

## WORLD ENERGY OUTLOOK 2013 FACTSHEET

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

- ▶ **Global energy demand will grow to 2035, but government policies can influence the pace.** In the New Policies Scenario, our central scenario, global energy demand increases by one-third from 2011 to 2035. Demand grows for all forms of energy, but the share of fossil fuels in the world's energy mix falls from 82% to 76% in 2035. Low-carbon energy sources (renewables and nuclear) meet around 40% of the growth in primary energy demand. Nearly half of the net increase in electricity generation comes from renewables.
- ▶ **The centre of gravity of global energy demand moves decisively towards emerging economies – they account for more than 90% of net energy demand growth to 2035.** Energy demand growth in Asia is led by China this decade, but shifts towards India and, to a lesser extent, Southeast Asia after 2025. The Middle East emerges as a major energy consumer, with its gas demand growing by more than the entire gas demand of the OECD: the Middle East is the second-largest gas consumer by 2020 and third-largest oil consumer by 2030, redefining its role in energy markets.
- ▶ **Global energy trade is re-oriented from the Atlantic basin to the Asia-Pacific region.** China is becoming the largest oil-importing country; India becomes the largest importer of coal by the early 2020s. Improved energy efficiency and a boom in unconventional oil and gas production help the United States to move steadily towards meeting almost all of its energy needs (in energy equivalent terms) from domestic resources by 2035.
- ▶ **Non-OPEC supply plays the major role in meeting net oil demand growth this decade, but OPEC plays a far greater role after 2020.** Technology unlocks new types of oil resources and improves recovery rates in existing fields, pushing up estimates of the amount of oil that remains to be produced. But this does not mean that the world is on the cusp of a new era of oil abundance. An oil price that rises steadily to \$128 per barrel (in year-2012 dollars) in 2035 supports the development of these new resources.
- ▶ **The market for natural gas gradually becomes more global, with potential implications for pricing.** Gas demand rises by almost half to 2035. New sources of gas, both conventional and unconventional, bring greater diversity to global supply. Changes in the cast of major LNG suppliers create new linkages between regional gas markets, notably between those of North America and the Asia-Pacific, narrowing to a degree the wide regional gas price differentials that exist today. In a Gas Price Convergence Case, convergence between regional gas prices is more rapid, pushing prices down, gas demand up (by 107 bcm in 2035) and lowering gas import bills.
- ▶ **The magnitude of future global coal demand growth is uncertain, particularly because of the varying stringency of environmental policies.** In the New Policies Scenario, OECD coal use falls by one-quarter by 2035 as coal is backed out of power generation. By contrast, demand expands by one-third in non-OECD countries – predominantly in India, China and the ASEAN region – despite China reaching a plateau after 2025. Globally, coal remains the leading source of electricity generation in the New Policies Scenario, though its share falls from 41% to 33% in 2035.
- ▶ **As the source of two-thirds of global greenhouse-gas emissions, the energy sector will be pivotal in determining whether or not climate change goals are achieved.** Energy-related carbon-dioxide emissions rise by 20% to 37.2 Gt in the New Policies Scenario, leaving the world on track for a long-term average temperature increase of 3.6 °C.
- ▶ **Achieving universal access to modern energy remains imperative; fossil-fuel subsidies continue to distort energy markets.** In 2011, nearly 1.3 billion people worldwide lacked access to electricity and more than 2.6 billion relied on the traditional use of biomass for cooking. Over 95% were located in Asia and sub-Saharan Africa. The global cost of fossil-fuel subsidies expanded to \$544 billion in 2012 despite efforts at reform. Financial support to renewable sources of energy totalled \$101 billion.

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### *How will persistent disparities in energy prices alter global economic geography?*

- ▶ **Large differences in regional energy prices have sparked a debate about the role of energy in unleashing or frustrating economic growth.** Brent crude oil has averaged \$110 per barrel in real terms since 2011, a sustained period of high oil prices that is without parallel in history. Natural gas prices have fallen sharply in the United States, largely because of the recent shale gas boom, and today are about one-third of import prices to Europe and one-fifth of those to Japan. Electricity price differentials are also large, with industrial consumers in Japan and Europe paying on average more than twice as much for electricity as their counterparts in the United States; even Chinese industrial consumers pay almost double the US level.
- ▶ **Energy costs can be vital to the competitiveness of energy-intensive industries, particularly where energy accounts for a significant share of total production costs and where the resulting goods are traded extensively.** Energy-intensive sectors – including chemicals, primary aluminium, cement, iron and steel, pulp and paper, glass and glass products, and refining – account globally for 20% of industrial value added, 25% of industrial employment and 70% of industrial energy use. Energy costs are greatest in the chemicals industry (including the petrochemicals sub-sector), where they can represent around 80% of total production costs. Lower gas and electricity prices in 2012 in the United States relative to Europe equated to estimated savings of close to \$130 billion for the entire US manufacturing industry.
- ▶ **Natural gas price differentials narrow in our central scenario, though gas and industrial electricity prices in the European Union and Japan remain around twice the level of the United States in 2035.** In many emerging economies, particularly in Asia, strong growth in domestic demand for energy-intensive goods supports a swift rise in their production (accompanied by export expansion). As a consequence, developing Asia increases its export market share of energy-intensive goods to a level equal to that of the European Union by 2035. Elsewhere energy prices and the industrial outlook are more clearly linked. The United States, which experiences relatively low energy prices, sees a slight increase in its share of global exports of energy-intensive goods in the period to 2035. Conversely, the combined share of the European Union and Japan declines by 13 percentage points relative to current levels, though the European Union remains the leading exporter of energy-intensive goods.
- ▶ **Rising energy prices across many regions have led to major shifts in energy and overall trade balances, as well as to energy expenditures taking a growing share of household income.** In 2012, spending on energy imports reached record levels in many regions. The contrast between the United States and other large importers is striking: annual energy import bills in the United States have fallen by 40% since 2008, while they have increased slightly in the European Union and continued to climb in many other regions. The share of energy expenditures in household income in the European Union reached a high of almost 8% in 2008; today it is slightly lower. In non-OECD countries, including China, this share is below the OECD average. But in China it has grown rapidly over the last eleven years with increasing energy prices and improved living standards.
- ▶ **High energy prices do not have to result in onerous energy costs for end-users or the national economy.** Energy efficiency improvements could mitigate high energy costs while concurrently addressing energy security and environmental concerns. Policymakers can also boost energy competitiveness by supporting indigenous sources of energy supply, including renewables, nuclear power and unconventional gas. Regardless of the composition of energy supply, efficient and competitive markets can minimise the cost of energy to an economy. Additionally, a carefully conceived international climate change agreement can help to ensure that energy-intensive industries in countries that act decisively to limit greenhouse-gas emissions do not face unequal competition from countries that fail to do so.

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### *Should we worry about oil scarcity, or abundance?*

- ▶ **Estimates of ultimately recoverable resources of oil continue to increase as technologies unlock types of resources, such as light tight oil, that were not considered recoverable only a few years ago.** Our latest estimates for remaining recoverable resources show 2 670 billion barrels of conventional oil (including NGLs), 345 billion of light tight oil, 1 880 billion of extra-heavy oil and bitumen, and 1 070 billion of kerogen oil. Cumulatively, 790 billion barrels of oil need to be produced in total to meet projected demand in the New Policies Scenario.
- ▶ **Oil supply rises from 89 mb/d in 2012 to 101 mb/d in 2035 in the New Policies Scenario.** Key components of the increase are unconventional oil (up 10 mb/d) and natural gas liquids (NGLs) linked to the increase in global gas output (up 5 mb/d). Conventional crude oil's share in total oil production falls, from 80% in 2012 to two-thirds in 2035. The role of OPEC in quenching the world's thirst for oil is temporarily reduced over the next ten years, notably as US light tight oil and Brazilian deepwater output step up, but the share of OPEC countries in global output rises again in the 2020s, as they remain the only large source of relatively low-cost oil. Iraq is the largest single source of oil production growth, followed by Brazil, Canada and Kazakhstan. The United States is the world's largest oil producer for much of the period to 2035.
- ▶ **Based on analysis of more than 1 600 fields, we estimate the observed decline rate for conventional fields that have passed their peak is around 6% per year.** Unconventional plays, such as light tight oil or oil sands, are heavily dependent on continuous investment and drilling to prevent the large initial decline rates for individual wells translating into rapid field-level declines. Declining output from existing fields is a major driver of upstream investment. Total upstream spending in the oil and gas sectors is expected to rise to more than \$700 billion in 2013, a new high, and will need to remain around these levels for the next decade, before the annual average dips slightly, as lower-cost OPEC Middle East countries then provide most of the increase in supply.
- ▶ **Oil use is increasingly concentrated in just two sectors: transport and petrochemicals.** Demand in China increases the most (up 6 mb/d), as it overtakes the United States as the largest oil consumer by around 2030, followed by India (up 4.5 mb/d). The Middle East becomes the third-largest centre of oil demand, at 10 mb/d in 2035, underpinned by a fast-growing population and by oil subsidies, which were equivalent to \$520/person in 2012. In the OECD, demand for oil declines due to efficiency gains and fuel switching. Among oil products, diesel sees by far the largest increase, rising by more than 5 mb/d between 2012-2035, compared with a rise in gasoline demand of 2 mb/d.
- ▶ **The global refining sector is set for turbulent times over the coming decades as the industry is re-shaped by declining oil demand in OECD markets alongside rapid growth in demand in non-OECD Asia and the Middle East.** Pressures on the refining system are amplified by the changing composition of feedstocks, including a growing share of natural gas liquids that often bypass the refining system altogether. Our conservative estimate of 13 mb/d of new refineries to 2035, mostly in China, India and the Middle East, adds to global over-capacity, increasing competition for available crude as well as for product export markets. The consequences in terms of lower utilisation rates and potential rationalisation of capacity are mostly borne by OECD refining sectors, Europe in particular, where oil demand is falling. Over the period to 2035, nearly 10 mb/d of global refinery capacity is at risk of low utilisation rates or closure. Changing patterns of demand, supply and refining also have major implications for global oil trade. The net North American requirement for imported crude oil all but disappears by 2035, and the region becomes a large exporter of products. Asia becomes the unrivalled centre of the global oil trade, drawing in a rising share of the available crude not just from the Middle East but also from Russia, the Caspian, Africa, Latin America (mainly Brazil) and North America (Canada).

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### Power and renewables: electrifying developments

- ▶ **In the New Policies Scenario, world electricity demand increases by more than two-thirds over the period 2011-2035.** The power sector represents over half of the increase in global primary energy use, a rise comparable to current US total energy demand. Non-OECD countries account for the bulk of incremental electricity demand, led by China (36%), India (13%), Southeast Asia (8%) and the Middle East (6%).
- ▶ **Fossil fuels continue to dominate the power sector, although their share of generation declines from 68% in 2011 to 57% in 2035.** Coal remains the largest source of generation, with strong growth in non-OECD countries far outweighing reductions in OECD countries. Natural gas expands the most in absolute terms of any source, increasing in most regions. Coal-fired generation rebounds in the short term in the United States, reversing the recent coal-to-gas switch, as gas prices recover from very low levels. In Europe, gas-fired generation regains favour versus coal gradually on rising CO<sub>2</sub> prices and the need for flexible capacity, but only gets back to 2010 levels after 2030. Beyond fossil fuels, nuclear power maintains a 12% share of electricity generation globally, with expansion mainly occurring in Asia.
- ▶ **The share of renewables in total power generation rises from 20% in 2011 to 31% in 2035, as they supply nearly half of the growth in global electricity generation.** Renewables overtake gas as the second-largest source of generation in the next couple of years and approach coal as the leading source by 2035. Rapid expansion of wind and solar PV raises fundamental questions about power market designs and their ability to ensure adequate investment and long-term reliability of supply. China sees the biggest absolute increase in generation from renewable sources, more than the gains in the European Union, United States and Japan combined.
- ▶ **Global subsidies to renewables reached \$101 billion in 2012, up 11% on 2011, and need to expand to \$220 billion in 2035 to support the level of deployment in the New Policies Scenario.** In 2012, renewable subsidies were highest in the European Union (\$57 billion) and the United States (\$21 billion). Wind becomes competitive in a growing number of regions, with about one-quarter of generation over the period to 2035 not requiring any subsidy. Solar PV becomes competitive in only a limited number of markets (when measured at “cost parity”) and requires an average subsidy of \$130/MWh through to 2035 in order to compete. Thanks to falling costs, solar PV is now being rapidly deployed, but policymakers need to ensure subsidy schemes do not place excessive burdens on end-users and that there is a fair allocation of costs for those with and without solar PV.
- ▶ **Biofuels use triples, rising from 1.3 million barrels of oil equivalent per day (mboe/d) in 2011 to 4.1 mboe/d in 2035, by which time it represents 8% of road-transport fuel demand.** Advanced biofuels, which help address sustainability concerns about conventional biofuels, gain market share after 2020, reaching 20% of biofuels supply in 2035. Subsidy costs for biofuels increase steadily over time, reflecting limited scope for further cost reductions for conventional biofuels and strong growth in use.
- ▶ **Global investment in the power sector amounts to \$17 trillion through to 2035, with over 40% in transmission and distribution networks.** Residential electricity prices increase in nearly all regions, in part due to rising fossil fuel prices. However, electricity becomes more affordable over time in most regions, as income levels increase faster than household electricity bills.
- ▶ **CO<sub>2</sub> emissions from the power sector rise from 13.0 gigatonnes (Gt) in 2011 to 15.2 Gt in 2035, retaining a share of around 40% of global emissions over the period.** Increasing penetration of low-carbon technologies and improvements in the thermal efficiency of fossil-fuelled power plants help to slow the growth in CO<sub>2</sub> emissions from the power sector. The evolution of the power sector will be critical to meeting climate change goals, due to the sector’s rapid growth and because low-carbon alternatives are more readily available.

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### What is Brazil's energy outlook?

- ▶ **Brazil's resources are abundant and diverse; their development over the coming decades moves the country into the top ranks of global energy producers.** More super-giant fields have been discovered in Brazil over the last ten years than in any other country. These offshore discoveries have confirmed Brazil's status as one of the world's foremost oil and gas provinces. But Brazil's resources are not limited to hydrocarbons: it has an estimated 245 GW of hydropower potential (around two-thirds of which has yet to be developed), wind power potential approaching 350 GW and considerable solar potential.
- ▶ **Brazil's energy sector undergoes a huge expansion between now and 2035.** It plays a central role in meeting the world's oil needs through to 2035, accounting for one-third of the net growth in global supply in the New Policies Scenario. Brazil's oil production rises from 2.2 mb/d in 2012 to 4.1 mb/d in 2020 and to 6 mb/d in 2035, making it the world's sixth-largest oil producer in 2035. This growth is heavily dependent on highly complex and capital-intensive deepwater developments, where Brazil is set to consolidate its position as the global leader, accounting for almost 60% of global deepwater production in 2035. Natural gas production (mainly associated with oil production) grows strongly, reaching more than 90 bcm by 2035.
- ▶ **Brazil's primary energy demand rises by 80% in the New Policies Scenario to reach 480 Mtoe in 2035, spurring and accompanying steady growth in economic output.** Consumption in the end-use sectors has doubled since 1990, and is set to grow robustly, led by industry (80% increase), followed by transport (77%) and buildings (66%). Brazil achieves its goal of providing universal energy access early in the projection period. Electricity demand doubles to reach 940 TWh in 2035. If the Amazon were to prove to be off-limits for new hydropower projects, then the 70 GW expansion of hydropower foreseen in the New Policies Scenario would largely exhaust Brazil's remaining hydro potential. Most of the anticipated growth in capacity is expected to come from run-of-river projects, increasing the contingency of power output on natural and seasonal variations. Wind resources are already being harnessed on a competitive basis and continue to be developed, particularly in the northeast of Brazil where wind projects are operating at very high capacity factors. Natural gas remains prized as a reliable complementary source of power with generation capacity quadrupling, to 40 GW, in 2035.
- ▶ **A pivotal factor in shaping Brazil's energy outlook will be the country's success in maintaining high levels of investment, which average \$90 billion per year.** Almost two-thirds of this is required in the oil sector and more than a quarter to expand power generation and the transmission network. The heaviest burden lies with Petrobras, the world's largest deepwater operator, placing an emphasis on its ability to deploy resources effectively across a huge and varied investment programme.
- ▶ **Brazil's production of biofuels expands more than three-fold to 1 million barrels of oil equivalent per day in 2035.** Suitable cultivation zones are more than sufficient to achieve this expansion in supply without impinging upon environmentally sensitive areas. Sugarcane ethanol continues to dominate biofuels supply, with over 80% of the total. Biofuels account for nearly one-third of the energy used in road transport by 2035, enhancing the energy performance of the transport sector and helping to slow the growth in demand for oil products.
- ▶ **Brazil's energy sector remains one of the least carbon-intensive in the world, despite greater availability and use of fossil fuels.** Brazil is already a world leader in renewable energy and is set to almost double its output from renewables by 2035, maintaining their 43% share of the domestic energy mix. Per-capita CO<sub>2</sub> emissions increase by 50% to reach 3 tonnes of CO<sub>2</sub>, but this is still only 70% of the world average in 2035.