



International
Energy Agency

Secure • Sustainable • Together

Energy and Climate Change

World Energy Outlook Special Report

EXECUTIVE
SUMMARY

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 29 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency's aims include the following objectives:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
 - Improve transparency of international markets through collection and analysis of energy data.
 - Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
 - Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

IEA member countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Korea
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States



International
Energy Agency

Secure • Sustainable • Together

© OECD/IEA, 2015

International Energy Agency
9 rue de la Fédération
75739 Paris Cedex 15, France

www.iea.org

Please note that this publication is subject to specific restrictions that limit its use and distribution.

The terms and conditions are available online at www.iea.org/t&c/

The European Commission also participates in the work of the IEA.

A major milestone in efforts to combat climate change is fast approaching. The importance of the 21st Conference of the Parties (COP21) – to be held in Paris in December 2015 – rests not only in its specific achievements by way of new contributions, but also in the direction it sets. There are already some encouraging signs with a historic joint announcement by the United States and China on climate change, and climate pledges for COP21 being submitted by a diverse range of countries and in development in many others. The overall test of success for COP21 will be the conviction it conveys that governments are determined to act to the full extent necessary to achieve the goal they have already set to keep the rise in global average temperatures below 2 degrees Celsius (°C), relative to pre-industrial levels.

Energy will be at the core of the discussion. Energy production and use account for two-thirds of the world's greenhouse-gas (GHG) emissions, meaning that the pledges made at COP21 must bring deep cuts in these emissions, while yet sustaining the growth of the world economy, boosting energy security around the world and bringing modern energy to the billions who lack it today. The agreement reached at COP21 must be comprehensive geographically, which means it must be equitable, reflecting both national responsibilities and prevailing circumstances. The importance of the energy component is why this *World Energy Outlook Special Report* presents detailed energy and climate analysis for the sector and recommends four key pillars on which COP21 can build success.

Energy and emissions: moving apart?

The use of low-carbon energy sources is expanding rapidly, and there are signs that growth in the global economy and energy-related emissions may be starting to decouple. The global economy grew by around 3% in 2014 but energy-related carbon dioxide (CO₂) emissions stayed flat, the first time in at least 40 years that such an outcome has occurred outside economic crisis. Renewables accounted for nearly half of all new power generation capacity in 2014, led by growth in China, the United States, Japan and Germany, with investment remaining strong (at \$270 billion) and costs continuing to fall. The energy intensity of the global economy dropped by 2.3% in 2014, more than double the average rate of fall over the last decade, a result stemming from improved energy efficiency and structural changes in some economies, such as China. Around 11% of global energy-related CO₂ emissions arise in areas that operate a carbon market (where the average price is \$7 per tonne of CO₂), while 13% of energy-related CO₂ emissions arise in markets with fossil-fuel consumption subsidies (an incentive equivalent to \$115 per tonne of CO₂, on average). There are some encouraging signs on both fronts, with reform in sight for the European Union's Emissions Trading Scheme and countries including India, Indonesia, Malaysia and Thailand taking the opportunity of lower oil prices to diminish fossil-fuel subsidies, cutting the incentive for wasteful consumption.

The energy contribution to COP21

Nationally determined pledges are the foundation of COP21. Intended Nationally Determined Contributions (INDCs) submitted by countries in advance of COP21 may vary in scope but will contain, implicitly or explicitly, commitments relating to the energy sector. As of 14 May 2015, countries accounting for 34% of energy-related emissions had submitted their new pledges. A first assessment of the impact of these INDCs and related policy statements (such as by China) on future energy trends is presented in this report in an “INDC Scenario”. This shows, for example, that the *United States’* pledge to cut net greenhouse-gas emissions by 26% to 28% by 2025 (relative to 2005 levels) would deliver a major reduction in emissions while the economy grows by more than one-third over current levels. The *European Union’s* pledge to cut GHG emissions by at least 40% by 2030 (relative to 1990 levels) would see energy-related CO₂ emissions decline at nearly twice the rate achieved since 2000, making it one of the world’s least carbon-intensive energy economies. *Russia’s* energy-related emissions decline slightly from 2013 to 2030 and it meets its 2030 target comfortably, while implementation of *Mexico’s* pledge would see its energy-related emissions increase slightly while its economy grows much more rapidly. China has yet to submit its INDC, but has stated an intention to achieve a peak in its CO₂ emissions around 2030 (if not earlier), an important change in direction, given the pace at which they have grown on average since 2000.

Growth in global energy-related GHG emissions slows, but there is no peak by 2030 in the INDC Scenario. The link between global economic output and energy-related GHG emissions weakens significantly, but is not broken: the economy grows by 88% from 2013 to 2030 and energy-related CO₂ emissions by 8% (reaching 34.8 gigatonnes). Renewables become the leading source of electricity by 2030, as average annual investment in non-hydro renewables is 80% higher than levels seen since 2000, but inefficient coal-fired power generation capacity declines only slightly. With INDCs submitted so far, and the planned energy policies in countries that have yet to submit, the world’s estimated remaining carbon budget consistent with a 50% chance of keeping the rise in temperature below 2 °C is consumed by around 2040 – eight months later than is projected in the absence of INDCs. This underlines the need for all countries to submit ambitious INDCs for COP21 and for these INDCs to be recognised as a basis upon which to build stronger future action, including from opportunities for collaborative/co-ordinated action or those enabled by a transfer of resources (such as technology and finance). If stronger action is not forthcoming after 2030, the path in the INDC Scenario would be consistent with an average temperature increase of around 2.6 °C by 2100 and 3.5 °C after 2200.

What does the energy sector need from COP21?

National pledges submitted for COP21 need to form the basis for a “virtuous circle” of rising ambition. From COP21, the energy sector needs to see a projection from political leaders at the highest level of clarity of purpose and certainty of action, creating a clear expectation of global and national low-carbon development. Four pillars can support that achievement:

1. **Peak in emissions** – set the conditions which will achieve an early peak in global energy-related emissions.
2. **Five-year revision** – review contributions regularly, to test the scope to lift the level of ambition.
3. **Lock in the vision** – translate the established climate goal into a collective long-term emissions goal, with shorter-term commitments that are consistent with the long-term vision.
4. **Track the transition** – establish an effective process for tracking achievements in the energy sector.

Peak in emissions

The IEA proposes a bridging strategy that could deliver a peak in global energy-related emissions by 2020. A commitment to target such a near-term peak would send a clear message of political determination to stay below the 2 °C climate limit. The peak can be achieved relying solely on proven technologies and policies, without changing the economic and development prospects of any region, and is presented in a “Bridge Scenario”. The technologies and policies reflected in the Bridge Scenario are essential to secure the long-term decarbonisation of the energy sector and their near-term adoption can help keep the door to the 2 °C goal open. For countries that have submitted their INDCs, the proposed strategy identifies possible areas for over-achievement. For those that have yet to make a submission, it sets out a pragmatic baseline for ambition.

The Bridge Scenario depends upon five measures:

- Increasing *energy efficiency* in the industry, buildings and transport sectors.
- Progressively reducing the use of the *least-efficient coal-fired power plants* and banning their construction.
- Increasing investment in *renewable energy technologies* in the power sector from \$270 billion in 2014 to \$400 billion in 2030.
- Gradual phasing out of *fossil-fuel subsidies* to end-users by 2030.
- Reducing *methane emissions* in oil and gas production.

These measures have profound implications for the global energy mix, putting a brake on growth in oil and coal use within the next five years and further boosting renewables. In the Bridge Scenario, coal use peaks before 2020 and then declines while oil demand rises to 2020 and then plateaus. Total energy-related GHG emissions peak around 2020. Both the energy intensity of the global economy and the carbon intensity of power generation improve by 40% by 2030. *China* decouples its economic expansion from emissions growth by around 2020, much earlier than otherwise expected, mainly through improving the energy efficiency of industrial motors and the buildings sector, including through standards for appliances and lighting. In countries where emissions are already in decline today, the decoupling of economic growth and emissions is significantly accelerated; compared

with recent years, the pace of this decoupling is almost 30% faster in the *European Union* (due to improved energy efficiency) and in the *United States* (where renewables contribute one-third of the achieved emissions savings in 2030). In other regions, the link between economic growth and emissions growth is weakened significantly, but the relative importance of different measures varies. *India* utilises energy more efficiently, helping it to reach its energy sector targets and moderate emissions growth, while the reduction of methane releases from oil and gas production and reforming fossil-fuel subsidies (while providing targeted support for the poorest) are key measures in the *Middle East* and *Africa*, and a portfolio of options helps reduce emissions in *Southeast Asia*. While universal access to modern energy is not achieved in the Bridge Scenario, the efforts to reduce energy-related emissions do go hand-in-hand with delivering access to electricity to 1.7 billion people and access to clean cookstoves to 1.6 billion people by 2030.

Five-year revision

A five-year cycle for the review of mitigation targets is needed to provide the opportunity for commitment to stronger climate ambition over time. The energy context in which climate goals are being set is changing rapidly as the cost and performance of many low-carbon technologies improves and countries start to see the success of their low-carbon policies. The strategy set out in the Bridge Scenario can keep the 2 °C climate goal within reach in the near-term, but goals beyond 2025 need to be strengthened in due course. Agreeing a mechanism at COP21 that will permit reviewing the level of ambition every five years will regularly shine a light on progress, and send a clearer message to investors of the long-term commitment to the full extent of the necessary decarbonisation.

Lock in the vision

Translating the 2 °C goal into subordinate targets, including a clear, collective long-term emissions goal, would provide greater ease and certainty in expressing future policy on a basis consistent with the longer term objective. Such targets would reinforce the need for the energy sector to adopt a long-term development pathway that is low carbon. Fostering the development of new technologies will be necessary in order to achieve the ultimate climate goal and, as set out in the “450 Scenario”, measures beyond those in the Bridge Scenario could allow the necessary technologies to reach maturity before they need to be widely deployed. Early support of wind and solar technologies has played a pivotal role in driving down costs and achieving their large-scale deployment. A similar approach is needed to develop and deploy technologies that safeguard the reliability of power supply as the contribution of variable renewables increases (e.g. through energy storage), deliver additional emissions reductions in the power sector and industry (e.g. carbon capture and storage) and grow the share of alternative fuel vehicles in road transport. Investment in the 450 Scenario is only a little higher than other scenarios, but is oriented more strongly towards low-carbon energy supply and energy efficiency, emphasising the need for effective means to finance such investments (particularly in countries where such financing instruments may not yet exist).

Track the transition

There must be a strong process for tracking progress towards nationally determined mitigation goals. Evidence of tangible results will give the necessary confidence to all countries and energy sector stakeholders that everyone is acting in harmony. The related energy data systems are, in any case, essential to underpin domestic policy-making and identify those who are struggling with implementation and may need assistance. Details of the post-2020 reporting and accounting frameworks may not be settled at COP21, but the agreement should at least establish some high-level principles, including the need for rules for the measurement and reporting of emissions and the need to develop accounting rules for the different types of mitigation goals that are likely to be put forward by countries. Tracking progress towards energy sector decarbonisation is complex and requires a broader set of measurements than are collected and monitored in many countries today. In recognition of this need, a set of appropriate high-level metrics to track energy sector decarbonisation is proposed in the report.

Secure a legacy of energy change

Will 2015 be the year in which decision-makers are able to establish the much-needed climate for change? The answer cannot yet be known. But to assist the process beyond the recommendations in this report, the IEA will publish timely updates of its INDC analysis, incorporating new submissions, in the lead up to COP21. It will also submit the key findings of this report for endorsement by Ministers at their biennial meeting under IEA auspices (17-18 November 2015). Beyond COP21, the IEA will continue to assess the impact of national contributions and collective prospects as they are further developed, refined, revised and implemented, drawing on the wealth of energy data and indicators at its command.

A transformation of the world's energy system must become a unifying vision if the 2 °C climate goal is to be achieved. The challenge is stern, but a credible vision of the long-term decarbonisation of the sector is available to underpin shorter term commitments and the means to realise it can, ultimately, be collectively adopted. The world must quickly learn to live within its means if this generation is to pass it on to the next with a clear conscience.



International
Energy Agency

online
bookshop

www.iea.org/books

PDF versions
at 20% discount

International Energy Agency
9 rue de la Fédération
75739 Paris Cedex 15, France

Tel: +33 (0)1 40 57 66 90
E-mail: books@iea.org

This publication reflects the views of the IEA Secretariat but does not necessarily reflect those of individual IEA member countries. The IEA makes no representation or warranty, express or implied, in respect of the publication's contents (including its completeness or accuracy) and shall not be responsible for any use of, or reliance on, the publication.

IEA PUBLICATIONS, 9 rue de la Fédération, 75739 Paris Cedex 15

Printed in France by IEA, June 2015

Cover design: IEA, photo credits: © GraphicObsession

Energy and Climate Change

The world is moving towards a crucial climate change meeting in Paris in December 2015 (COP21). The negotiations there will be based on national pledges, formally known as Intended Nationally Determined Contributions, with the goal of setting the world on a sustainable path.

The International Energy Agency has long emphasised to its members and the world at large that energy production and use which is not compatible with international environmental requirements is not sustainable: it fails the test of energy security. The IEA, therefore, feels an obligation to make a contribution to COP21 – a contribution which reconciles climate and energy needs. That is the purpose of this special report in the *World Energy Outlook* series.

The report:

- Presents a detailed first assessment of the energy sector impact of known and signalled national climate pledges for COP21.
- Proposes a bridging strategy to deliver a near-term peak in global energy-related greenhouse-gas emissions, based on five pragmatic measures that can advance climate goals through the energy sector without blunting economic growth.
- Highlights the urgent need to accelerate the development of emerging technologies that are, ultimately, essential to transforming the global energy system into one that is consistent with the world's climate goals.
- Recommends four key pillars on which COP21 can build success, from an energy sector perspective.

For more information, and the free download of the report, please visit:
www.worldenergyoutlook.org/energyclimate