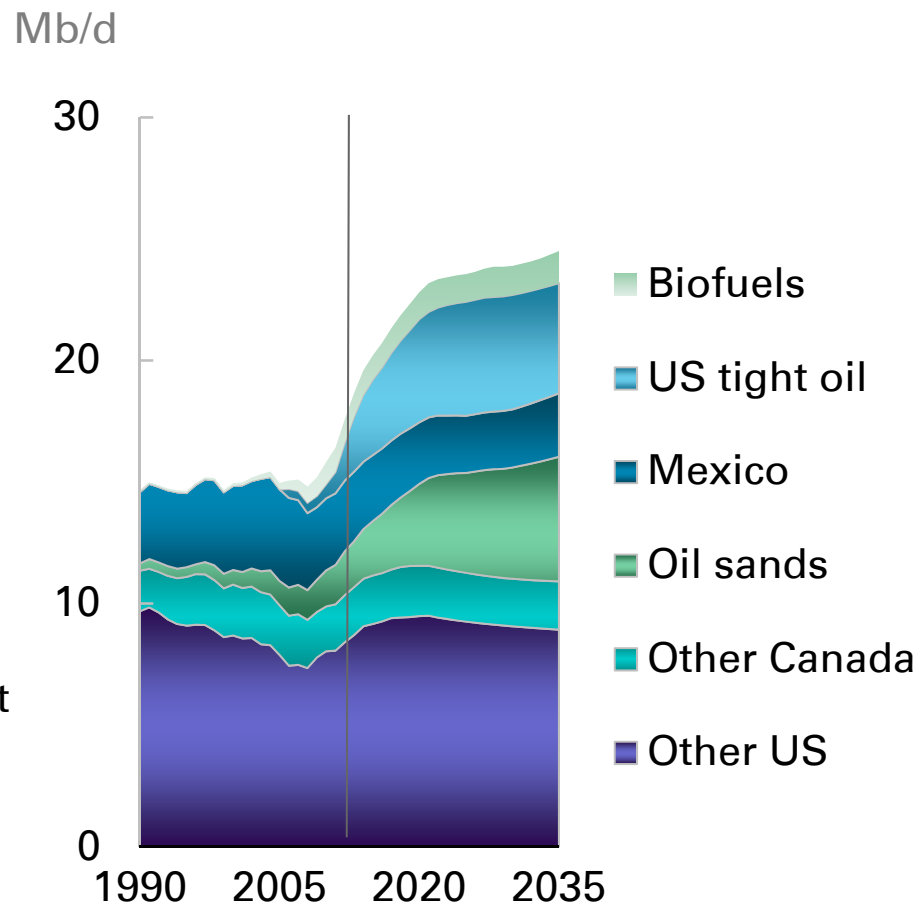


Falling transport demand and rising unconventional...

Liquids demand by sector



Liquids supply by source



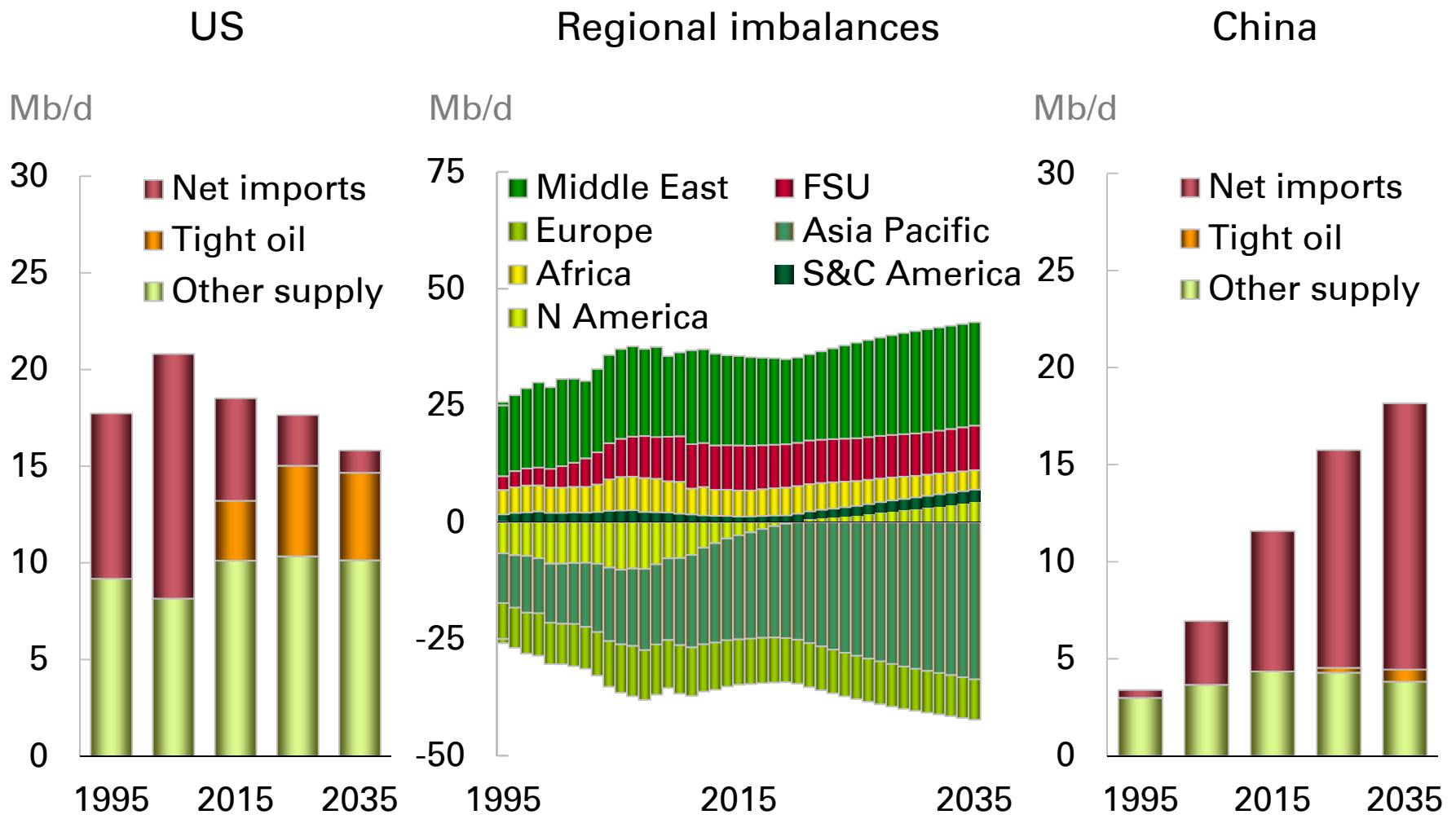


...are upending North American oil balances

- Liquids consumption is likely to drop by 2.5 Mb/d to 20.5 Mb/d by 2035 with declines in US transport accounting for more than all the net decline. By 2035, US demand will be 24% lower than the 2005 peak.
- Fuel economy improvements have accelerated due to consumer reactions to rising prices, tightening policy, and enabled by technological improvements. Enhancements to the internal combustion engine and gradual hybridization of the fleet are expected to sustain efficiency gains.
- Meanwhile, supply growth will be driven by unconventional oil, with gains in US tight oil (3 Mb/d), Canadian oil sands (3.3 Mb/d), and biofuels (0.4 Mb/d) all contributing to regional growth. The US (3.6 Mb/d) and Canada (3.4 Mb/d) will experience the largest non-OPEC supply increases in the world.
- Overall, North American liquids supply will increase by 42% by 2035 compared to today's levels, and by 63% when compared to 1990. The US will surpass Russia and Saudi Arabia in 2013 as the largest liquids producer in the world, primarily due to tight oil growth.



Oil trade continues to shift from West to East...





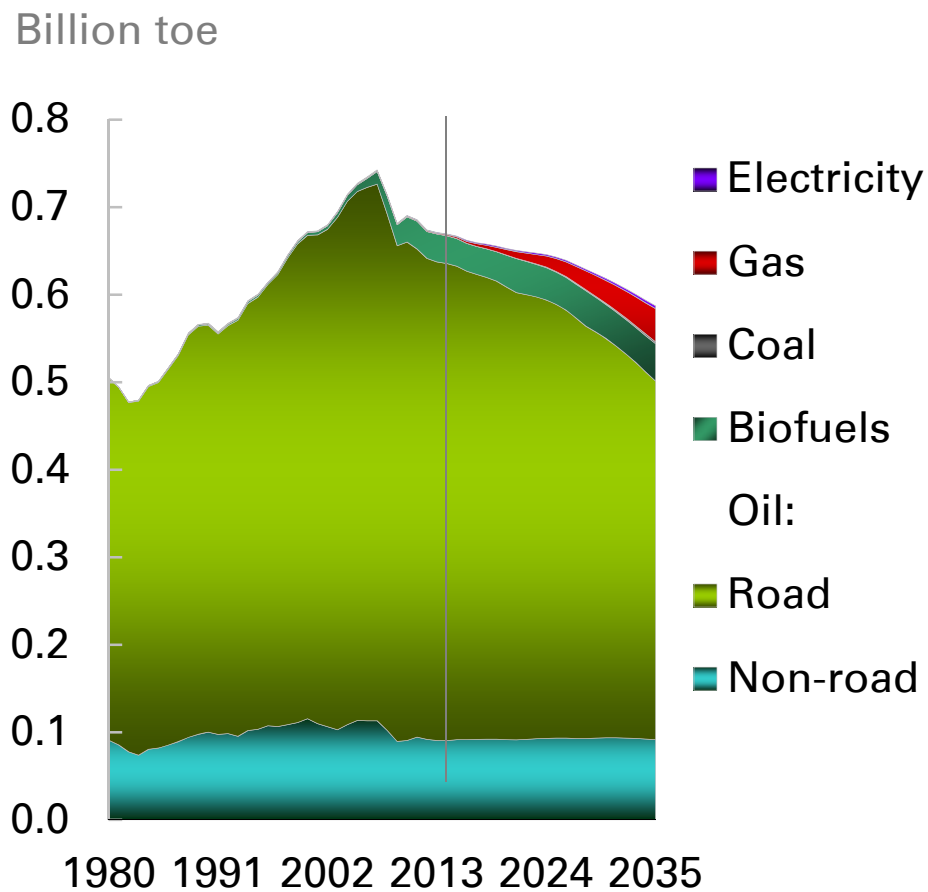
...as Asian imports surge amid North America's transformation

- In the US, the increase in tight oil production coupled with declining demand will continue the dramatic shift in import dependence. Imports are set to decline from a peak of well over 12 Mb/d, or 60% of demand, in 2005 to just 1 Mb/d, or less than 10% of demand in 2035.
- China's import requirement, on the other hand, is projected to more than double from today's levels to almost 14 Mb/d, or 75% of demand, a level and share of demand higher than the US at its peak. China will likely surpass the US as the world's largest importer in 2014 and the largest consumer by 2029.
- On a regional basis, led by China's growing import requirement, Asia will account for nearly 80% of inter-regional net imports by 2035, up from 57% today.
- Meanwhile, the Middle East's share of inter-regional net exports will dip from 54% in 2012 to 52% by 2035, suggesting that Asia will not only require Middle Eastern oil, but will also pull oil from other surplus regions such as the Americas, Africa, and the FSU.

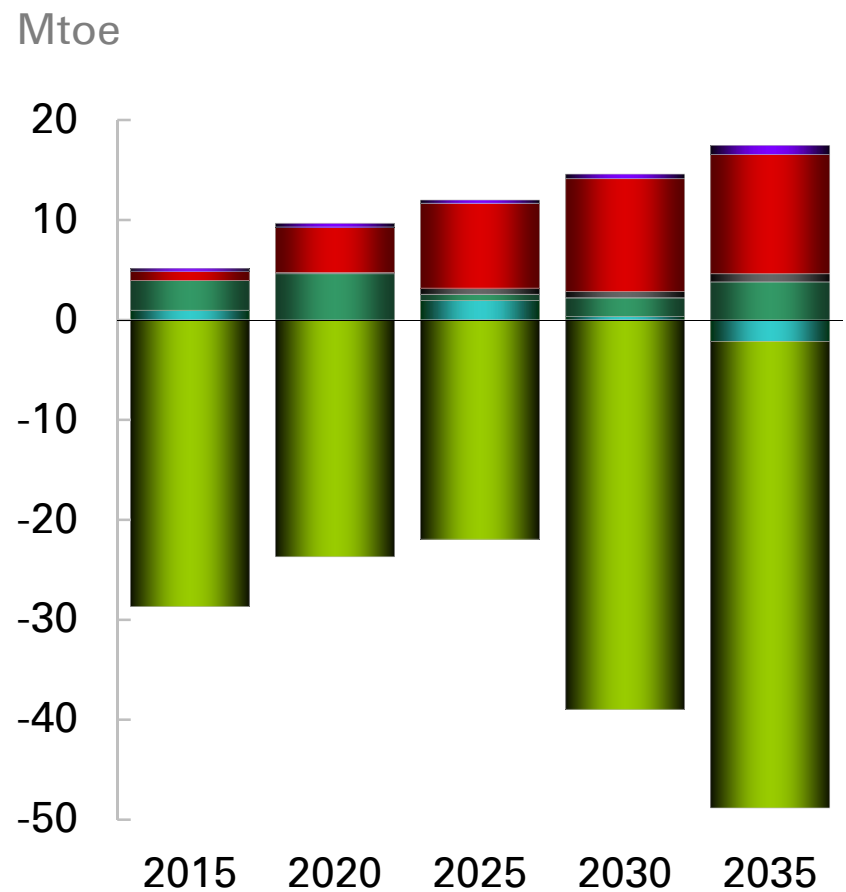


North American transport demand declines...

Transport demand by fuel



Five year increments by fuel





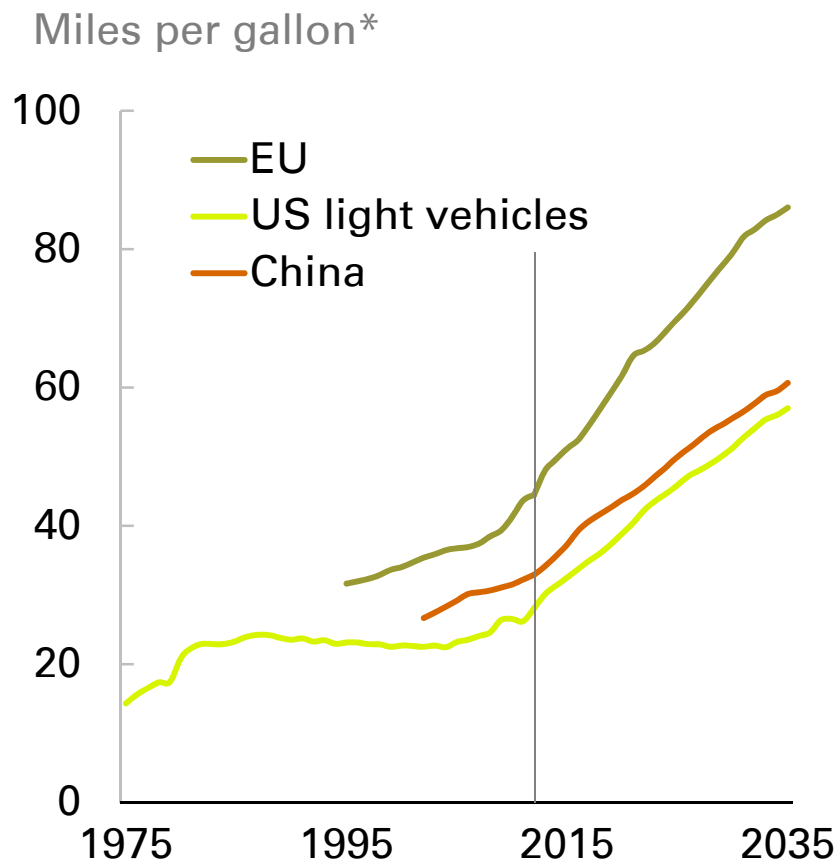
...as prices and policy boost vehicle fuel economy

- North American energy consumption in transport declines (-0.6% p.a.) between 2012 and 2035 (after growing by 0.8% p.a. 1990-2012), primarily due to accelerating gains in fuel economy. Other factors include reduced average miles driven (as with fuel economy, partly driven by the impact of high oil prices) and slow growth in the vehicle fleet.
- Transport demand will remain dominated by oil (85% in 2035, mostly for road use): alternatives are likely to remain uneconomic in many market segments without policy support. Natural gas is nonetheless the fastest growing alternative (17% p.a.), particularly LNG for heavy duty vehicles, rail and shipping. Gas is expected to approach the biofuels share by 2035 (which reaches 7% on an energy basis, up from 5% in 2012). Electricity's share remains below 1% as pure electric vehicles remain uncompetitive.
- By the end of the outlook period, natural gas is starting to make significant inroads into the transport sector – during 2030-35 natural gas makes up 70% of non-oil transport fuels growth and contributes to an acceleration in the decline of oil demand, which during this period falls by 49 Mtoe (-1.8% p.a.).

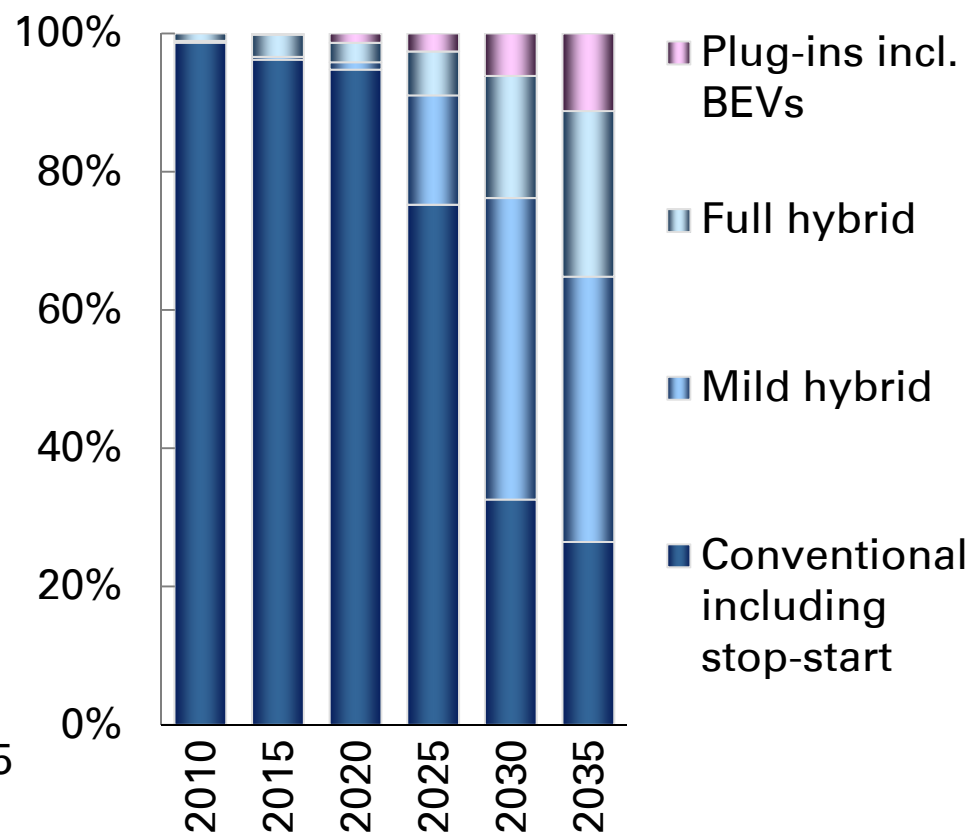


Policy and technology enable efficiency improvements...

Fuel economy of new cars



Vehicles sales by type



*New European Driving Cycle Basis



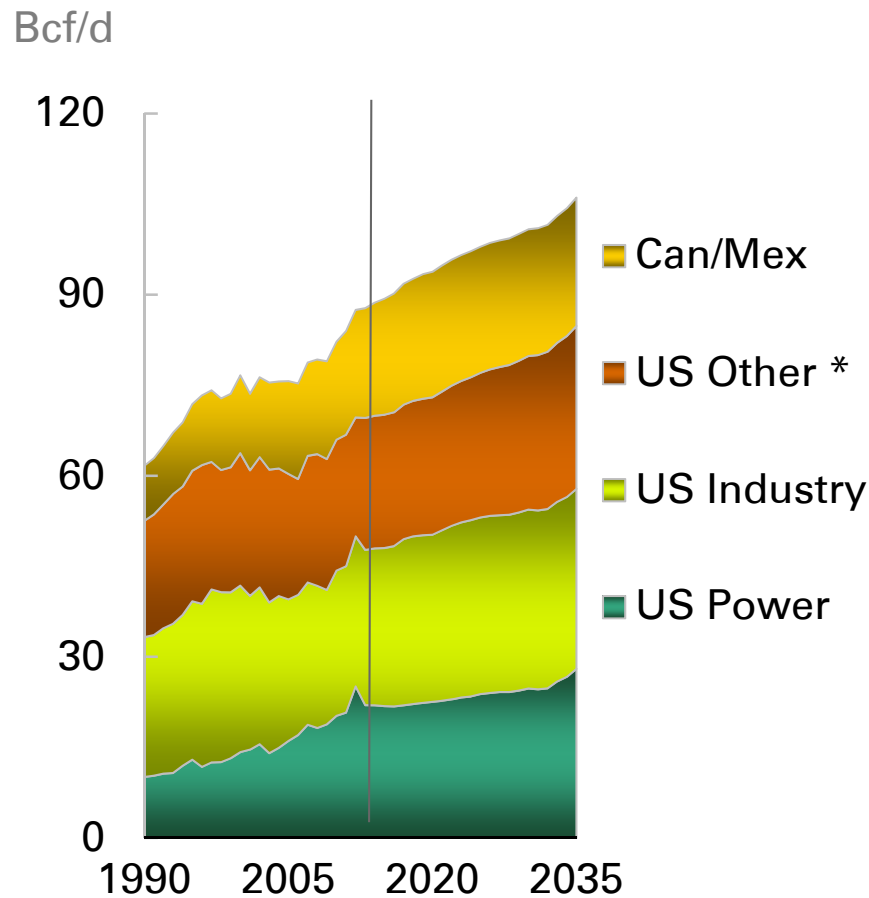
...as the vehicle fleet gradually shifts to hybrids

- Fuel economy has been improving in recent years at rates not seen since the period after the first oil price shock in 1973. Recent gains have been driven by consumer reaction to rising prices and tightening policy (e.g. CAFE standards in the US and CO₂ emissions limits in Europe) and have been made possible by technology improvements.
- Efficiency gains are likely to be sustained, with new car fuel economy in the US, EU and China improving by 2.5%-3% p.a. over the outlook period. The gains come initially from powertrain enhancements (direct injection, stop-start, engine downsizing, boosting) and other measures such as light-weighting, followed by the gradual penetration of hybrid powertrains into the vehicle fleet.
- By 2035, conventional vehicles in North America are just 26% of total sales, while hybrids dominate (full hybrids 24%, mild hybrids 38%). Plug-in vehicles, including full battery electric vehicles (BEVs), are forecast to make up 11% of sales in 2035. Plug-ins have the capability to switch to oil for longer distances and are likely to be preferred to BEVs, based on current economics and consumer attitudes toward range limitations.

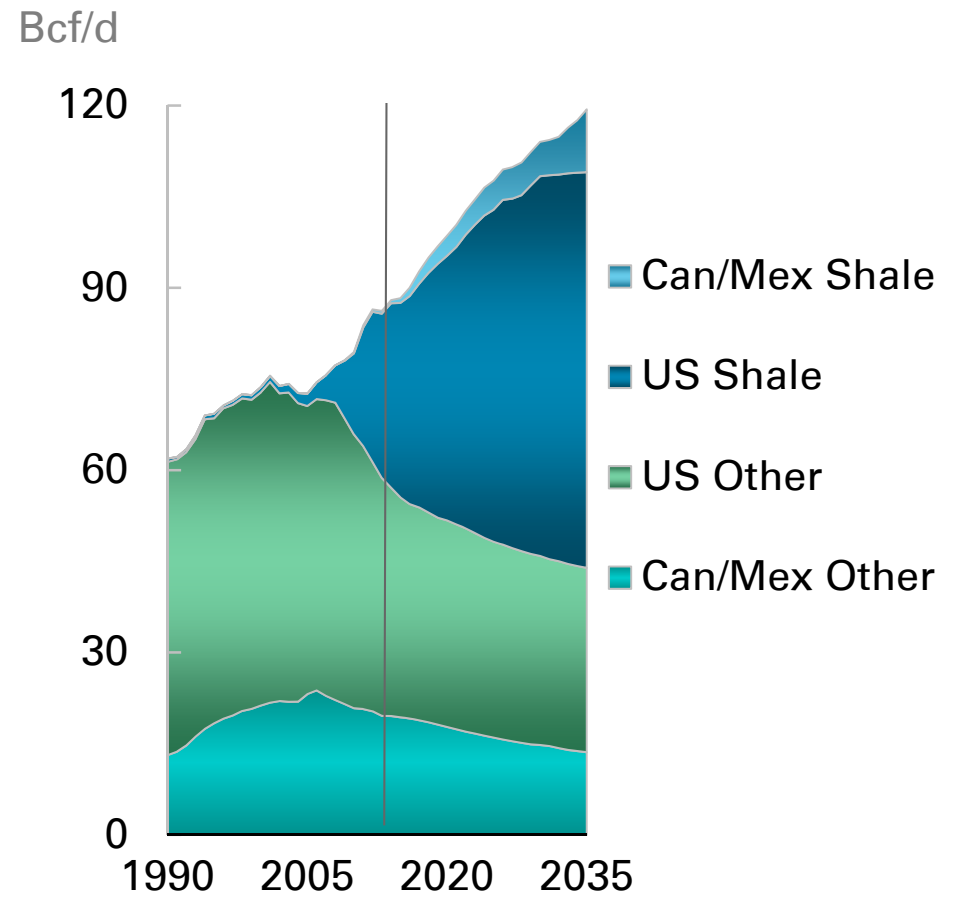


US natural gas use increases in all sectors...

Gas demand by sector



Gas supply by source



*Includes transport



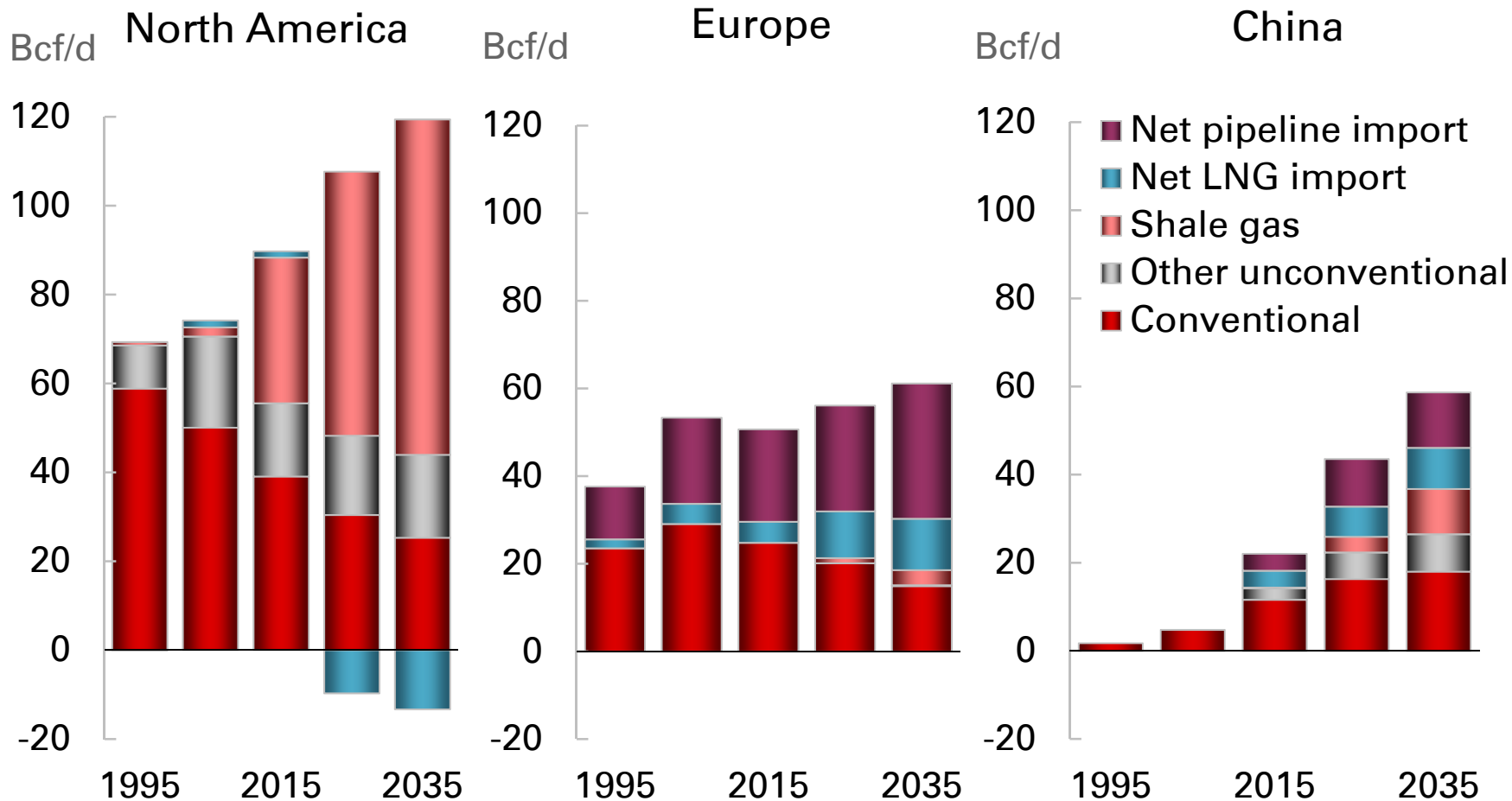
...while shale gas increasingly dominates supply

- North American natural gas demand will reach 106 Bcf/d by 2035 (+18.6 Bcf/d). US growth will be in all sectors: industry (5 Bcf/d), transport (3.9 Bcf/d), other (3.4 Bcf/d), and power generation (2.9 Bcf/d). Demand in Canada and Mexico also increases (3.5 Bcf/d), largely for power generation. In 2035, the region will account for 21% of global demand.
- In the US, natural gas (and renewables) displaces coal in power generation; gas (and electricity) also displaces coal in industrial use. Gas use in power generation expands by 12% and in industry by 20%. Gas in transport reaches an 8% market share in 2035, matching that of biofuels.
- Meanwhile, the supply of shale gas continues to grow robustly in the US (40 Bcf/d), joined later by growth in Canada and Mexico (10 Bcf/d), more than offsetting declines in regional conventional supplies (-17 Bcf/d). The US will remain the largest natural gas producer in the world, accounting for 19% of total supplies in 2035.
- Shale gas supplies will account for 63% of regional output by 2035, up from 29% today and just 2% ten years ago.



Differences in the prospects for unconventional gas...

Sources of gas supply by region





...help shape regional supply patterns

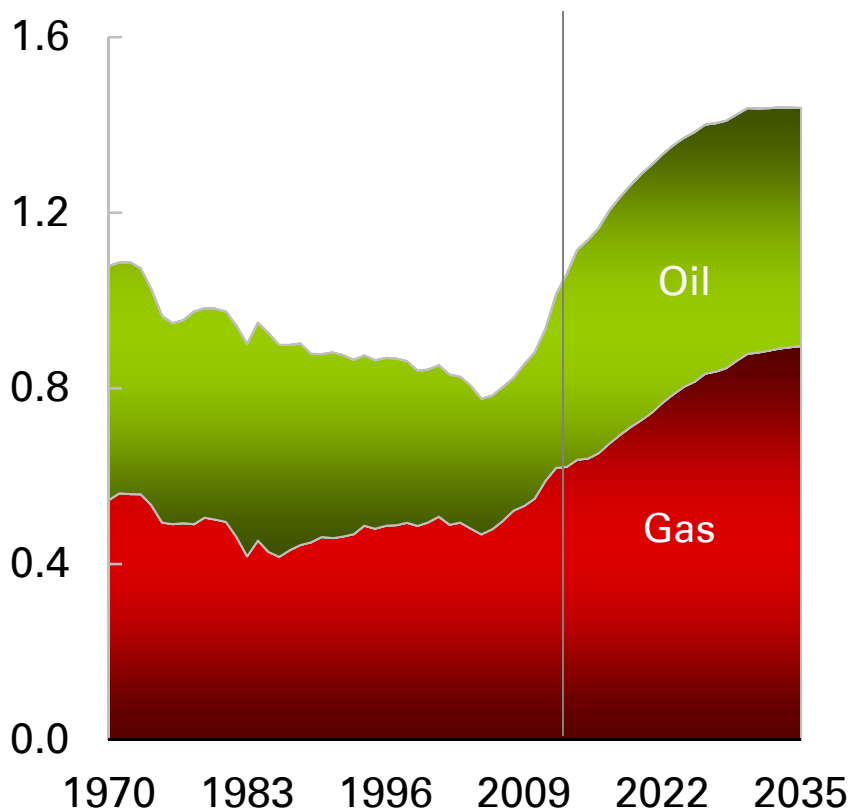
- North American unconventional gas production growth will more than meet rising consumption, making the region a net exporter by 2017. The US is set to become a net exporter in 2018, with net exports reaching 10.6 Bcf/d by 2035. It will become a net LNG exporter from 2016, and will account for 15% of global LNG exports 2035.
- Europe sees domestic production decline by 1.4% p.a. over the outlook, despite expanding unconventional supplies reaching 3.7 Bcf/d by 2035. Although European gas demand grows by just 1% p.a., Europe increasingly relies on imported gas, in particular on net imports via pipeline which meet 51% of demand by 2035, up from 37% today.
- China, by contrast, enjoys strong growth in domestic production (5.7% p.a.) across all types of supply. Shale gas makes the largest contribution to growth (10 Bcf/d, 43% p.a.), with most of it coming on line after 2020. Nonetheless, Chinese demand growth will still require a rapid expansion of imports (8.3% p.a.) both via pipeline and LNG. Pipeline imports from the FSU remain the dominant source of imports, expanding by 8% p.a..



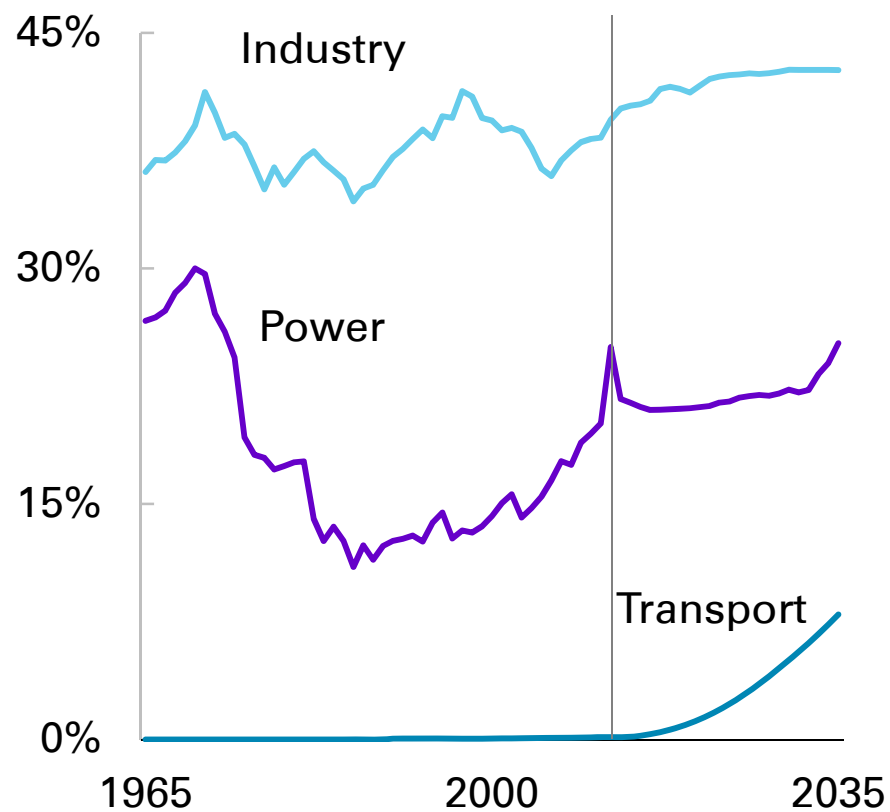
The shale revolution in the US provides an example...

US oil and gas supply

Billion toe



Gas share of US sector demand





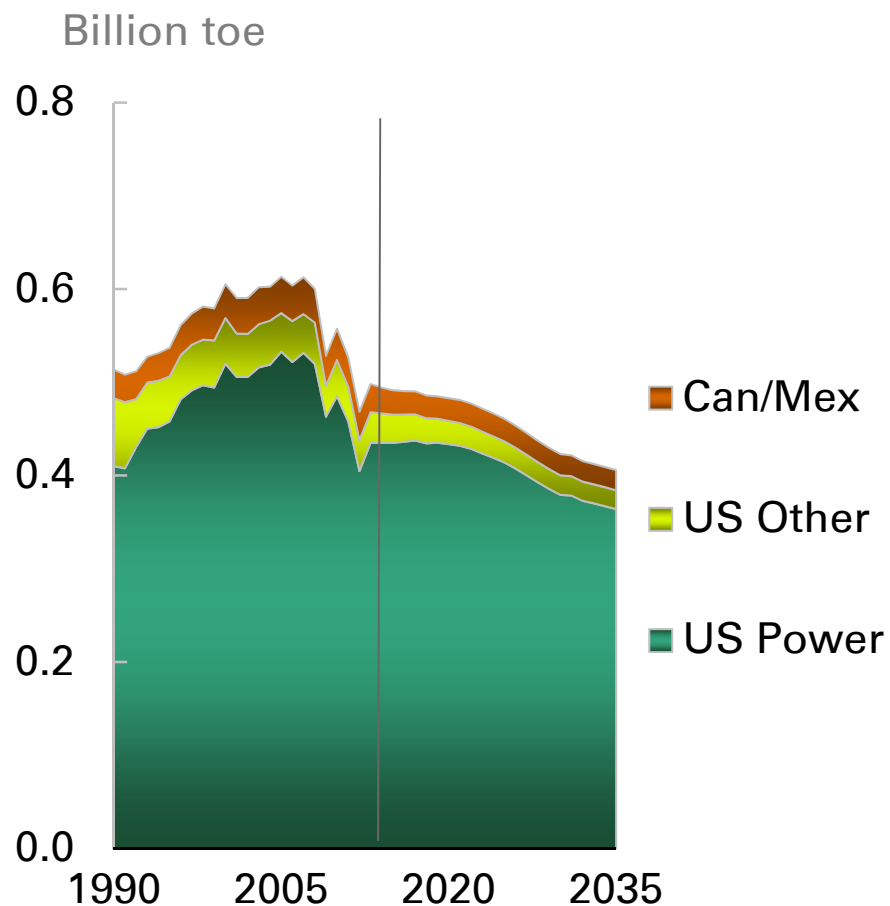
...of how energy markets adjust

- US shale gas output will grow by 4.3% p.a. between 2012 and 2035, enabling overall US natural gas production to rise by 45%. This is causing a series of adjustments in energy markets: some already evident, others developing over time.
- One of the first responses has been on the supply side. A flexible rig fleet that can switch between oil and gas has responded to relatively low gas prices by focusing more on liquids growth.
- On the demand side, shale gas gives US natural gas a competitive advantage relative to other fuels. This is already visible in the power sector, where gas is likely to continue to grow (0.5% p.a.) at the expense of coal, despite the rapid expansion of renewables.
- Next, new investment responding to lower gas prices will drive an increase in gas's market share in the industrial sector, from 39% in 2012 to 42% by 2035. And later in the forecast period, gas will start to penetrate the transport sector: gas will be the fastest-growing fuel (18% p.a.) in a sector where overall demand is falling (-0.9% p.a.).

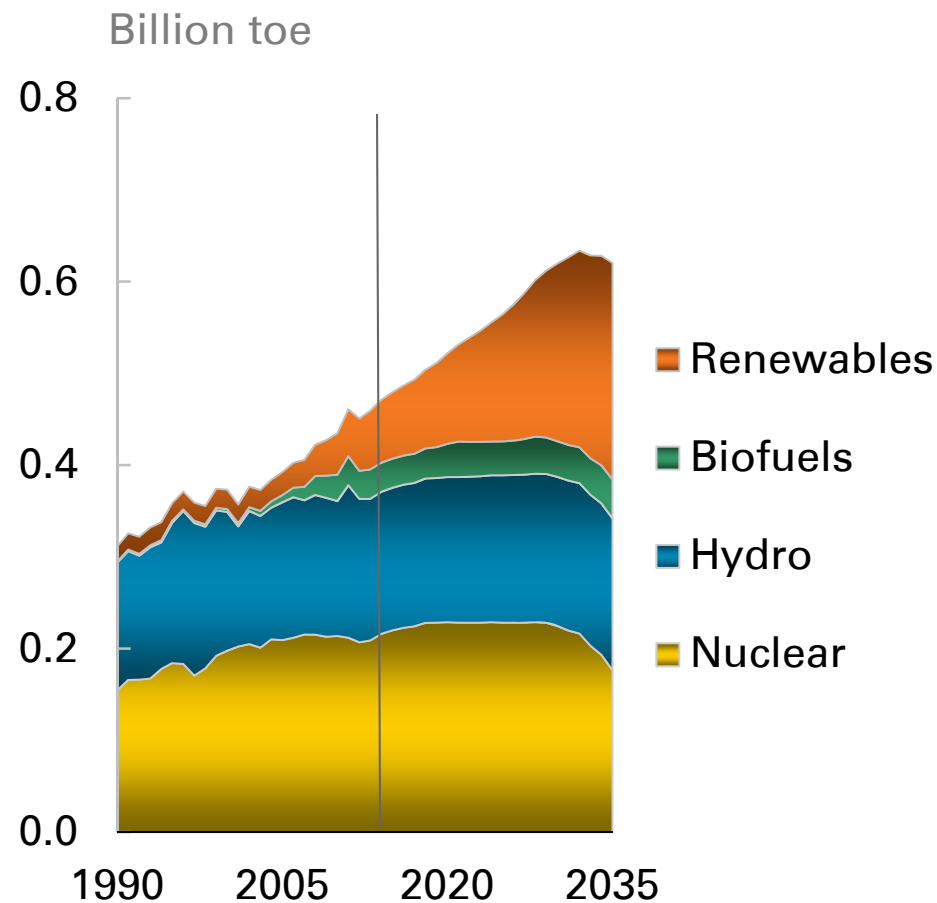


Coal demand continues to decline in North America...

Coal demand by sector



Non-fossil fuel demand





...while renewables expand in power and transport

- Coal consumption falls (-0.6% p.a.) from 2012 to 2035 in North America, with demand in 2035 13% lower than it is today despite overall growth of 14% for power demand (the sector in which coal is almost exclusively used in the region).
- In the US, competitively-priced natural gas, rapidly growing renewables, and regulatory pressures on coal-fired power plants all limit coal's use. Despite this decline, coal will remain the dominant fuel in power generation.
- Renewables (including biofuels) on the other hand grow by 5.2% p.a. from 2012 to 2035 at the regional level, and by 4.7% p.a. in the US. Renewables in power generation reach a regional market share of 18% in 2035, while biofuels capture 7% in transport. In the US, renewables in power generation increase by 277%, while biofuels demand rises by 31%, increasing the share of renewables in power and transport.
- Nuclear generation declines by 15% (-17% in the US) due to plant retirement at the end of the outlook while hydro increases by 6%.



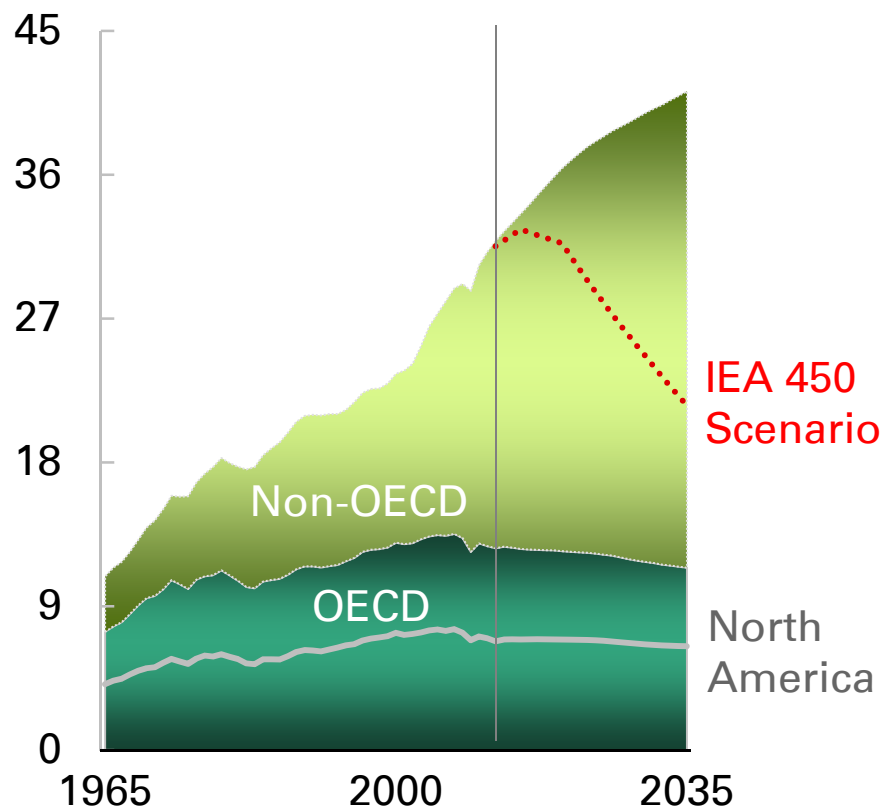
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CO₂ emissions from energy use continue to rise globally...

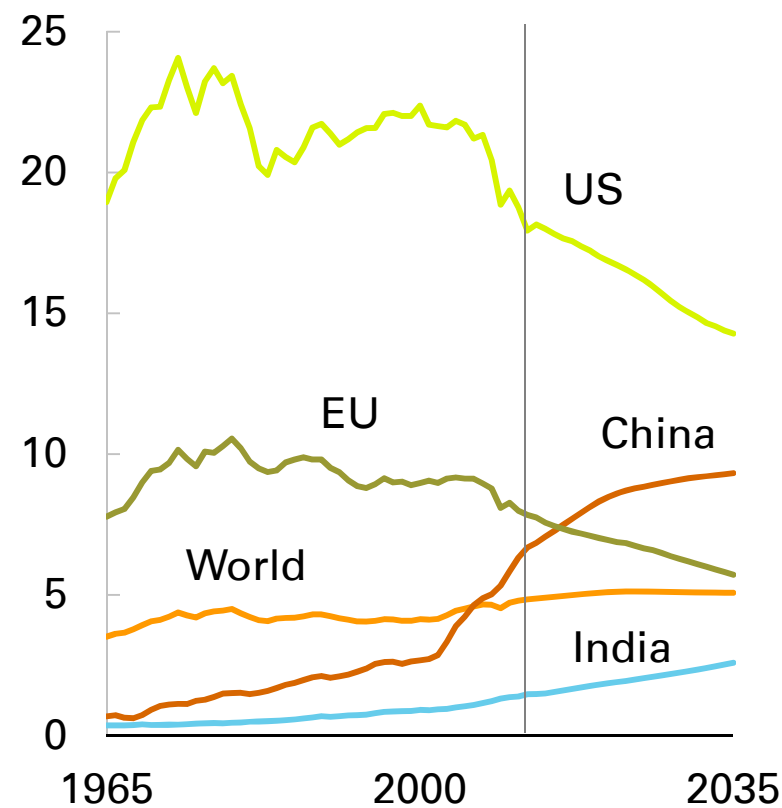
Emissions by region

Billion tonnes CO₂



Emissions per capita

Tonnes CO₂





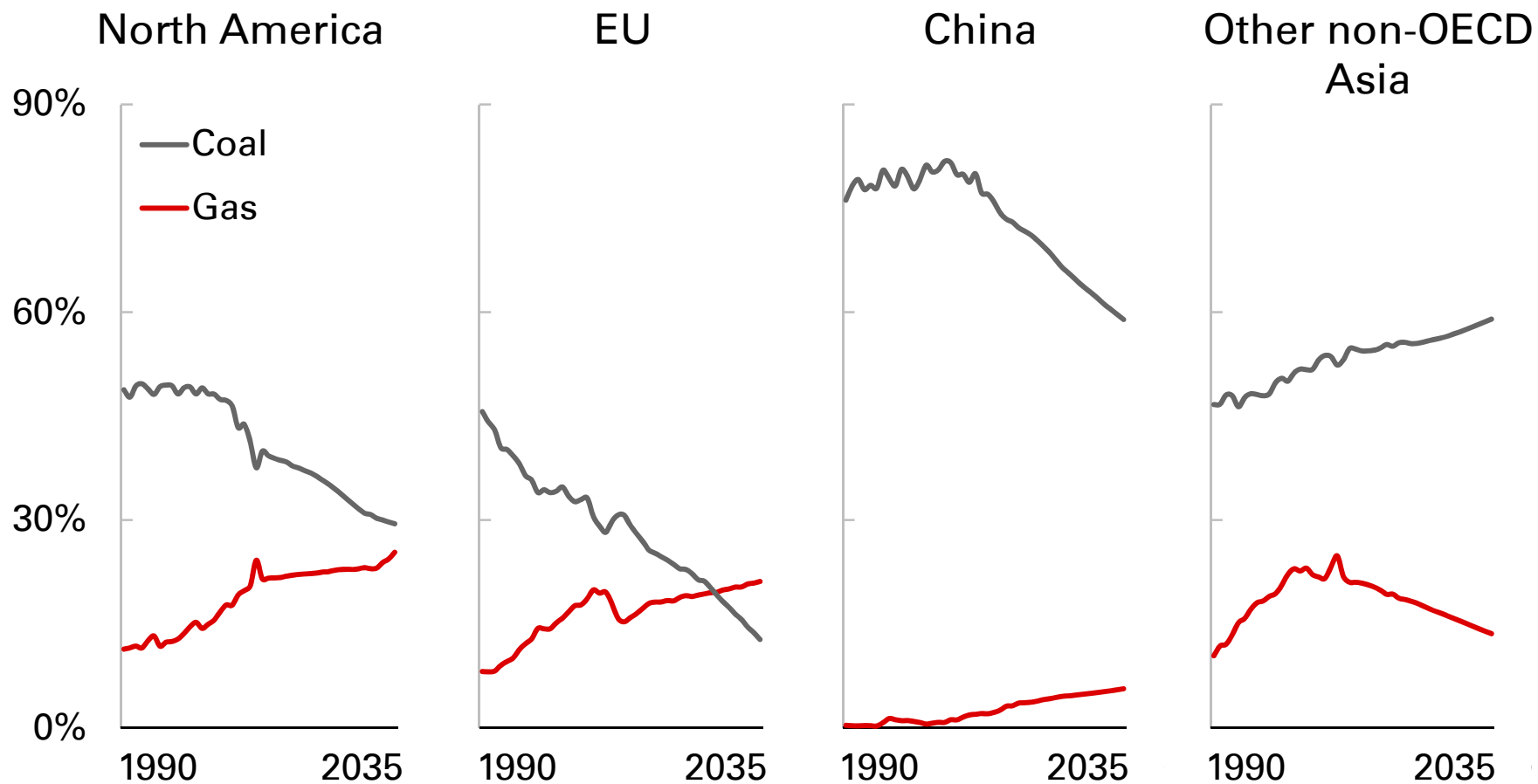
...but decline in North America

- Global CO₂ emissions from energy use grow by 29% or 1.1% p.a. over the forecasting period. Policies to curb emissions continue to tighten, and the rate of growth of emissions declines, but emissions remain well above the path recommended by scientists (illustrated by the IEA's "450 Scenario"). Global emissions in 2035 are nearly double the 1990 level.
- Emissions growth is due to non-OECD economies (1.9% p.a.) while OECD emissions continue to decline (-0.4% p.a.). The OECD falls back to 1990 levels; non-OECD emissions in 2035 are more than triple the 1990 level.
- In North America, emissions drop by 0.2% p.a. and in the US by 0.3% p.a.. US emissions in 2035 return to levels not seen since 1987. Emissions decline despite a small increase in energy consumption, as the North American energy mix gradually decarbonizes.
- In per capita terms, China overtakes the EU in 2017, and the OECD average in 2033, but remains well below the US level in 2035.



The power sector is the main driver of fuel mix changes...

Share of power sector fuel consumption





...with different regional outcomes for coal-gas competition

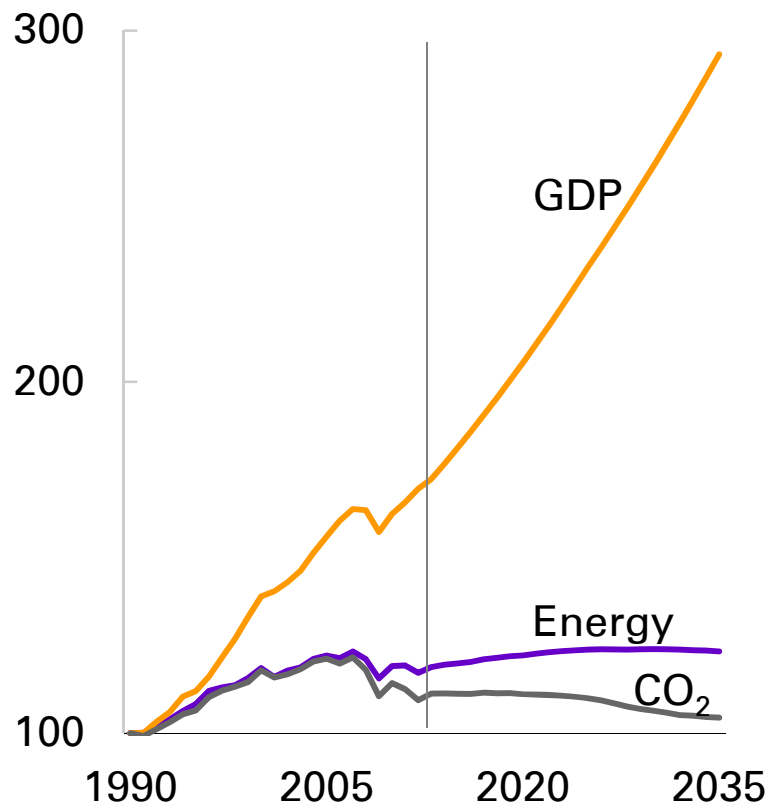
- The power sector, where all fuels compete, is the largest and most diversified driver of the global fuel mix. The global competition between coal and natural gas gives an example of the underlying forces at work.
- Changes are relatively small on the global level. The share of coal in power generation falls from 43% to 37% between 2012-35, while the share of natural gas remains at 21%. But these aggregate changes mask much livelier regional patterns.
- In North America, gas gains on the back of new technologies unlocking new, cheaper supplies. In the EU, a similar outcome but on the back of carbon price and climate change policy (but note the temporary replacement of gas with cheaper coal in recent years). China's economy is based on local coal; economic rebalancing and a preference for cleaner fuels will, with rising income, gradually change this situation. In the rest of developing Asia, coal simply remains the most economic option.
- These massive changes partly offset each other. Except in the EU, they are driven by economics.



Energy efficiency is restraining North American emissions...

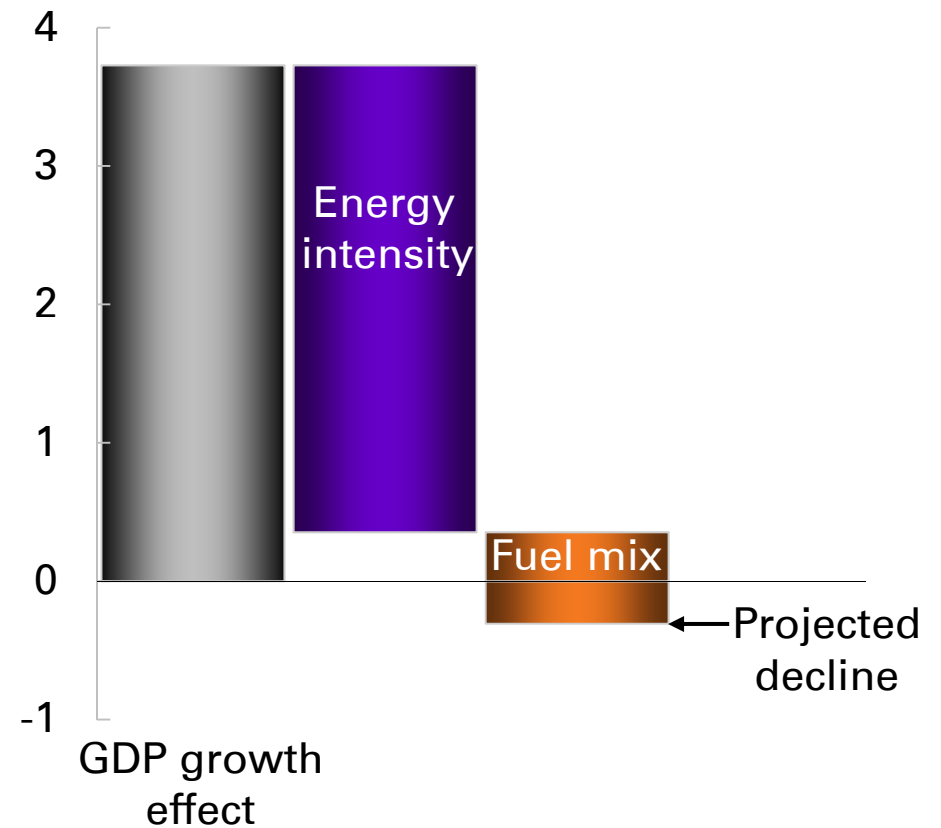
GDP, energy and emissions

Index: 1990 = 100



Emissions growth 2012 to 2035

Billion tonnes CO₂



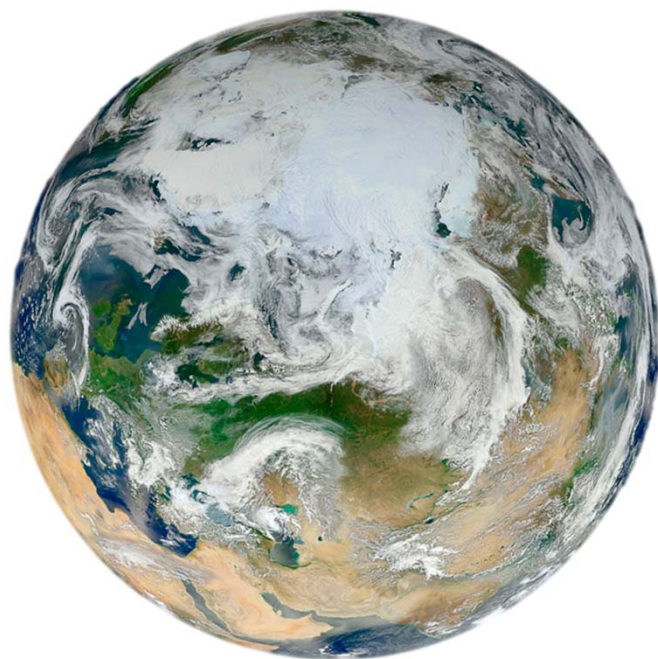


...but fuel mix changes remain a missed opportunity

- The widening gap between GDP and energy consumption illustrates the impact of falling energy intensity; and the gap between energy and CO₂ emissions reflects changes in carbon intensity, brought about by changes in the fuel mix.
- Without the projected decline in energy intensity, CO₂ emissions in 2035 would be more than 50% higher than our forecast, given the projected economic growth. The effect of the expected change in the fuel mix is much smaller – about one-fifth as large – though bigger than in the past.
- More than two-thirds of the fuel mix effect comes from the rising share of renewables; most of the remainder comes from changes in the fossil fuel mix, in particular, the substitution of coal with gas.
- Competition and innovation, guiding the global improvement in energy intensity, are not directing changes in the energy mix toward faster improvements of carbon intensity. The market does not do for carbon intensity what it does for energy intensity because energy is costly, and carbon is not.

Conclusion

Meeting the global/North American energy challenge



- Sufficient and available?
 - Yes – new energy sources and efficiency improvements
 - North America leads the way
- Secure and reliable?
 - Mixed – improving for North America, a concern for others
- Sustainable?
 - Room for improvement, even with lower North American emissions