Mitigation benefits of actions, initiatives and options to enhance mitigation ambition

Addendum
Renewable energy supply
2015

United Nations
Climate Change Secretariat

SUMMARY

This updated technical paper compiles information on mitigation benefits of actions, initiatives and options to enhance mitigation ambition, with a focus on two thematic areas: promotion of renewable energy supply and acceleration of energy efficiency in urban environments. It also compiles information on support for actions in those thematic areas and possible actions to be undertaken by the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP). Information for the update was provided at the technical expert meetings that took place during the ninth part of the second session of the ADP, held in June 2015 in Bonn, Germany, and at the other meetings dedicated to the discussions on workstream 2 held during 2015, as well as in relevant submissions from Parties and observer organizations and in relevant literature on the implementation of policy options. This update builds on the previous versions of the technical paper, which are contained in documents FCCC/TP/2014/3 and Add.1 and FCCC/TP/2014/13 and Add.1–4.

This updated technical paper consists of the main document and two addenda. The addenda are focused on the promotion of renewable energy supply and acceleration of energy efficiency in urban environments. They elaborate on drivers for accelerated implementation and key policies, practices and technologies for catalysing action in those thematic areas.

TABLE OF CONTENTS

I. Introduction

01. This updated technical paper on mitigation benefits of actions, initiatives and options to enhance mitigation ambition was requested by the Conference of the Parties at its twentieth session.[1] The previous versions of the technical paper are contained in documents FCCC/TP/2013/4, FCCC/TP/2013/8 and Add.1 and 2, FCCC/TP/2014/3 and Add.1 and FCCC/TP/2014/13 and Add.1–4. This latest update does not supersede the previous versions but rather builds on the findings, information and options to enhance mitigation ambition contained therein.

02. This update is based on information provided at the technical expert meetings (TEMs) held during the ninth part of the second session of the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP), held in June 2015 in Bonn, Germany, on unlocking mitigation potential through the promotion of renewable energy (RE) supply and accelerated energy efficiency (EE) in urban environments.[2] It draws on relevant submissions from Parties and observer organizations as well as other relevant information on the implementation of RE and EE policy options, including through multilateral cooperation.

03. This addendum covers the discussions on RE supply and consists of two parts: one focusing on drivers for accelerated implementation and the other on key policies, practices and technologies for accelerating implementation in relation to RE supply. The scope of this addendum is defined by the following topics discussed at the latest TEM: policies to promote distributed energy generation and financial incentives for RE. Issues related to other policy options discussed at the previous TEM are not covered.

II. Technical summary on the promotion of renewable energy supply

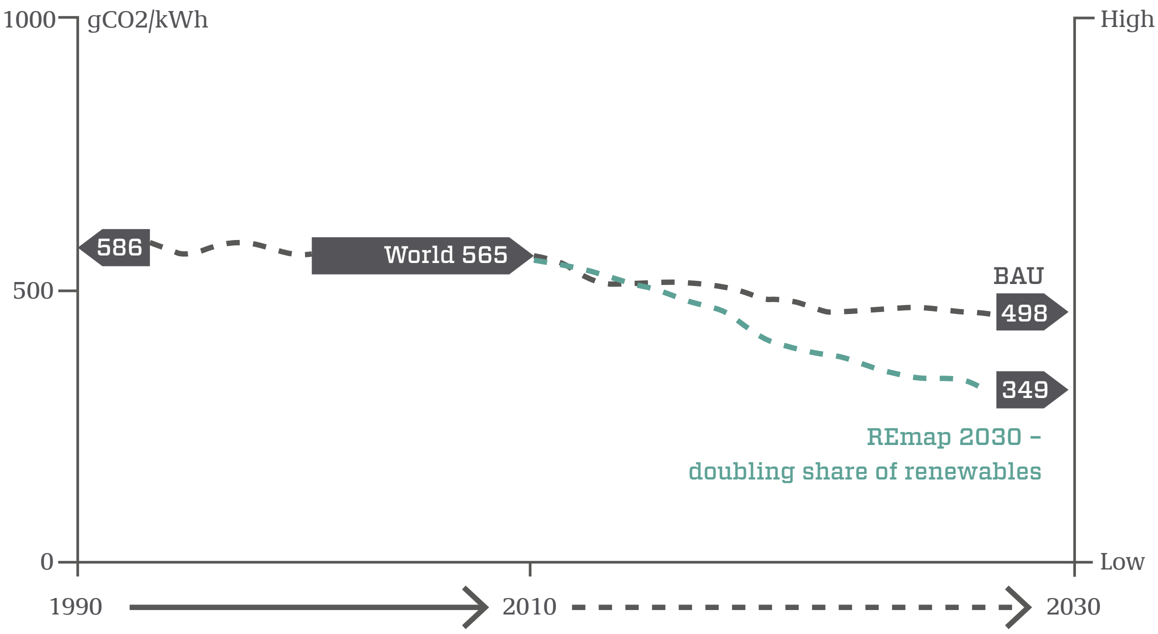
A. Drivers for accelerated implementation

04. Continued scaling up and replication of successful and innovative policies in the energy sector are urgently required in order to meet the critical climate and development goals put forward by the international community. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) shows that, if global greenhouse gas (GHG) emissions are not kept at or below the 2010 level by 2030, the efforts involved in and costs of future actions would have to increase significantly. For example, medium-term (2030–2050) mitigation costs could increase by 44 per cent if immediate action is delayed (IPCC, 2014). Clean energy technologies, policies and measures can be applied today that will significantly contribute to early action on GHG emission reduction while also supporting critical sustainable development co-benefits.

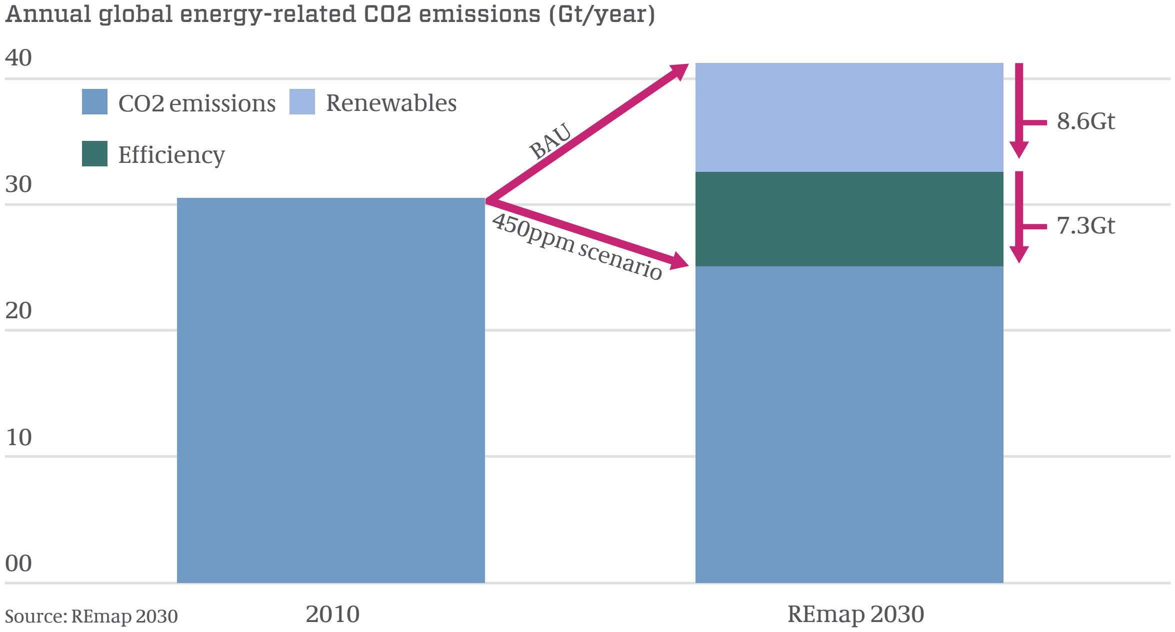
05. As presented in figure 1, REmap 2030, the renewable energy road map prepared by the International Renewable Energy Agency (IRENA), shows that doubling the share of RE worldwide could lead to a reduction of 8.6 gigatonnes of carbon dioxide equivalent emissions by 2030 as compared with the 'business as usual' scenario. In combination with efficiency measures, this could lead to a shift by 2030 to emission pathways that are consistent with the goal to hold the temperature increase to below 2 °C (IRENA, 2014[3]).

[1] Decision 1/CP.20, paragraph 19(b).
[2] Detailed information on the TEMs held under the ADP in June 2015, including the initial summaries of the discussions at the meetings, is available at <http://unfccc.int/bodies/awg/items/8895.php> and <http://unfccc.int/bodies/awg/items/8896.php>.
[3] All such references refer to publications listed at the end of the main document, FCCC/TP/2015/4.

Figure 1
REmap 2030 scenarios



Source: Remap 2030



Source: REmap 2030

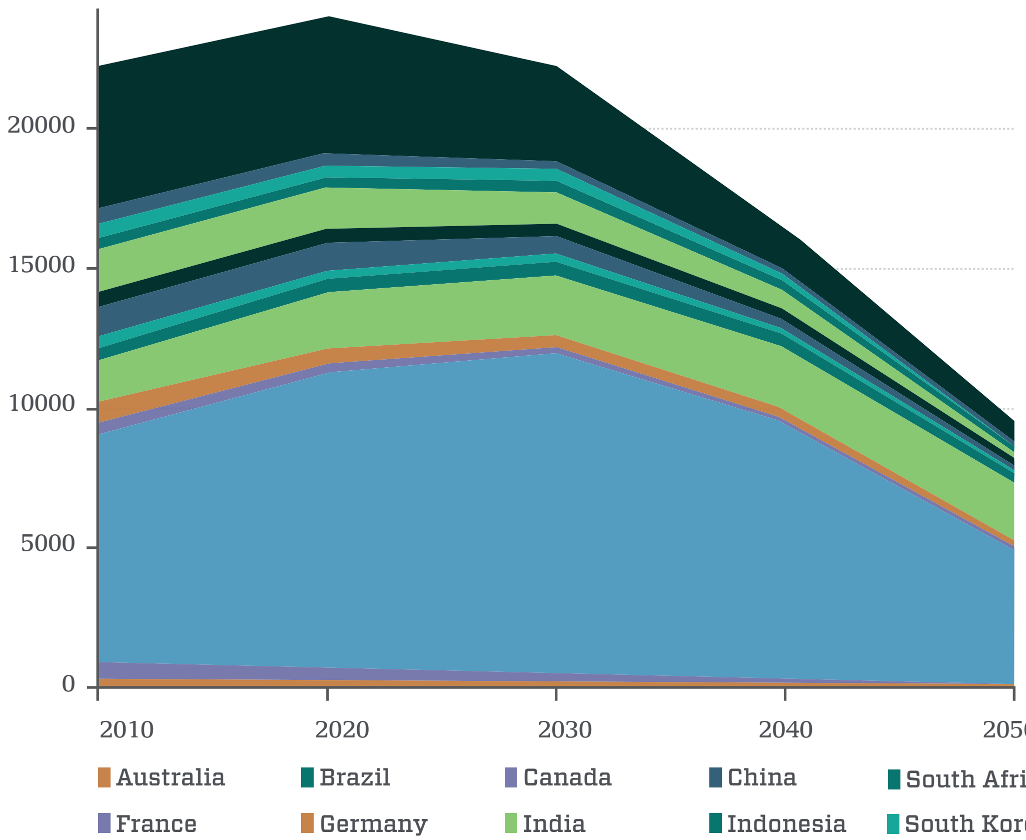
Source: Presentation made by the International Renewable Energy Agency at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.
Abbreviation: BAU = business as usual.

06. However, it should be noted that many Parties have indicated the strong need to go beyond doubling the share of RE in order to reach an emission pathway that avoids dire social, economic and environmental outcomes, particularly for vulnerable developing countries and island nations. Increasing the level of global ambition in order to focus on transformative RE policies and measures is imperative to avoid catastrophic climate impacts, particularly in developing countries.[4]

07. In order to reach more ambitious RE targets, the global community must rapidly pursue transformative RE policies and significantly scale up investment. The IRENA REmap analysis emphasizes the need for the fundamental transformation of the electricity and transport sectors, the development and deployment of breakthrough and innovative technologies, the early retirement of high-emitting technologies and key industrial shifts to reach that outcome (IRENA, 2014).

08. Looking at a longer time-horizon, the study on deep decarbonization published by the Institute for Sustainable Development and International Relations (IDDRI) puts forward technically and economically feasible national pathways to significantly reduce GHG emissions. According to the study, commercial and non-commercial RE technologies will play a critical role in achieving emission reduction targets. However, the study notes that, in order to achieve such targets, ambitious and urgent action is required. In line with scaled-up deployment and fast learning rates, the study also anticipates significant reductions in the cost of RE up to 2050. Examples of national-level deep decarbonization pathways are presented in figure 2.

Figure 2
National-level deep decarbonization pathways by 2050



Source: Presentation made by the Institute for Sustainable Development and International Relations at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.
Abbreviations: UK = United Kingdom of Great Britain and Northern Ireland, USA = United States of America.

[4] African Group Renewable Energy Partnership Proposal.

09. In addition to supporting global mitigation goals, RE deployment can support critical national development goals. Economic, social and environmental development goals provide the essential foundation for RE-related action and policy design. Increasing attention is being given to the sustainable development co-benefits associated with RE policies.[5]

10. Key sustainable development co-benefits that can be supported by RE include:

(a) Economic development through diversification, employment and enterprise development, energy security and independence, reduced energy costs and technological innovation and competitiveness;

(b) Social development through improved education, energy access, gender equality, health and comfort;

(c) Environmental quality through biodiversity protection, climate change mitigation and adaptation, sustainable use of natural resources, local air and water quality improvements and decreases in water use.

11. As noted in paragraph 10(a) above, RE can support key economic development co-benefits. As a notable example, IRENA estimates that there were 7.7 million jobs in the area of RE in 2014 (IRENA, 2015a) and 16 million jobs in RE are expected to be added by 2030 under the REmap 2030 scenario.[6]

12. RE is also playing an important role in supporting economic diversification in a number of country contexts. The United Arab Emirates' plans to align RE development with economic diversification as a key national development priority and its progress in doing so are highlighted in spotlight box 1.

Spotlight box 1

Renewable energy for economic diversification in the United Arab Emirates

While the **United Arab Emirates** (UAE) is a major hydrocarbon producer and exporter, the country also views economic diversification as a critical action to achieve key sustainable development goals aligned with environmental stewardship, energy security, resiliency, job creation and green growth. UAE also seeks to become a global leader in innovative and competitive industries.

Economic diversification and sustainable development are key pillars of Vision 2021 of UAE as well as the subnational strategies of the country's seven emirates. At the highest level, the country's Green Growth Strategy, informed by diverse stakeholder workshops, brings together actions across key sectors of the economy, including high-tech heavy industry, advanced manufacturing and clean technology, aviation, transport, education and clean energy, among others.

In alignment with the above-mentioned high-level strategies and plans, UAE supports a stable policy and regulatory framework to promote renewable energy (RE) domestically and internationally. The UAE RE company, Masdar, invests significantly in RE supply,

[5] Low-emission transport tool of the Low Emission Development Strategies Global Partnership, available at <http://ledsgp.org/transport>.

[6] Presentation made by IRENA at the ADP TEM on RE in June 2015.

demonstration (through Masdar City) and research (through the Masdar Institute). The domestic investments in RE of UAE recently experienced notable success, with the first 200 MW procured for a 1 GW solar plant tendered at USD 0.06/kWh. UAE also invests internationally and provides significant foreign aid for RE development. Through all of these actions, UAE presents a strong example of a country investing in RE to achieve critical environmental and development goals, domestically and globally.

Source: Presentation made by UAE at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.

13. As highlighted in spotlight box 2, distributed renewable energy generation offers great potential in terms of supporting positive economic development outcomes associated with energy access. According to the World Bank and the International Energy Agency, approximately 60 per cent of individuals without access to electricity will be most efficiently and cost-effectively served through mini-grids or other small-scale off-grid systems rather than grid extension, which is often economically unfeasible for remote and rural areas (European Union Energy Initiative Partnership Dialogue Facility (EU EI PDF), 2014). Moreover, mini-grids powered by RE can also reduce the costs associated with the transportation of diesel and other fuel to remote areas.

Spotlight box 2

Energy access in Africa and leading solutions in Kenya

Approximately two thirds of Africa's population currently lacks access to electricity. In rural areas, the issue is even more pronounced, with only 15 per cent of rural Africans having access to power. However, a significant portion of Africa's population is expected to live in urban areas by 2050. Through a combination of both distributed generation and large-scale grid-connected renewable energy (RE) projects, a number of countries in the region are leading efforts to address this issue.[a]

As one notable example, Kenya's Lake Turkana Wind Power Project is expected to provide 20 per cent of Kenya's electricity and fits into a broader national goal to add 5,000 MW power to the grid over the next three years. To further address energy access issues, Kenya's Rural Electrification Authority is supporting mini-grid deployment in a number of rural areas. In many cases, RE and hybrid RE-diesel systems offer the most economically feasible solutions to accessing energy in rural areas of Kenya.[b]

Sources:
[a] European Union Energy Initiative Partnership Dialogue Facility. 2014. Mini-grid Policy Toolkit. Available at <http://minigridpolicytoolkit.euei-pdf.org/policy-toolkit>.
[b] Mushakavanhu T. 2015. Kenya is building Africa's wind energy farm to generate a fifth of its power. Available at <http://qz.com/444936/kenya-is-building-africas-biggest-wind-energy-farm-to-generate-a-fifth-of-its-power/>.

14. The climate benefits associated with RE go beyond mitigation to support key adaptation goals. Some adaptation co-benefits of RE are highlighted in spotlight box 3.

Spotlight box 3

Adaptation co-benefits of renewable energy

From a holistic climate perspective, actions for the deployment of renewable energy (RE) are fundamental in supporting both mitigation and adaptation goals. Key adaptation co-benefits associated with RE include:

- Reduction in water use through the deployment of certain RE technologies, such as photovoltaics and wind energy, which consume significantly less water than traditional thermal technologies;
- Improvement in the resilience of electricity systems through the use of RE mini-grids and other distributed generation technologies that can reduce potential climate-related disruptions (e.g. by supporting back-up generation);
- Improvement in the adaptive capacity of communities to prepare for and respond to potential climate-related emergencies by expanding cost-effective access to RE.

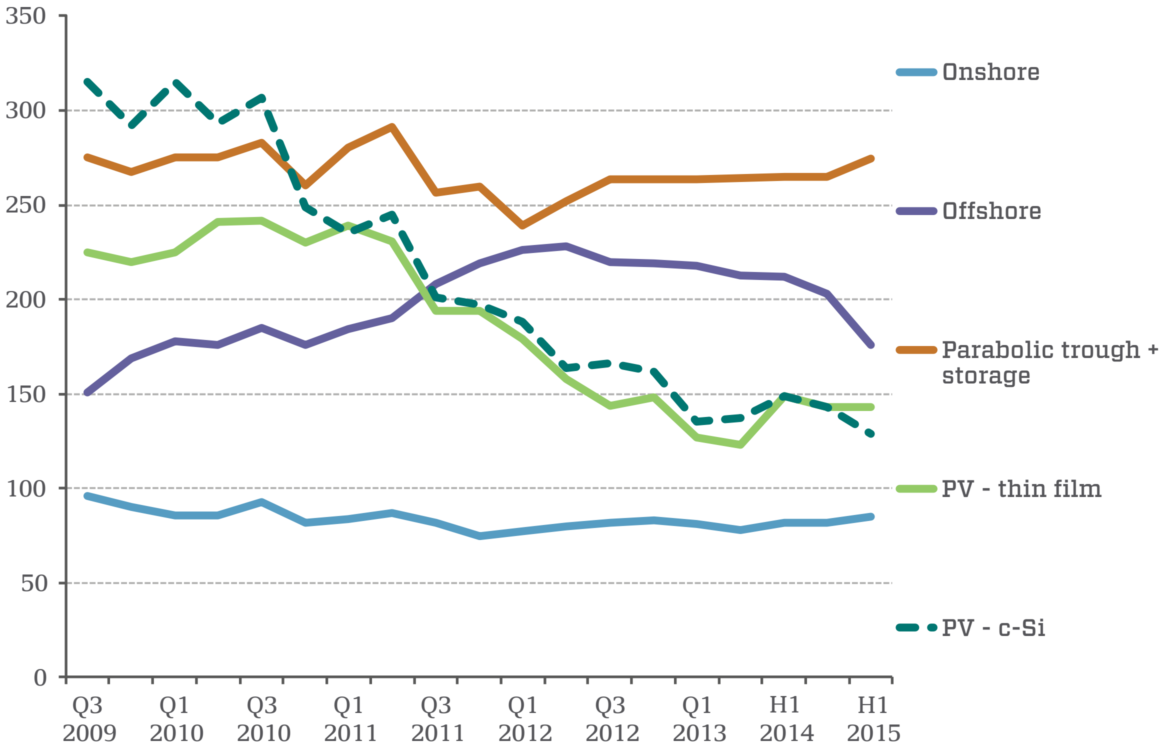
Sources:
Worldwatch Institute. 2012. For Vulnerable Regions, Renewable Energy Is Key to Climate Adaptation. Available at <http://blogs.worldwatch.org/revolt/for-vulnerable-regions-renewable-energy-is-key-to-climate-adaptation/>.

15. It should be noted that in some cases RE may have adverse short- and long-term impacts (e.g. loss of jobs in the fossil energy industry and impacts on landscape and habitats). It is critical for policymakers to address such potential negative impacts and to reduce misperceptions regarding perceived negative impacts. In some cases, the growth of employment in the RE industry may compensate for some job losses elsewhere in the energy sector, at least in aggregate terms if not for individual workers. A study conducted in Aragon, Spain, for example, found that the RE industry generates between 1.8 and 4 times more jobs per MW installed than conventional sources (United Nations Environment Programme, 2011). Presumably, labour retrenchment will take the form of not replacing workers that retire or the redeployment of workers to other sectors, accompanied by targeted retraining programmes.

16. With technological advances and expanded economies of scale, RE technology costs have decreased significantly over the last few decades, driving down overall project costs and supporting scaled-up deployment.[7] Since 2004, the cost of solar photovoltaics (PV) has declined by 75 per cent, bringing the average price of solar energy to USD 0.08/kWh. Figure 3 presents changes in the levelized cost of electricity for various RE technologies from 2009 to 2015. It should be noted that a key component of the levelized cost of electricity for RE technologies is the cost of finance, which varies by technology and location. Typically, the more mature technologies of onshore wind and solar PV are accepted as relatively low risk and gain more favourable financing terms. The financing of offshore wind projects, however, is still highly project specific, depending on the distance from the shore, the construction technology used and the experience of the developer.

[7] Presentation made by IRENA at the ADP TEM on RE in June 2015.

Figure 3
Levelized cost of electricity for renewable energy technologies, in USD/MWh (from third quarter of 2009 to first half of 2015)



Source: Bloomberg New Energy Finance

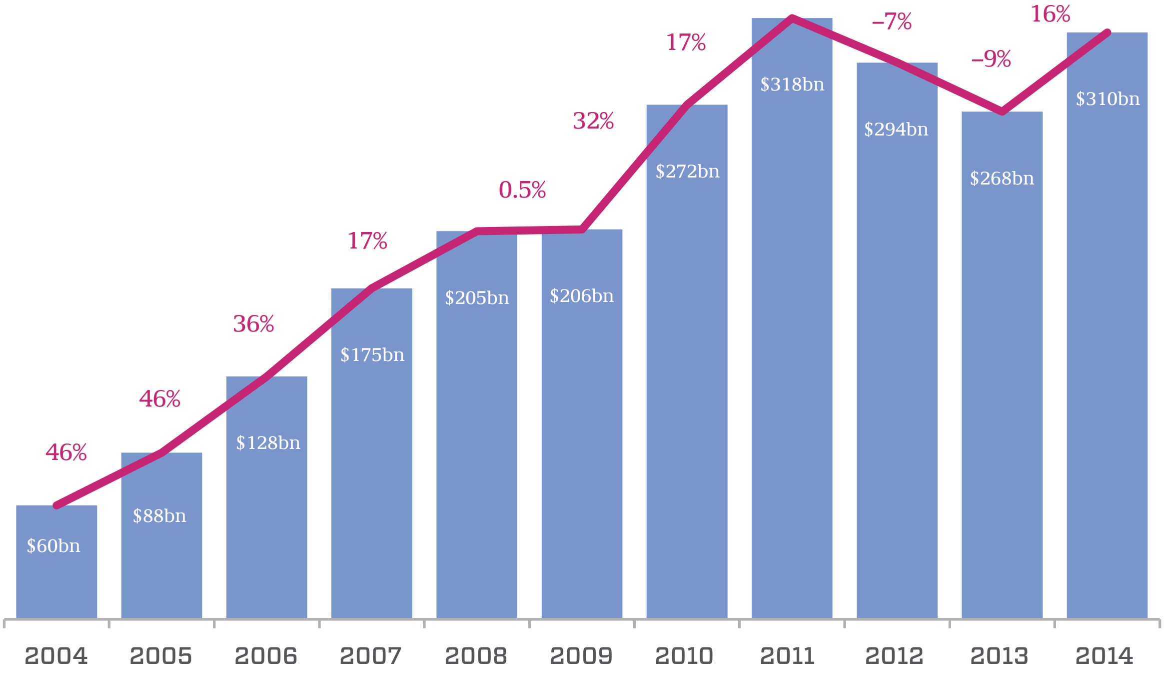
Source:
Presentation made by Bloomberg New Energy Finance at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.
Note: The levelized cost of electricity is the price that must be received per unit of output as payment for producing power in order to break even. The calculation standardizes the units of measuring the life-cycle costs of producing electricity, thereby facilitating the comparison of the cost of producing 1 MWh by each technology. The cost is denominated in 2012 USD/MWh.
Abbreviations: H = half year, offshore = offshore wind, onshore = onshore wind, PV = photovoltaics, PV c-SI = crystalline silicone, Q = quarter year.

17. Aligned with the overall trend for decreasing technology costs, in a number of contexts RE is now the lowest-cost option to enable critical emission reduction goals to be met.[8] Furthermore, as technical aspects of storage technologies continue to improve while costs decrease, RE potential will be greatly increased. However, system-wide integration measures must also continue to improve, across sectors and energy carriers, to support the significant scaling up of RE.[9]

18. Financial risks associated with RE continue to be better understood and, thus, more easily addressed, [10] allowing for expanded investment in and design of innovative finance instruments. As such, in 2014, USD 310 billion was invested in RE, a fivefold increase since 2004. Furthermore, since 2012, investment in new RE capacity has grown at a greater pace than investment in fossil fuel power capacity (IRENA, 2014).[11] Figure 4 presents the significant increase in clean energy investments over the period 2004–2014.

[8] Presentation made by the Renewable Energy Policy Network for the 21st Century at the ADP TEM on RE in June 2015.
[9] Low-emission transport tool of the Low Emission Development Strategies Global Partnership, available at <http://ledsgp.org/transport>.
[10] Presentation made by IRENA at the ADP TEM on RE in June 2015.
[11] As footnote 9 above.

Figure 4
Global investments in renewable energy and energy efficiency during the period 2004–2014



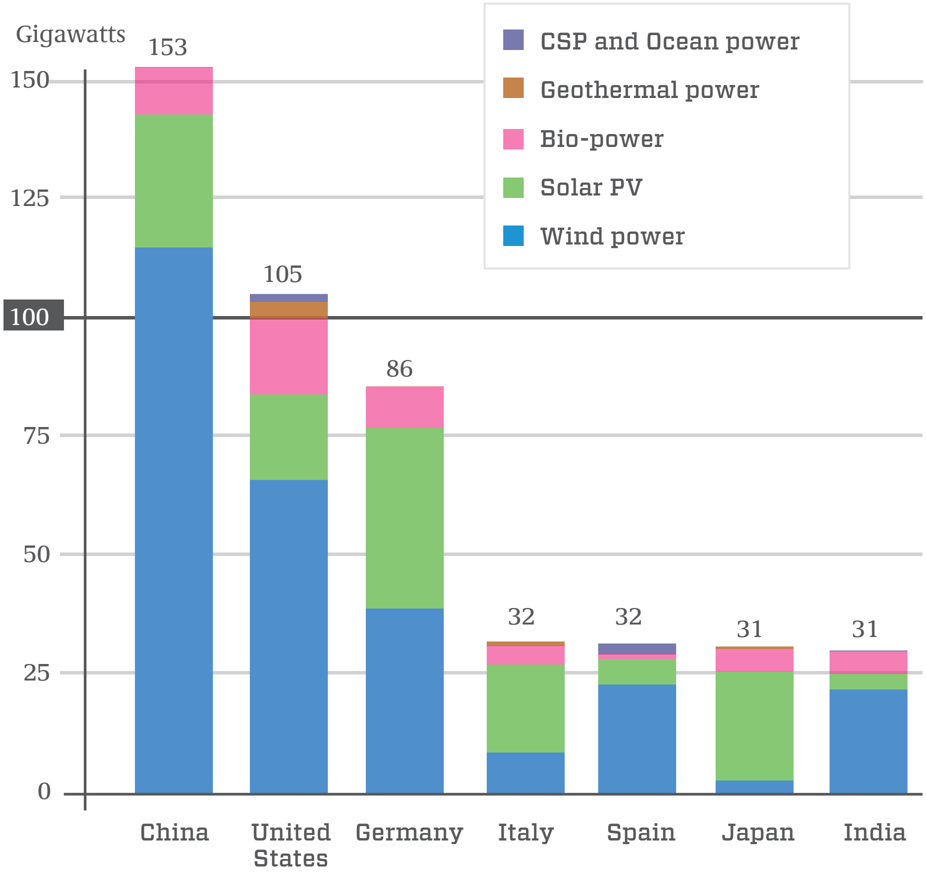
Note: Total values include estimates for undisclosed deals. Includes corporate and government R&D, and spending for digital energy and energy storage projects (not reported in quarterly statistics

Source: Presentation made by Bloomberg New Energy Finance at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy held in June 2015.
Abbreviation: R&D = research and development.

19. Much progress has been made in scaling up RE deployment around the world. Since 2011, over half of global additions to the capacity of the power sector have come from RE sources.[12] Figure 5 presents the countries with the highest levels of installed RE capacity as at 2014.

[12] As footnote 9 above.

Figure 5
Countries with the highest levels of installed renewable energy capacity, excluding hydropower



Source: Renewable Energy Policy Network for the 21st Century. 2015. Global Status Report.
Abbreviations: CSP = concentrated solar power, PV = photovoltaics.

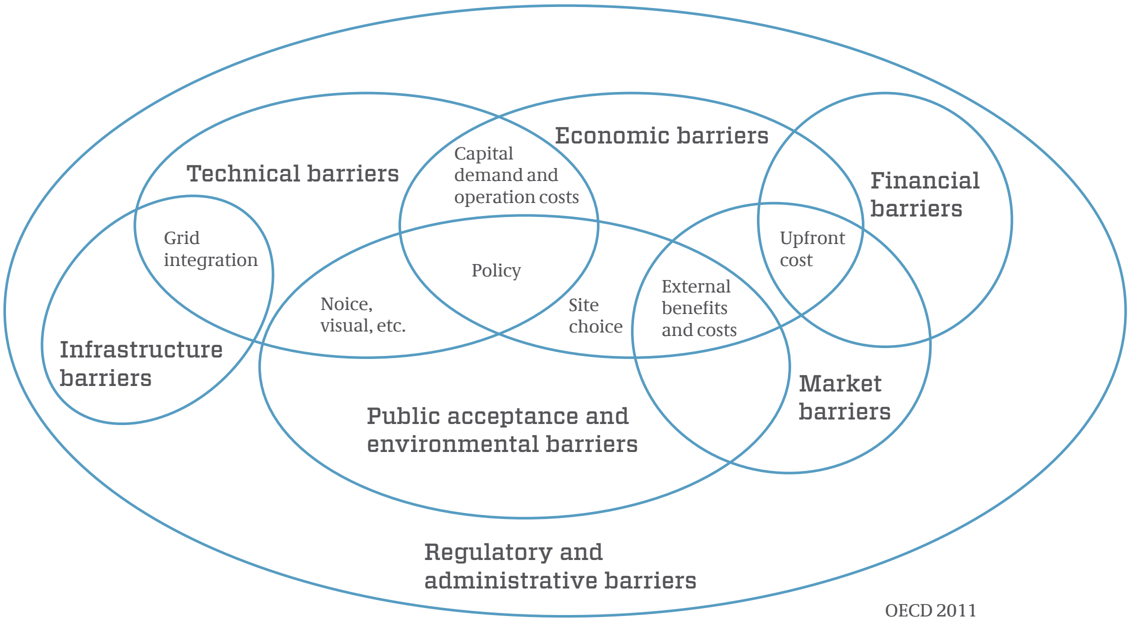
20. However, to reach the goal of doubling RE capacity by 2030,[13] IRENA estimates that annual global investment must be increased to USD 650 billion on average between now and 2030. On robust low-carbon pathways, energy efficiency and fuel cost savings can partially or fully offset the required investments.[14] Despite strong progress, a number of barriers, unique to various national circumstances, continue to hinder RE deployment.

21. From an economic, financial and market perspective, and despite decreasing technology costs, the cost of capital to finance RE projects, as well as real or perceived investment risks, are significant barriers in a number of national contexts. Governments also struggle to balance budget allocations across various, and sometimes competing, national priorities, and certain policies, such as fossil fuel subsidies, can greatly hinder RE development. Furthermore, lack of incorporation of environmental externalities with energy prices also serves to impede investment in RE (European Commission, 2014); and evolving market conditions and policy uncertainty or instability present further challenges for investment in RE.[15] In addition, cumbersome permitting and regulatory requirements can stymie investment.

[13] Presentation made by IRENA at the ADP TEM on RE in June 2015.
[14] Presentation made by IDDRI at the ADP TEM on RE in June 2015.
[15] Presentation made by Bloomberg New Energy Finance at the ADP TEM on RE in June 2015.

22. Furthermore, from a technical and infrastructure perspective, with many countries reaching higher penetrations of variable renewables in the electricity grid, smart and innovative grid integration/ system-wide policies and actions are required to ensure flexibility and address variability-related challenges.[16] In addition, needs and challenges in relation to human capacity and public acceptance necessitate investment in education and training programmes to build a strong workforce and informed communities in support of RE deployment.[17] Those and other key barriers to RE deployment are presented in figure 6.

Figure 6
Key barriers to renewable energy deployment



Source:
Presentation made by the Center for Clean Air Policy at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.
Abbreviation: OECD = Organisation for Economic Co-operation and Development.

23. Spotlight box 4 presents the Government of Mexico's approach to addressing key barriers to RE deployment.

[16] Greening the Grid. Available at <http://greeningthegrid.org/>.
[17] Presentation made by IRENA at the ADP TEM on RE in June 2015.

Spotlight box 4

Effective actions to address barriers to the deployment of renewable energy in Mexico

Mexico is taking a multifaceted approach to addressing critical renewable energy (RE) related challenges. In particular, as an oil-producing country, Mexico has faced significant political and economic barriers to RE development. To address key challenges, Mexico pursued the robust actions presented in the figure, which has led to a fourfold increase in wind power capacity since 2010, supported by a USD 9 billion investment in wind power since 2006. Furthermore, with continued strong support, wind power capacity is expected to increase from 2.6 GW in 2014 to 9.5 GW in 2018.

Lack og experience with RE	Initial FIT and capacity payment built confidence among IPP and regulators
Uneven playing field for RE	Economic incentives (e.g. accelerated depreciation, lower capacity penalties, netmetering)
Limited transmission	Transmission tender Increased transmission capacity for wind
Lack of financing	Syndicated loans (reduce risk for local banks)
State-owned monopoly	Sweeping energy sector reforms requires 35% clean energy by 2024, opened market fully to privat sector

Source: Presentation made by the Center for Clean Air Policy at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.
Abbreviations: FIT = feed-in tariff, IPP = independent power producer.

B. Key policies, practices and technologies

24. This chapter discusses two clusters of policy options: distributed energy generation[18] and broader financial incentives used to promote RE supply. The policy options presented are informed by experiences with and lessons learned from RE initiatives around the world and represent some of the key policies and actions introduced in a large number of countries to support the scaled-up deployment of RE in the context of national development and broader climate goals.

25. The use of distributed energy generation in many parts of the world improves access to modern energy services, the lack of which continues to impede sustainable development. Recent assessments suggest that as many as 1.3 billion people still do not have access to electricity and more than 2.6 billion people rely on traditional biomass for cooking and heating (Renewable Energy Policy Network for the 21st Century (REN21), 2014). However, people in remote and rural areas of the world have continued to gain access to electricity, modern cooking, heating and cooling as the installation and use of distributed RE technologies have increased. This expansion is a direct result of improvements in affordability, the inclusion of distributed energy in national energy policies, greater access to financing, increased knowledge about local resources and more advanced technologies that can be tailored to meet customers' specific needs.

26. As an indicator of the significant global support for RE deployment, 164 countries had adopted RE targets as at early 2015 (REN21, 2015). RE targets have been developed with varying characteristics, as presented in figure 7. Such targets often provide a high-level and critical signal of government support for RE and, along with national development goals, form the foundation for broader RE enabling frameworks and actions.

Figure 7
Spectrum of renewable energy targets

1	2	3	4
Political announcements and vision statements	**Energy strategies and scenarios**	**Detailed roadmaps and action plans**	**Legally binding renewable energy targets**
(e.g. white papers, regional-level energy communiqués, declarations and plans)	(e.g.electricity expansion plans, integrated resource plans)	(e.g. NREAPs, five-year plans, renewable energy programmes, technology -specific roadmaps)	(e.g. Laws, Renewable Obligations, Renewable Fuel Standards, Renewable Portfolio Standards, etc.)

Increasing specificity, measurability and binding character →

Source: International Renewable Energy Agency. 2015. Renewable energy target setting.
Abbreviation: NREAP = national renewable energy action plan.

27. Building on high-level targets and on the basis of unique national circumstances, countries and jurisdictions are developing various policies, actions and enabling frameworks to support RE deployment. Figure 8 presents a global picture of the number of countries that have implemented various RE policies.

[18] Also known as decentralized energy.

Figure 8
Number of countries with common renewable energy policies

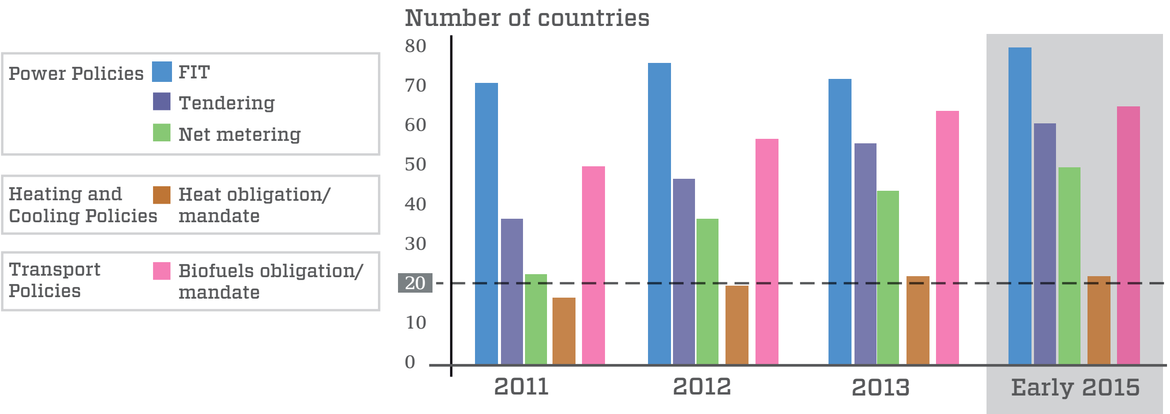


Figure does not show all policy types in use. Countries are considered to have policies when at least one national or state/provincial-level policy is in place.

Countries with multiple policies of the same type (e.g., national and sub-national FIT policies) are represented as one unit in the total number of countries with that policy type.

Source: Presentation made by the Renewable Energy Policy Network for the 21st Century at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.
Abbreviation: FIT = feed-in tariff.

28. As a high-level trend, although feed-in tariffs (FITs) are still the most widely adopted RE policy, many countries are designing new competitive tendering approaches and RE standards to support deployment.[19] In many cases, countries are adopting multifaceted portfolios of RE policies and actions to provide comprehensive and effective support. The robust policy packages of Uruguay, California and Sweden are highlighted in spotlight box 5.

[19] Presentations made by the Center for Clean Air Policy and Bloomberg New Energy Finance at the ADP TEM on RE in June 2015.

Spotlight box 5

Robust renewable energy policy packages in Uruguay, California and Sweden

Uruguay presents a strong model of a country catalysing renewable energy (RE) through a robust policy package and the engagement of the private sector. As at 2014, approximately 90 per cent of Uruguay's electricity was drawn from RE sources and investment in RE nearly tripled between 2012 and 2013. In 2015, wind power made up 28 per cent of the country's power capacity, an increase from only 1 per cent in 2010. To achieve such positive outcomes, Uruguay designed reverse auctions that led to significant increases in wind power capacity and declines in the price of wind power. In addition, the auction mechanism is currently supporting 200 MW solar photovoltaic additions. The Government of Uruguay designed a net metering policy, tax exemptions and a solar hot water heater mandate to support RE deployment. Independent power producers and small self-generators currently make up 50 per cent of RE suppliers in Uruguay, and the Government continues to actively engage the private sector and communities in policy design and implementation. Uruguay's policy package has focused largely on incentivizing investment and engaging the private sector, with less emphasis on regulations and mandates.[a]

California's RE capacity has increased twofold since 2010, with the State adding more than 11,000 MW from 2010 to 2014. California's Renewable Portfolio Standard has provided a critical policy mechanism to support renewable electricity and has been increased over time to align with changing market conditions and to ensure ongoing deployment. To balance electricity supply and demand, California's utilities have interconnected with States in the region to trade resources efficiently. Distributed generation is another important element of the State's energy mix and policies such as net metering, distributed generation auctions and a specific high-level goal to reach 12,000 MW distributed generation by 2020 are facilitating expanded deployment. Finally, the State's cap-and-trade policy is supporting the market-driven development of RE through utilities at the regional level. California's RE policy package highlights the need for the design and implementation of various complementary policies and actions to achieve strong outcomes in terms of RE deployment.[a, b]

Sweden has prioritized key climate and energy goals by implementing a comprehensive suite of long-term policies and actions. Within the country's broader support framework, key policies include: carbon taxes, an emissions trading scheme, a bilateral renewable certificate programme, research, development and deployment measures, financial support through small and medium enterprise loans and technology investment grants, and collaborative action and information-sharing networks, such as the Regional Energy Climate Advisors. In particular, Sweden's renewable certificate programme has been integral in supporting renewable electricity through an innovative bilateral partnership with Norway. Under the market-based, technology-neutral scheme, electricity suppliers and certain end-users purchase RE certificates allocated to RE producers on the basis of MWs produced. The policy allows suppliers to meet the RE quota while also providing additional revenue to RE producers.

In 2012, Norway joined Sweden's certificate programme, making it the first bilateral renewable certificate programme globally. On the basis of the success of those and other key policies, in 2015 more than 50 per cent of Sweden's electricity was supplied by renewables (exceeding the European Union 2020 target on renewables) and in 2013 the country had reduced emissions by 23 per cent since 1990 while also experiencing strong economic growth. Key factors supporting Sweden's success include: long-term political will and consistent policy signals to ensure investor confidence and a stable RE market; design of a robust policy package, drawing on international lessons learned and good practices, to address key barriers and enable investment from a unique country perspective; and the integration of electricity policy and markets across national borders.[c]

Sources:
[a] Presentation made by the Center for Clean Air Policy at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.
[b] California Energy Commission. 2015. Quarterly Fuel and Energy Report. Available at <http://www.energy.ca.gov/renewables/quarterly_updates/ >.
[c] Presentation made by Sweden at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.

B.1. Strengthening enabling frameworks for the implementation of distributed energy generation and other renewable energy policies

29. To address the critical barriers to RE deployment described above, developing a strong and robust RE policy framework, aligned with national circumstances, can provide the foundation for successful RE-related action. Such frameworks should be transparent, progressive and monitored over time to inform policy iteration and revisions under evolving market circumstances. Within such frameworks, critical players from the public and private sectors as well as civil society (e.g. utilities, policymakers, project developers, customers, local communities and municipalities.) should be actively engaged to inform policy design and implementation.

30. Policy frameworks are often based on a high-level vision for RE deployment informed by diverse stakeholder interests and perspectives. Champions across the government can be instrumental in building interministerial support and facilitating the realization of the vision.

31. RE policy frameworks and strategies incorporate: robust data and analysis to provide a strong evidence base for action; effectively designed policies and actions to catalyse deployment; critical grid integration considerations; innovative finance mechanisms and opportunities for private-sector collaboration to support implementation; and actions to build capacity in key areas of need. Research, development and demonstration efforts are also often critical components of a robust RE framework, supporting the innovation and market evolution of RE, as well as the development of local manufacturing industries. High-level policy frameworks should also integrate operation and maintenance considerations for smaller-scale distributed generation (DG) systems and provide appropriate incentives and support to ensure system sustainability.[20]

[20] Presentation made by the Technology Executive Committee (TEC) at the ADP TEM on RE in June 2015.

32. Aligned with those broader framing elements for RE-related action, the International Energy Agency Renewable Energy Technology Deployment (IEA-RETD) recommends the following ‘policy ingredients’ under the ACTION star framework: alliance-building, communicating, target-setting, integrating RE into all policymaking, optimizing (policies) and neutralizing/levelling the playing field (IEA-RETD, 2012).

33. To support effective RE policy frameworks and complementary actions, capacity-building is needed in a number of specific national settings. Strengthening capacity within the public (policymakers, planners, utilities, technical institutions, etc.) and private (project developers, bankers, investors, entrepreneurs, etc.) sectors as well as within civil society (communities, academia, non-governmental organizations, etc.) can facilitate positive outcomes for RE policies and actions. While robust RE policy frameworks share common characteristics, each is unique to individual national circumstances, challenges, opportunities and sustainable development goals (World Resources Institute, 2013).

B.2. Policy options for promoting distributed energy generation

34. DG can play a critical role in supporting the scaling up of RE worldwide. Distributed energy is produced by smaller (often 1 to 100 kW) systems, sited close to end-users.[21] Aggregation of those systems can support grid resilience, flexibility and efficiency by diversifying electricity supply and decreasing transmission and distribution losses.[22] Furthermore, DG often provides the most cost-effective option for expanding energy access to rural areas. DG allows for increased ownership and engagement of individuals and local communities in the provision of electricity.[23]

35. Mini-grids are one type of DG technology gaining increasing attention and support around the world. Mini-grids are electricity systems serving communities or groups of end-users, such as households and enterprises, which may or may not be connected to the electricity grid. Mini-grids are powered by one or more energy sources (such as hybrid diesel-RE systems), often connected to battery arrays, and are differentiated from systems serving single households (Sustainable Energy for All, 2014). Mini-grids integrate smaller-scale generation and distribution systems and utilize effective management and billing approaches to ensure sustainability. [24]

36. DG also encompasses grid-connected or off-grid systems for single households or businesses. Off-grid decentralized systems are playing a critical role in supporting energy access and other key development goals in developing countries. The systems are leading to innovations in business models and economics in the energy sector, while also supporting grid resilience and expanding energy access (IRENA, 2015c). One example of a successful off-grid energy access programme in Bangladesh is presented in spotlight box 6.

[21] Presentation made by the TEC at the ADP TEM on RE in June 2015.
[22] Electric Power Research Institute. Available at <http://www.epri.com/Pages/Default.aspx>.
[23] Presentation made by the TEC at the ADP TEM on RE in June 2015.
[24] Presentation made by EU EI PDF at the ADP TEM on RE in June 2015.

Spotlight box 6

Solar home systems to support energy access in Bangladesh

The Government of **Bangladesh** established the Rural Electrification Board in 1977 to expand energy access, primarily through grid connection. It became clear that complementary off-grid options were needed to meet energy access goals in a timely and cost-effective manner. To meet that need, in partnership with the World Bank, the Government established a Solar Home System (SHS) programme in 2002 that linked energy access needs with the country's well-established and flourishing microfinance industry.

The Government's Infrastructure Development Company Limited (IDCOL) leveraged long-standing relationships between microfinance institutions (MFIs) and rural clients to provide a new service and to expand energy access. To implement the programme, IDCOL first chose successful MFIs for public–private partnerships (PPPs). With dedicated training, grants and loans, the selected MFIs then became the financiers, sellers and technicians for the installation and maintenance of the systems. IDCOL also established and certified technical standards for the technologies and implemented an SHS buy-back programme for customers connected to the grid within one year of purchase.

As a result of the SHS programme, over 3 million systems were installed from 2003 to 2014. The following lessons learned associated with key policy actions contributed to that successful outcome:

- PPPs with well-established MFIs helped to build awareness, increase consumer confidence and expand the customer base;
- Declining and phasing out subsidies over time helped to ensure market sustainability with decreasing government intervention;
- Establishing and certifying product standards can increase consumer confidence and, thus, increase system sales;
- SHS buy-back initiatives can expand the customer base to include areas planned for future electricity grid connection;
- Training of MFIs and customers on SHS installation, operation and maintenance supports long-term sustainable outcomes.

Source: The World Bank. 2014. Scaling Up Access to Electricity: The Case of Bangladesh. Available at <https://openknowledge.worldbank.org/bitstream/handle/10986/18679/887020BRI0Live00Box385194B00PUBLIC0.pdf?sequence=1>.

37. Various factors, such as geography, availability of RE sources, distance from the central grid, economics, purchasing power and settlement patterns, have an impact on the choice of electricity systems. Given those factors, in a number of cases stand-alone mini-grid and other DG systems are offering optimal solutions for accessing electricity.[25] In fact, Bloomberg New Energy Finance (BNEF) estimates that 13 per

[25] Presentation made by EU EI PDF at the ADP TEM on RE in June 2015.

cent of global electricity will be derived from smaller-scale solar systems by 2040 and that, in all major economies, rooftop solar power will be less expensive than power from the electricity grid (BNEF, 2015). However, effective policies and planning are required to ensure optimal outcomes for DG.

38. In addition to barriers across RE technologies, DG faces unique economic, political and institutional barriers. At the most basic level, DG policy frameworks do not exist in a number of countries and are nascent, non-transparent and/or weak in others. Furthermore, understanding various stakeholder perspectives (e.g. of utilities, policymakers and communities) can create a complex environment for the design of effective DG policies, and policy complexity or uncertainty can hinder investment. From a technical standpoint, integrating variable DG into the electricity grid requires the consideration of broader grid integration. Finally, financial barriers and perceived or real risks associated with DG, as well as low levels of human and institutional capacity at the country level, can also hinder the expansion of DG markets.[26]

39. In the context of high-level DG and RE policy frameworks, various actions and policies can be designed and implemented to support the deployment of smaller-scale RE technologies, in the context of unique national circumstances and goals. Key actions and policies, as well as enabling practices to support effective policy design and implementation, are described in paragraphs 40–44 below and summarized in table 1.

40. **Interconnection standards**: Robust interconnection standards are crucial for all RE projects. In the context of DG, interconnection standards provide the conditions and technical requirements that must be met to connect DG to the electricity grid. Effective standards reduce the costs and time involved in connecting DG to the grid while also ensuring grid reliability and safety. By standardizing procedures and simplifying processes, interconnection standards can support cost-effective and successful DG deployment and avoid inefficiencies associated with DG approval on a case-by-case basis. Strong design of interconnection standards, building on international experience and good practices, is critical in supporting successful DG markets (Barnes et al., 2013; Freeing the Grid, 2015 and Varnado et al., 2009).[27]

41. **Net metering**: The value of excess electricity produced by DG systems, typically connected to a home or business, and fed into the grid can be determined by means of net metering policies. Well-designed net metering policies are often critical in supporting DG markets. Under one approach for tariff-based net metering design, DG power production is subtracted from power usage at the end of a billing cycle and customers are billed in relation to 'net' kWh. Any excess kWh can then be applied as a credit in the next billing cycle or utilities can pay customers a certain rate for the excess power. However, it should be emphasized that this is just one approach to net metering. Effective net metering policy design will be highly specific to the unique national circumstances and goals of each country or jurisdiction (Barnes et al., 2010; Barnes et al., 2013; and Varnado et al., 2009).[28]

42. **Mini-grid support mechanisms**: Various models and approaches have been deployed to support mini-grids. Mini-grids may be operated and maintained by communities, private entities, utilities or some combination of those actors through hybrid models. Depending on the approach used, policy, financial and capacity-building needs to ensure successful outcomes will differ.[29] In all cases, communities served by the systems are integral to ensuring long-term success. Mini-grids can also be an important contributor to economic development by providing power directly to businesses and through the development of new businesses to support the operation and maintenance of the systems (EU EI PDF, 2014). Mali's experience in supporting micro-grid deployment is detailed in spotlight box 7.

[26] Presentation made by the TEC at the ADP TEM on RE in June 2015.
[27] American Council for an Energy-Efficient Economy. Available at <http://aceee.org/>.
[28] Freeing the Grid 2015: Best Practices in State Net Metering Policies and Interconnection Procedures, available at <http://freeingthegrid.org/>; and Clean Energy Solutions Center, available at <https://cleanenergysolutions.org/>.
[29] Presentation made by the Gesellschaft für Internationale Zusammenarbeit at the ADP TEM on RE in June 2015.

Spotlight box 7

Micro-grid support mechanisms in Mali

Mali is a leader of mini-grid deployment in Africa. The Government of Mali has supported mini-grids at various levels, resulting in the deployment of more than 160 stand-alone systems throughout the country by 2015. At the highest level, various energy-sector policies, including the Energy Sector Organization Law and National Energy Policy, specifically prioritize energy access and mini-grid development. In addition, and to provide significant institutional support, the Government created the Malian Agency for the Development of Domestic Energy and Rural Electrification (AMADER) as the lead agency for the regulation and support of rural electrification and mini-grids, as well as the Rural Electrification Fund (REF). REF, managed by AMADER, provides a funding mechanism to support private-sector mini-grid development, including capital cost grants for projects and feasibility studies for mini-grid deployment in the poorest areas of the country. In addition, AMADER supports both a competitive bidding process for mini-grid development in specified electrification zones of the country and 'spontaneous project applications for rural electrification' that can be submitted outside of the formal competitive bidding process.

With approval from AMADER, developers are permitted to set tariff rates for mini-grid electricity sold, an approach that has been credited with supporting innovative electricity business models within the country. Finally, support for diesel system hybridization with RE technologies has also supported mini-grid expansion in the country. This experience provides a strong example of a multifaceted approach to supporting mini-grid deployment.

Sources: Forthcoming National Renewable Energy Laboratory paper on energy access and the presentation made by Mali at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.

43. Mini-grid policy and regulatory environments should be supported by a clear strategy. Legal considerations and approaches to addressing key challenges related to licensing, grid connection in the event that the grid is extended, and tariff design are critical components of such strategies. Successful mini-grid strategies can be supported by designing effective regulatory instruments and policies for each electricity system model (e.g. off and on grid), building the capacity of mini-grid project developers and developing a pipeline of bankable mini-grid projects. Once those actions are in place, mobilization of finance can be supported as another integral element of success.[30] Spotlight box 8 presents a list of key policies, regulations and financial mechanisms to support mini-grids.

[30] Presentation made by EU EI PDF at the ADP TEM on RE in June 2015

Spotlight box 8

Policies, regulations and financial mechanisms to support mini-grids

- National Electricity or Electrification Policy
- Rural Electrification Strategy and Master Plan
- Energy and Electricity Law (incl. implementing institutions)
- Tariff Policy and Regulation (incl. Connection Fee)
- Fiscal Policy and Regulation (Taxation, Import Duty, etc.)
- Technical Regulation (incl. Grid Connection)
- Quality of Service Regulation
- Environmental Policy and Regulation
- Generation and Distribution Permits and Licences
- Concession Contracts and Schemes
- Power Purchase Agreements (PPA)
- Grants and Subsidies (incl. capital expenditure, operating expenditure and performance based)
- Loan Support and Risk Mitigation Instruments
- Technical Assistance (incl. Awareness Raising and Promotion, Vocational Training, Institutional Capacity Development, Network Development, Project Developer Guidelines, relevant Data (e.g. grid extension, socio-economic data, resource maps)

Source: Adapted from European Union Energy Investment Partnership Dialogue Facility. 2014. Mini-grid Policy Toolkit.

44. Further actions to enable finance for DG: Various mechanisms and approaches can be used to support the provision of finance for distributed RE. Key actions include: designing and implementing financial incentives such as FITs, net metering or hybrid policies; ensuring policy stability to provide investors with certainty of revenue; supporting the development of innovative and effective DG business models; streamlining and standardizing contracts and related DG processes; considering the elimination or revision of non-conducive fossil fuel subsidies and RE import taxes; ensuring utilities are a key player in DG implementation and broader grid-integration efforts; and considering the use of international finance mechanisms to scale up DG, such as nationally appropriate mitigation actions and the Green Climate Fund.[31] Policies and enabling practices to support DG, as well as examples from different countries and jurisdictions, are highlighted in table 1.

[31] Presentation made by the TEC at the ADP TEM on RE in June 2015.

Table 1
Policy options for promoting distributed generation of renewable energy

Policy options and key elements of enabling environments to support successful policy replication and implementation	Select examples
Policy option: interconnection standards	
• **Ensure the eligibility** of all renewable energy (RE) technologies (including combined heat and power) and equal access for all developers and self-generators • **Engage utilities** as critical stakeholders in the design and implementation of interconnection standards • **Reduce interconnection application costs** (especially for small-scale technologies) and simplify/fast-track the application process for small generators • **Conduct grid integration studies** to inform capacity and engineering limits associated with interconnection • **Ensure** the transparency, accessibility and timeliness of the process[a]	• European Union – PV GRID project[b] • Philippines – manual on photovoltaic (PV) interconnection[c] • United States – Massachusetts Department of Energy Resources - interconnection standards[d]
Policy option: net metering	
• Ensure the inclusion and eligibility of all RE technologies (including combined heat and power) and all customer classes • Set capacity limits based on distributed generation (DG) grid integration studies and on-site consumer loads • Consider a tiered policy for smaller-scale or less complex projects • Set billing system on the basis of net electricity used and allow excess power to 'roll over' to the next billing cycle for a set period of time • Consider community solar approaches and aggregated net metering[e]	• Jamaica – net billing pilot project[f] • Seychelles – net metering programme[g] • United States – California Public Utilities Commission net metering policy[h]
Policy option: mini-grid support mechanisms	
• Support a stable and long-term mini-grid policy environment to raise investor confidence	• Cabo Verde – community-based support for hybrid wind-PV-diesel mini-grids[i]

Policy options and key elements of enabling environments to support successful policy replication and implementation	Select examples
Policy option: mini-grid support mechanisms	
• Ensure robust, transparent and standardized policies and regulations that clearly articulate guidelines, requirements and permissible tariffs • Streamline permitting and other project development processes to ensure cost-effectiveness and ensure that all relevant entities supporting permits, finance and other aspects of mini-grid development are easily accessible • Consider exempting very small mini-grids from certain regulations to facilitate an efficient mini-grid support environment[k]	• India – biomass-PV mini-grid support[j] • Kenya – Rural Electrification Authority mini-grid support • Mali – micro-grid capital cost grants, competitive bidding and other actions[j]
Further actions to facilitate finance for DG	
• Design and implement financial incentives such as feed-in tariffs, net metering or hybrid policies • Ensure policy stability to provide investors with certainty of revenue, support the development of innovative and effective DG business models and streamline and standardize contracts and related DG processes • Consider the elimination or revision of fossil fuel subsidies and RE import taxes • Ensure that utilities are key players in DG implementation and broader grid integration efforts • Consider international finance mechanisms, such as nationally appropriate mitigation actions and the Green Climate Fund[l]	• Bangladesh – Solar Home System microfinance programme • China – progressive pricing of electricity consumption • Ethiopia – workshop on nationally appropriate mitigation actions (NAMAs) to support mini-grids and rural electrification[m] • Pakistan – NAMA supporting mechanisms for promoting DG[n] • United Kingdom – feed-in tariff for small-scale renewables

Sources:
[a] Barnes J, Culley T, Haynes R, Passera L, Wiedman J and Jackson R. 2013. Best Practices in State Net Metering Policies and Interconnection Procedures. Interstate Renewable Energy Council and The Vote Solar Initiative. Available at <http://freeingthegrid.org/wp-content/uploads/2013/11/FTG_2013.pdf>; Varnado L and Michael S. 2009. Connecting to the Grid: A Guide to Distributed Generation Interconnection Issues. Interstate Renewable Energy Council. Available at <http://www.irecusa.org/connecting-to-the-grid-guide-6th-edition/>; American Council for an Energy-Efficient Economy. Available at <http://aceee.org/>; Freeing the Grid 2015: Best Practices in State Net Metering Policies and Interconnection Procedure. Available at <http://freeingthegrid.org/>; and Clean Energy Solutions Center. Available at <https://cleanenergysolutions.org/>.
[b] PV GRID. Available at <http://www.pvgrid.eu/de/home.html>.
[c] Deutsche Gesellschaft für Internationale Zusammenarbeit. 2013. Manual for interconnection: Report for supporting the interconnection of rooftop-PV systems in the Philippines. Available at <http://www.giz.de/expertise/downloads/Fachexpertise/giz2013-en-manual-interconnection-rooftop-pv.pdf>.
[d] Massachusetts Department of Energy Resources. 2015. Interconnection. Available at <https://sites.google.com/site/massdgic/

home/interconnection>.
[e] Barnes J and Varnado L. 2010. The Intersection of Net Metering and Retail Choice: An Overview of Policy, Practice, and Issues. Interstate Renewable Energy Council. Available at <http://www.irecusa.org/the-intersection-of-net-metering-and-retail-choice-an-overview-of-policy-practice-and-issues/>; Barnes J, Culley T, Haynes R, Passera L, Wiedman J and Jackson R. 2013. Best Practices in State Net Metering Policies and Interconnection Procedures. Interstate Renewable Energy Council and The Vote Solar Initiative. Available at <http://freeingthegrid.org/wp-content/uploads/2013/11/FTG_2013.pdf>; Varnado L and Michael S. 2009. Connecting to the Grid: A Guide to Distributed Generation Interconnection Issues. Interstate Renewable Energy Council. Available at <http://www.irecusa.org/connecting-to-the-grid-guide-6th-edition/>; Freeing the Grid 2015: Best Practices in State Net Metering Policies and Interconnection Procedures. Available at <http://freeingthegrid.org/>; and Clean Energy Solutions Center. Available at <https://cleanenergysolutions.org/>.
[f] Jamaica Public Service Limited. Available at <http://www.myjpsco.com/>.
[g] Couture T, Jacobs D, Rickerson W and Healey V. 2015. The Next Generation of Renewable Electricity Policy. Clean Energy Solutions Center. National Renewable Energy Laboratory. Available at <http://www.cleanenergyministerial.org/Portals/2/pdfs/Solution-sCenter-NextGenREPolicy.pdf>.
[h] California Public Utilities Commission. Available at <http://www.cpuc.ca.gov/puc/>.
[i] Adapted from European Union Energy Initiative Partnership Dialogue Facility. 2014. Mini-grid Policy Toolkit. Available at <http://minigridpolicytoolkit.euei-pdf.org/policy-toolkit>.
[j] European Union Energy Initiative Partnership Dialogue Facility. 2014. Mini-grid Policy Toolkit. Available at <http://minigridpolicy-toolkit.euei-pdf.org/policy-toolkit>.
[k] Presentation made by Mali at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.
[l] Presentation made by the Technology Executive Committee at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.
[m] Ecofys. 2015. Ethiopian Minister and stakeholders join forces to shape rural electrification NAMA. Available at <http://www.ecofys.com/en/news/ethiopian-minister-and-stakeholders-join-forces-to-shape-rural-electrificat/>.
[n] Ecofys nationally appropriate mitigation actions database. Available at <http://www.nama-database.org/index.php/Main_Page>.

B.3. Policy options and financial incentives for promoting renewable energy supply

45. In the context of broader RE frameworks, various economic and financial policies, incentives and instruments are being implemented around the world to support RE deployment. Some key policies and actions are described in paragraphs 46–63 below, with enabling practices based on international experience highlighted in table 2.

46. Feed-in tariffs:[32] At the end of 2013, FITs had been implemented in 98 countries and jurisdictions around the world, making them one of the most widely employed policies globally (REN21, 2014). FITs support investment in RE by providing a guaranteed price per kWh for renewable electricity generation through purchase contracts with developers. FITs also often incorporate 'guaranteed access to the grid' provisions in order to decrease investor risk and ensure developed resources are integrated into the grid. FITs can either be set at a fixed rate or linked to the market electricity rate with an added (fixed or variable) premium. Many countries have adopted or are moving towards the latter approach (Couture et al., 2010 and 2015; and REN21, 2014).

47. Policy goals provide the foundation for FIT design and can inform FIT payments, which often vary in relation to technology and can vary in relation to location, resource availability and project size. As RE markets evolve, technology costs should inform FIT payment levels; however, changes to FITs should be made predictably and transparently to avoid policy uncertainty, which can hinder investment.

48. Adopting annual declines in FIT payments is one approach to supporting policy certainty (see spotlight box 9) while also ensuring flexibility in relation to project and technology costs. Streamlining FIT processing, administration and approvals can also support a more efficient policy environment and reduce policy costs. Finally, policymakers can also consider FIT cost containment approaches, such as establishing maximum installed capacity caps or reducing FIT payments predictably when capacity goals are achieved (Couture et al., 2010 and 2015; and Organisation for Economic Co-operation and Development (OECD), 2015).[33]

[32] It should be noted that FITs are also used to support DG and are covered in detail in this section.
[33] Clean Energy Solutions Center. Feed-in Tariffs: Good Practices and Design Considerations. Available at <https://cleanenergysolutions.org/policy-briefs/fit>; and National Renewable Energy Laboratory. Feed-In Tariffs. Available at <http://www.nrel.gov/tech_deployment/state_local_governments/basics_tariffs.html>.

Spotlight box 9

Feed-in tariffs in the United Kingdom of Great Britain and Northern Ireland

Established in 2010, the **United Kingdom of Great Britain** and **Northern Ireland**'s feed-in tariff (FIT) policy allows homeowners, businesses and other entities with renewable energy (biogas, hydro, solar and wind) systems under 5 MW to receive tariff payments for electricity produced. Tariffs differ in relation to system type and size. Under a digression approach, FIT payments are reduced at set times (annually or quarterly) depending on the technology.a This approach provides policy certainty and increases investor confidence. However, levels of technology deployment can also inform/alter the digression schedule and level, in order to support a stable market. To support increased deployment of community-level renewable energy, the United Kingdom Government will be increasing the tariff level to 10 MW for community approaches.[b]

Sources:
[a] United Kingdom Feed-In Tariffs. Available at <http://www.fitariffs.co.uk/>.
[b] Presentation made by the United Kingdom at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.

49. Auctions/tendering contracts: Countries are increasingly supporting RE deployment through auction and tendering approaches. Through a competitive tendering process, governments and/or utilities can select project bids to meet RE capacity goals. In many cases, this approach has resulted in lower project costs as compared with FITs (Philibert, 2011) (see spotlight box 10).

Spotlight box 10

Renewable energy competitive tendering in South Africa

In 2011, the Government of **South Africa** implemented the Renewable Energy Independent Power Producer Procurement Programme (REIPPP), establishing a competitive bidding process to support large-scale renewable energy (RE) deployment in the country and replacing a feed-in tariff programme. Since that time, four bidding processes have taken place, with a fifth one currently under development. The first three bidding windows resulted in USD 1.5 billion in domestic and international private investment for 64 projects with a total installed capacity of 3,915 MW.

The process is also supporting significant declines in the prices of solar and wind power and reductions in emissions. As the programme continues, the Government expects the continued scaling up of RE deployment, resulting in significant emission reductions and other positive developments. Key features of REIPPP supporting successful outcomes include:

- Use of multiple 'bidding windows' to support learning over time and declines in electricity prices;
- Use of an independent entity to manage the process and evaluate bids;
- Evaluation of project bids in relation to sustainable development co-benefits, such as job creation, business development and emission reductions, to support broader sustainable development goals, in addition to cost and technical requirements;
- Design of the programme to reflect unique national circumstances.

Source: Presentation made by South Africa at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.

50. However, auction/tendering approaches are often most appropriate and efficient for larger/utility-scale RE projects, rather than small-scale projects, as administration costs can outweigh the benefits in the latter cases (Bird et al., 2012). On the basis of unique national circumstances, policymakers may choose to use a mix of auctions and FITs to support RE projects of different sizes. To support cost reductions, many governments have also adopted reverse auction approaches, whereby lowest-price viable project bids are selected from prequalified project developers (Miller et al., 2013; IRENA, 2015b; and OECD, 2015).

51. To reduce costs, it is important to streamline administrative processes associated with auctions. Furthermore, providing timely, accurate and transparent information to developers is critical in ensuring a fair and competitive auction environment. Policymakers should also support the stability of the policy by avoiding unexpected changes and ensuring any revisions to the process are transparent.

52. Two-phase tender processes can also support positive auction outcomes by requiring developers to demonstrate technical capabilities before bids are submitted (Couture et al., 2010 and 2015). In addition to considering project feasibility, costs and grid integration, linking project selection to sustainable development criteria can support the attainment of broader climate and socioeconomic goals (Eberhard et al., 2014). IRENA provides detailed guidance on auction design in its 2015 publication Renewable Energy Auctions: A Guide to Design (IRENA, 2015b).

53. Renewable electricity standards or quotas: Renewable electricity standards (RES), also known as renewable portfolio standards or quotas, are one of the most widely adopted RE policies around the world, with 79 jurisdictions having implemented RES as at 2013 (REN21, 2014). RES mandate a specific amount of generated or sold electricity to be supplied by RE resources, such as wind and solar. Effective RES are often scaled up over time to steadily reach a specified goal at a certain date and align with broader RE strategies and plans. To support optimal RE-related outcomes, policymakers should avoid unpredictable shifts in the policy and clearly define the standard.

54. RES targets are informed by robust analysis, taking into account resource supply, geospatial and siting considerations, costs and project economics, grid integration requirements including transmission and distribution, and interactions with other policies. Stakeholder engagement is also critical in informing RES design. RES set-asides can be used to support specific technologies that may benefit overall policy goals, such as grid load balancing, while other traditional RE technologies may be excluded, such as hydro (National Renewable Energy Laboratory, 2013).

55. RES compliance mechanisms, such as payments that can be made as an alternative to complying with RES or alternative compliance payments, are important in controlling costs and ensuring targets are met. Country-specific costs and benefits of compliance, along with technology costs, can be used to inform compliance payment levels.

56. Many countries have also established renewable electricity certificate (REC) programmes to provide an alternative approach to meeting RES requirements. RECs encompass the environmental attributes of RE generation and can be bought by entities to comply with RES. Finally, to support robust policy action, RES can also be complemented by other policies such as FITs and other finance mechanisms, carbon cap-and-trade systems, tax incentives, grid integration measures and DG policies (Bird et al., 2010; and OECD, 2015).[34]

57. Renewable energy tax measures and incentives: As at 2014, at least 39 countries had implemented RE tax incentives, such as production and investment tax credits, to support RE deployment.[35] Production tax credits are based on kWh energy produced and, thus, are explicitly tied to actual RE production. Investment tax credits are linked to project capital investment and reduce the tax liability of the project owner on the basis of that investment (Mendelsohn and Kreycik, 2012).

58. While the design of specific tax incentive levels and cost control provisions will depend greatly on specific country circumstances, policymakers can enable positive outcomes by supporting a stable and predictable policy environment, considering and addressing risks associated with credits that are not tied to actual production, and establishing appropriate time frames that align with overall policy goals. Reducing or eliminating import and value-added taxes on RE technologies and components can also provide a strong impetus for expanded investment (Boekhoudt et al., 2014).

59. Emission pricing instruments such as carbon taxes and emissions trading: Various countries and jurisdictions have designed GHG emission pricing instruments to support RE and low-carbon development. One example is carbon taxes, which can support positive changes in consumer behaviour, production and investment by providing a strong price signal linked to the emission intensity of energy sources. Carbon and energy tax revenues can be reinvested to support RE and other low-carbon actions (OECD, 2015).

60. Another example is emissions trading systems, which establish a cap for GHG emissions or intensity. Under such systems, entities emitting GHG emissions are allocated tradable allowances linked to emissions, providing a market-based mechanism to determine the price of carbon and meet the cap. Establishing an appropriate cap is critical in supporting low-carbon investment. When effectively designed, cap-and-trade systems can encourage abatement action at the lowest cost. Cap-and-trade systems are often complemented by other policies to support low-carbon energy development, such as RES and REC programmes and carbon taxes (OECD, 2015).

61. Grid integration actions: As countries around the world reach higher penetrations of renewable electricity, grid integration actions become increasingly important to support system reliability, flexibility and efficiency. As a first step, countries often undertake studies to assess the impacts of RE

[34] Clean Energy Solutions Center. Renewable Electricity Standards: Good Practices and Design Considerations. Available at <https://cleanenergysolutions.org/policy-briefs/res>.
[35] REN21 Interactive Map. Available at <http://www.ren21.net/status-of-renewables/ren21-interactive-map/>.

integration into the grid, as well as opportunities for grid improvement, and use this information to inform the setting of high-level RE targets.

62. Following that analysis and the development of targets, countries can consider various measures to support optimal outcomes, including: the use of ancillary services to support system reliability and flexibility; electricity supply and demand balancing measures; improvements to system operations; use of flexible generation; improvement of forecasting methods; and implementation of demand response and storage measures (Cochran et al., 2012; and Miller et al., 2015) (see spotlight box 11).[36] The United States Agency for International Development Greening the Grid website provides a toolkit and step-by-step guidance to support countries in considering and implementing actions.

Spotlight box 11

Battery storage – Tesla Energy Powerwall system

In 2015, Tesla Energy launched a 10 kWh energy storage system known as the Powerwall. While the system was originally designed for residential use, the storage units can also be combined to support mini-grids at the community level. Cost-effective storage systems, along with other key grid integration measures, can support the significant scale up of variable renewable energy.

Source: Tesla. Available at <http://www.teslamotors.com/powerwall>.

63. Further actions to facilitate the provision of finance for RE: In addition to the policies described in paragraphs 46–62 above, countries are pursuing various actions to support finance in the context of specific challenges and opportunities:

(a) Concessional loans are offered with lower interest rates and/or longer grace periods than traditional loans. They can support RE deployment by reducing the cost of capital for project development. Risk associated with such loans is often spread across governments, developers and other finance partners (see spotlight box 12) (Climate Policy Initiative, 2014);

(b) Green bonds are debt obligation instruments that can be used to provide finance for RE projects on the basis of benefits to the environment and climate (Climate Economic Analysis for Development, Investment and Resilience, 2015);[37]

(c) Loan guarantees and insurance products can be used to mitigate real or perceived risks associated with RE development. By taking on a portion of the project risk, the cost of capital can be reduced and investment increased (World Bank, n.d.);

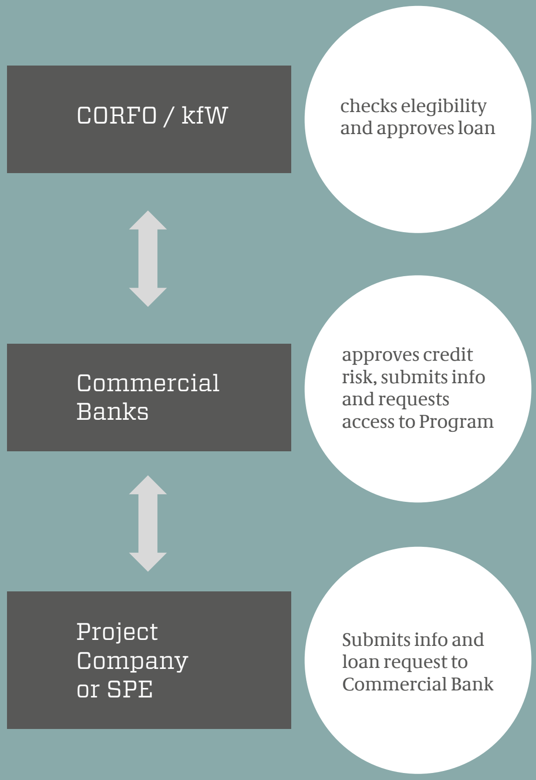
(d) Capacity-building for financial actors and project developers is a need that has been addressed by many governments and institutions through successful capacity-building programmes that have resulted in increased local investment in RE.

[36] Greening the Grid. Available at <http://greeningthegrid.org/>.
[37] Climate Bonds. Explaining Climate Bonds. Available at <https://www.climatebonds.net/market/explaining-green-bonds>.

Spotlight box 12

Financial support mechanisms for renewable energy in Chile

To address energy security concerns and support other key development and environmental goals, the Government of **Chile** put forward a target for 45 per cent of new installed power capacity to come from renewable energy (RE) sources between 2014 and 2025. To support that target and address challenges associated with bank lending for RE projects, the Chilean Economic Development Agency (CORFO) implemented a long-term, low interest rate concessional loan programme for local banks to lend to RE and energy-efficiency projects. The figure below presents the structure of the lending programme, which resulted in finance for 15 RE projects and set the stage for longer-term lending to RE projects in the country, with one third of Chilean banks now engaged in financing RE projects.



64. Table 2 summarizes key policies and enabling practices to support RE deployment. In addition, the table presents examples of policies in place around the world.

Table 1
Policy options and financial incentives for promoting renewable energy supply

Policy options and key elements of enabling environments to support successful policy replication and implementation	Select examples
Policy option: feed-in tariff	
• **Establish and support stable and predictable feed-in tariff (FIT)** payment levels, ensure long-term FIT contractual agreements and streamline process, administration and approval • **Design varying FITs** adjusted to technology and consider variations in relation to location, resource availability and project size • **Set FIT payments** on the basis of robust technology/project cost data • **Guarantee access to the grid** and consider linking FITs with grid support services	• Ghana – FIT policy • Indonesia – subnational FIT policies • Mexico – FIT • United Kingdom – small-scale FITs
Policy option: auction/tendering contracts[a]	
• Support utility-scale projects through auction and tendering approaches and consider complementary policies such as FITs to support smaller-scale projects • Design an auction approach that minimizes costs and aligns with unique national circumstances and goals • Link project selection to sustainable development criteria to support broader climate and socioeconomic goals • Streamline auction processes and reduce administrative costs • Ensure transparent, accurate and timely information for developers/bidders • Consider a more robust assessment of the technical capabilities of developers/bidders through a two-stage approach • Support policy stability and, if required, ensure transparent changes to the process	• Egypt – auction for solar and wind tariffs[b] • South Africa – Renewable Energy Independent Power Producer Procurement Programme • Taiwan Province of China – combined FIT policy and competitive tendering for renewable energy (RE)[c] • Uruguay – reverse auction for RE
Policy option: renewable electricity standard/quota	
• Conduct robust analysis of RE resources, geospatial and siting	• Nova Scotia, Canada – 25

Policy options and key elements of enabling environments to support successful policy replication and implementation	Select examples
Policy option: renewable electricity standard/quota	
considerations, grid integration requirements, costs and project economics, and complementarities with other policies prior to designing RE policies • Set and steadily increase interim goals over time, leading up to a final goal at a specified date • Ensure policy predictability and stability and design complementary policies • Consider set-asides that may support broader policy goals • Adopt cost compliance payments and cost control provisions • Consider the design of a renewable electricity certificate system	per cent RE by 2015 • Republic of Korea – 10 per cent RE by 2020 • California, United States – 33 per cent RE by 2020
Policy option: grid integration actions	

• Conduct a grid integration impact study to inform high-level RE targets and opportunities to support system reliability, flexibility and efficiency with increased levels of variable RE
 	
• Design and implement measures most appropriate to unique national circumstances, which may include:[d]
  • Ancillary services to support system reliability and flexibility
  • Improvements to system operations
  • Use of flexible generation
  • Improvement of forecasting methods and use of other smart-grid technologies
  • Demand response and balancing
  • Storage measures
  • Actions and policies related to distributed generation covered in chapter II.B.2 above
	• Ireland – all island grid study[e]
	
	• Jamaica – grid impact analysis for RE penetration
	
	• Spain – ancillary service study[f]

Policy option: tax incentives and measures	
• Design tax incentive levels and cost control provisions on the basis of specific country circumstances and goals • Support a stable and predictable tax policy environment • Consider and address risks associated with tax credits that are not tied to actual production • Establish appropriate time frames that align with overall policy goals	• China – 50 per cent value-added tax rebate for solar development[g] • Japan – green investment tax incentive[h] • Sweden – wind depreciation tax incentives[h]

Policy options and key elements of enabling environments to support successful policy replication and implementation	Select examples
Policy option: carbon tax[i]	
• **Perform robust analysis** to inform design of an efficient and equitable carbon tax policy • **Consider trade-offs (winners and losers) and implement actions** (e.g. revenue distributions) to address equity issues • **Regularly assess complementarity** of carbon tax and emissions trading schemes (ETSs) with other policies to support cost-effective outcomes and avoid overlap	• Chile – carbon tax • British Columbia, Canada – carbon tax • Sweden – carbon tax
Policy option: emissions trading	
• **Design an appropriate cap level** for ETSs to ensure carbon price incentivizes investment • **Regularly assess complementarity** of ETSs with other policies to support cost-effective outcomes and avoid overlap	• China – subnational ETS • European Union – ETS • North-eastern United States – regional greenhouse gas initiative
Further actions to facilitate the provision of finance for RE	
• **Ensure a stable policy, regulatory and legal environment** • **Consider property rights** issues that may hinder investment • **Build capacity of finance-related institutions** (public and private), project developers and entrepreneurs • **Design effective actions to reduce investment risks** and costs of long-term financing for RE • **Consider aggregation of smaller-scale projects** to reduce transaction costs associated with finance • **Streamline permitting processes** associated with project development • **Build social and community support** for RE	• Chile – Chilean Economic Development Agency concessional loan programme • Mexico – syndicated loan programme • Philippines – Leyte geothermal partial credit guarantee[j] • Ukraine – sustainable energy lending facility[k] • United Arab Emirates - Masdar City to support long-term RE investment

Sources:
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[b] Presentation made by Bloomberg New Energy Finance at the Ad Hoc Working Group on the Durban Platform for Enhanced Action technical expert meeting on renewable energy in June 2015.
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[d] International Renewable Energy Agency. 2015. Offgrid renewable energy systems: Status and methodological issues. Available at <http://www.irena.org/DocumentDownloads/Publications/IRENA_Off-grid_Renewable_Systems_WP_2015.pdf>.
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[h] The KPMG Green Tax Index 2013. Available at <kpmg.com/greentax>.
[i] Carbon Tax Center. Available at <http://www.carbontax.org/>. Available at <http://siteresources.worldbank.org/EXTENERGY2/Resources/SREP_financing_instruments_sk_clean2_FINAL_FOR_PRINTING.pdf>.
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