

# RENEWABLE ENERGY

## Medium-Term Market Report 2015

### EXECUTIVE SUMMARY

### Market Analysis and Forecasts to 2020



International  
Energy Agency  
Secure  
Sustainable  
Together



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## 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.

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

## EXECUTIVE SUMMARY

**Supported by policies aimed at enhancing energy security and sustainability, renewable electricity expanded at its fastest rate to date (130 GW [gigawatts]) in 2014 and accounted for more than 45% of net additions to world capacity in the power sector.** Renewable generation costs continued to decline in many parts of the world and the announcement of some very low contract prices over the past year should support further development with reduced remuneration levels in areas as diverse as Brazil, India, the Middle East, South Africa and the United States. Even in a lower fossil fuel price environment, the policy drivers for renewable electricity – energy diversification, local pollution and decarbonisation aims – remain robust. And some key countries, such as China and India, have bolstered their deployment ambitions going forward.

**As a result, renewables are expected to be the largest source of net additions to power capacity over the medium term.** They account for almost two thirds of the expansion by 2020, with non-hydro sources nearly half of the total.<sup>1</sup> The renewable share of generation rises from 22% in 2013 to over 26% in 2020 and renewable generation reaches a level more than today's total combined demand of China, India and Brazil. But the annual deployment trend is expected to slow due to persistent policy and market integration uncertainties in some areas, notably Europe and Japan, as well as financing, access and integration challenges in developing countries. Consequently, global growth under the *Medium-Term Renewable Energy Market Report (MTRMR) main case* forecast is not as fast as it could be and falls short of what's needed to put renewables on track to meet longer-term climate change objectives.

**However, enhanced policies driven by the energy security, local pollution and climate benefits of renewables can trigger a virtuous cycle, putting development on a more firm path to meet long-term climate change goals.** This report's *accelerated case* projection assesses the impacts of possible policy changes in key countries, which could accelerate cumulative renewable power growth by 25% with rising annual deployment.

### Shifting technology and geographical drivers of renewable power deployment

**Onshore wind leads the global renewable growth, accounting for over one-third of the renewable capacity and generation increase.** *Solar PV* is the second-largest source of new capacity, another third of deployment. *Hydropower* accounts for one-fifth of new renewable additions, and over a quarter of generation growth. Meanwhile, *other renewable technologies* grow slower on an absolute basis, but still scale up significantly. For example, bioenergy is supported by coal-to-biomass conversions in Europe and a significant scale-up in non-OECD Asia using domestic resources. Offshore wind should more than triple by 2020, with expected decreases in generation costs and additions from a large project pipeline in Europe.

**In the countries of the Organisation for Economic Co-operation and Development (OECD), renewables account for virtually all net additions to power capacity,** when accounting for fossil fuel and nuclear retirements, mostly from non-hydro sources. But the OECD comprises only one-third of renewable growth as annual deployment stabilises at lower levels. Amid generally sluggish demand growth, OECD power systems face challenges to maintain long-term policy frameworks while shifting

<sup>1</sup> Analysis from the IEA *Medium-Term Renewable Energy Market Report 2015* and the forthcoming IEA *World Energy Outlook 2015*.

away from high incentive levels and integrating higher variable renewable penetrations. The *European Union-28* (EU-28) is the second largest market in absolute terms (after China), but annual deployment declines. Even with persistently low gas prices, the *United States*, the third largest market, remains dynamic, but uncertainty over federal incentives creates a volatile deployment pattern. In *Japan*, a tight power supply situation and a generous support scheme spur strong solar PV growth, though grid integration challenges cause a declining annual trend. Still, some newer markets with robust demand are emerging (e.g. Mexico).

**With fast-growing power demand, diversification needs and local pollution concerns, China, India and Brazil and other developing countries account for two-thirds of the renewable expansion over the medium term.** In the non-OECD, renewables account for almost half of net additions to power capacity, but the role of fossil fuels remains large, pointing to significant upside potential for renewables to meet fast-growing demand needs.

**China alone accounts for 40% of global renewable capacity growth, an amount triple the current total power capacity of the United Kingdom.** China requires almost one-third of cumulative new investment to 2020. China's generation needs, pollution concerns and a favourable policy environment with ambitious targets drive the forecast. Announced power sector reforms to support the integration of higher levels of variable renewables should help reinforce their role. Robust expansion is expected in onshore wind, whose cumulative capacity more than doubles, and solar PV, whose cumulative capacity almost quadruples. The annual growth of hydropower slows, but cumulative hydropower capacity growth is as large as the current total power capacity of Australia.

**The renewables market is also expanding strongly in other non-OECD countries.** India's renewable growth is poised to accelerate, with ambitious new government targets for solar PV and wind. In Brazil, non-hydro renewables are playing an important diversification role amid regional drought conditions. Hydropower expands most strongly in Asia, and non-hydro sources begin to take off in Egypt, Thailand and emerging areas, such as the Middle East. Still, many non-OECD markets remain at the initiation phase of development and face challenges related to market access barriers, grid constraints, policy and market design, or the cost and availability of financing.

**Current trends suggest some markets in Sub-Saharan Africa (SSA) are poised to leapfrog to an economic development paradigm based on affordable renewables.** With huge resources, improving economics and policy momentum, renewables should meet almost two-thirds of power demand growth in SSA through 2020. Given its large remaining potential, hydropower continues to play an important role in meeting new demand needs across the region. In South Africa, price competition through transparent and well-designed auctions has spurred rapid cost reductions in onshore wind and solar PV. Elsewhere, rising demand and strong diversification needs drive a portfolio of renewable growth in markets such as Ethiopia and Kenya though policy and market access challenges may limit the pace in a number of other markets. Moreover, affordable small-scale solar PV can help energy access in rural areas and improve electricity provision in urban zones, where grid-connected power is not always reliable. Overall, however, realising higher levels of renewable penetration in the entire region would require addressing persistent barriers, improving financing conditions, adopting new business models and good policies and governance.



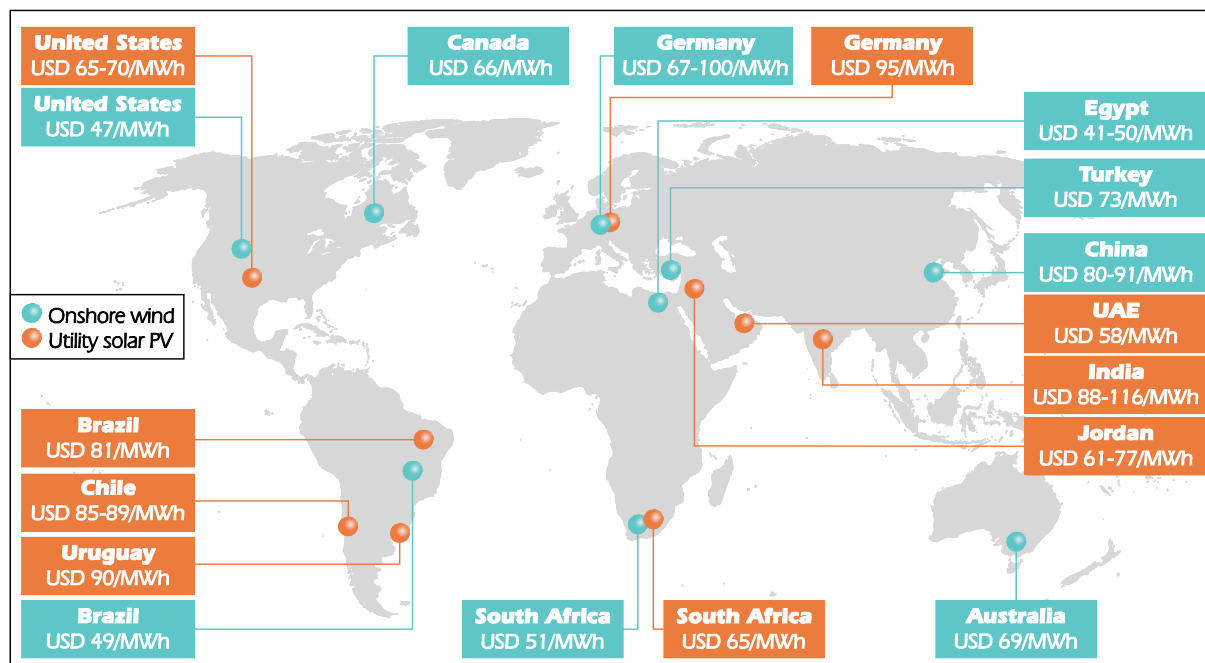
## Cost effectiveness of renewable power to further improve, but policies remain key

The effect of the lower oil price environment on global renewable power deployment is more perception than reality. While oil may compete more directly with biofuels for transport and renewable heat, its impact in the power sector is limited only to oil-fired peaking plants and gas generation in areas with oil indexation, such as in Europe and in Asian liquefied natural gas markets. Renewable attractiveness depends more on government willingness to maintain policy support and appropriate market design. Persistent uncertainties in these areas pose a far larger forecast risk.

The *MTRMR main case* forecast sees annual investment in new renewable capacity to 2020 averaging around USD 230 billion annually, lower than the near USD 270 billion in 2014. This trend is driven mainly by slowing capacity growth, but also by decreasing investment costs for the most dynamic technologies. Onshore wind and solar PV comprise nearly two-thirds of new investment.

Renewable generation costs are forecast to continue decreasing. From 2010-15, indicative global average onshore wind generation costs for new plants fell by an estimated 30% on average while that for new utility-scale solar PV declined by two-thirds. Over 2015-20, the *MTRMR* forecasts new onshore wind costs to decline by a further 10% while new utility-scale solar PV declines by an additional quarter. High levels of incentives are no longer necessary for solar PV and onshore wind, but their economic attractiveness still strongly depends on the regulatory framework and market design. Meanwhile, some technologies (offshore wind, solar thermal electricity and some bioenergy) require continued policy support to bring them down the learning curve.

**Map 1** Recent announced long-term remuneration contract prices for renewable power (e.g. preferred bidders, PPAs or FITs) to be commissioned over 2015-19



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of International frontiers and boundaries and to the name of any territory, city or area.

Note: values reported in nominal USD; PPAs = power purchase agreements. US values are calculated excluding tax credits; US wind value corresponds to Interior Region for commissioned projects in 2014. Other values reported correspond to projects that are expected to be commissioned over 2015-2019. Delivered project costs may ultimately be different than those reported at the time of the auction or the signature of the PPA. For full sourcing explanation, see “Renewable Technologies: Global Technologies” chapter.

**Recent announced long-term remuneration contract prices offer evidence of such indicative forecasted costs and suggest *even lower generation costs* are possible in the next few years with technology progress, better financing and expansion into newer markets with better resources.** New onshore wind can be contracted today in a number of countries at USD 60-80/MWh, with the best cases around USD 50/MWh (e.g. Brazil, Egypt, South Africa, some US states). Meanwhile, new utility-scale solar PV projects can be contracted at USD 80-100/MWh with the best cases at USD 60/MWh (e.g. United Arab Emirates, Jordan, South Africa, some US states). As technology costs have declined, financing conditions, which vary across countries and over time, play a more important role. And the lowest prices have emerged in countries with a combination of price competition for long-term contracts, good resources and financial de-risking measures and/or concessional financing. These conditions are not present in all markets, but they do indicate potential ahead for some countries to leapfrog to development based on more affordable clean power.

**While onshore wind and solar PV have not yet achieved widespread competitiveness versus fossil fuels, benchmark cost ranges are increasingly comparable with generation costs from gas,** even in the current fuel price regime. In countries such as Brazil and South Africa, onshore wind can represent a more cost-effective source of new generation than fossil fuels. But comparability in low-price gas markets, such as the United States, would require further cost reductions. These ranges remain generally higher than that for new coal-fired generation, except in higher-priced coal markets or in the presence of robust carbon pricing. Meanwhile, hydropower, geothermal and bioenergy are largely competitive versus fossil fuels, but face risks related to financing, project development and social acceptance.

**This improving cost trend does not automatically imply that solar PV and onshore wind are competitive or cost-effective versus alternatives.** Competitiveness also depends on the value of the generation and the system costs associated with integrating higher shares of variable renewables. The potential hedge value of renewables against fuel price volatility and the environmental externalities associated with fossil fuels would also need to be accounted for. In any case, their improving economics suggest that renewables are an increasingly valuable option in a well-diversified portfolio of energy investments from both the investor and system perspective.

## Renewables increase in other sectors, though growth lags that for electricity

**To date, the progress of renewables in the heating sector, which comprises almost half of total final energy consumption, and transport, accounting for a quarter of consumption, has been slower than in electricity.** Renewables are crucial to the diversification and decarbonisation of these sectors as well, but development is falling well short of what is needed to meet climate change objectives.

**Global renewable energy use for heat, excluding traditional biomass, grows only moderately over the medium term.** Renewable heat support schemes, particularly in OECD Europe, remain important growth drivers and a number of non-OECD countries have policies to support small-scale solar thermal systems. Initiatives that encourage district heating networks are also expected to help facilitate the integration of renewable heat. While renewable heat technologies can be cost-effective options, an extended period of lower oil prices could undermine growth, particularly in bioenergy markets. The use of renewables for heat in industry has large potential, particularly in non-OECD countries, though the market is growing slowly. Encouraging applications for the provision of process heat in industry are coming about. Yet, stronger uptake of renewable heat overall requires deeper and more widespread policy frameworks.



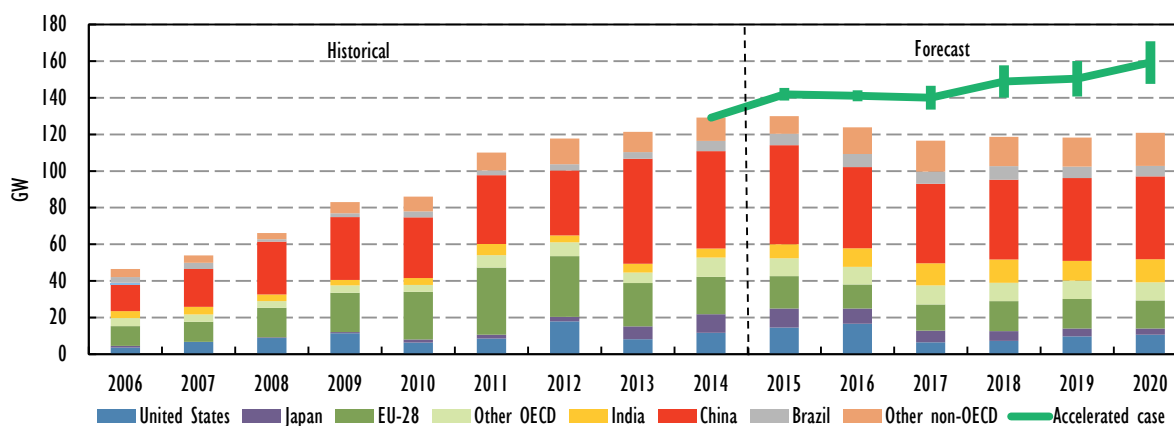
**Blending mandates are expected to support biofuels for transport demand and production, even with the lower oil price environment.** Overall, biofuels growth is forecast to stabilise, reaching over 4% of road transport demand in 2020. In the past year, mandates and supportive policies have been strengthened in key markets such as Brazil, India, Indonesia and Malaysia. Lower oil prices have actually facilitated the removal of fossil fuel subsidies in several countries, which should improve the attractiveness of biofuels. But a number of risks limit growth. The United States continues to face structural challenges in scaling up ethanol to more than 10% of gasoline demand while the EU-28 has introduced a 7 percentage point (pp) cap on the contribution of conventional biofuels towards the 10% renewable transport target for 2020. Moreover, a continued low oil price environment may lead to increased scrutiny of support policies for biofuels going forward and the decline in gasoline and diesel prices has already affected discretionary blending economics in certain markets.

**Significant development of advanced biofuels is necessary for diversification and decarbonisation of transport in the longer term, particularly in challenging sectors such as aviation, but the sector requires further policy support.** Since 2013 advanced biofuels have made good progress, with nine commercial-scale plants commissioned, seven of these in 2014-15. Policies that mandate blending levels and provide capital incentives, along with the development of secure local feedstock supply chains, have been fundamental. New projects may require oil prices around USD 100/bbl or above to be attractive. There is significant potential to reduce the costs. But a sustained long-term policy commitment would be needed, which may face risks from the lower oil price environment.

### With enhanced policy and market frameworks, renewable growth could accelerate

**Driven by a stronger embrace of the energy security, local pollution and climate benefits, cumulative renewable power growth over 2014-20 could be 25% higher than in the *main case* forecast, with a rising annual market.** Under this *accelerated case* projection, annual investment could reach over USD 315 billion by 2020. Achieving the accelerated case would require policy makers to send clearer signals to phase out the oldest and most polluting power plants while developing countries, in particular, would need to address market access and investment risks that keep financing costs elevated.

**Figure 1** Renewable power net additions to capacity under main and accelerated cases



**A set of OECD enhanced policy changes would need to include:**

- A clear signal in the United States on the durability of federal tax incentives and the implementation of the Environmental Protection Agency (EPA) Clean Power Plan.
- The rapid clarification of renewable policy uncertainties in some markets where renewables are starting to accelerate (e.g. Mexico, Turkey).
- The implementation of stable and sustainable policy frameworks that give greater certainty about the long-term revenue streams of renewable projects (e.g. EU-28 target governance).
- Greater measures to ensure the grid and system integration of variable renewables (e.g. Japan, European regional markets).
- Implementation of fair rules and appropriate electricity rate design for reaping the benefits from fast-growing distributed solar PV while allocating the network costs (e.g. United States and Europe).

**A set of enhanced policy changes in developing countries would need to include:**

- More certainty over the credible implementation of ambitious long-term policy frameworks in some markets (e.g. India).
- Greater measures to reduce regulatory barriers and improve the system and grid integration of variable renewables (e.g. China, South Africa), particularly distributed solar PV.
- Improved market access and strengthened financial sustainability in the power sector through, for example, the removal of fossil fuel subsidies and the use of well-designed price competition mechanisms to help spur cost reductions.
- Improved financing conditions with greater stakeholder consultation during policy design, development institution participation to reduce off taker risks and concessional financing.

**While energy security and local sustainability concerns provide a first-order motivation for adopting enhanced policies, the improving affordability of renewables can have positive ramifications for global climate change negotiations.** Energy remains at the heart of global climate change solutions and a dramatic scale-up of renewable investment, along with increased energy efficiency and other measures, remains central. Policies to spur an *accelerated* renewable growth profile, as described here, would put the global power system on a firmer path to limit the long-term global average temperature increase to 2°C. At the same time, a clear supportive outcome from the COP 21 climate conference in December 2015 could create a virtuous cycle for renewable deployment. Such a situation would provide further policy certainty that would decrease renewable investment risks and reduce financing costs, thus making local energy security and sustainability aims more attainable.

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# RENEWABLE ENERGY

## Medium-Term Market Report 2015

Renewable sources of energy now stand poised to lead the world in new electricity supply. Supported by policies aimed at enhancing energy security and sustainability, renewable power expanded at its fastest rate to date in 2014 and now represents more than 45% of overall supply additions. Deployment continues to shift towards energy-hungry emerging markets, and some countries, such as China and India, have bolstered ambitions. Moreover, sustained technology progress, expansion into newer markets with better resources, and improved financing conditions are facilitating more cost-effective deployment for the most dynamic technologies (solar photovoltaics and onshore wind).

But will renewable growth in the coming years falter, or could an even faster expansion take place? Dramatic falls in fossil fuel prices over the past year have raised questions over the competitiveness of renewables and government willingness to maintain policy support. Policy uncertainties remain in the Organisation for Economic Co-operation and Development (OECD), where electricity demand has been stagnating in some markets and the rapid deployment of renewables can put incumbent utilities under pressure. For emerging markets, regulatory, grid and financing conditions can pose challenges to growth. Meanwhile, progress in the transport and heating sectors remains comparably slow, with advanced biofuels and renewable heat technologies requiring enhanced policy attention to scale up.

The *Medium-Term Renewable Energy Market Report 2015* assesses these trends in the electricity, transport and heat sectors, identifying drivers and challenges to deployment, and making projections through 2020. It also assesses the potential impacts of enhanced policy actions under an accelerated case for renewable power, which would put the world more firmly on a path to a more sustainable and secure energy system.

## Market Analysis and Forecasts to 2020

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