POLICY NOTE ON GREEN INVESTMENT

COP21 PARIS AGREEMENT: BUSINESS PERSPECTIVES ON ENERGY MARKETS AND GREEN INVESTMENT

EMnet Working Group Meeting: 7 March 2016

INVESTMENT
ENERGY *RISK MANAGEMENT*
INFRASTRUCTURE INNOVATION
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COP21 Paris Agreement: Business perspectives on energy markets and green investments

This Policy Note provides insights and policy recommendations from the private sector on the business implications of the Paris Agreement at the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21) in December 2015. The analysis builds on the "Greening of the Economy" Working Group held on 7 March 2016 at the headquarters of the Organisation for Economic Co-operation and Development (OECD) in Paris and organised by the OECD Emerging Markets Network (EMnet), in addition to desk research and bilateral discussions with EMnet members.

Key messages include:

- Strong commitments from the private sector ahead of COP21 contributed to the positive outcome of the Paris Agreement on climate change.
- While the share of renewable energy will increase in the future, fossil fuels (e.g. coal, gas and oil) will still play a key role, particularly in emerging markets.
- Given the changes needed in the future energy mix to achieve the Paris Agreement, policy makers need support the development of renewable energy, promote energy efficiency, reduce fossil-fuel subsidies and make their use more sustainable. These approaches must consider the specific contexts and needs of developing countries.
- In addition to promoting core climate policies, governments must also tackle policy misalignments that can hinder green investment. Conflicting incentives in competition, trade, tax and innovation policies, for example, can inadvertently discourage cleaner and more efficient investment.
- Strong public-policy commitments, economic and political stability, and a favourable investment climate are critical elements to drive further green investment in emerging markets.
- Corporate strategies will need to be adjusted to reflect the post-COP21 scenario. Governments need to choose incentives carefully to encourage the adoption of new and innovative low-carbon technologies.
- In emerging economies, tenders and competitive auctions are used increasingly over feed-in tariffs to support early deployment of renewable-based electricity.

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OECD EMERGING MARKETS NETWORK

The Emerging Markets Network (EMnet) is an OECD-sponsored initiative dedicated to the private sector. Managed by the OECD Development Centre, the Network fosters dialogue and analysis on emerging economies and their impact on global economic, social and environmental issues.

EMnet gathers top executives (chief executive officers, vice presidents, managing directors, chief financial officers, heads of strategy, chief economists) of multinational companies from diverse sectors, willing to engage in debates with high-level policy makers, including heads of state and ministers, and OECD experts.

EMnet events are closed to the public and media and operate under Chatham House rule to encourage open and dynamic discussions on doing business in Africa, Asia and Latin America.

To learn more about EMnet, please see http://www.oecd.org/dev/oecdemnet.htm.

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ABBREVIATIONS AND ACRONYMS

CCS	Carbon capture and storage
CO_2	Carbon dioxide
COP21	21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change
ETS	Emissions trading system
GW	Gigawatt
HFCs	Hydro fluorocarbons
IEA	International Energy Agency
NDCs	Nationally Determined Contributions
MW	Megawatt
OECD	Organisation for Economic Co-operation and Development
PPA	Power Purchase Agreement
PPP	Purchasing power parity
PV	Photovoltaic
R&D	Research and development
RD&D	Research, development and demonstration
REC	Renewable Energy Certificate
TWh	Terawatt hours
UNFCCC	United Nations Framework Convention on Climate Change

COP21: A NEW OPPORTUNITY TO ADDRESS CLIMATE CHANGE

Global changes paved the way to the Paris Agreement

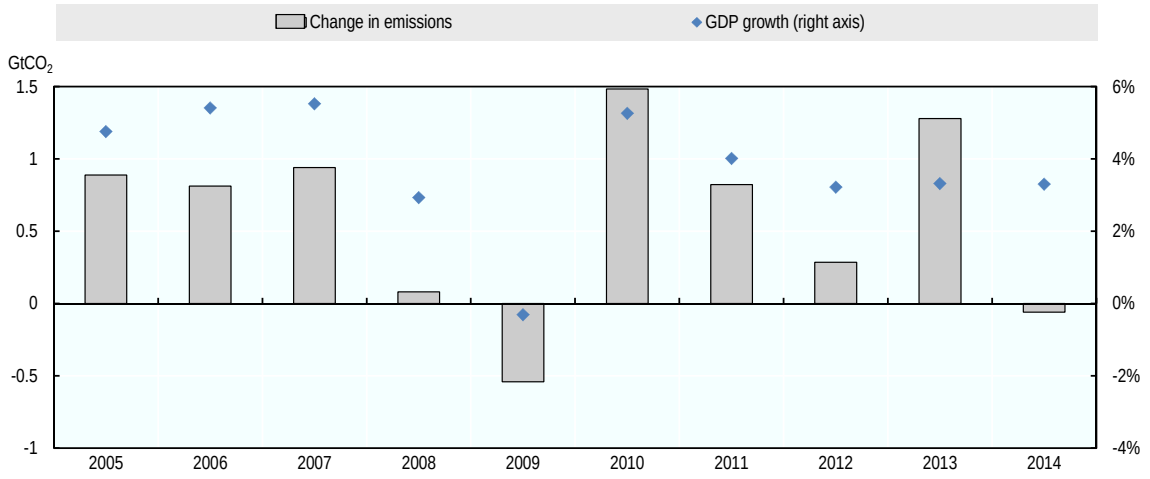
Recent favourable market conditions, positive industry dynamics and political momentum ahead of the 21st session of the Conference of the Parties on Climate Change (COP21) contributed to the positive outcome and the ratification of the Paris Agreement on climate change in April 2016.

Governments furthered the positive momentum by reducing fossil-fuel subsidies, supporting the development of renewable technologies, launching energy-efficiency measures and establishing carbon-emission trading systems. This helped to advance the historic decoupling of economic growth and carbon emissions that took place in 2014 (IEA, 2015a) and continued in 2015 (IEA, 2016a).

Favourable energy-market conditions

The global economy grew 3% in 2014 while carbon emissions stagnated. This decoupling highlights that the economy can grow without necessarily generating more emissions (Figure 1.1) (IEA, 2015a).

Figure 1.1. **Energy-related emissions and economic growth, 2005-14**



Source: IEA (2015b), *World Energy Outlook 2015*, http://dx.doi.org/10.1787/weo-2015-en.

Changing patterns of energy consumption in both the People's Republic of China (hereafter 'China') and OECD countries are largely at the source of these dynamics. China generated more energy from renewable sources, burned less coal and shifted from energy-intensive activities towards more services. In parallel, OECD economies increased energy-efficiency measures and promoted renewable-energy sources.

It also is worth noting that the sharp fall in fossil-fuel prices has not reduced the appetite for electricity generation from renewable sources. According to the IEA, "easier financing, new business models and clearer long-term price signals, underpinned by supportive policies, have driven investment despite low fossil-fuel prices" (IEA, 2016b). In the long term, the growing cost of extracting oil and gas as sources become more difficult to reach will provide a further competitive edge to renewables (IEA, 2015b).

Positive industry dynamics for renewable energies

With new installed capacity reaching 130 gigawatts (GW) in 2014 (about USD 270 billion in investments), the renewable energy sector has become, collectively, the second-largest source of electricity generation worldwide, behind coal (IEA, 2015b).

While hydropower still accounts for nearly three-fourths of total renewable electricity generation (94% from large hydropower projects in 2014), non-hydro renewable sources such as wind and solar photovoltaics (PV) have increased their share in the global energy mix (IEA, 2015b; IEA, 2015c).[1]

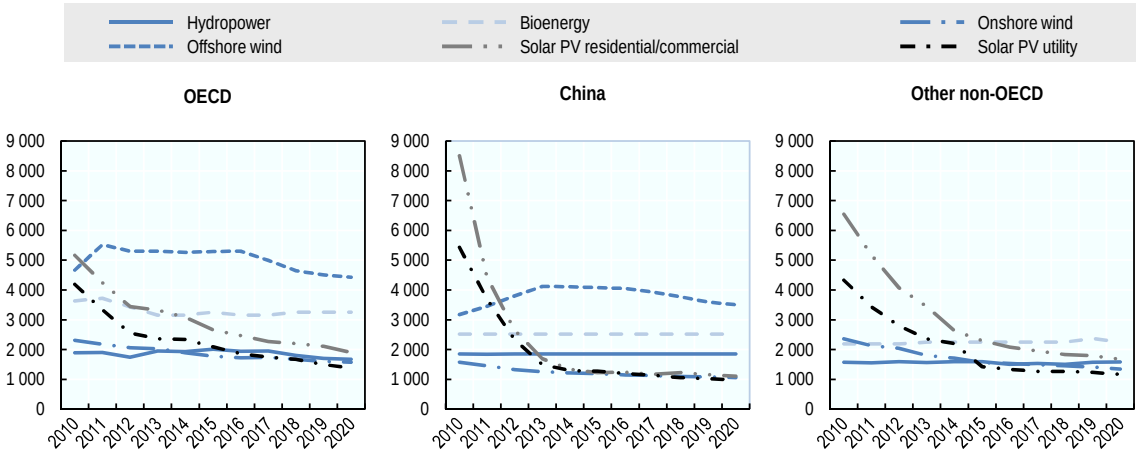
Wind and solar power also made significant gains in installed capacity. Wind power, like hydropower, added more capacity to the grid and witnessed a near-record year in 2014 with a total of 48 GW in capacity additions. Three regions accounted for most wind and solar installations: China (20 GW), the European Union (12 GW) and the United States (5 GW) (IEA, 2015b). The annual amount of solar PV installations reached almost 40 GW in 2013, a nearly 70-fold increase in one decade, mainly driven by Japan and China (IEA, 2015b).

The renewable energy industry also has become an important source of job creation. In 2014, the industry employed 7.7 million persons worldwide (excluding large hydro construction projects), which amounted to an 18% increase over the previous year. The main employers were the solar PV sector with 2.5 million jobs (mainly in China), bioenergy industries with 1.8 million and wind with 1 million (IRENA, 2015).[2]

Wind and solar are becoming increasingly cost-competitive (Figure 1.2). Technological improvements, the expansion of manufacturing capacity and lower costs of production lines in China (accounting for 70% of global production in 2014) led the way to the bulk of cost reductions in solar PV. Reduced production costs and lower prices for solar panels were accompanied by lower "soft costs" in areas such as system design, installation and labour. In the wind industry, recent innovations in turbine technology produce more electricity for modest additional costs (IEA, 2015b and 2015c).

Figure 1.2. **Weighted average annual renewable investment costs, 2010-20**

USD 2013/kW



Note: kW = kilowatt. Average unit investment costs as presented here are based on gross additions, which include capacity refurbishments that typically cost less than new capacity. Costs can vary over time due to technology changes as well as the markets in which deployment is occurring in a given year.
Source: IEA (2015c), *Renewables Information 2015*, http://dx.doi.org/10.1787/renew-2015-en; based on IEA analysis of data from Bloomberg LP (2014) (accessed June 2014).

Private sector taking action and encouraging governments to follow

The private sector played an important role in the run-up to COP21 by advocating for strong emissions targets, showing their willingness to meet climate goals and supporting the implementation of more effective carbon pricing and the phase-out of fossil-fuel subsidies.

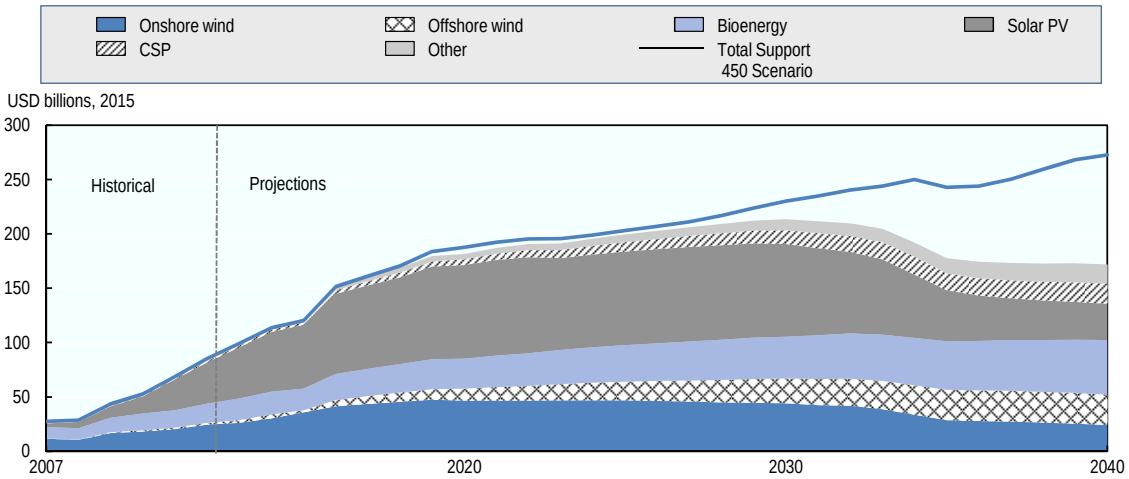
In May 2015, the CEOs of 120 of the world's largest investment funds (totalling USD 12 trillion in assets) signed a letter jointly urging Group of Seven (G7) finance ministers to agree to strong targets for emissions reductions at COP21 (IIGCC, 2015). Furthermore, a letter from the CEOs of 79 multinational companies (with more than USD 2.1 trillion of revenue in 2014), including EMnet members Engie, Iberdrola, Mahindra & Mahindra, ManpowerGroup, Siemens, Tata and Veolia, offered governments the opportunity "to meet and co-design tangible actions as well as ambitious, effective targets" (WEF, 2015).

The Carbon Pricing Leadership Coalition brought together more than 1 000 companies and 74 countries to support effective carbon-pricing policies. Through the Fossil Fuel Subsidy Reform Communiqué, hundreds of businesses, 40 governments and a large number of international organisations called for accelerating the phase-out of inefficient fossil-fuel subsidies (FFFsR, 2015).

Favourable public policies in support of green growth

Prior to COP21, governments played a key role by phasing out fossil-fuel energy sources in favour of a greater focus on renewables. Due in part to market fluctuations in a context of declining oil prices, some countries like India, Malaysia and Indonesia reduced their fossil-fuel subsidies significantly. It is estimated that between 2009 and 2014, reforms carried out around the world collectively enabled more than USD 100 billion in public savings (IEA, 2015b). On the other hand, subsidies supporting renewable-energy technologies reached USD 112 billion in 2014 and are expected to rise by 50% in 2040 to USD 170 billion (Figure 1.3).

Figure 1.3. **Subsidies by technology, 2007-40**



Note: CSP = concentrating solar power
Source: IEA (2016a), *World Energy Outlook 2016*, http://dx.doi.org/10.1787/weo-2016-en.

As part of a reciprocal subsidy peer review, the United States and China identified inefficient fossil-fuel support policies. This exercise was undertaken ahead of the 2016 Group of Twenty (G20) summit in Hangzhou (White House, 2014). The peer review was an achievement in that it highlighted the main subsidy policies and subsequent reform prospects in both countries. China identified nine inefficient fossil-fuel support policies, including a collection of subsidies to the transport sector amounting to USD 15 billion a year (Government of Germany et al., 2016). The United States highlighted 16 inefficient fossil-fuel support policies, some of them costing USD 1 billion or more annually (OECD, 2016a; Government of China et al., 2016).

The engagement of the Chinese and US governments was a key success factor for the Paris Agreement. In a joint statement in Washington DC in September 2015, Presidents Barack Obama and Xi Jinping reaffirmed the "Joint Announcement on Climate Change" they had made in November 2014 (White House, 2015). The announcement highlighted a number of US climate-change initiatives, including the Clean Power Plan, which aims to reduce CO_2 emissions from the power sector to 32% below 2015 levels by 2030, and the Significant New Alternatives Policy (SNAP) programme, which introduces new measures for reduced use and emissions of hydro fluorocarbons (HFCs). China also announced the launch by 2017 of a nationwide emissions trading system (ETS) that is expected to increase the total percentage of priced carbon on the

market from 13% to nearly 50%. China also is taking action to improve energy efficiency, whereby more than half of the country's production is now subject to mandatory energy-efficiency standards compared to 3% in 2005 (IEA, 2015b).

Paris Agreement: Main takeaways for businesses

The unprecedented level of participation at COP21 in Paris led to an agreement including pledges from 190 countries. The commitments, represented by the countries' Nationally Determined Contributions (NDCs), cover more than 95% of all energy-related greenhouse gas emissions (Chatterton, 2015). The scale of these commitments amounts to a real game-changer compared to past agreements; for example, the 1992 Kyoto Protocol covered only 15% of global energy-related emissions.

The outcomes of COP21 sent clear and strong political signals about the willingness to transition, by the end of the century, to zero net greenhouse gas emissions. To support this goal, economic and social policies must become resilient to climatic variability. In addition, financing must be leveraged, investment in technology scaled up further and capacity building expanded to support these aims. More specifically, the Paris Agreement includes a long-term goal of keeping temperature "well below" 2°C and to pursue the "efforts to limit" temperature increase to 1.5°C. The agreement further highlights that developing countries will take longer to achieve the peaking of emissions (UNFCCC, 2015).

The OECD experts from the EMnet Working Group underscored climate change mitigation, adaptation and finance as the elements of the agreement that are particularly relevant for the private sector. Mitigation refers to actions to reduce greenhouse gas emissions, adaptation to measures to enhance resilience to the impacts of climate change, and finance to the efforts to increase public funds available for low-carbon and climate-resilient investment.

Mitigation commitments to boost renewables and energy-efficiency opportunities

In terms of mitigation, the Paris Agreement establishes a set of binding commitments to "prepare, communicate and maintain" NDCs and to communicate a new NDC every five years. The agreement presses parties to "pursue domestic measures with the aim of achieving the objectives" (UNFCCC, 2015) without making this a binding obligation. Finally, it encourages countries to communicate their long-term low-emission strategies.

These mitigation commitments should further drive the implementation of supportive measures to develop renewables and promote energy-efficiency projects. New low-emission projects will be supported by major banks that pledged to scale up financing for renewable energy, green bonds and other low-carbon solutions. Examples of commitments include companies such as Crédit Agricole (dedicating USD 60 billion by 2018), BNP Paribas (lending USD 15 billion by 2020) and Bank of America (USD 125 billion pledged to low-carbon businesses by 2025) (Nakhooda, 2015; BNP Paribas, 2015).

In addition, industrial groups are taking action to support the development of a low-carbon economy. Mahindra & Mahindra announced in October 2016 its adoption of an internal carbon price of USD 10 per tonne of carbon emitted. This commitment is aligned with the company's

target to reduce greenhouse gas emissions by 25% and with India's national climate-change policy following the ratification of the Paris Agreement (Mahindra & Mahindra, 2016).

Adaptation commitments will support infrastructure investments

Adaptation was highlighted as a crucial issue in the agreement. The qualitative, collective goal is to enhance adaptive capacity, strengthen resilience and reduce vulnerability. Nonetheless, countries "should" but are not obligated to communicate on their adaptation actions and priorities. As underscored by the IEA, investments of USD 359 trillion will need to be made in the building, industry, transport and power-generation sectors between 2015 and 2050 to reach the 2°C target (IEA, 2015d). Many of these investments will contribute to adaptation objectives.

These investments also will be opportunities for private companies seeking to invest in areas relevant for adaptation, such as constructing new buildings and expanding or retrofitting existing buildings and power plants. Adapting fossil-fuel-fired power plants for climate resiliency will offer additional opportunities. For example, to extend their lifetime, existing coal-fired power plants should be ready for Carbon Capture and Storage (CCS) retrofits, taking into account the space required for future storage sites and capture-related equipment (IEA, 2016b). Finally, the commitments made during COP21 by 25 Green Building Councils and 125 corporate members to "register, renovate or certify over 1.25 billion square metres of green building space" (about twice the size of Singapore) will represent significant opportunities for the private sector (World Green Building Council, 2015).

Climate finance to unlock green investment from the private sector

Financial support for the new climate goals plays a major role in the agreement, as stated in Article 2.1.c., which highlights the need for finance flows to be "consistent with a pathway towards low greenhouse gas emissions and climate-resilient development" (UNFCCC, 2015). Developed countries are legally obligated to "provide financial resources to assist developing country Parties with respect to both mitigation and adaptation." The agreement "strongly urges" developed countries to scale up their level of financial support, "with a concrete roadmap to achieve the goal of jointly providing USD 100 billion annually by 2020" (UNFCCC, 2015).

Increased public financial support can play a role in improving the profitability of green investments and the development of innovative low-carbon technologies. Various institutions such as bilateral and multilateral development banks, as well as green investment banks, have been providing public climate finance. Since 2007, the European Investment Bank has increased its lending for renewable-energy and energy-efficiency projects, while the German national KfW Development Bank aims to invest EUR 27 billion every year to implement the bank's energy turnaround plan by 2020 (Cochran et al., 2014). Since 2006, the European Bank for Reconstruction and Development has combined support for national-policy dialogue through its Sustainable Energy Initiative with project-level financing for less-energy-demanding industries (Cochran et al., 2014).

Publicly capitalised green investment banks are a new type of institution being used by policy makers to attract private capital into low-carbon, climate-resilient infrastructure projects, notably investments in renewable energy and energy efficiency. Green investment banks tend to combine

innovative transaction structures, risk-reduction and transaction-enabling techniques with local and market expertise. Green investment banks and similar entities have been established at the national level (e.g. Australia, Japan, Malaysia, Switzerland and the United Kingdom), the state level (e.g. Connecticut, Hawaii and New York in the United States), the county level (e.g. Montgomery County, Maryland in the United States) and the city level (Masdar City in the United Arab Emirates) (OECD, 2016b).

Finally, green bonds can facilitate raising capital for projects with an identified positive environmental impact. Green bonds can be issued by private and public entities and offer fixed returns over a fixed timeframe, in fixed periodical instalments. The market for green bonds is developing rapidly; it increased from USD 3 billion issued in 2012 to USD 47.8 billion in 2015, and reached USD 93.4 billion in 2016 (Jun et al., 2016; Moody's, 2017).

Future emissions scenarios and energy mix to reach the 2°C target

The Paris Agreement aims at "holding the increase in the global average temperature to well below 2°C above pre-industrial levels" (UNFCCC, 2015). The IEA's *Energy Technology Perspectives 2016* developed potential temperature-rise pathways for the time horizon 2012-50, describing three different scenarios with 6°C, 4°C and 2°C targets (Box 1.1).

Box 1.1. Three scenarios in the IEA's Energy Technology Perspectives 2016

The *Energy Technology Perspectives 2016* report describes three scenarios assessing the impact on climate change of different policy options and technological advancements.

The 6°C scenario assumes no additional measures to mitigate emissions beyond policy measures already in place. By 2050, this "business as usual" scenario could translate into an increase of 60% in carbon emissions and a long-term increase in temperature of 5.5°C.

The 4°C scenario takes into account recent pledges to increase energy efficiency and limit carbon emissions. To limit the temperature rise to 3.7°C, this ambitious scenario requires significant policy action and technological changes.

The 2°C scenario, in line with the Paris Agreement, sets the goal of keeping the long-term increase in temperature below 2°C. To achieve this objective by 2050, the energy intensity of GDP and the carbon intensity of primary energy both have to be reduced globally by about 60% starting today (IPCC, 2014).

Source: IEA (2016b), *Energy Technology Perspectives 2016*, http://dx.doi.org/10.1787/energy_tech-2016-en; IEA (2015b), *World Energy Outlook 2015*, http://dx.doi.org/10.1787/weo-2015-en; IPCC (2014), *Climate Change 2014*, www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_full.pdf.

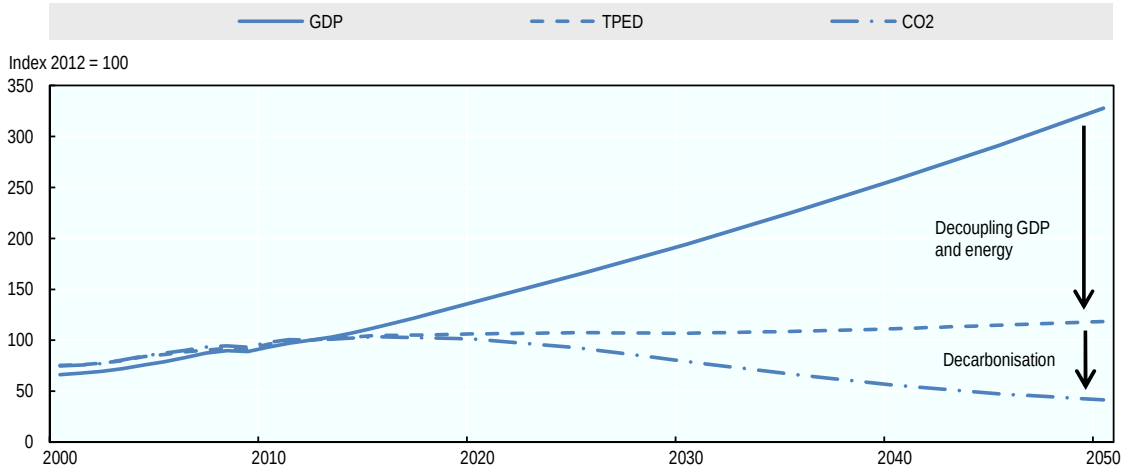
Since the first COP meeting in 1995, the global economy has grown more than 45% in purchasing power parity (PPP), with global primary energy demand and CO2-related emissions growing along the same trend (40%) (World Bank, 2015; IEA, 2015d). Since 2000, emissions have grown on average by 2.4% per year. According to recent IEA analysis, a peak in emissions would be possible around 2020, using existing technologies but pushing further on energy efficiency, renewables, reforms of fossil-fuel subsidies, declining reliance on inefficient coal and methane-emissions reduction. Carbon emissions will then grow at a slower 0.5% rate in the 2020s

and 2030s (IEA, 2015b). Technology innovation and research and development (R&D) will play important roles in accelerating the process.

Decoupling GDP and energy, together with decarbonisation, will be essential to achieve the 2°C scenario (Figure 1.4). Starting in 2014, the global economy in GDP terms could keep growing without consuming more energy (measured in Total Primary Energy Demand), triggering a decoupling in GDP growth and energy consumption. Global GDP could triple with an increase in primary energy use of only 20%. The IEA argues that some progress has been made in decoupling energy use and GDP, but the rate needs to be accelerated from 1.1% per year over the last decade to 2.6% by 2050.

Limiting carbon emissions is not, however, sufficient to reach the 2°C scenario; these must actually be pushed to below the current levels. Carbon emissions from primary energy demand must be reduced by 60% across all sectors such as power, industry, transport, building and other transformation activities (IEA, 2015d).

Figure 1.4. **Development of global GDP, primary energy and emissions in the IEA 2°C scenario, 2000-50**

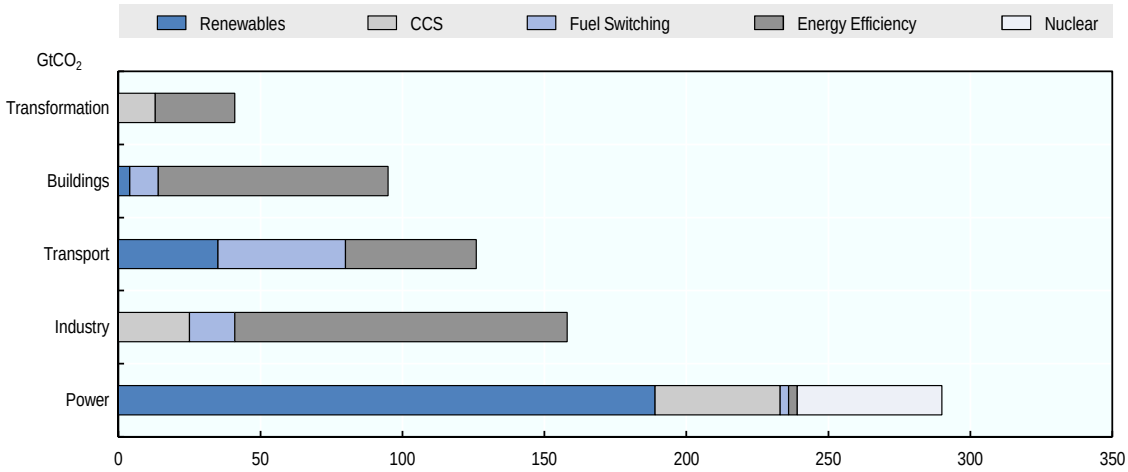


Note: TPED = total primary energy demand.
Index: Energy Sector Carbon Intensity Index (ESCII), www.iea.org/etp/etp2015/secure/figures/global_outlook/
Source: IEA (2015d), *Energy Technology Perspectives 2015*, http://dx.doi.org/10.1787/energy_tech-2015-en.

Energy efficiency will play a key role in emissions reductions and will generate investment opportunities

The 2°C scenario also takes into account the crucial role played by energy-efficiency measures in reducing dependency on fossil fuels. It estimates that by 2050, 64% of the reduction in energy intensity will be due to energy efficiency (IEA, 2015d). Energy efficiency could provide as much as 40% of the emissions reduction needed to achieve the 2°C target (IEA, 2016b). Figure 1.5 demonstrates that energy efficiency is widespread and represents the majority of potential emissions reductions in four out of the five carbon-intensive sectors.

Figure 1.5. **Cumulative CO_2 reductions by sector in the 2°C scenario to 2050**



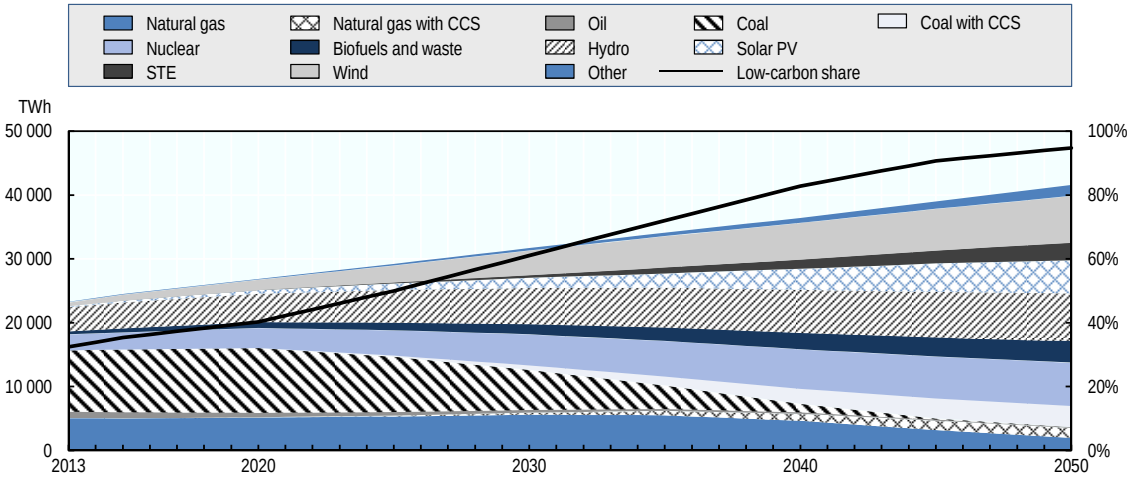
Note: CCS = carbon capture and storage
Source: IEA (2016b), *Energy Technology Perspectives 2016*, http://dx.doi.org/10.1787/energy_tech-2016-en.

Estimates for annual global energy efficiency-related investment reached USD 221 billion in 2015, a 6% increase from 2014 (IEA, 2016d). To be on track for the 2°C target, however, the IEA estimates that a total of about USD 31 trillion in investments in energy efficiency from 2015 to 2040 will be needed (IEA, 2015b). Opportunities for private investment will be the largest in the transport sector with a USD 19 trillion potential, with a focus on improving fuel-efficiency standards for light-duty vehicles. Over the same 2015-40 period, energy-efficiency investments for buildings are estimated at around USD 10 trillion, including interventions for more efficient household and office appliances as well as heating and cooling systems. Finally, investments in industry-related energy-efficiency measures will be three times higher in non-OECD countries, and half of them will be happening in China (IEA, 2015b). Notably, China's 13th Five Year Plan (2016-20) targets a 15% improvement in energy intensity, with 65% of the energy savings coming from economic restructuring (IEA, 2016d).

The energy mix of the future will make room for renewables

The 2°C scenario foresees that electricity generation will be completely decarbonised by 2050. The deployment of renewables and a strong carbon price will be key components of these efforts (IEA, 2016b). Renewables will dominate the energy mix with the share of 22% in 2013 expected to reach 67% in 2050 (with about 30% coming from solar and wind sources). The share of coal- and gas-fired power plants with CCS is expected to reach 12% while nuclear generation increases from 11% to 16% over the same period (Figure 1.6).

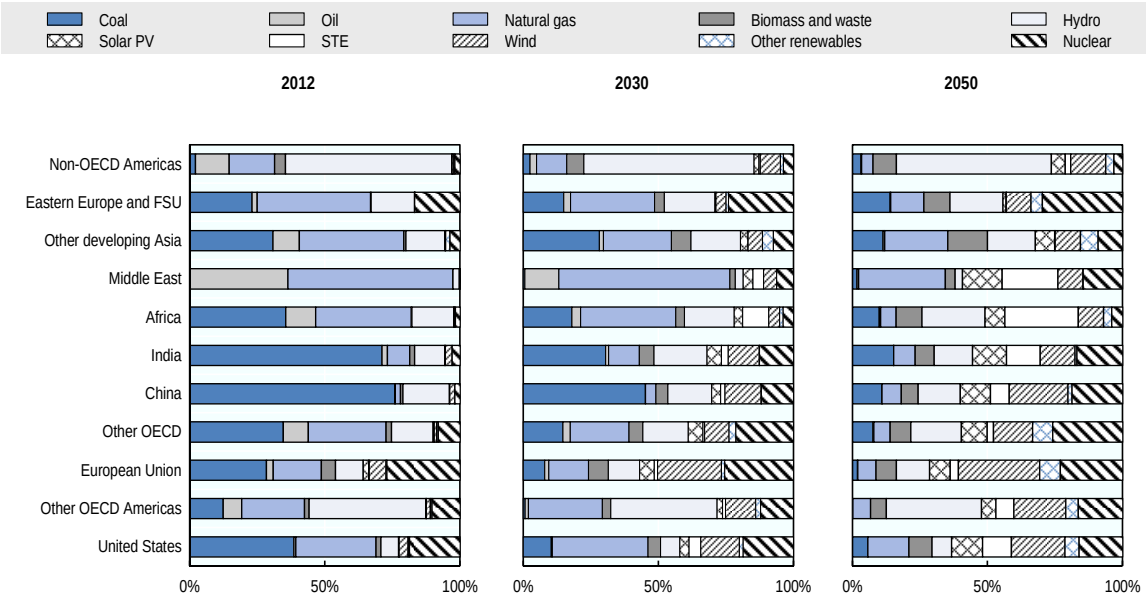
Figure 1.6. **Global electricity generation mix in the 2°C scenario, 2013-50**



Note: TWh = terawatt hours; STE = solar thermal electricity; CCS = carbon capture and storage. Low-carbon share refers to the combined share of the generation of electricity from renewables, nuclear and CCS.
Source: IEA (2016b), *Energy Technology Perspectives 2016*, http://dx.doi.org/10.1787/energy_tech-2016-en.

Lower use of fossil fuels for power generation depends on local conditions. Opportunities, resource endowments and policy conditions drive the strategies to decarbonise electricity systems. In the IEA 2°C scenario, opportunities for businesses in the renewables sector will emerge mainly in Africa, the Americas and the European Union, where by 2050 renewables could cover more than two-thirds of the energy mix. Fossil fuels with CCS will account for 25% or more of the generation mix in Eastern Europe, the former Soviet Union, the Middle East and Asia (Figure 1.7).

Figure 1.7. **Evolution of electricity generation mixes in the 2°C scenario, 2012-50**

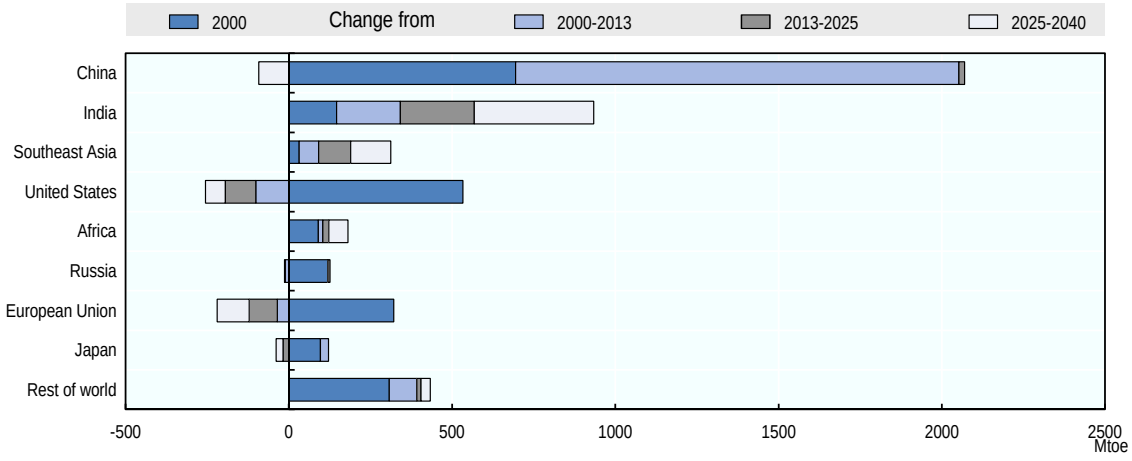


Note: STE = solar thermal electricity, FSU = former Soviet Union
Source: IEA (2015d), *Energy Technology Perspectives 2015*, http://dx.doi.org/10.1787/energy_tech-2015-en.

The future of coal demand

Despite drops in demand and trade of coal, investments are expected to continue. The IEA foresees that coal will represent 25% of the total primary energy demand by 2040 (Figure 1.8) (IEA, 2015b).

Figure 1.8. **Change in coal demand by region up until 2040**



Note: Coal demand in 2040 is the sum of the time periods shown.
Source: IEA (2015b), *World Energy Outlook 2015*, http://dx.doi.org/10.1787/weo-2015-en.

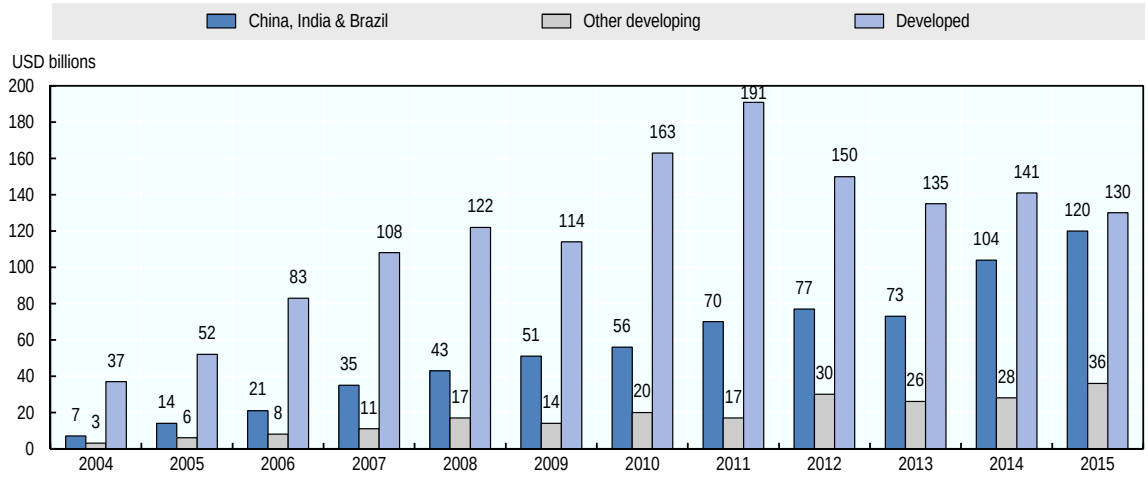
Today India, China and the United States account for 72% of the global demand. China will maintain its demand for coal until 2040, which peaked in 2013. This stabilisation is mainly driven by the "new normal" status of the national economy, with moderate GDP growth rates and greater emphasis on services and domestic consumption. China's dominant role in driving global coal demand is expected to be passed on to India and Southeast Asia.

India will soon overcome the United States as the world's second-largest coal consumer, while coal demand is expected to decline in OECD countries. In 2015, the Indian government announced its goal to double the production of coal by 2020 to meet growing internal demand and to decrease dependency on imports. In contrast, the demand in the United States and the European Union is expected to be one-third lower in 2040 than in 2013. This drop will be driven by a mix of factors, including stricter carbon-emission regulations, increased use of renewable-power generation and low natural-gas prices, which can encourage coal-to-gas switching.

PROMOTING PRIVATE GREEN INVESTMENT

Private investment in renewable energy has increased significantly in the past decade, with a consistent upward trend from emerging economies, particularly China, Brazil and India (Figure 1.9). Supportive climate and investment policies can play an important role in sustaining this growth. Between 2004 and 2015, investment in clean energy (domestic and international) grew nearly six-fold from USD 62 billion to USD 348.5 billion annually, with more than half of these investments taking place in the Asia-Pacific region (MacDonald, 2016). New infrastructure investments in transport, water systems and energy are expected to require around USD 90 trillion additional funds between 2015 and 2030, highlighting the scale of the needs and the potential role for private investment in the future (GCEC, 2014).

Figure 1.9. **Global new investment in renewable energy, 2004-15**



Note: New investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals. Developed volumes are based on OECD countries excluding Mexico, Chile and Turkey.
Source: Frankfurt School of Finance & Management (2016), *Global Trends in Renewable Energy Investment 2016*, http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2016lowres_0.pdf data from UNEP and Bloomberg New Energy Finance.

Setting up climate policies and aligning them with the broader policy portfolio

The OECD report on *Aligning Policies for a Low-Carbon Economy* highlights that the effectiveness of climate policies can be weakened if not aligned with the broader policy portfolio (OECD, 2015g). These misalignments can happen in multiple dimensions, including at different levels of government, with different stakeholders or beyond national borders. For example, sub-national governments are critical decision makers for urban transport planning, but a lack of co-ordination and capacity can hinder efforts towards climate-policy action. Furthermore, import tariffs and protectionism can penalise the diffusion of successful low-carbon technologies. Setting a coherent and supportive policy framework is essential to attracting more investment.

Supportive policies for private investment and innovation in low-carbon technologies

Beyond climate-change policies, governments need to ensure the proper enabling environment for both national and international investors in low-carbon technologies. The importance of private funds to support both early and more mature stages of technological development highlights the need to mitigate barriers to long-term investment. In the field of renewable energy, for example, key policy obstacles include inefficient fossil-fuel subsidies, retroactive changes in support of clean-energy projects, and a lack of incentives to invest in transmission, distribution and energy storage (OECD, 2015b). OECD's *Policy Framework for Investment* (OECD, 2015c) and *Policy Guidance for Investment in Clean Energy Infrastructure* (OECD, 2015b) highlights the following ways government can seek to mobilise private green investment. These strategies should be considered alongside analysis of the specific context and needs of developing countries.

- **Promote sound investment policy principles to ensure predictability in the long term**, by focusing on the protection of intellectual property rights (securing land tenure and against expropriation), contract enforcement, transparency and land rights, and non-discrimination (OECD, 2015c).
- **Encourage investment promotion and facilitation towards greener technologies for the long term**, by creating incentives to shift investments away from fossil fuels to low-carbon technologies in the power sector, facilitating the licensing process for renewable-energy projects, reducing legal and administrative costs, and putting a price on carbon (OECD, 2015a).
- **Reinforce competition policies to limit market distortions and facilitate access for new entrants**, by keeping markets open and neutral to maximise foreign and domestic investment. Distortions in clean-energy markets can be generated when giving outward investment or state-owned enterprises preferential access to finance. Key issues include the design of transparent procurement processes and the unbundling of vertically integrated electricity operators (OECD, 2015c).
- **Improve financial-market policy and use innovative financial mechanisms**, by facilitating long-term access to finance for investment in renewable-electricity projects. Policy makers can support the development of debt instruments, green bonds, guarantees or other risk-reduction tools and specialised institutions, such as green investment banks, to promote private investment in renewable energy, low-carbon technologies and climate-resilient infrastructure (OECD, 2016b; OECD, 2015d; OECD and Bloomberg Philanthropies, 2015).

- **Ensure policy coherence across all levels of government**, by strengthening consistency of policy objectives through early participation of key stakeholders, including authorities dealing with natural-resource management, energy, investment and environment. Reinforced cooperation can help in the case of urban mobility, where sub-national governments seeking to implement climate policies can face organisational, institutional and financial bottlenecks (OECD, 2015g).
- **Address outstanding barriers to international trade and investment**, by looking at local-content requirements, incentives favouring domestic versus foreign investors and regulatory restrictions on FDI (OECD, 2015a).

Instruments to support private investment in renewable energies

According to EMnet Working Group participants, a reliable regulatory framework ensuring transparency and predictability is essential to promote long-term private investment in renewable energies. Key elements include clear renewable-energy targets and a well-defined development strategy for the sector.

In addition, a variety of targeted, time-limited incentive schemes exist to attract investment in deployed renewable-power technologies such as feed-in tariffs, tax incentives, Renewable Energy Certificates (RECs) and public tenders. Their degree of effectiveness can vary, however, depending on the timing of the incentives, technological maturity and other specific market conditions. To drive down costs, incentive schemes should include a provision also for their eventual phase-out (Cárdenas Rodríguez et al., 2014; Haščič et al., 2015).

As highlighted by the IEA's *Medium-Term Renewable Energy Market Report 2016*, different markets will use various sets of instruments to promote investments in renewable-energy technologies:

- In **China**, driven by growing air-pollution concerns, the government is using feed-in tariffs and minimum-generation quotas to achieve renewable-energy targets.
- In **North America**, the United States adopted federal tax incentives, Canada focuses on investment-policy improvements and Mexico uses long-term auction contracts and green certificates.
- In the **Asia and Pacific** region (excluding China), India will use a new competitive tender policy to drive solar PV expansion. In Japan and the ASEAN countries, feed-in tariffs will be the main policy instrument to promote renewable investment.
- In the **European Union**, tenders and competitive auctions will be chosen increasingly over feed-in tariffs to support renewable-energy projects. Specific country contexts can affect national growth prospects.
- In **Latin America**, renewable-energy investments have been promoted through competitive energy tenders; the current regional economic slowdown is, however, expected to reduce the demand and the outlook for new renewable projects, particularly in a key regional market like Brazil.
- In the **Middle East and North Africa**, government-backed tenders are the main driver of growth in renewables.

- In **sub-Saharan Africa**, hydropower remains the main focus for the development of renewables, with the exception of South Africa's renewable procurement programme for solar PV and onshore wind (IEA, 2016e).

Furthermore, to attract more investors in emerging countries, competitive bidding processes can be reinforced by well-defined rules and incentives such as long-term Power Purchase Agreements (PPAs) guaranteed by governments, indexed and cost-reflective tariffs, and streamlined permitting processes.

Several studies highlight that public support for research, development and demonstration (RD&D) (e.g. through grants, tax incentives and other public expenditures) has contributed significantly to the early-stage design of solar PV technologies (Gambhir, Gross and Green, 2014). This suggests that governments should use public R&D funding to stimulate the development of early-stage technologies such as smart grids, offshore wind and CCS (Gambhir, Gross and Green, 2014). In the case of more mature technologies such as solar PV, feed-in tariffs have played a larger role than public R&D in mobilising private investment (Gambhir, Gross and Green, 2014; Grau, Huo and Neuhoff, 2012).

Finally, EMnet Working Group participants highlighted that thanks to recent technological improvements, renewable energies have become much more competitive, the capital expenditure needed has decreased and prices have come down dramatically. In this context, however, sectoral competitiveness is possible only where the proper regulatory conditions are in place.

Forthcoming OECD research on *Enabling Investment and Innovation in Renewable Energy* will assess empirically how specific climate-mitigation policies and broader investment conditions impact investment and innovation in the renewable-power sector within G20 and OECD countries (OECD, 2017a; OECD, 2017b forthcoming). The project also will assess how investment conditions interact with climate policies. This research aims to help G20 and OECD policy makers enhance the effectiveness of incentives and other climate policies in encouraging investment and innovation in renewables by addressing misalignments in the broader investment environment.

PRIVATE SECTOR INSIGHTS AND RECOMMENDATIONS

The outcomes of COP21 were received positively by the participants in the March 2016 meeting of the EMnet Working Group on Greening the Economy. The Paris Agreement was acknowledged as a key milestone, set to influence and reshape future business strategies. Key areas of discussion of the EMnet Working Group included the composition of the future energy mix, the role of emission-trading schemes, the risks associated with doing business in emerging economies and the impact of COP21 on future business strategies. This section also features messages from the private sector on the opportunities for renewable energy investment in Asia, which draw upon the discussions at the EMnet Asia meeting held in March 2016.

The fossil-fuel mix of tomorrow will experience dynamic changes

Members of the EMnet Working Group highlighted the importance of considering the composition of tomorrow's fossil-fuel mix and its implications for the private sector. Participants and IEA experts had similar views on the different pathways that each fossil-fuel category is

expected to follow in the future. The IEA depicts a pathway to the 2°C climate goal through technologies approaching commercial viability and assumes the implementation of a set of policies to reduce carbon emissions. The following points highlight the outlook for the fossil-fuel mix in a context of increasing climate action (IEA, 2015b).

- **Oil:** While still representing 40% of the energy mix in 2014, oil consumption is set to decline throughout OECD countries after reaching peak demand by 2020. The global demand is expected to drop from 90 million barrels per day (mb/d) in 2014 to 74 mb/d in 2040.
- **Gas:** Investment and consumption of gas are expected to grow until the end of the 2020s, when additional policies limiting CO_2 emissions will be introduced.
- **Coal:** It is expected that coal will follow different demand-growth trajectories based on country-specific situations. The demand is set to increase significantly in India and Southeast Asia, decrease in the United States and the European Union and remain flat in China after peak demand in 2013.

The implementation of the Paris Agreement will be challenging

The participants of the EMnet Working Group highlighted the numerous implementation challenges policy makers face to achieve the objectives of the Paris Agreement and discussed a few ideas to address them. Development of carbon-pricing mechanisms, support for energy-efficiency and renewable energies, deployment of CCS technology, and the reduction of air pollution were the main topics debated during the meeting.

Implement competitive carbon-pricing mechanisms. This involves introducing strong carbon prices to raise the cost of using fossil fuels without CCS and therefore discourage their use (IEA, 2015d). In the context of low-carbon prices, however, triggering new investments in the power sector will require additional incentives (especially for projects moving from pilot to large-scale deployment). The soon-to-be implemented Chinese emissions trading system will triple the volume of priced carbon on the global market by 2017. This will set crucial standards for the future of carbon-trading markets, opening new opportunities for low-carbon investments.

Increase the focus on energy efficiency. Energy efficiency will potentially contribute to 40% of total emissions reductions in the 2°C scenario, and even more in the emerging economies. Though progress has been made, energy efficiency only attracted 12% of all energy-related investments in 2015 (IEA, 2016c). Participants in the EMnet Working Group stressed that energy efficiency is touching all sectors of the economy; the impact on residential energy consumption, however, can be considered higher than in other sectors. Recently adopted measures should further strengthen support for energy efficiency, such as the European Union's Efficiency First initiative and the commitment of the 2017 German G20 Presidency to set a "framework for investments in low/zero-carbon energy technologies" (IPEEC, 2016). A possible way forward involves the design of policies seeking to minimise financial risks, promote technology improvements, and develop green bonds for energy efficiency and energy contracting.

Leverage the momentum for renewables to meet the emission-reduction targets. Large-scale deployment of wind and solar PV technologies will require energy storage and smart-grid infrastructure. On the policy side, these technologies rely more on predictability and reliability in

the regulatory framework than on economic incentives. Participants particularly emphasised the importance of clear and stable long-term price signals, which can reduce investment risks for utility projects. While solar PV and wind technologies have become more cost-competitive, other industries such as offshore wind, solar-thermal energy or ocean power still require high investment costs that are slowing their development (IEA, 2015d). Participants pointed out that the environment of low-interest rates in OECD countries has had a positive effect on the renewable-energy sector, reducing the cost of debt and encouraging more investments. However, companies are preparing for the possibility of a future tightening of monetary policy, which could have an impact on energy-related investments (IEA, 2016c).

Implement CCS-ready plants as they become commercially viable. CCS technology has great potential to contribute to a low-carbon economy; it still needs appropriate public policy support, however, particularly in developing countries. The IEA highlights that the most important CCS projects are currently based in Canada and the United States (IEA, 2015d). In October 2014, SaskPower's Boundary Dam power station in Canada became the world's first commercial electricity-generating unit with full carbon capture (Box 1.2). Given the long technical lifetime of power-generation technologies, it is important to avoid lock-in of carbon-intensive technologies, which can be done by either equipping plants with CCS or designing them for future retrofits. Taking CCS into account in future plans, as is done for fuel supply, grid and cooling connections, would mean considering transport and large-storage capacity for future CO_2 (IEA, 2015d).

Tackling the issues of air pollution, climate mitigation and energy access at the same time can generate positive synergies and goes hand-in-hand with the transformation of the energy sector agreed at COP21. The *Fifth Assessment Report of the Intergovernmental Panel on Climate Change* highlights that designing horizontal policies addressing the issues of energy security, climate and air pollution together can be less expensive than dealing with them independently (IPCC, 2013).

Box 1.2. Making CCS technology commercially viable: Canada's SaskPower Boundary Dam

Carbon capture and storage (CCS) technology, while not yet largely deployed in emerging economies, has shown progress in reaching commercial viability in more mature markets. In October 2014, the SaskPower Boundary Dam project in Canada developed the world's first commercial electricity-generating unit, where nearly 90% of carbon emissions are captured and stored every year. The project rebuilt a coal-fired generation unit with CCS technology. More than 60% of the total cost of the project, which was CAD 1.3 billion (Canadian dollars), went to the installation of CCS technology, and 38% covered the retrofit costs (MIT, 2016). Financial support came from various stakeholders and included contributions from the federal and provincial governments. The project faced numerous technical challenges along the way. Nonetheless, in April 2016 SaskPower announced that 757 000 tonnes of CO_2 had been captured since the operational start-up in 2014 (MIT, 2016).

Source: IEA (2015d), *Energy Technology Perspectives 2015*, http://dx.doi.org/10.1787/energy_tech-2015-en; MIT (2016), "Boundary Dam Fact Sheet", https://sequestration.mit.edu/tools/projects/boundary_dam.html

Emissions trading systems and carbon taxes have potential but require careful design

According to EMnet Working Group participants, discussions at COP21 lacked appropriate emphasis on carbon pricing via mechanisms such as emissions trading systems (ETS) or carbon taxes. Participants agreed that ETS should not be seen as mechanisms to provide greater public-revenue sources but should act rather as catalytic instruments to redirect funds towards green investments. As mentioned by IEA experts, the success of the new Chinese nationwide ETS, set to come into force in 2017, is crucial for global carbon pricing efforts and essential to achieve COP21 targets (Box 1.3). The decision to implement carbon taxes should consider the broader fiscal-reform agenda. By combining carbon taxes with the use of low-carbon technologies, greater emissions reductions are more likely to be achieved (OECD, 2015f).

Box 1.3. Emissions trading systems in China: Pilot projects and the nationwide rollout

Since 2011, China has been experimenting with seven pilot regional emissions trading systems (ETS) in cities (Shanghai, Shenzhen, Chongqing, Tianjin and Beijing) and provinces (Hubei and Guangdong). The country will launch a three-year pilot national ETS starting in 2017 through the National Development and Reform Commission (NDRC) (OECD, 2015e). The sectors targeted include nonferrous metals, building materials, metallurgy, power generation, aviation and chemicals, and will account for 3 000 to 4 000 million tonnes of CO_2 per year (ICAP, 2015). The results of the new nationwide ETS will be crucial to reach the 2°C target set at COP21 and encourage a higher volume of private investment in renewables in China. Investment in renewables is traditionally public and channelled through state-owned enterprises (Wang, 2015). If successful, this new ETS in China could potentially serve as a model to be replicated in other countries.

Source: OECD (2015e), *Climate Change Mitigation: Policies and Progress*, http://dx.doi.org/10.1787/9789264238787-en; Wang, H. (2015), *Emissions Trading in China*, www.iisd.org/sites/default/files/publications/emissions-trading-in-china-renewable-energy.pdf.

Political, transfer and pricing risks can hinder investment in renewable energies

Participants in the EMnet Working Group highlighted that political, transfer and pricing risks could prevent investments in clean technologies from happening. First, short-term political gains can mask the potential long-term benefits stemming from clean investments. Second, transfer risks were identified as one of the barriers to be addressed when investing in emerging economies. Transfer risks refer to the probability of losses due to currency volatility and restrictions. Finally, pricing risks, based on the volatility of various business incentives, were identified as a major risk for companies seeking stable returns on investment.

A range of risk-mitigation tools can support investment in clean energy. Guarantees often are used as a credit-enhancement mechanism for debt instruments such as bonds and loans. Guarantees also can be used in the context of guaranteeing the performance of a given technology such as solar panels or wind turbines and energy-efficient technologies. Insurance products may protect against a range of risks such as construction or operational risks, market risks such as price changes, weather-related production-volatility risks, and political, regulatory or policy issues (OECD, 2015d).

Corporate strategies will be adjusted to reflect the post-COP21 context

Members of the EMnet Working Group highlighted the importance of changes in corporate and investment strategies to adjust to a new post-COP21 environment. Companies are leveraging the post-COP momentum to integrate more sustainable practices into their business models. The French company Engie cancelled a coal-fired plant project originally planned in Turkey. This was a result of an announced three-year transformation plan to divest from fossil-fuel sources (Engie, 2015). Italy's Enel is aiming to achieve carbon neutrality of its production mix by 2050 and make 55% of its total managed capacity from renewable energy sources by 2019 (Enel, 2016a; Enel, 2016b).

The financial sector also has started to adjust its business strategy to reflect the COP21 engagements. For example, BNP Paribas pledged to more than double its lending in the renewable energy sector from nearly EUR 7 billion in 2014 to EUR 15 billion in 2020 (BNP Paribas, 2015). The Portfolio Decarbonization Coalition seeks to reduce portfolio exposure to greenhouse gas emissions and increase investments in areas such as renewable energy sources, gathering 27 asset owners and representing over USD 3 trillion in assets under management (UNEP FI, 2016). Finally, the Montreal Carbon Pledge has been signed by over 120 investors with over USD 10 trillion in assets under management, pledging to measure and disclose the carbon footprint of part or their entire equity portfolio (PRI, 2016).

Finally, initiatives such as the Oil and Gas Climate Initiative, representing 20% of global oil and gas production, were mentioned as a response from the oil and gas industry to the challenge of climate change (OGCI, 2016). This is an industry-driven initiative analysing the role of natural gas in the future energy mix, exploring carbon-reduction instruments and tools, and sharing visions on technical and non-technical solutions to meet future energy needs.

Renewable energy opportunities in Asia abound

At the EMnet Asia meeting on regional integration, which took place on 8 March 2016, one session focused on business opportunities for renewable energy. Participants highlighted India's efforts to increase investment in renewables and the increasing cost-competitiveness of solar in certain regions, as well as the potential that hydropower still has to offer.

Renewable energy is one of the sectors targeted by "Make in India", a programme announced by Prime Minister Modi in 2014 aiming to turn India into a global design and manufacturing hub. The initiative includes a range of support measures for the deployment and development of renewable power in the country, such as tax holidays and customs-duty exemptions. India's annual solar installations are expected to grow more than four-fold by 2017, and the government has set a target to reach 100 gigawatts (GW) in solar capacity by 2022. The accompanying increases in manufacturing scale and experience can lower costs for solar modules. Moreover, the government is seeking to attract investors in solar energy by providing a range of financial-support instruments, including energy subsidies, duty exemptions, guarantee schemes, loans at concessional rates and special incentives for all renewable-energy technologies exported from India (Make in India, 2016a, b).

From a market-dynamics perspective, solar PV has become more and more cost-competitive over the years in certain states in India. For example, Solairedirect, an Engie subsidiary, won 140

megawatts (MW) in solar projects in the Rajasthan state with an offer of INR 4.35 (Indian rupees) per KwH, compared to INR 4.65 for coal. Solar is becoming competitive in terms of project delivery (between tendering and final commissioning). Solar PV facilities of up to 200 MW can now be delivered in 13 months, and such projects are becoming more attractive to international banks seeking to invest in India (Solairedirect, 2016).

While hydro is viewed as an "old" source of renewable power compared to newer developments such as solar PV, hydropower projects on the Mekong River – flowing through China, Myanmar, Thailand, Lao PDR, Cambodia and Viet Nam – are a promising source of future generation capacity that can be exported throughout the region. Despite numerous challenges, such as large capital expenditure requirements, and technological and social risks, participants also highlighted the potential and importance for hydropower to both improve electricity access and contribute to economic development. Key challenges include improving grid connections and electrical regulations. The countries in the region are lacking a common grid code. In addition, sustainability challenges extend far beyond simply environmental concerns to include settlement relocation and loss of livelihoods. Accordingly, regional co-operation is essential to benefit from and ensure the sustainability of the Mekong River (OECD, 2016c).

CONCLUSION

The agreement reached at COP21 sent a strong policy signal that governments are committed to reduce carbon emissions and fight global warming. In the future energy-mix scenario, the development of the renewable energy sector will be accompanied by important energy-efficiency programmes and a more sustainable use of fossils fuels. The private sector welcomed the results of COP21 and is preparing to adapt future business strategies to the expected changes in the energy mix.

Public commitments and pledges must, however, be accompanied by context-specific policy decisions to reduce carbon emissions, scale up green investment, promote clean infrastructure and support the development of low-carbon technologies.

In this transition period, governments need to make careful choices for the right incentives to support the private sector. While so far, for example, feed-in tariffs have been the preferred way of promoting low-carbon technologies, competitive auctions have been chosen increasingly in recent times to support early deployment of renewable-based electricity and further engage with the private sector. Fossils fuel subsidies should be also reduced. Establishing an appropriate policy framework also will be essential for governments in emerging markets to encourage greater green investment. Participants emphasised the need to promote fair competition amongst energy providers to set the right pricing of carbon emissions.

In emerging markets, political, transfer and pricing risks were highlighted as key barriers to green investment that policy makers should tackle as a priority. It is also important to note that the fall in global oil prices is not impacting persistent interest in renewable energies.

Finally, in addition to promoting core climate policies, governments must also tackle policy misalignments that can hinder green investment. Conflicting incentives in competition, trade, tax and innovation policies, for example, can inadvertently discourage cleaner and more efficient investment.

Notes

[1] Large hydropower is defined here as more than 10 MW.

[2] Job creation in bioenergy industries include biofuels (1.8 million), biomass (822 000) and biogas (381 000). For further details, see IRENA (2015), Renewable Energy and Jobs: Annual Review 2015, International Renewable Energy Agency, Abu Dhabi. Employment data from IRENA refer to direct and indirect jobs. Indirect jobs include employment in upstream industries that supply and support core activities of renewable energy. The employment data includes information for the latest available year. Overall, most of the numbers are from 2013 and 2014.

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