



International
Energy Agency

**BACKGROUND PAPER BY THE
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Key Points

- In 2011 the oil market continued to tighten. There were unexpected shortfalls in both OPEC and non-OPEC supply.
- In 2012 world growth should slow, supply improve and market fundamentals ease. But geopolitical uncertainty may keep prices high.
- Our longer-term view (to 2035) is based on a New Policies Scenario assuming moderate implementation of countries' existing policies and public commitments.
- Energy demand will increase by one third, with 90% of that growth outside the OECD.
- Demand for all fossil fuels increases, but apart from gas their share of the global energy mix declines.
- All of the net increase in oil demand comes from the transport sector in emerging economies, while oil companies have to turn to more difficult and costly sources.
- Trading patterns change as the US produces more, improves efficiency and imports less. Emerging Asia's import dependence rises sharply.
- Meanwhile, gas benefits from fuel diversification, increased LNG trade and rapid development of unconventional gas (which reaches 1/5 of total gas production by 2035).
- Coal should continue to grow strongly for ten years: beyond that, growth will depend on government policies and developments in clean coal technology.
- Non-hydro renewables see impressive growth to 15% of power supply. Technologies are increasingly competitive but will continue to benefit from financial support.
- Phasing out nuclear power in the OECD would raise demand (and prices) for fossil fuels and make it harder and more expensive to combat climate change.
- "Energy for all by 2030" is achievable with only marginal impact on GHG emissions. But it needs more investment, clearer policies and engagement with the private sector.
- Policies to address climate change become more effective, but more is needed and the door to capping temperature rise at 2°C is closing.

The Current Oil Market

Oil market fundamentals continued to tighten throughout 2011, sustaining crude prices at elevated levels, despite concerns about global economic slow-down. IEA estimates from the latest *Oil Market Report* suggest that implied global stock draw during 2011 averaged 0.6 mb/d, after the 0.9 mb/d tightening seen in 2010. OECD total industry oil stocks fell below five-year average levels in July and ended December some 29 mb in deficit, at 2 611 mb. OECD stocks appear tightest in Europe and the Pacific, but North American inventory stands above the five-year average. The market looks less tight when forward demand cover is assessed. At 57.2 days, end-December stock cover was 1.6 days' supply higher than the five-year average.

Whereas market tightening in 2010 derived from post-recession demand strength, the focus in 2011 shifted to supply shortfalls. Libyan crude supply has recovered sharply recently, but nonetheless a total of 425 mb of supply was lost due to the crisis in 2011, of which only around 75% was compensated by higher supply from other OPEC producers and the IEA Collective Action combined. Tight 2011 oil supply conditions were exacerbated by exceptional unplanned stoppages affecting non-OPEC supply during 2Q11 to 1Q12, averaging 650-750 kb/d throughout. This affected, among others, the North Sea, Canada, China, Syria, Yemen and latterly Sudan/South Sudan, nearly eradicating anticipated non-OPEC growth for the year, and causing supply growth to lag even the muted global oil demand growth of 0.7 mb/d seen in 2011.

Prospects for 2012

Looking ahead through 2012, our projections assume that global GDP growth slows this year from 2011's 3.7% to 3.3%. The European economy contracts by 0.2%, while North America and the Pacific see growth averaging close to 2%, slightly stronger than in 2011. Non-OECD economic and oil demand growth remain more robust, with collective economic growth of 5.7%, albeit China slows from 9.2% to 8.2%. Overall, global oil demand is seen averaging 89.9 mb/d in 2012, an increase of 0.8 mb/d from 2011. Despite slowing growth, China nonetheless generates nearly 50% of total 2012 demand growth. Non-OECD demand grows by 1.2 mb/d, while in the OECD, sluggish economic growth and high prices combined see demand contract by 0.3 mb/d.

Risks within the oil demand outlook appear fairly well balanced: the projection is founded on an assumption that policy makers get to grips with the euro zone debt crisis. Failure to do so would imply weaker economic growth and could eclipse global oil demand growth entirely. On the other hand, weather extremes or fuel switching in the power sector can unexpectedly inflate oil demand levels. Recent experience from nuclear capacity outages in Japan suggests oil demand there some 250-300 kb/d higher than under a normal nuclear capacity scenario.

Our latest outlook envisages markets could be better supplied in 2012 than they were last year. Assuming that exceptional 2011 outages are not repeated, non-OPEC supply is expected to rebound and grow by 0.9 mb/d. Growth has an orientation towards the Americas, and derives from, among others, light tight oil supply in the US, Canadian oil sands, deepwater supply from Brazil and is further augmented by growth from Colombia and Russia. Gas developments among OPEC countries generate a further 0.5 mb/d of condensate and NGL supply growth.

Current OPEC effective spare capacity of 2.8 mb/d is much tighter than the levels above 5 mb/d evident in 2009/2010. However, with OPEC producers expected to add a net increment of 0.83 mb/d in production capacity by 3Q12 (Libya, Angola, Iraq) and with non-OPEC supply growth assumed to outstrip 2012 oil demand growth, there is some prospect for market fundamentals to ease, notably during the first four to five months of 2012. This rather more benevolent outlook for the market in 2012 is of course highly dependent on how several re-emerging supply-side concerns, such as Sudan/South Sudan and, particularly Iran, unfold during the course of the year.

We continue to watch very closely how refiners worldwide deal with the reallocation of crude supplies arising from the imposition of US sanctions and the EU embargo on Iranian oil. Geopolitical uncertainty surrounding events in the Middle East Gulf is already built into today's high, and potentially damaging, crude prices. The market itself remains the best mechanism for ensuring replacement supplies are made available in the event of any supply disruption. Currently there is not a major supply disruption underway, but if the situation changes, then of course IEA emergency stocks exist to provide temporary market liquidity should conditions warrant.

The Outlook to 2035

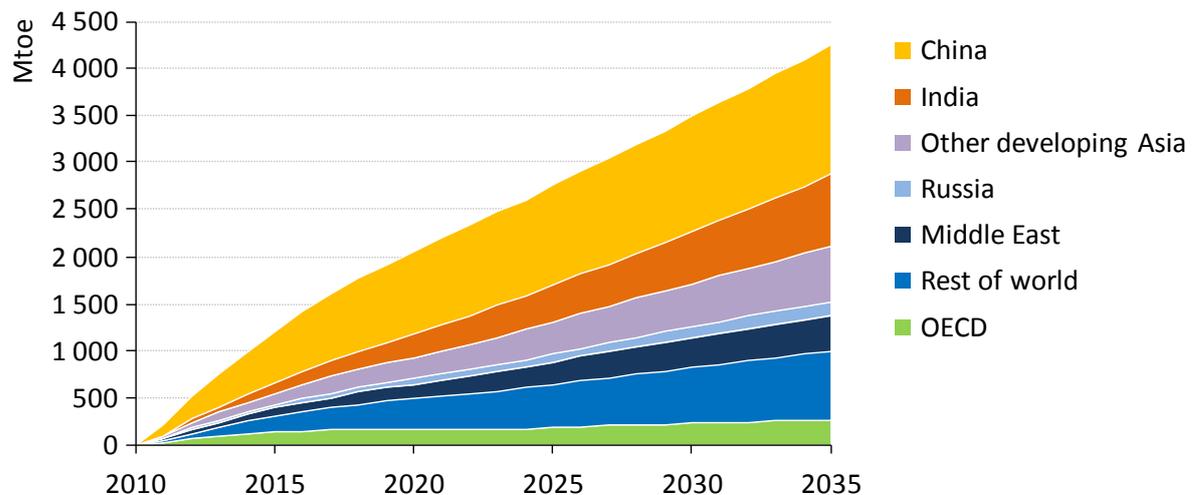
The 2011 edition of the IEA's *World Energy Outlook (WEO-2011)* was released on 9 November and brings together the latest data and policy developments to provide analysis and insight into global energy markets, today and for the next 25 years. *WEO-2011* analyses three scenarios and multiple case studies differentiated by their respective assumptions about future energy-related policies adopted by governments. The baseline for our analysis is the New Policies Scenario. Its policy assumptions take current policies as a starting point and then (cautiously) incorporate the broad policy commitments announced by countries around the world to deal with energy security, climate change, local pollution and other energy-related challenges. These commitments include targets for energy production and energy efficiency, phase-outs or additions of nuclear power, national pledges to reduce greenhouse-gas emissions and the elimination of wasteful fossil-fuel subsidies.

Economic growth, population growth and energy prices are other major assumptions taken in the *WEO-2011* New Policies Scenario. Worldwide, economic growth is assumed to average 3.5% per year and the population is assumed to expand by some 1.7 billion people between 2010 and 2035. In real terms, the IEA crude oil import price rises from \$78 to \$120 per barrel over the *Outlook* period; the North American natural gas import price rises from \$4.4 to \$8.6 per MBtu between 2010 and 2035, but is considerably lower than prices in the other major markets of Europe and Asia given more abundant supplies. These price paths are not a forecast. Rather, they reflect our judgement of the prices that would be needed to encourage sufficient investment in supply to meet projected demand over the *Outlook* period. The New Policies Scenario assumes limited CO₂ prices for some countries, with varying price levels, mechanisms and sectors affected.

Key projections and trends

Global energy demand is projected to increase by one-third between today and 2035 as a result of economic growth and shifting demographic trends such as population growth and urbanisation (Figure 1). These trends are driven by non-OECD countries, which account for more than 90% of the increase in energy demand in the *Outlook* period.

Figure 1: Growth in world primary energy demand by region in the New Policies Scenario, 2010-2035

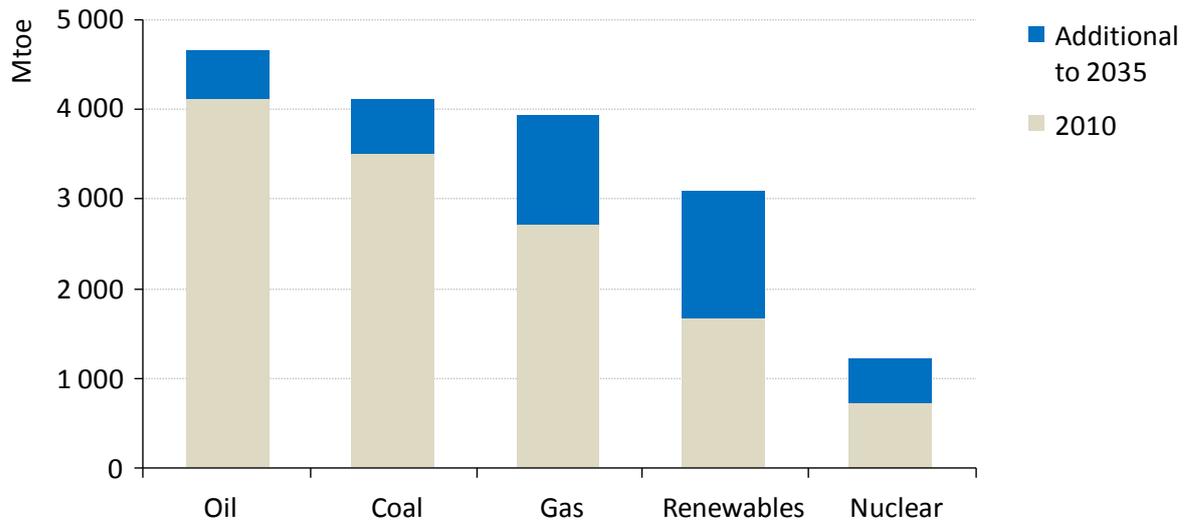


Source: IEA/World Energy Outlook 2011

Given the interdependency of global energy markets, this underscores the critical importance of non-OECD energy policies in shaping our energy future. Fossil fuels remain the dominant source of energy. However, while demand for fossil fuels continues to rise in absolute terms their share of global energy consumption declines from 81% in 2010 to 75% in 2035 as renewable energy technologies make further inroads.

Increasing demand for mobility in non-OECD countries boosts global liquids (oil and biofuels) demand to 104 million barrels per day (mb/d) in 2035, up from 88 mb/d in 2010. The total number of passenger cars doubles, reaching almost 1.7 billion at the end of the *Outlook* period. The rise in liquids use comes despite the continuing emergence of alternative vehicle technologies that use oil much more efficiently or not at all, such as electric vehicles.

Figure 2: World primary energy demand by fuel in the New Policies Scenario, 2010-2035



Source: IEA/World Energy Outlook 2011.

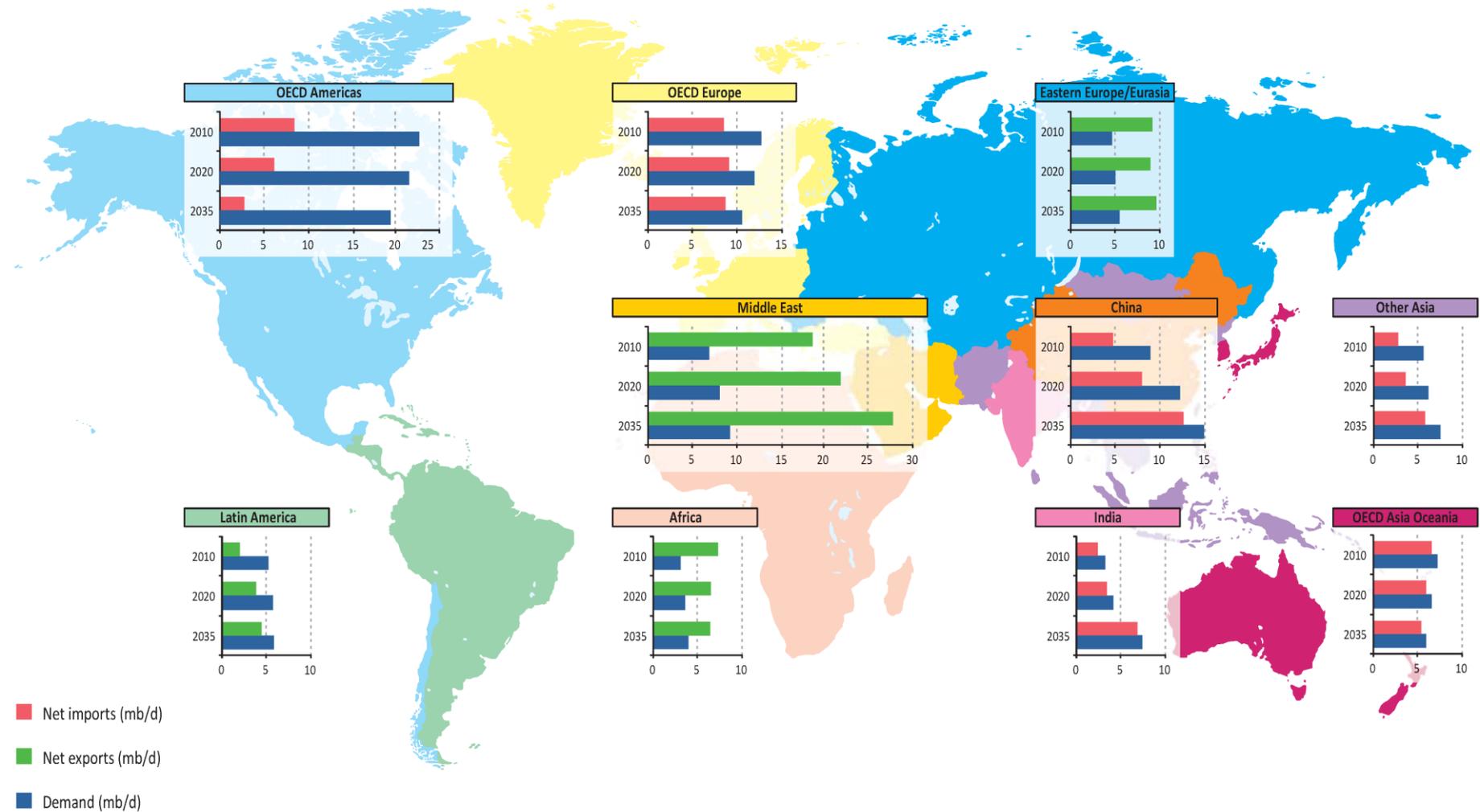
The cost of bringing oil to market rises

On the supply side, oil companies increasingly turn to resources that are more difficult to extract and therefore costlier. Conventional crude oil in total oil supply declines slightly by the end of the *Outlook* period as natural gas liquids (18 mb/d in 2035), unconventional sources (10 mb/d) and biofuels (4 mb/d) make significant contributions to meeting increased demand. Over time, oil supply becomes more concentrated in the Middle East and North Africa. Overall, we project the largest production increases to come from Iraq, adding 5 million barrels per day and Saudi Arabia almost 4 million. OPEC accounts for more than half of production in 2035. By contrast, production declines in most non-OPEC countries, with Brazil, Canada and Kazakhstan being notable exceptions. We calculate that 47 mb/d of gross capacity additions will be needed to replace declining production at maturing oil fields. This necessitates huge investments in upstream oil in the *Outlook* period.

And trading patterns change

Oil trade patterns are also set to change with the rise of major new economic players (Figure 3). We project oil imports to the United States, currently the world's biggest importer, to drop to 6.2 mb/d in 2035 (lower than 1990 levels). This trend underlines the critical role of energy efficiency policies, as improved vehicle efficiency causes US oil demand to decline by 3.5 mb/d (or 20%). It also reflects the potential for expanding supply of US domestic crude oil, natural gas liquids and biofuels. US light tight oil production has shown increasing promise. Imports into Japan also decline while European imports remain relatively flat at 9 mb/d, as demand and regional production decline almost in parallel. However, increasing reliance on oil imports elsewhere heightens concerns about the cost of imports and supply security. Net imports to China exceed 12.5 mb/d by 2035, up by almost 8 mb/d from current levels. India's net imports grow by over 4 mb/d to nearly 7 mb/d – the second-largest increase. The reliance on imports in developing Asia, as a whole increases from 56% of total oil needs in 2010 to 84% in 2035.

Figure 3: Regional oil demand and net trade in the New Policies Scenario (mb/d)



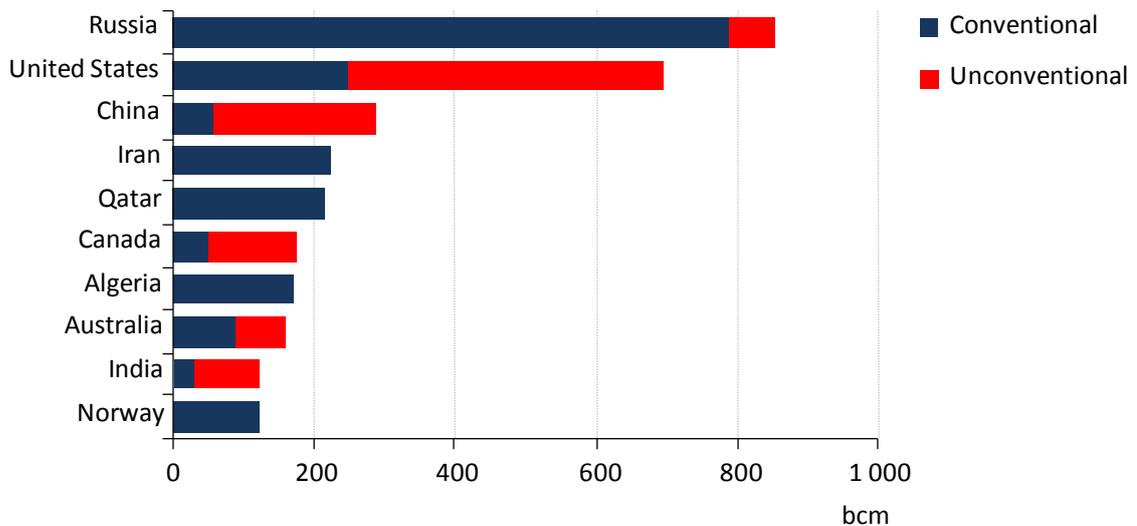
This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Source: IEA/World Energy Outlook 2011.

Golden prospects for natural gas

In our New Policies Scenario, demand for natural gas rises by 45% and it is the only fossil fuel to increase its share of the energy mix. Factors both on the demand and supply sides point to a bright future, even a golden age, for natural gas. On the demand side, natural gas is a particularly attractive fuel for countries and regions that are urbanising and seeking to satisfy rapid growth in energy demand, such as China, India and the Middle East. On the supply side, the combined application of horizontal drilling and well-stimulation techniques such as hydraulic fracturing has unlocked previously non-commercial resources of unconventional gas (including shale gas, tight gas and coal-bed methane). This success has dramatically changed the global supply picture and has had positive implications for gas security. Unconventional gas, being more geographically distributed around the world than conventional resources, now accounts for half of the natural gas resource base. We project that it will account for one-fifth of global gas supply in 2035. However, this future hinges in part on the ability of governments and industry to deal successfully with the environmental concerns – air, water and land impacts – associated with unconventional gas production. The largest contributions for future gas supply growth come from Russia, China, Qatar, the United States and Australia (Figure 4).

Figure 4: Largest natural gas producers in 2035



Source: IEA/World Energy Outlook 2011.

Coal demand remains strong

Over the last decade, coal has met half of the increase in global energy demand. Going forward, coal use and its implications for energy security and the environment will depend largely on policy and technology choices. Furthermore, China and India, the two largest consumers of coal in 2035, will remain key actors in global coal markets. In our New Policies Scenario, we project continued strong growth in coal use in the next 10 years, and a levelling off thereafter as countries diversify.

In this scenario, global coal demand grows by 25% in 2035 relative to 2009. If instead we assume that current policies are maintained (*i.e.* our Current Policies Scenario), global coal demand increases by 65% through 2035. We find that deploying more efficient technologies could have a major impact on air emissions: if the average efficiency of all coal-fired power plants was raised by five percentage points in 2035 relative to the New Policies Scenario, power sector CO₂ emissions would be 8% lower (with local pollution benefits). While carbon capture and storage technologies might boost long-term prospects for coal use, economic and technical hurdles limit its deployment in the New Policies Scenario.

Renewables are pushed towards centre stage

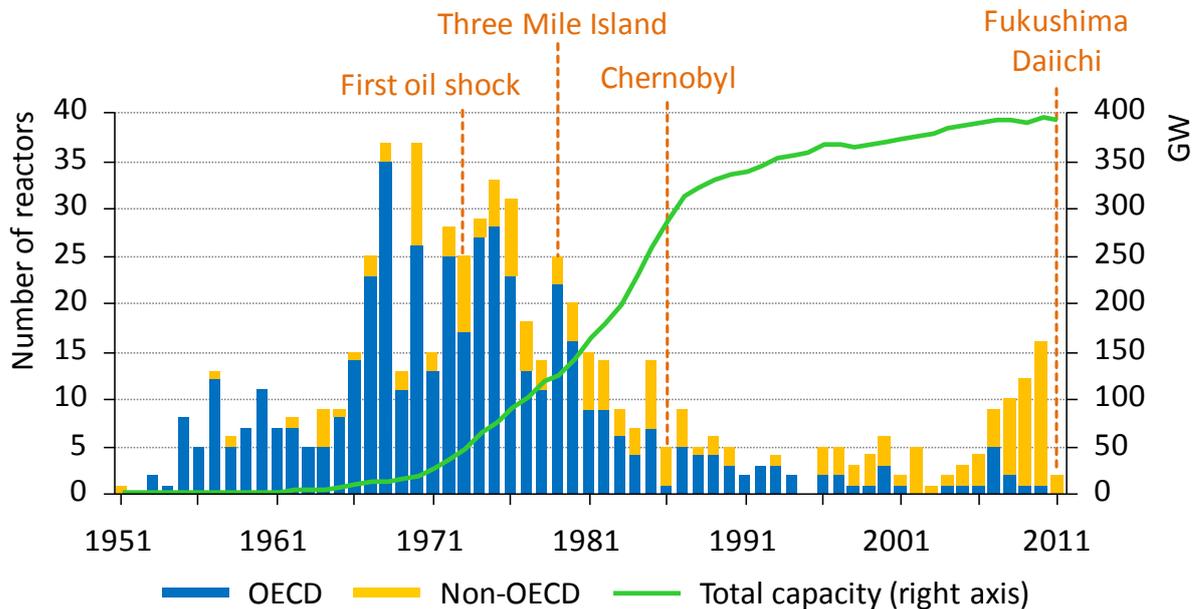
Renewable energy experiences impressive growth during the *Outlook* period. The share of non-hydro renewables (primarily wind and solar) in power generation rises from 3% in 2009 to 15% in 2035, while hydro maintains its share at 15%. Global biofuels supply triples. Cost reductions are making renewable energy technologies more competitive, but subsidies are expected to play an important role in accelerating their deployment and thereby driving further cost reductions. When well-designed, subsidies to renewable energy can bring lasting economic and environmental gains. Even as unit subsidy costs fall, annual subsidies to non-hydro renewables and biofuels expand to \$250 billion in 2035 as deployment scales up. For comparison, global subsidies to fossil-fuel consumption are estimated at \$409 billion in 2010.

But second thoughts on nuclear power would have far-reaching consequences

In considering the long-term implications of Fukushima Daiichi, accidents at Three Mile Island in 1979 and Chernobyl in 1986 are obvious points of reference. These accidents, coupled with other factors, profoundly affected the trajectory of nuclear power, derailing new builds globally over the following decades. New construction starts fell from an average of 26 per year in the 1970s to just 7 in the 1980s and 1990s (Figure 5). Will nuclear power development after Fukushima experience a similar slowdown? For the moment the answer appears to be no as the events have not led to a significant change in policies in countries such as China, India, Russia and Korea that are driving the expansion of nuclear power at the global level. This is confirmed by the New Policies Scenario of WEO-2011 in which nuclear output rises by more than 70% over the period to 2035, only slightly less than projected last year.

Nonetheless, given the increased uncertainty post-Fukushima, the WEO-2011 also examines the possible implications of a more substantial shift away from nuclear power in a Low Nuclear Case, which assumes that no new OECD reactors are built, that non-OECD countries build only half of the additions projected in our New Policies Scenario and that the operating lifespan of existing nuclear plants is shortened. While creating opportunities for renewables, such a low-nuclear future would also boost demand for fossil fuels: the increase in global coal demand is equal to twice the level of Australia's current steam coal exports and the rise in gas demand is equivalent to two-thirds of Russia's current natural gas exports. The net result would be to put additional upward pressure on energy prices, raise additional concerns about energy security and make it harder and more expensive to combat climate change. The consequences would be particularly severe for those countries with limited indigenous energy resources which have been planning to rely relatively heavily on nuclear power. It would also make it considerably more challenging for emerging economies to satisfy their rapidly growing demand for electricity.

Figure 5: Nuclear reactor construction starts, 1951-2011



Achieving energy for all will not cost the earth

Making energy supply secure and curbing energy’s contribution to climate change are often referred to as the two over-riding challenges faced by the energy sector on the road to a sustainable future. Yet there is another key strategic challenge for the energy sector, one that also requires immediate and focused attention by governments and the international community. It is the alarming fact that today billions of people lack access to the most basic energy services, electricity and clean cooking facilities.

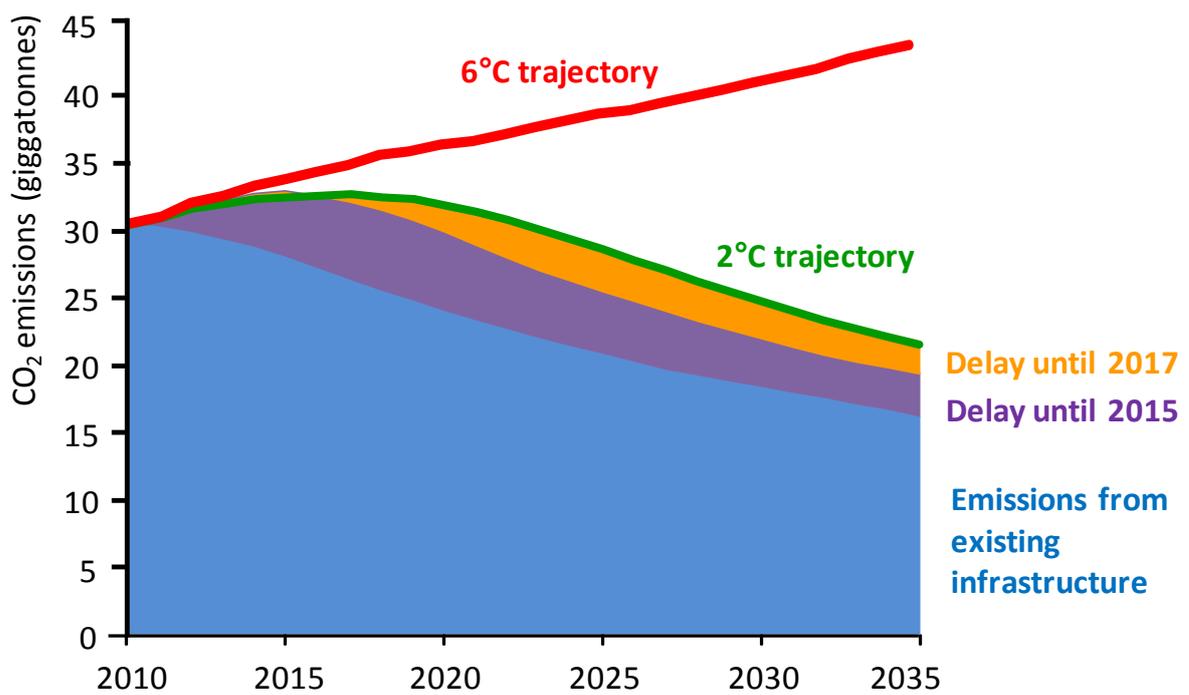
The IEA’s World Energy Outlook has focused attention on modern energy access for a decade, providing the international community with quantitative, objective analysis. Our latest estimate is that currently 1.3 billion people did not have access to electricity, around 20% of the global population, and that almost 2.7 billion people relied on the traditional use of biomass for cooking, around 40% of the global population. More than 95% of these people are in either sub-Saharan Africa or developing Asia and 84% live in rural areas. Based on the continuation of current levels of investment in modern energy access, the absolute numbers of people without access to modern energy in 2030 will be scarcely changed. In sub-Saharan Africa, the numbers without modern energy access will have actually increased. Neither the policies adopted today nor the continuation of a business-as-usual approach will do nearly enough to achieve universal access to modern energy services by 2030. Some existing policies designed to help the poorest miss their mark: only 8% of the subsidies to fossil-fuel consumption in 2010 reached the poorest 20% of the population.

We estimate that in 2009, around \$9 bn was invested globally to provide first access to modern energy, but more than five times this amount, \$48 bn, needs to be invested each year if universal access is to be achieved by 2030. Private sector investment needs to grow the most, but this will not happen unless national governments adopt strong governance and regulatory frameworks and invest in capacity building. Universal access by 2030 would increase global demand for fossil fuels and related CO₂ emissions by less than 1%, a trivial amount in relation to the contribution made to human development and welfare.

Limiting temperature rise to 2°C: the door is closing

In the New Policies Scenario, the world is on a trajectory that results in a level of emissions consistent with a long-term average temperature increase of more than 3.5°C. Without these new policies, we are on an even more dangerous track, for a temperature increase of 6°C or more. The WEO-2011 also puts forward a 450 Scenario, which outlines an energy sector pathway for stabilising the atmospheric concentration of CO₂ emissions at 450 parts per million and targets limiting the global temperature increase to 2°C (Figure 6).

Figure 6: World energy-related carbon dioxide emissions by scenario



Source: IEA/World Energy Outlook 2011.

The key message in the 450 Scenario is that we cannot afford to delay tackling climate change if it is to be achieved at reasonable cost. Nearly 80% of allowable CO₂ emissions up to 2035 are already locked in by existing infrastructure. If stringent new action is not forthcoming by 2017, the energy-related infrastructure then in place will generate all the CO₂ emissions allowed in the 450 Scenario up to 2035, leaving no room for additional power plants, factories and other infrastructure unless they are zero-carbon, which would be extremely costly.