

WORLD ENERGY OUTLOOK 2009 FACT SHEET

Why is our current energy pathway unsustainable?

- **Global energy use is set to fall in 2009 – for the first time since 1981 on any significant scale – as a result of the financial and economic crisis, but demand is set to resume its long-term upward trend once the economic recovery gathers pace.** By 2030, the Reference Scenario, which assumes no change in government policies, sees world primary energy demand a dramatic 40% higher than in 2007.
- **Collectively, non-OECD countries account for over 90% of the increase, their share of global primary energy demand rising from 52% to 63%.** China and India represent over 53% of incremental demand to 2030. Coupled with strong growth from ASEAN, this is contributing to a refocusing of the global energy landscape towards Asia. Outside of Asia, the Middle East sees the fastest rate of increase, contributing 10% to incremental demand.
- **Fossil fuels remain the dominant sources of energy worldwide, accounting for 77% of the demand increase in 2007-2030.** Although oil demand is expected to drop by 2.2% in 2009 as a whole, following a drop of 0.2% in 2008, it is projected to recover from 2010 as the world economy pulls out of recession, rising from around 85 million barrels per day in 2008 to 105 mb/d in 2030, an increase of around 24%. In 2007-2030, demand for coal grows by 53% and demand for natural gas by 42%.
- **Electricity demand grows by 76% in 2007-2030, requiring 4 800 gigawatts (GW) of capacity additions - almost five times the existing capacity of the US.** Coal remains the dominant fuel of the power sector, its share of the global power generation mix rising by 2 percentage points to 44% in 2030. But higher fossil-fuel prices, as well as increasing concerns over energy security and climate change, boost the share of renewables-based electricity generation from 18% in 2007 to 22% in 2030.
- **The world's energy resources are adequate to meet the projected demand increase through to 2030 and well beyond.** But these Reference Scenario trends have profound implications for environmental protection, energy security and economic development. The continuation of current trends would have dire consequences for climate change. They would also exacerbate ambient air quality concerns, thus causing serious public health and environmental effects, particularly in developing countries.
- **While the OECD imports less oil in 2030 than today in the Reference Scenario, some non-OECD countries, notably China and India, see big increases.** Most gas-importing regions also see their imports rise. As non-OPEC conventional oil production peaks around 2010, most of the increased output comes from OPEC countries. The increase in natural gas exports comes mainly from Russia, Iran and Qatar.
- **The Reference Scenario projections imply a persistently high level of spending on oil and gas imports by almost all importing countries.** China overtakes the US soon after 2025, to become the world's biggest spender on oil and gas imports, while India surpasses Japan soon after 2020 to take third place. Cumulative OPEC revenues from oil and gas exports increase to \$30 trillion between 2008 and 2030, almost a five-fold increase on earnings over the past 23 years.
- **In the Reference Scenario, 1.3 billion people still lack access to electricity in 2030 compared with 1.5 billion people today.** Universal electricity access could be achieved with additional power-sector investment of \$35 billion per year in 2008-2030 and with only a modest increase in primary energy demand and related CO₂ emissions.

WORLD ENERGY OUTLOOK 2009 FACT SHEET: ENERGY INVESTMENT

The Impact of the financial crisis

- **Energy investment worldwide has plunged recently in the face of a tougher financing environment, weakening final demand for energy and falling cash flows – the result, primarily, of the global financial and economic crisis.** Energy companies are drilling fewer oil and gas wells, and cutting back spending on refineries, pipelines and power stations. Many ongoing projects have been slowed and a number of planned projects postponed or cancelled. Businesses and households are spending less on energy-consuming appliances, equipment and vehicles.
- **In the oil and gas sector, most companies have announced cutbacks in capital spending, as well as project delays and cancellations.** We estimate that global upstream oil and gas investment budgets for 2009 have been cut by around 19% compared with 2008 – a reduction of over \$90 billion. Since October 2008, over 20 planned large-scale upstream oil and gas projects, involving around 2 mb/d of oil production capacity, have been deferred indefinitely or cancelled. The bulk of these projects are oil sands in Canada. A further 29 projects, involving 3.8 mb/d of oil capacity, have been delayed by at least 18 months.
- **Power-sector investment is expected to be severely affected by financing difficulties, as well as by weak demand.** Global electricity consumption is projected to drop by 1.6% in 2009 – the first annual contraction since the end of the Second World War. Weakening demand is reducing the immediate need for new capacity. In late 2008 and early 2009, investment in renewables-based power generation fell proportionately more than that in other types of generating capacity. For 2009 as a whole, it could drop by close to one-fifth. Without the stimulus provided by government fiscal packages, it would have fallen by almost 30%.
- **Falling energy investment will have far-reaching and, depending on how governments respond, potentially serious effects on energy security, climate change and energy poverty.** Any prolonged downturn in investment threatens to constrain capacity growth in the medium term, particularly for long lead-time projects, eventually risking a shortfall in supply. This could lead to a renewed surge in the price of oil and other forms of energy in a few years time, when demand is likely to be recovering, and become a constraint on global economic growth. Weaker fossil-fuel prices are also undermining the attractiveness of investments in clean energy technology. Cutbacks in energy-infrastructure investments also threaten to impede access by poor households to electricity and other forms of modern energy.
- **The financial crisis has made it all the more uncertain whether the full energy investment needed in the longer term to meet growing energy needs can be mobilised.** The capital required to meet projected energy demand through to 2030 is huge, amounting in cumulative terms to \$26 trillion (in year-2008 dollars) – equal to \$1.1 trillion (or 1.4% of global GDP) per year on average in the Reference Scenario. Over half of all energy investment worldwide is needed in non-OECD countries, where demand and production are projected to increase fastest. With little prospect of a quick return to the days of cheap and easy credit, financing energy investment will, in most cases, be more difficult and costly than it was before the crisis.

WORLD ENERGY OUTLOOK 2009 FACT SHEET: NATURAL GAS

What role for gas in the global energy mix?

- **The demand for natural gas worldwide is set to resume its long-term upwards trend, though the pace of demand growth hinges critically on the strength of climate policy action as well as on the rate of economic growth.** In the Reference Scenario, global primary gas demand rises by 41% from 3.0 trillion cubic metres in 2007 to 4.3 tcm in 2030 – an average rate of increase of 1.5% per year. Over 80% of this increase occurs in non-OECD countries, with the biggest rise in the Middle East. The power sector remains the single largest driver of gas demand in all regions. In the 450 Scenario, in which governments are assumed to take strong action to cut CO₂ emissions, world gas demand grows by 17% between 2007 and 2030 (an average annual rate of growth of 0.7%), but is 17% lower in 2030 compared with the Reference Scenario.
- **The world's remaining resources of natural gas are easily large enough to cover any conceivable rate of demand increase through to 2030 and well beyond, though the cost of developing new resources is set to rise over the long term.** The long-term global recoverable gas resource base is estimated at more than 850 tcm, of which 45% is unconventional gas (shale gas, tight gas and coalbed methane). To date, only 66 tcm of gas has been produced (or flared) - equal to less than 8% of total recoverable resources.
- **The non-OECD countries as a whole are projected to account for almost all of the projected increase in global natural gas production between 2007 and 2030 in both the Reference and 450 Scenarios.** The Middle East, which holds the largest reserves and has the lowest production costs, sees the biggest increase in output (and in exports) in absolute terms in both scenarios. Globally, the share of unconventional gas is projected to rise from 12% in 2007 to 15% in 2030. This projection is subject to considerable uncertainty, especially after 2020; there is potential for output to increase much more.
- **The rate of decline in production from existing fields is the prime factor determining the amount of new capacity and investment needed to meet projected demand.** A detailed, field-by-field analysis of the historical gas-production trends of nearly 600 fields (accounting for 55% of global production) undertaken for *WEO-2009* finds that close to half of the world's existing production capacity will need to be replaced by 2030 as a result of depletion.
- **The recent rapid development of unconventional gas resources in the United States and Canada, particularly in the last three years, has transformed the gas-market outlook, both in North America and in other parts of the world.** It remains highly uncertain whether this boom in unconventional gas production can be replicated in other parts of the world that are endowed with such resources, as in most cases those resources have not yet been appraised in detail.
- **The unexpected boom in North American unconventional gas production, together with the depressive impact of the recession on demand, is expected to contribute to an acute glut of gas supply in the next few years.** The under-utilisation of pipeline capacity between the main regions and global LNG liquefaction capacity combined is expected to rise from around 60 bcm in 2007 to close to 200 bcm in the period 2012-2015, as a number of new projects come on stream. Gas suppliers to Europe and Asia-Pacific will come under increasing pressure to modify their pricing terms and cut prices to stimulate demand.

WORLD ENERGY OUTLOOK 2009 FACT SHEET:
What might a low-carbon energy future look like?

- **Without a change in policy, the world is on a path for a rise in global temperature of up to 6 °C, with catastrophic consequences for our climate.** To avoid the most severe weather and sea-level rise and limit the temperature increase to about 2 °C, the greenhouse-gas concentration needs to be stabilised at around 450 ppm CO₂-equivalent. *WEO-2009* assesses the implications for the energy sector of achieving a 450 Scenario.
- **In the 450 Scenario, global energy-related CO₂ emissions need to peak just before 2020 at 30.9 gigatonnes (Gt) and decline thereafter to 26.4 Gt in 2030 - which is 34% less than in the Reference Scenario.** Of the 3.8 Gt reduction relative to the Reference Scenario in 2020, sectoral agreements in transport and industry and national policies generate 2.1 Gt, with the remainder achieved through cap-and-trade in the power and industry sectors in OECD countries (where the CO₂ price reaches \$50 per tonne), including the use of carbon-market mechanisms to fund CO₂ abatement in non-OECD countries (at a CO₂ price of about \$30 per tonne). National policies and measures in China - already under consideration by the government - would bring about some 1 Gt of reductions by 2020 - or 25% of the total 3.8 Gt - placing China at the forefront of global efforts to combat climate change.
- **The 450 Scenario is achievable - but very challenging.** It assumes a hybrid policy approach, comprising a plausible combination of cap-and-trade systems, sectoral agreements and national measures, with countries subject to common but differentiated responsibilities. End-use efficiency is the largest contributor to CO₂ emissions abatement in 2030 compared with the Reference Scenario, accounting for more than half of total savings. Early retirement of old, inefficient coal plants and their replacement by more efficient coal or gas fired power plants, mainly in China and in the United States, accounts for an additional 5% of the global emissions reduction. The increased deployment of renewables accounts for 20% of CO₂ savings, while increased use of biofuels in the transport sector accounts for 3%. Finally, additional carbon capture and storage (CCS) and nuclear each represents 10% of the savings in 2030, relative to the Reference Scenario.
- **To realise the 450 Scenario, additional investment of \$10.5 trillion is needed globally in the energy sector in the period 2010-2030, relative to the Reference Scenario.** But investments in industry, transport and buildings are more than offset by fuel cost savings, which in the transport sector alone amount to over \$6.2 trillion over the period. The 450 Scenario also offers important energy security and environmental co-benefits. Oil and gas import bills in OECD countries in 2030 are much lower than in 2008; and in 2030 they are 30% lower in both China and India than in the Reference Scenario. The 450 Scenario also sees a major reduction in air pollution, particularly in non-OECD countries.
- **The geographical and sectoral distribution of the abatement and investment in the 450 Scenario does not determine how those actions are financed - that is entirely a matter for negotiation.** In the 450 Scenario, the energy sector in non-OECD countries would need around \$200 billion of additional investment in clean energy and efficiency in 2020 - including \$70 billion for nationally appropriate mitigation actions (NAMAs) and a similar amount to achieve sectoral standards in transport and industry. A portion of this non-OECD investment will need to be co-financed by OECD countries.

WORLD ENERGY OUTLOOK 2009 FACT SHEET:
***Has the financial crisis changed the outlook for CO₂ emissions
and the global climate?***

- **The financial crisis has had a considerable impact on the energy sector worldwide and CO₂ emissions could fall in 2009 by as much as 3%.** This decline would be steeper than at any time in the last 40 years. The crisis has also led to a deferral of investment in polluting technologies. This would lead to global emissions in 2020 being 1.9 gigatonnes (Gt) or 5% lower - even in the absence of new government policies - than estimated last year in the Reference Scenario of *WEO-2008*. The impact of the financial crisis and lower growth accounts for three-quarters of this improvement, while government stimulus spending to promote low-carbon investments and other new climate policies account for the remaining quarter.
- **Despite the impact of the financial crisis, energy-related CO₂ emissions in the Reference Scenario still rise from 28.8 Gt in 2007 to 34.5 Gt in 2020 and 40.2 Gt in 2030.** World greenhouse-gas emissions, including non-energy related CO₂ and all other gases, are projected to grow from 42.4 Gt CO₂-equivalent in 2005 to 56.5 Gt CO₂-eq in 2030 - an increase of one-third.
- **Non-OECD countries account for all the projected increase in energy-related CO₂ emissions.** In the Reference Scenario, OECD emissions in 2030 are 3% lower than in 2007. By contrast, all major non-OECD countries see their emissions rise. Of the 11 Gt growth in global emissions between 2007 and 2030, China accounts for 6 Gt, India for 2 Gt and the Middle East for 1 Gt. However, while non-OECD countries today account for 52% of the world's annual emissions of energy-related CO₂, they are responsible for only 42% of the world's cumulative emissions since 1890.
- **The power-generation sector accounts for over half the increase in emissions in the Reference Scenario.** This is driven by a 60% rise in emissions from coal-fired generation. The Reference Scenario sees big improvements in CO₂ intensity in transport and industry but these are substantially outweighed by increased travel and higher output in the iron and steel and cement industries.
- **The rising global consumption of fossil fuels is still set to drive up greenhouse-gas emissions and world temperatures, resulting in potentially catastrophic and irreversible climate change.** Even taking account of the impact of the financial crisis, the projected rise in emissions in the Reference Scenario puts us on a course for doubling the concentration of those gases in the atmosphere to around 1 000 parts per million (ppm) of CO₂-equivalent by the end of this century. This would entail an eventual global average temperature increase of up to 6°C.
- **The UN Climate Change Conference in Copenhagen provides an opportunity to take prompt action.** If the world wishes to limit to 25% the probability that global average temperature will rise more than 2°C, CO₂ emissions over the period 2000-2049 must not exceed 1 trillion tonnes. Between 2000 and 2009, the world emitted 313 billion tonnes of CO₂.

WORLD ENERGY OUTLOOK 2009 FACT SHEET: ENERGY PRICE ASSUMPTIONS

Price volatility will continue, but the days of cheap energy are over

- **The WEO projections are based on an assumption - not a forecast - that energy prices follow a rising trend through to 2030.** These assumptions are based on a top-down assessment of the price levels that would be needed to encourage sufficient investment in supply to meet projected demand. Prices rise faster in the Reference Scenario, in which no change in government policies is assumed, than in the 450 Scenario, in which climate policies depress fossil-energy use and, therefore, prices. These trajectories should not be seen as forecasts, nor should the smooth price paths assumed be interpreted as a prediction of stable energy markets: prices will, in reality, certainly deviate from these assumed trends in response to short-term fluctuations in demand and supply, to exchange rates and to geopolitical events.
- **In the Reference Scenario, oil prices are assumed to rebound with rising demand and supply costs.** In real terms, the average IEA crude oil import price, a proxy for international prices which in 2008 averaged around \$3 per barrel less than WTI, is assumed to reach \$87 per bbl in 2015, \$100 per bbl by 2020 and \$115 per bbl by 2030 (in year-2008 dollars). In nominal terms, prices approach \$102 per bbl by 2015, \$131 per bbl by 2020 and almost \$190 per bbl by 2030. Gas and coal prices are assumed to increase broadly in line with oil prices, reflecting the dynamics of inter-fuel competition and rising supply costs.
- **The assumption of rising oil prices is based on our expectation of gradually tightening international oil markets - assuming the world economy recovers steadily.** Global oil demand is expected to recover as the economy pulls out of recession, outpacing the growth in capacity, while recent large cutbacks in upstream and downstream investment will have a big impact on supply in the next three to five years as a result of the long lead times in bringing new projects on stream. Although the underlying trend may be upwards, prices are likely to remain highly volatile. In the longer term, the rising marginal costs of supply, together with demand growth in non-OECD countries, will continue to exert upward pressure on prices.
- **In the 450 Scenario, oil prices are assumed to follow the same upward trajectory as in the Reference Scenario to 2015 and then remain flat to 2030, due to weaker demand.** This means there is less need to produce oil from costly fields higher up the supply curve in non-OPEC countries. The oil price is assumed to plateau at \$90 per bbl in real terms in 2020. Gas prices are correspondingly lower. Coal prices are reduced even more, as demand falls much more than for oil or gas. Final prices also take into account carbon prices under the cap-and-trade systems that are assumed to be introduced in many parts of the world in this scenario. The CO₂ price in the OECD reaches \$50 per tonne in 2020 (which increases the cost of a barrel of oil by \$21) and \$110 per tonne in 2030 (which increases the cost of a barrel of oil by \$46).
- **In some countries, end-user prices rise faster than international prices, because subsidies are assumed to be reduced.** In most non-OECD countries, at least one fuel or form of energy continues to be subsidised, usually through price controls that hold the retail or wholesale price below the level that would prevail in a truly competitive market. In 2007, energy-related consumption subsidies in 20 non-OECD countries (accounting for over 80% of total non-OECD primary energy demand) amounted to about \$310 billion. Most of these countries have policies to reform subsidies, though often the intended timing is vague and the commitment is half-hearted. We assume that these subsidies are gradually reduced, but at varying rates across regions.