

## WORLD ENERGY OUTLOOK 2012 FACTSHEET

### *How will global energy markets evolve to 2035?*

- ▶ **Taking all new developments and policies into account, the world is still failing to put the global energy system onto a more sustainable path.** The New Policies Scenario, our central scenario, shows that several fundamental trends persist: energy demand and CO<sub>2</sub> emissions rise ever higher; energy market dynamics are increasingly determined by emerging economies; fossil fuels remain the dominant energy sources; and providing universal energy access to the world's poor continues to be an elusive goal.
- ▶ **Energy demand and CO<sub>2</sub> emissions rise ever higher in the New Policies Scenario.** Global energy demand increases by over one-third in the period to 2035. Energy-related CO<sub>2</sub> emissions rise from an estimated 31.2 Gt in 2011 to 37.0 Gt in 2035, pointing to a long-term average temperature increase of 3.6 °C. A lower rate of global economic growth in the short term would make only a marginal difference to longer-term energy and climate trends.
- ▶ **Emerging economies drive global energy markets.** The share of non-OECD energy demand rises from 55% in 2010 to 65% in 2035. China accounts for the largest share of the growth in global energy use, with its demand rising 60% by 2035, followed by India (where demand more than doubles) and the Middle East. OECD energy demand in 2035 is just 3% higher than in 2010, but there are dramatic shifts in its energy mix as fuel substitution sees the collective share of oil and coal drop by fifteen percentage points to 42%.
- ▶ **Fossil fuels remain the principal sources of energy worldwide, though renewables grow rapidly.** Demand for oil, gas and coal grows in absolute terms through 2035, but their combined share of the global energy mix falls from 81% to 75% during that period. The unlocking of unconventional resources portends a very bright future for natural gas, which nearly overtakes coal in the primary energy supply mix by 2035. Nuclear power maintains a 12% share of electricity generation, a downward revision from previous projections in light of additional policy changes in several countries prompted by the accident at Fukushima Daiichi. Renewables deployment is driven by incentives, falling costs, rising fossil fuel prices and, in some cases, carbon pricing: their share of electricity generation grows from 20% in 2010 to 31% by 2035.
- ▶ **Subsidies to fossil fuels continue to distort energy markets and expanded considerably last year despite international efforts at reform.** Global fossil-fuel consumption subsidies totalled \$523 billion in 2011, almost 30% higher than in 2010. The increase reflects higher international energy prices and rising consumption of subsidised fuels. The subsidy bill would have been even more expensive without reform efforts in several countries. Financial support to renewable energy, by comparison, amounted to \$88 billion in 2011.
- ▶ **An energy renaissance in the United States is redrawing the global energy map, with implications for energy markets and trade.** The United States, which currently imports around 20% of its total energy needs, becomes all but self-sufficient in net terms by 2035 thanks to rising production of oil, shale gas and bioenergy, and improved fuel efficiency in transport. Falling US oil imports mean that North America becomes a net oil exporter by around 2030. This accelerates the ongoing shift in the international oil trade towards Asian markets, putting greater focus on the security of strategic routes that link them to the Middle East.
- ▶ **Large-scale investment in energy-supply infrastructure is required to replace existing supply capacity and expand to meet growing energy needs.** In the New Policies Scenario, cumulative investment of \$37 trillion is needed in the world's energy supply system over 2012-2035, equivalent to 1.5% of global GDP on average during that period. Of the total, non-OECD countries require 61%. Oil and gas supply account for \$19 trillion of the total; \$17 trillion goes to the power sector, including for generation, transmission and distribution.

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### *What is the future for oil and gas?*

- ▶ **Growth in oil consumption in emerging economies, particularly for transport in China, India and the Middle East, more than outweighs reduced demand in the OECD, pushing global oil use steadily higher.** Global oil demand in the New Policies Scenario, our central scenario, increases slowly to 2035, reaching 99.7 mb/d – up from 87.4 mb/d in 2011. China alone accounts for 50% of the net increase worldwide. A steady decline in OECD regions is brought about by efficiency gains, inter-fuel substitution and saturation effects.
- ▶ **Trucks deliver a large share of oil demand growth.** The transport sector already accounts for well over half of global oil consumption, and this share increases as the number of passenger cars doubles to 1.7 billion and demand for road freight rises quickly. The latter is responsible for almost 40% of the increase in global oil demand: oil use for trucks – predominantly diesel – increases much faster than that for passenger vehicles, in part because fuel-economy standards for trucks are much less widely adopted.
- ▶ **The United States is projected to become the largest global oil producer before 2020, exceeding Saudi Arabia until the mid-2020s.** At the same time, new fuel-efficiency measures in transport begin to curb US oil demand. The result is a continued fall in US oil imports, to the extent that North America becomes a net oil exporter around 2030. This accelerates the switch in direction of international oil trade towards Asia, putting a focus on the security of the strategic routes that bring Middle East oil to Asian markets. The United States, which currently imports around 20% of its total energy needs, becomes all but self-sufficient in net terms by 2035 – a dramatic reversal of the trend seen in most other energy-importing countries.
- ▶ **Non-OPEC oil output steps up over the current decade, but supply after 2020 depends increasingly on OPEC.** A surge in unconventional supplies, mainly from light tight oil in the United States, and oil sands in Canada, natural gas liquids, and a jump in deepwater production in Brazil, pushes non-OPEC production up after 2015 to a plateau above 53 mb/d, from under 49 mb/d in 2011. This is maintained until the mid-2020s, before falling back to 50 mb/d in 2035. Output from OPEC countries rises, particularly after 2020, bringing the OPEC share in global production from its current 42% up towards 50% by 2035. The net increase in global oil production is driven entirely by unconventional oil, including a contribution from light tight oil that exceeds 4 mb/d for much of the 2020s, and by natural gas liquids. Of the \$15 trillion in global upstream oil and gas investment that is required over the period to 2035, almost 30% is in North America.
- ▶ **Natural gas is the only fossil fuel for which global demand grows in all three scenarios.** In the New Policies Scenario, world demand increases to almost 5 tcm in 2035 compared to 3.4 tcm today. This is a result of rapid growth in developing countries, led by China, but some growth also in the OECD – due in part to abundant supply in North America. Gas resources are ample to meet this demand and estimates of their magnitude are growing.
- ▶ **Unconventional gas accounts for nearly half of the increase in global gas production to 2035, with most of the increase coming from China the United States and Australia.** But the unconventional gas business is still in its formative years, with uncertainty in many countries about the extent and quality of the resource base and concerns about the environmental impact of production. Public confidence can be underpinned by robust regulatory frameworks and exemplary industry performance. By bolstering and diversifying sources of supply, tempering demand for imports (as in China) and fostering the emergence of new exporting countries (as in the United States), unconventional gas can accelerate movement towards more diversified trade flows, putting pressure on conventional gas suppliers and on traditional oil-linked pricing mechanisms for gas.

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### *What are the main trends in the power generation sector?*

- ▶ **Electricity demand will continue to grow: in the New Policies Scenario, our central scenario, global demand for electricity grows over 70% to almost 32 000 TWh by 2035.** The increase comes overwhelmingly from non-OECD countries; over half from China and India alone. Coal remains the backbone of generation globally, particularly outside the OECD, but its share of the mix is eroded from two-fifths to one-third. In the OECD, coal-based generation declines and is overtaken by gas and renewables by 2035. Generation from renewables globally grows to almost three times its 2010 level by 2035; its share in the generation mix grows from 20% to 31%. Renewables growth in the OECD comes mainly from wind (47%), bioenergy (16%), solar PV (15%) and hydro (11%). Hydro accounts for 42% of the increase in renewables in non-OECD countries, but wind (25%), bioenergy (16%), and solar PV (10%) also play an important role.
- ▶ **A total of 5 890 GW of capacity additions – more than the total installed capacity of the whole world in 2011 – is required over the *Outlook* period.** One-third of this is to replace retiring plants; the rest is to meet growing electricity demand. Renewables represent half the capacity additions, at 3 000 GW over the period 2012-35, followed by gas at 1 400 GW. The total power sector requires investment over 2012-35 of \$16.9 trillion, almost half the total energy supply infrastructure investment in this period. Two-fifths of this investment is for electricity networks, while the rest is for generation capacity. Of the investment in generation capacity, more than 60% is for renewables – principally wind (22%), hydro (16%), and solar PV (13%).
- ▶ **Electricity prices are set to increase by 15% in real terms on average by 2035, driven by higher fuel prices, increased use of renewables and, in some regions, CO<sub>2</sub> pricing.** There are significant regional differences: the highest prices persist in the European Union and Japan, well above those in the United States and China. Household electricity bills increase by as much as 30% by 2035 in some regions, though incomes grow more quickly, resulting in a falling share of expenditure over time going towards electricity bills. Where renewables subsidies are passed on to consumers through electricity prices, the additional tariff component can be substantial: by 2020, renewables subsidies add 15% to residential electricity prices in the European Union.
- ▶ **Primary energy demand for modern bioenergy – biofuels for transport and products derived from biomass feedstocks and biogas to produce electricity and heat – more than double over the *Outlook* period, fostered by government policy.** Global bioenergy resources are more than sufficient to meet projected demand without competing with food production, though this will require sustainable management of land use. In 2035, modern bioenergy demand is largest in the European Union, where industrial and residential heat account for nearly half of the demand, followed by the United States and Brazil, where the increase is mainly driven by transport. As policy goals exceed some regions' production capacity (particularly the European Union, Japan and India), international trade of solid biomass for power generation and biofuels for transport increases about six fold.
- ▶ **Energy subsidies are essential to the growth in renewable energy, especially in the power sector, as many renewables are still more expensive than conventional sources.** In 2011, energy subsidies reached \$88 billion, an increase of 24% compared to 2010, mainly due to the extraordinary expansion of solar PV in the European Union, particularly in Germany and Italy. The rapid growth of renewables means that subsidies rise to nearly \$240 billion in 2035 (about \$180 billion for electricity and the remainder for biofuels), although some technologies reach a degree of competitiveness by the end of the *Outlook* period, such as onshore wind in the European Union and in China. Subsidies to renewable-based electricity amount to a total of \$3.5 trillion over 2012-2035, of which over one quarter is already locked in by commitments to existing capacity and about 70% is set to be locked in by 2020.

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### *Energy efficiency: six steps toward a hat-trick of energy goals*

- ▶ **Energy efficiency can improve energy security, spur economic growth and mitigate pollution, but current and planned efforts fall well short of tapping its full economic potential.** A number of major energy-consuming countries (China, United States, the European Union and Japan) have adopted new energy efficiency measures over the last year. Progress towards their implementation is projected to contribute to a reduction in global energy intensity (energy consumption per unit of GDP) of 1.8% a year through to 2035 in the New Policies Scenario, a major improvement compared with only 0.5% per year over the last decade. Nonetheless, a significant share of the economic potential of energy efficiency – four-fifths in the buildings sector and more than half in industry – remains untapped, mostly due to non-technical barriers.
- ▶ **Our Efficient World Scenario offers a blueprint to realise the economically viable potential of energy efficiency.** We set out the policies that governments would need to enact to lower market barriers, thereby minimising transaction costs and enabling the necessary energy efficiency investments to move ahead. Those investments pay back well before the end of the lifetime of the energy capital stock and result in a hat-trick of goals in terms of economic gains, energy security improvements and environmental protection.
- ▶ **The Efficient World Scenario sees a more efficient allocation of resources, boosting cumulative global economic output through 2035 by \$18 trillion.** This is equivalent to the current GDP of the United States, Canada, Mexico and Chile combined. GDP gains in 2035 are greatest in India (3.0%), China (2.1%), the United States (1.7%) and OECD Europe (1.1%). Additional investment of \$11.8 trillion in efficient end-use technologies is more than offset by a \$17.5 trillion reduction in fuel bills and a \$5.9 trillion cut to supply-side investment.
- ▶ **Growth in global primary energy demand is halved in the Efficient World Scenario, relative to the New Policies Scenario, and energy intensity improves at 2.6 times the rate of the last 25 years.** Oil demand peaks at 91 mb/d before 2020 and declines to 87 mb/d in 2035, 12.7 mb/d lower than in the New Policies Scenario. This is equal to the current production of Russia and Norway combined. By 2035, coal demand is lower than today, and 1 350 million tonnes of coal equivalent (Mtce) lower than in the New Policies Scenario. Natural gas demand is 680 bcm lower than in the New Policies in 2035, roughly equivalent to the demand of the United States in 2010. As a result of lower demand, oil prices are \$16/bbl lower in 2035 than in the New Policies Scenario.
- ▶ **In the Efficient World Scenario, energy-related CO<sub>2</sub> emissions peak before 2020 and decline to 30.5 Gt in 2035, pointing to a long-term average temperature increase of 3 °C.** The rapid deployment of energy-efficient technologies can delay the complete “lock-in” of CO<sub>2</sub> emissions permitted for a 2 °C trajectory – which is set to happen in 2017 in the New Policies Scenario – until 2022, buying five extra years to reach a global climate agreement. In addition to energy efficiency, however, low-carbon technologies will be needed to achieve the 2 °C goal. In the Efficient World Scenario, emissions of local pollutants are also cut sharply, bringing environmental and health benefits to China and India in particular.
- ▶ **We propose six categories of policy action, which, if widely implemented, can turn the Efficient World Scenario into reality.** These categories include: increasing the visibility of energy efficiency through strengthening its measurement and disclosing its gains; prioritising efficiency by integrating it into the decision-making process in government, industry and society; increasing its affordability by creating appropriate business models and financing instruments; making efficiency mainstream by incentivising the most efficient technology options and discouraging the least efficient ones; making it real by implementing monitoring, verification and enforcement activities; and making it realisable by increasing governance and administrative capacity at all levels.

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### *What is Iraq's energy outlook?*

- ▶ **Iraq's energy sector holds the key to the country's future prosperity and can make a major contribution to the stability and security of global energy markets.** Iraq is already the world's third-largest oil exporter and has the resources and plans to increase rapidly its oil and natural gas production as it recovers from three decades punctuated by conflict and instability. Success in developing Iraq's hydrocarbon potential and effective management of the resulting revenues can fuel Iraq's social and economic development. Failure will hinder Iraq's recovery and put global energy markets on course for troubled waters.
- ▶ **Iraq's ambition to expand its oil and gas output need not be limited by the size of its hydrocarbon resources or by the costs of producing them.** Development of the sector will be determined by the speed at which substantial impediments to investment are removed, clarity on how Iraq plans to derive long-term value from its hydrocarbon wealth, international market conditions and Iraq's success in consolidating political stability and developing its human resource base. In our Central Scenario, an Iraq-specific scenario that forms part of the New Policies Scenario in *WEO-2012*, its oil production more than doubles to 6.1 mb/d by 2020 and reaches 8.3 mb/d in 2035. The largest increase in production comes from the super-giant fields in the south of Iraq, around Basrah. The increase in Iraqi oil production of more than 5 mb/d over the period to 2035 makes Iraq by far the largest contributor to global supply growth (accounting for 45% of the anticipated growth in global output), overtaking Russia in the 2030s to become the world's second-largest oil exporter. The growth of Iraq's production means that it becomes a key supplier to fast-growing Asian markets, mainly China.
- ▶ **Natural gas can play a much more important role in Iraq's future, reducing the dominance of oil in its energy mix.** In the Central Scenario, Iraq's production of natural gas grows to almost 90 bcm in 2035, with domestic demand exceeding 70 bcm. The move away from liquid fuel towards gas for power generation frees up oil for export; without this transition Iraq would forego around \$530 billion in export revenues and domestic oil demand would be more than 1 mb/d higher in 2035. Gas exports start around 2020, providing a cost-competitive source of potential supply to neighbouring countries, European markets and Asia.
- ▶ **Catching up and keeping pace with rising demand for electricity is critical to Iraq's national development.** We estimate that Iraq needs 70% more net power generation capacity to meet current demand fully. In our Central Scenario, if planned new capacity is delivered on time, grid-based electricity will catch up with estimated peak demand around 2015. Over the period to 2035, Iraq needs to install around 70 gigawatts of generation capacity.
- ▶ **Iraq stands to gain almost \$5 trillion in revenues from oil export over the period to 2035, an annual average of \$200 billion and an opportunity to transform the country's future prospects.** In the Central Scenario, Iraq's gross domestic product (GDP) in 2035 is five times larger (in real terms) than today, its energy demand four times higher, and its GDP per capita comparable with that of Brazil today.
- ▶ **Iraq will need cumulative energy investment of over \$530 billion in the Central Scenario, equivalent to just over 10% of the projected revenue from oil and gas exports.** The annual investment need is highest in the current decade, at more than \$25 billion per year on average — almost three times higher than estimated investment in 2011. Delay could be costly. In our Delayed Case, energy investment increases only modestly, resulting in a much lower trajectory for oil production (reaching 4 mb/d in 2020 and 5.3 mb/d in 2035). The impact on Iraq's economy is a cumulative loss of \$3 trillion compared with the Central Scenario. The reduced flow of oil from Iraq also tightens international oil markets, resulting in prices that are nearly \$15 higher in real terms than in the Central Scenario in 2035.

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### *How will water impact future energy supply?*

- ▶ **Energy is becoming a thirstier resource.** Global freshwater use for energy production in 2010 totalled 583 billion cubic metres (bcm), or some 15% of the world's total water use. Of that, water consumption – the amount used but not returned to its source – was 66 bcm. In the New Policies Scenario, water use increases by 20% over 2010-2035, while consumption rises by a more dramatic 85% (more than double the rate of energy demand growth). These trends are underpinned by a shift towards higher efficiency power plants with more advanced cooling systems (that reduce overall water use but increase consumption) and expanding biofuels production. Energy efficiency, wind and solar PV contribute to a low-carbon energy future without intensifying water demands significantly.
- ▶ **Water is growing in importance as a criterion for assessing the physical, economic and environmental viability of energy projects.** Among other examples, water use could become increasingly challenging for unconventional gas development and power generation in parts of China and the United States, India's fleet of water-intensive coal-fired plants, Canadian oil sands production and maintaining reservoir pressures to support oil output in Iraq.
- ▶ **Many water-related challenges that the energy sector faces can be managed with available technology, but some solutions involve trade-offs.** Advanced cooling systems can significantly reduce water use and impacts on water resources for fossil fuel-based and nuclear power plants – the largest users of water in the energy sector – although this can entail additional costs and reduce plant efficiency. Biofuels production can also be very water-intensive. Its water use can be optimised by selecting water-efficient biomass (such as switchgrass or crop waste products) and irrigation technologies, as well as locations that receive ample rainfall for biomass growth.

### *A continuing focus on the goal of universal modern energy access*

- ▶ **Despite progress, nearly 1.3 billion people remain without access to electricity and 2.6 billion do not have access to clean cooking facilities.** Ten countries – four in Asia and six in Africa – account for two-thirds of those people without electricity and just three countries – India, China and Bangladesh – account for more than half of those without clean cooking facilities.
- ▶ **In the absence of further action, we project that nearly one billion people will be without electricity and 2.6 billion people will still be without clean cooking facilities in 2030.** In the case of electricity, the number of people in developing Asia without access almost halves and Latin America achieves universal access before 2030 but, in sub-Saharan Africa, a worsening trend persists until around 2025. For cooking, developing Asia sees a significant improvement, but the number of people without access in India alone in 2030 is still twice the population of the US today. In sub-Saharan Africa, the picture worsens by around one-quarter by 2030.
- ▶ **We estimate that nearly \$1 trillion in cumulative investment is needed to achieve universal energy access by 2030.** This is equivalent to just 3% of total energy-related infrastructure investment. The UN Year of Sustainable Energy for All generated welcome new commitments toward universal access, but more is required. Our Energy for All Case shows that universal access would only increase global energy demand by 1% in 2030 and CO<sub>2</sub> emissions by 0.6%.
- ▶ **We present an Energy Development Index (EDI) for 80 countries, to aid policy makers in tracking progress towards providing modern energy access.** It is a composite index that measures energy development at the household and community level. It reveals a broad improvement in recent years, with China, Thailand, El Salvador, Argentina, Uruguay, Vietnam and Algeria showing the greatest progress. There are also a number of countries whose EDI scores remain low; countries in sub-Saharan Africa dominate the lower half of the rankings.