

G20 Toolkit of Voluntary
Options for Renewable
Energy Deployment:
Progress Report

Introduction

Agreed upon by energy ministers in October 2015 and subsequently endorsed by G20 leaders, the *G20 Toolkit of Voluntary Options for Renewable Energy Deployment* is key to the objective of accelerating renewable energy growth through joint action. With the co-ordination of the International Renewable Energy Agency (IRENA), significant progress has been achieved in all five action areas since October 2015 and particularly under the G20's Chinese Presidency in 2016.

The Toolkit has had, and continues to have, a significant impact. Thus far, it has helped to:

- Establish the present-day cost and competitiveness – along with outlooks for 2025 – for solar photovoltaics (PV), concentrating solar power (CSP), and onshore and offshore wind.
- Further refine and expand the IEA/IRENA renewable energy policy database.
- Provide guidelines for the planning of variable renewable energy (VRE) integration into power systems, and apply these guidelines to concrete country case studies.
- Provide background analysis that supports the design and development of a new G20 risk mitigation facility for renewable energy investment projects.
- Generate a unique dataset of renewable energy technology deployment options, based on the IRENA REmap 2030 programme, for every G20 member.
- Provide new important data related to the global potential of bioenergy from agricultural residues.

At the meeting in Beijing on 30 June 2016, energy ministers agreed to a voluntary action plan on renewable energy. This plan calls for continued implementation of the Toolkit, with a focus on voluntary options and in-depth analysis at a country level, thereby promoting bilateral and multilateral collaboration under the G20 framework.

As the momentum continues to increase, four organisations, namely IRENA, the International Energy Agency (IEA), the Organisation for Economic Co-operation and Development (OECD) and the World Bank, are actively contributing to the implementation of the Toolkit. The summary that follows offers highlights of the progress made to date and indicates sources of additional information. The expectation is that this body of work will continue to expand further over the coming years.

TOOLKIT MANDATE

Renewable energy has become a key pillar of energy policy and contributes to economic growth, energy security and sustainable development. In October 2015, Group of Twenty (G20) Energy Ministers adopted the *Toolkit of Voluntary Options for Renewable Energy Deployment*, with the objective of accelerating renewable energy growth through joint action. All actions presented in the Toolkit are voluntary options for G20 countries to take up as they consider useful in the context of national circumstances and priorities.

The G20 asked IRENA to co-ordinate the implementation of the Toolkit in co-operation with other international organisations including the IEA, the OECD, the Organization of the Petroleum Exporting Countries (OPEC) and the World Bank. Under the Chinese Presidency in 2016, the *G20 Voluntary Action Plan on Renewable Energy* was put forth with the aim of taking Toolkit activities a step further in terms of accelerating deployment.

This document describes implementation activities over the past year for the five action areas that comprise the Toolkit. It describes how the G20 has made a difference through the Toolkit, and it proposes a set of next steps for the G20 in the implementation of the Toolkit.

The G20 Energy Sustainability Working Group (ESWG) provided inputs and feedback during the meeting in Shenzhen on 12 April 2016.



Renewable Energy Costs

ANALYSIS OF TECHNOLOGY COSTS, COST REDUCTION POTENTIAL AND GOOD-PRACTICE EXCHANGES

PROGRESS SINCE OCTOBER 2015: IRENA AND PARTNER DELIVERABLES

In the framework of G20 Toolkit activities IRENA released a report in June 2016, *The Power to Change: Solar and Wind Cost Reduction Potential to 2025*, which examines the potential cost reduction opportunities for solar PV, CSP, and onshore and offshore wind. This report used top-down learning curve estimates, complemented by detailed bottom-up technology analysis, to identify potential cost reduction opportunities and drivers to 2025.

While solar and wind power technologies are commercially available, they still have significant potential for further cost reduction. By 2025 the global weighted average levelised cost of electricity (LCOE) of solar PV could fall by 59%, and that of CSP could fall by up to 43%. Onshore and offshore wind could see declines of 26% and 35%, respectively.

With the right regulatory and policy frameworks, solar and wind technologies can still unlock significant additional cost reductions out to 2025 and beyond. There is significant potential for each technology to see continuous installed cost reductions and performance improvements, leading to lower LCOEs. This offers a great opportunity to broaden the scope of commercial applications, and it is critical for continued market growth.

Cost reductions will be driven by increasing economies of scale, more competitive supply chains and technology improvements that will raise capacity factors and/or reduce installed costs. All of this will take place against a backdrop of increasing competitive pressures that will drive innovation.

Looking forward, as equipment costs for solar and wind power continue to fall, balance of system costs, operations and maintenance (O&M) and the cost of capital will rise in importance as cost reduction drivers. However, the cost reduction potential identified in the report will not happen without the right policy and regulatory frameworks in place. Much work therefore needs to be done if these cost reduction potentials are to be unlocked.

The World Bank has developed a Model for Electricity Technology Assessment (META) that facilitates comparative assessment of the economic costs of more than 50 electricity generation and delivery technologies, including conventional generation options (thermal, hydroelectric, etc.), non-conventional options (renewables) and emerging options such as power storage and carbon capture and storage (CCS). META has an option for incorporating the costs associated with externalities in power generation, such as local pollution and greenhouse-gas emissions. The META model also can be used to undertake uncertainty analysis for selected key inputs. META is populated with default performance and cost data inputs drawn from three representative countries. Users also have the option of customising the data for new countries. META was recently updated and aligned with the IRENA costing work.

IMPACT: HOW THE G20 HAS MADE A DIFFERENCE

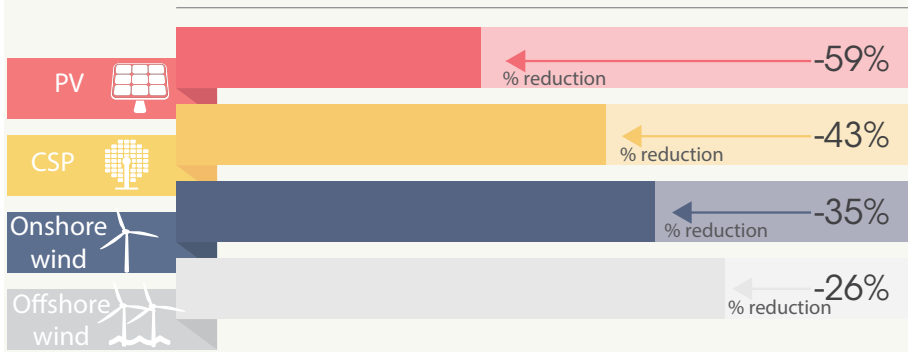
G20 countries represent the largest markets for renewable power generation technologies, and for solar and wind in particular. Support policies in G20 countries have helped set in motion a virtuous circle where support policies have driven increased deployment, spurred technological improvements and reduced costs. As a result, onshore wind has become one of the most competitive options for new generation capacity, while the cost of electricity from solar PV has fallen by around 60% since 2009. The new costing study shows the potential for cost reductions from ongoing technology improvements, increased economies of scale and competitive pressures. It highlights that the significant cost differentials that exist today represent a significant source of future cost reduction opportunities for G20 countries.

PROPOSED NEXT STEPS FOR THE G20

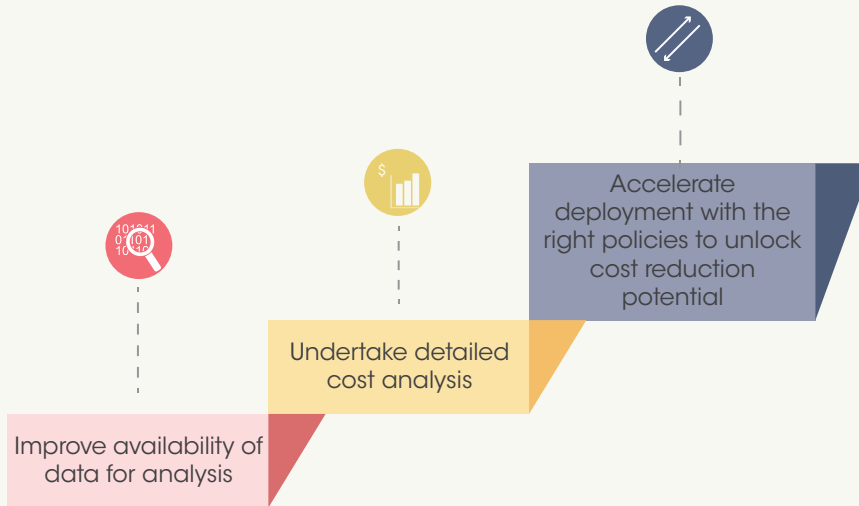
Unlocking the cost reduction potential identified in the report will require a shift in policy focus to address balance of system costs, O&M and financing costs in addition to major equipment costs. IRENA proposes to work with G20 countries to:

- Improve the availability of up-to-date, real-world project cost data for renewable power generation technologies in G20 countries, as a basis for ongoing analysis.
- Undertake a detailed cost analysis, with willing countries, that examines the cost components of solar and wind power technologies in order to identify opportunities for cost reductions, barriers to these cost reductions, lessons from other countries, and policy recommendations to unlock reduction potential.
- Put into practice the identified cost reduction opportunities through the identification of the appropriate policy options available to G20 countries, and disseminate findings regarding the cost effectiveness of solar and wind power generation.

Potential global reductions in solar and wind power LCOEs, 2015-2025



Unlocking the cost reduction potential requires a shift in policy focus. IRENA proposes to work with G20 countries to:





IEA/IRENA Database

GOOD PRACTICE EXCHANGES:

1. ENABLING NATIONAL POLICY DESIGN
2. INTEGRATION OF VARIABLE RENEWABLE POWER

PROGRESS SINCE OCTOBER 2015: IRENA AND PARTNER DELIVERABLES

BEST POLICY PRACTICE

IRENA and the IEA have continued to update the joint *Policies and Measures Database*. This involves working with countries to review existing policy entries and to update any relevant new policies to the database. The IEA/IRENA *Policies and Measures Database* provides a country-validated up-to-date overview of global renewable energy policy developments and now contains more than 700 policies for the G20 countries.

Given that the policy landscapes in the G20 countries have been evolving rapidly, IRENA strives to update the *Policies and Measures Database* bi-annually by contacting countries that are not IEA members to review existing policy entries and to include any relevant new policies in the database. Such inputs are supported by desk research. Updates have occurred in the first half of 2016 for nine G20 countries (Argentina, Brazil, China, India, Indonesia, Mexico, the Russian Federation, Saudi Arabia and South Africa). These reflect significant policy developments.

For instance:

1. **China** has been at the forefront of growth in solar PV and wind due to strong government commitment and continued policy support. As deployment continues, the country is adapting its incentives for renewable energy deployment. In 2016 feed-in tariffs (FiTs) for solar PV were decreased from USD 150-160 per megawatt-hour (MWh) to USD 123-151/MWh, in order to account for the continued decline in costs. Similarly, FiTs have been decreased for onshore and offshore wind.

In early 2016, China released a guide for province-level renewable energy target setting. The guide sets targets for the percentage of total electricity demand to be supplied by non-hydropower renewables in each province by 2020. This represents a concrete step in increasing the national-level share of renewables in electricity demand to 15% by 2020 (currently at 9%).

2. Data from **Mexico** indicate that the transformation of the electricity sector towards liberalisation has continued, with the announcement of new renewable energy auction rules in 2015. So far in 2016 auctions organised under these rules have contracted close to 400 megawatts (MW) of wind capacity and 1.7 gigawatts (GW) of solar PV capacity. The lowest price was received for solar PV, at USD 35.5/MWh.
3. After several years of slow progress, the outlook for the **Argentina's** renewable energy sector, especially wind, is positive. In March 2016 the country established a renewable energy target (8% of electricity generation by 2017; the current share is 2%) and introduced a FiT scheme and two tax incentives (accelerated depreciation and a value-added tax (VAT) rebate). In addition, plans for auctioning 1 GW of wind energy technology have been announced.
4. **South Africa** is carrying on with the successful implementation of its fourth round of renewable energy auctions. The four rounds so far have resulted in more than 6.1 GW of renewable capacity. Another 1.6 GW of renewables (primarily wind and solar) is set to be contracted in 2016.

Additionally, the IEA/IRENA database was upgraded recently to provide a high-level country descriptions. Both agencies will collaborate on delivering additional value to G20 countries through the use of this feature. To view an example of the database, please see the [weblink](#)¹.

The OECD is applying its *Policy Guidance for Investment in Clean Energy Infrastructure* (March 2015) to specific country contexts (starting with Jordan, a non-G20 country). The Policy Guidance is a non-prescriptive tool to help policy makers from G20 and other countries strengthen their domestic enabling conditions and national policy frameworks for renewable energy investment. The Policy Guidance was developed with substantial inputs from the World Bank Group and the United Nations Development Programme (UNDP), and a draft version was annexed to the *Communiqué of G20 Finance Ministers and Central Bank Governors* at their meeting of October 2013.

VRE INTEGRATION

In May 2016 IRENA convened its first Innovation Week, focused on power sector transformation, with the aim of gathering the industrial and political frontrunners to present, discuss and explore innovative solutions to power system integration issues. The 241 participants from 41 countries concluded that apart from technology business models, more efforts need to be focused on market design and policy framework innovation. Best practices from around the world show that solutions exist for integrating high shares of variable renewables, and important insights can be gained from studying best practices. Proceedings and presentations are available online at <http://www.irena.org/innovationweek2016/>

The IEA Grid Integration of Variable Renewables (GIVAR) programme released a new report, *Next Generation Wind and Solar Power: From Cost to Value*, on 1 June 2016. The report highlights that maximising the benefit of variable renewable energy (VRE) to the power system as a whole is as important as efforts to reduce costs. This system value should consider system benefits such as fuel savings, carbon dioxide (CO₂) emission reductions and capacity costs. The study also highlights how VRE can contribute to maximising its system value, showcasing best practice policies from several G20 countries. An extended version of the report will be released in October 2016, with detailed country case studies, expanding the scope of the analysis in line with the G20 toolkit to Brazil, China, Indonesia, Mexico and South Africa.

Since its inception in 2008, the IEA GIVAR programme has become a global reference in the analysis of VRE integration and power system transformation. The analyses provide valuable insights on the extent to which VRE can be integrated and how the shares could be raised further. Integration of VRE power options poses no technical or economic challenges at low shares, if basic rules are followed. System transformation strategies are key for effective integration of higher VRE shares. Reflecting the growing relevance of the topic for countries globally, the IEA has established a new unit for System Integration of Renewables. The first output of the new unit will be a manual for policy makers, *Getting Wind and Solar onto the Grid*. The manual provides practical guidance on how to ensure reliable and cost-effective VRE integration from the onset of deployment.

¹ <http://www.iea.org/policiesandmeasures/renewableenergy/?country=United%20Kingdom>

Energy policy making has always benefited from rigid model-based scenario analysis at various levels to define the long-term policy goals and the most economic investment pathways. Policy makers need certainty that the answers that are provided are robust, even if the renewables share is beyond levels experienced in the past. VRE integration may require measures to be implemented in order to ensure that the power system operates reliably.

The IRENA study *Addressing Variable Renewables in Long-Term Energy Planning (AVRIL)* presents best practices in G20 countries in terms of incorporating costs and some key technical constraints to ensure proper representation of systems reliability in long-term generation expansion models. The project aims to improve the methodologies used in long-term energy modelling tools to better assess the long-term investment strategies with higher shares of VRE.

The study maps the long-term impacts of VRE on the reliability of power system operation as well as their long-term investment implications. Relevant planning time horizons for the different VRE impacts are determined, and various planning tools linked with different time horizons are introduced. Finally, various tested approaches to address VRE impacts in long-term energy planning models are discussed.

The World Bank ESMAP VRE Grid Integration Support Program aims to increase the capacity of countries to develop policies, improve investment planning and encourage the adoption of best practices for VRE integration. The programme offers technical assistance for system operation and long-term grid planning in the strengthening of electricity dispatch, generation and transport infrastructure as well as for the development of economic, legal and regulatory framework conditions tailored to VRE integration. The programme has engaged with around 30 countries and regions and has provided numerous trainings and advisory services in the course of 2015/16.

VRE impact matrix on reliability

		Generation		Networks	
		Firm capacity	Flexibility of the system	Transfer capacity	Voltage control capability
Adequacy	Security	Most Relevant	Relevant	Relevant in certain systems	Negligible relevance
		Relevant	Relevant in certain systems	Relevant in certain systems	Negligible relevance
Stability		Relevant in certain systems	Relevant in certain systems	Relevant in certain systems	Negligible relevance

Most Relevant
 Relevant
 Relevant in certain systems
 Negligible relevance

IMPACT: HOW THE G20 HAS MADE A DIFFERENCE

G20 members have continued to present cases of best practice for various specific situations through the IEA/IRENA Policies and Measures Database.

The G20 is helping to raise awareness of the issue of planning for VRE integration, and the findings provide concrete solutions for how to improve long-term power sector planning that will be a cornerstone for successful deployment of high shares of renewable power. The critical importance of other forms of innovation related to markets, business models and policy frameworks also has been highlighted.

PROPOSED NEXT STEPS FOR THE G20

BEST POLICY PRACTICE

IRENA is ready to undertake an in-depth analysis of good practices in policy making, including for renewable energy heating. The proposed study will explore the current status of deployment in renewable energy heating, chart out the cost structures in different countries and provide an overview of relevant policies. It will identify good practices for policy design in the specific context of different countries and market segments. Special focus will be placed on monitoring the use of renewable energy actions based on work done previously by IRENA. The geographic scope of the study will be limited to the G20 countries, but insights from other countries, when applicable, also will be included.

The forthcoming OECD report *Enabling Investment and Innovation in Renewable Energy* (March 2017) is assessing empirically the effects of renewable energy policies (such as FiTs, public tenders and renewable portfolio certificates), other climate policies and broader investment conditions on investment and innovation in renewable electricity in G20 and OECD countries. The OECD stands ready to contribute lessons learned in G20 countries on the need to align

investment conditions with targeted renewable incentive schemes, in order to strengthen national policy frameworks for renewable energy investment.

VRE INTEGRATION

The G20 could benefit from deploying advanced planning tools to assess the ability of grids to accommodate high VRE shares. It also is recommended that enhancements in power sector planning continue, especially in relation to IT integration for power sector operation, electricity demand-side management and demand-side response. Sector coupling issues such as electrification of transport and heating also remain a priority. These measures will be of increasing importance as the renewable energy share in power generation rises.

Status of the G20 countries in IEA/IRENA *Policies and Measures Database*

 99	 17	 8	 84	 59	 45	 25	 31	 17	 26
 9	 47	 50	 26	 47	 38	 5	 3	 103	 779

Renewable Energy Risk Mitigation Facility



DEVELOPMENT OF A RENEWABLE-SPECIFIC RISK MITIGATION FACILITY

Financing the investments necessary to scale up the deployment of renewables is often considered the most serious challenge in advancing towards agreed objectives. In recognising that real or perceived risks of investing in renewables can raise the cost of finance substantially, the G20 included financial risk mitigation as one element in the Toolkit.

PROGRESS SINCE OCTOBER 2015: IRENA AND PARTNER DELIVERABLES

IRENA has published a report, *Unlocking Renewable Energy Investment: The role of risk mitigation and structured finance*, which examines how risks and barriers to financing renewables are addressed. Based on an assessment of successful instruments and approaches, it sets out a global action agenda to scale up investment in renewables over the coming years.

The report demonstrates the importance of an approach targeted specifically to renewable energy. It highlights the role of public finance in addressing investment risks and financing barriers so as to mobilise private finance, including large-scale investors. The action areas include advancing project pipeline development, increasing the use of existing guarantee instruments, developing new risk mitigation instruments, and applying structured finance mechanisms and capital market tools.

Highlighting the G20 Toolkit, the report recommends creating dedicated facilities to scale up investment in renewable energy. Such financing facilities could issue risk mitigation instruments and support the design or implementation of structured finance mechanisms targeted specifically at renewables. International climate finance, for example through the Green Climate Fund, could support the scale-up of renewables at the construction and project development stage via a dedicated risk mitigation facility.

A risk mitigation facility will only be effective if it can pick up a pipeline of strong investment-mature projects. In support of project pipeline development, IRENA launched its Sustainable Energy Marketplace (<http://marketplace.irena.org/>) at the United Nations Framework Convention on Climate Change (UNFCCC) 21st annual Conference of the Parties (COP 21) in Paris. The online platform connects project developers, financial institutions, investors and service/technology providers to improve project visibility and market liquidity in the renewable energy market. With almost 150 projects (5 GW) seeking investment of a total of USD 8 billion registered as of May 2016, the Marketplace can help supply a pipeline of investment-ready projects to a risk mitigation facility.

The structured finance approaches that can be advanced through a risk mitigation facility will have to build on standardisation of project documentation in order to enable an aggregation of projects to create portfolios that would be of interest to large institutional investors. IRENA and the [Terawatt Initiative](#) have launched the [Solar Energy Standardisation Initiative](#) to bring together public and private sector stakeholders, including law firms and financial institutions, to define and agree on the terms of standardised documentation for solar energy projects that would be effective and generally acceptable by finance institutions and guarantee issuers.

Scaling Solar brings together a suite of World Bank Group services under a single engagement aimed at creating viable markets for solar power in each client country. The “one-stop-shop” programme aims to make privately funded grid-connected solar projects operational within two years and at competitive tariffs. When implemented across multiple countries, the programme will create a new regional market for solar investment.

Components include competitive financing and insurance attached to tenders, delivering competitive bidding and ensuring rapid financial close post-tender, as well as risk management and credit enhancement products to lower financing costs and deliver power at lower tariffs. A major recent achievement was successful bidding for 50 MW in Zambia, with record low prices for the continent.

IMPACT: HOW THE G20 HAS MADE A DIFFERENCE

Government agencies and financial institutions of the G20 countries have advanced in the use of risk mitigation facilities both in their own countries and outside, and several examples of successful use of these instruments are documented in the IRENA report. In a G20 context this includes, for example, the Walney offshore wind farm in the United Kingdom and the Sarulla geothermal power plant in Indonesia, as well as other examples of successful engagement of development finance institutions from G20 members in partner countries. Other promising initiatives advanced by G20 members include the currency risk guarantee fund developed by India and the regional liquidity risk facility to cover off-taker risk developed by the German development bank KfW.

The Toolkit has provided the conceptual basis for a risk mitigation facility using structured finance approaches such as guarantee and/or mezzanine finance schemes to finance the project construction stage, combined with technical assistance facilities to address the barriers at the project development stage.

PROPOSED NEXT STEPS FOR THE G20

The Toolkit notes that G20 countries may request IRENA, following discussions within the G20 Energy Sustainability Working Group (ESWG), to organise a conference to exchange experiences in the use of risk mitigation instruments as an efficient means for public sector finance to mobilise private sector investments, and to develop a Toolkit on the use of voluntary risk mitigation instruments within the G20 framework. Work would be co-ordinated with the G20 Development Working Group and the Investment and Infrastructure Working Group.

As foreseen in the Toolkit, IRENA would organise a conference to exchange experiences in the use of risk mitigation instruments and structured finance. The objective of the conference would be to develop a more detailed and practical concept of a renewable energy-specific risk mitigation facility, building upon IRENA's work, and to discuss the potential use of risk mitigation instruments and structured finance options by G20 members.

The conference may take place in the first half of 2017 with participation from interested international and regional financial institutions (including climate finance institutions) and high-level officials from G20 countries. Consultation with the G20 ESGW will allow preparation for the conference in terms of the discussion points and logistics.

G20 REmap

ASSESSMENT OF COUNTRY RENEWABLE ENERGY TECHNOLOGY POTENTIAL AND DEVELOPMENT OF ROADMAPS

PROGRESS SINCE OCTOBER 2015: IRENA AND PARTNER DELIVERABLES

IRENA has assessed options for the world as a whole and for G20 countries through its global REmap programme, an explorative approach to policy and technology options. REmap – IRENA’s global renewable energy roadmap – offers a plan to double the share of renewables in the world’s energy mix by 2030. IRENA released the second edition of its global REmap report in March 2016.

The core message of the roadmap is that doubling the share of renewables by 2030 compared to today’s level is possible, cost-effective and economically beneficial, even as global energy demand grows. Doing so is one of the main ways that countries can meet the objectives set by the Paris Agreement and the United Nations’ Sustainable Development Goals (SDGs). Doubling the renewable share will be vital to achieve a carbon-free energy system in the next 50 years. In order for doubling to happen, current technology deployment needs to be accelerated, and there is a need to invest in innovation. IRENA carried out this assessment with experts from 40 countries that represent 80% of today’s global final energy demand.

As part of the work carried out under the G20 Chinese Presidency, IRENA has prepared a REmap analysis for the G20 as a whole as well as for each member. The aim of the resulting roadmap is to invite interested G20 countries to take part in a review and to use these findings to support their deliberations on renewable energy.

IMPACT: HOW THE G20 HAS MADE A DIFFERENCE

According to the findings from REmap, the G20 countries hold 75% of the total global deployment potential for renewable energy, and a similar share of the total global investment potential for renewables, between now and 2030. All G20 countries can increase their modern renewable energy share, but the potentials and economics vary by country.

The modern renewable energy share of the G20 in 2010 stood at 10% (19% when traditional uses of bioenergy are included), which can increase to 15% if the countries are to follow their current plans and targets. With the options identified by IRENA in consultation with country experts, the share can reach 25% with existing technologies, and even higher if new technologies are considered in combination with innovative deployment strategies. If additional measures for energy efficiency are deployed, the renewable energy share can increase to 29%. Realising the potential estimated in REmap requires an investment volume averaging USD 640 billion per year, equivalent to 70% of the total global investment needed to realise a doubling of the renewable energy share by 2030.

The time period left to double the renewable energy share in the global energy mix by 2030 is only 14 years. Urgent policy action is needed now, and policy makers must strengthen their efforts to avoid technology lock-in. Seven action areas have been identified for G20 policy makers:

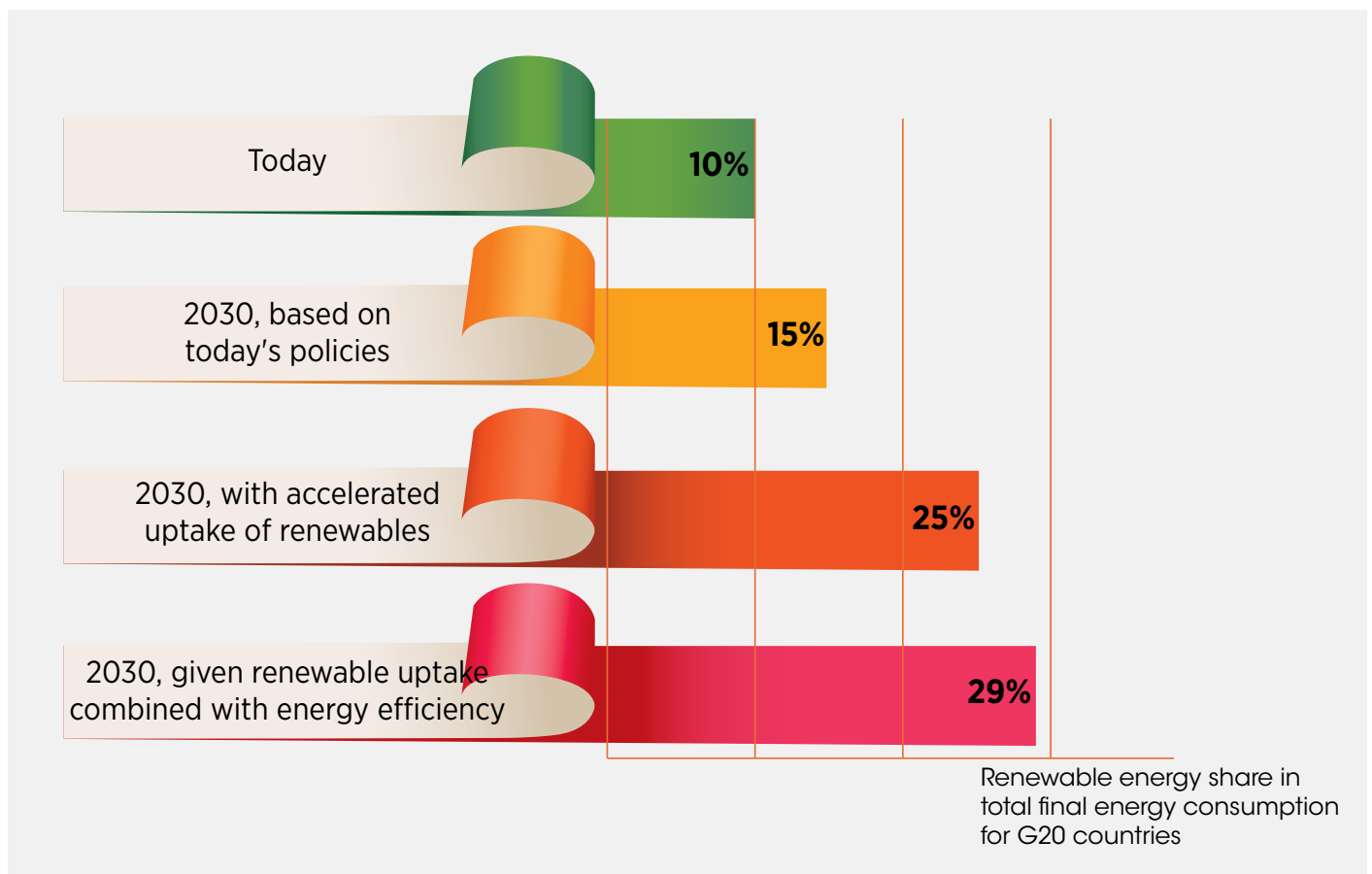
- Create synergies between energy efficiency and renewable energy deployment.
- Prioritise the introduction of greater flexibility into the power system.
- Promote the deployment of more renewables in end-use sector applications (building, industry and transport).
- Increase efforts to deploy modern bioenergy.
- Focus technology innovation efforts on specific areas where renewable energy solutions are not available or are too costly at present.
- Promote awareness about renewable energy technologies being cost-effective today in many cases and about the expectation of a continued, rapid decline in costs over the coming decades.
- Reflect the benefits of renewables in market prices.

PROPOSED NEXT STEPS FOR THE G20

Based on this roadmap that serves as a starting point for further engagement with the G20 at the country level, IRENA proposes as next steps the following “REmap G20 process” for the in-depth country study:

- Expand the time horizon of the REmap analysis from 2030 to 2050.
- Focus on the implications of the Paris climate agreement on energy supply and demand and on renewables deployment in particular. Use IRENA REmap’s analytical framework in the development of a decarbonisation agenda for the G20 energy sector and energy ministers, in co-ordination with other relevant ministers such as environment and natural resources.
- Develop dedicated REmap reports for all of the G20 on how to translate the analytical findings into action: establish a REmap expert working group consisting of IRENA’s REmap experts and national experts for deeper engagement with the country through focused group discussions, policy dialogues and technical workshops to develop a variety of recommendations on policy and regulatory development, based on the REmap analytical results.
- As new data come along, review and update the analysis periodically through the REmap expert working group.
- Through the REmap expert working group, discuss implementation of results and integration into long-term energy planning and the energy development strategy.

Doubling the G20 Renewable Energy Share





Modern Biomass

DEPLOYMENT OF MODERN BIOENERGY

The G20 ESGWG has called for countries to promote the cost-effective uptake of sustainable bioenergy feedstocks by conducting cost assessments, expanding the use of sustainability indicators and developing innovative biomass applications. Sustainable biofuels are integral to a successful strategy for sustainable development. By 2030, half of the most cost-effective renewable potential is from biomass – for cooking and heating, industrial process heat, electrical power and liquid transport fuels. Ideally, biomass use in 2030 should nearly double, and modern biomass use should more than triple, from 2010 levels.

PROGRESS SINCE OCTOBER 2015: IRENA AND PARTNER DELIVERABLES

In response to the G20 Toolkit objective, IRENA published analysis handbook, *Boosting Biofuels: Sustainable paths to greater energy security*, in April 2016. Expansion of bioenergy has faced at least three significant challenges from a sustainability standpoint. First, food and fuel supply often have been seen as being in conflict, calling into question the social sustainability of biofuels. Second, expanded biofuel production has been seen as leading to land-use change that reduces sequestration of carbon, calling into question the environmental sustainability of biofuels. Third, as alternative energy sources have developed, petroleum prices have plummeted, making it hard for liquid biofuels to compete, casting doubts on the economic sustainability of biofuels.

But there are several ways to boost both food and fuel production in a cost-effective fashion without using additional land. One is more systematic collection of residues from farms and planted forests (produced along with food and lumber). Another is sustainable intensification of crop and pasture lands, to produce the same amount of food on less land and thus free up land for energy crops. (Potential yields of major food crops are double those that the United Nations Food and Agriculture Organization (FAO) projects for 2050, and while similar amounts of high-quality land are used for crops and pasture, pasture provides just 3% of all food.) A third pocket of opportunity is reduced waste and losses in the food chain, which could free up further land for energy crops since one-third of food is currently lost or wasted. IRENA has calculated the potential from each of these areas by country, crop and food group. The results are published on the web alongside the summary report, which also describes significant potential to grow more food and fuel crops by reclaiming and replanting degraded forest land.

In May 2016, IRENA organised a workshop in Rome on Sustainable Bioenergy Supply Chains, in co-operation with the Bioenergy Agreement of the IEA and FAO, hosted by GSE. The organisations agreed to draft a key messages brief on the benefits of bioenergy and steps to be taken. They also agreed to organise a follow-up workshop on biomass potentials and prospects later in the year, with the idea of generating greater consensus on the amounts of bioenergy that might be realised by 2030.

IMPACT: HOW THE G20 HAS MADE A DIFFERENCE

G20 countries have played leading roles in bioenergy development and thus should play leading roles in ensuring that further bioenergy development is sustainable. The world's largest producers of liquid biofuels for transport, which account for about three-quarters of the current bioenergy use and cost-effective bioenergy potential, include G20 members Brazil (bioethanol from sugar cane), Indonesia (biodiesel from palm) and the United States (bioethanol from corn). The world's largest producers of bioenergy for heat and power, which account for around three-quarters of the current use and cost-effective potential, include G20 members Canada, Germany and the Russian Federation as well as the European Union more broadly and the United States, all of which have substantial planted forests.

Biofuel production in particular requires proper attention to sustainability issues related to the conversion of forest to farmland, and efforts are under way to address this. Increased livestock efficiencies and reforestation could halt forest loss and allow degraded forest to be rehabilitated (by making available more additional land than is taken up by the expansion of bioenergy production). Research and development is focused on technologies to produce more biofuels on less land from lignocellulosic feedstocks.

Forest output and energy production can further expand on a sustainable basis: wood pellets and chips can provide heat and power with lower carbon emissions than the fossil fuels they displace. Further, G20 countries will play a crucial role in providing development assistance to help raise agricultural yields in developing countries, which can make land available for bioenergy crops, and to spread efficient modern cook stoves which can reduce traditional wood use for cooking by one-half or two-thirds so that the wood can be used elsewhere.

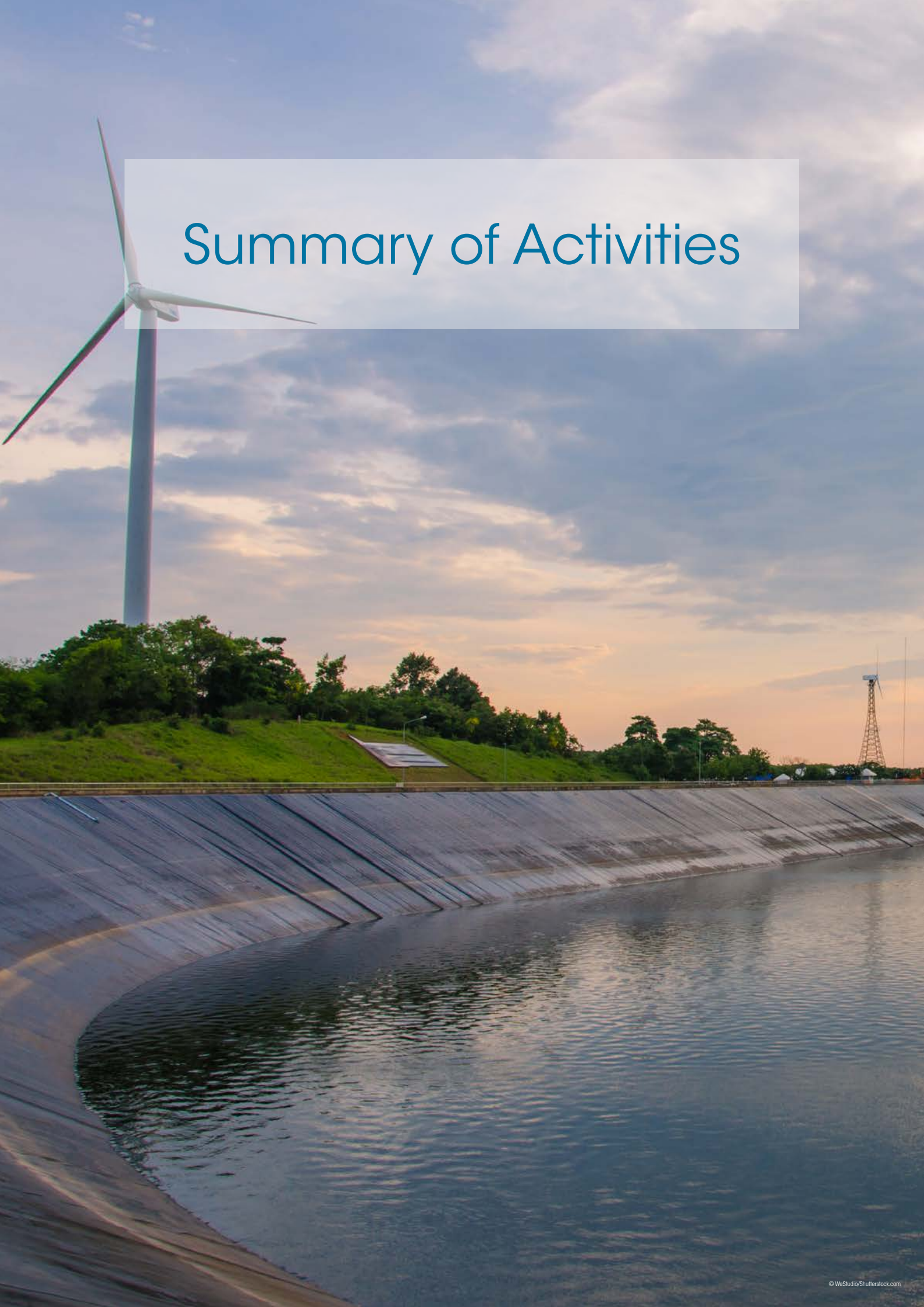
PROPOSED NEXT STEPS FOR THE G20

G20 countries should consider a systematic set of policies to promote sustainable bioenergy use. Some of these policies relate to sustainable intensification of agriculture: producing more food and energy on less land by raising yields. Other policies relate to encouraging collection of more farm and forest residues, accelerating global reforestation efforts, and reducing food waste and losses.

Several courses of action could help to increase agricultural yields, which is key to raising supplies of residues and to freeing land for bioenergy crops:

- Capacity building and extension services could be expanded to spread modern farming techniques in developing countries.
- Best practices on logistical approaches for cost-effective harvesting of farm and forest residues could be compiled and disseminated.
- Agroforestry strategies for investing in the cultivation of a mix of high-yielding food and fuel crops could be developed from successful experiences with stakeholders in different regions.
- Secure land tenure and effective land governance can be encouraged – through capacity building efforts in countries that do not have them – to provide financial incentives for long-term investment in intensive, sustainable land management.

Summary of Activities



IRENA-NEA (CHINA) WORKSHOP

2nd Energy Sustainability Working Group, Shenzhen, 12 April 2016

G20 TOOLKIT IMPLEMENTATION PROGRESS

IRENA organised a workshop in co-operation with the Chinese National Energy Administration (NEA) on 12 April during the 2nd ESG meeting. During the workshop, which was chaired by German and Chinese officials, discussions were undertaken regarding the options for implementation of the Toolkit with continued support from IRENA and other international organisations. Mr. Shi Lishan, Deputy Director General of the NEA, gave an opening speech calling upon all G20 Members to take the lead role in accelerating global deployment of renewable energy.

IRENA provided a recap of the Toolkit and a brief overview on the proposed actions under each component in the Toolkit. This was followed by five detailed presentations and discussions, which provided an opportunity to comment, question and provide inputs.

Key points made by IRENA during the presentations included:

- The cost of renewables has fallen greatly in recent years, but significant cost differences remain between countries and even among projects using the same technology within the same country. This offers an important opportunity for cost reduction. Moreover, in the coming decade, there is a potential for further innovation that can yield average cost reductions of 40-50% for utility-scale solar PV and 20-30% for onshore wind.
- REmap, the global roadmap for 2030, shows a significant cost-effective renewable energy potential on top of the policies in place. Country circumstances must be taken into account, as country potentials vary from a 10% renewables share to a 90% renewables share in total final energy use in 2030.
- Apart from the power sector, renewables deployment in the three end-use sectors (buildings, industry and transport) warrants more attention. In terms of CO₂ mitigation, the potential for renewables is on par with that of energy efficiency. Important synergies exist between energy efficiency and renewable energy policies.

During the session the IEA GIVAR programme was discussed.

The policy environment is developing rapidly. The joint IEA/IRENA database indicates 164 countries with renewable energy policies in place. The type of instruments is changing, with a strong growth of auctions in recent years.

Financing is important. Average financing needs need to double by 2020 and to triple in the coming 15 years. Risk mitigation can play a key role in this area.

Country feedback received during the side event included, but was not limited to:

- Strong interest in the area of cost and cost reduction, and in the forthcoming IRENA publication on country technology cost comparisons and cost reduction potentials for solar and wind power generation technologies. These were welcomed as input for this year's G20 discussions.
- Welcome for the REmap findings from March 2016 and the tables of G20 country results of technology options that were made available ahead of this meeting. Several countries indicated that they would revert with comments after consultation with their national experts, and they saw this exercise as an important contribution to the discussion of renewables progress and potentials and to a better understanding of the costs and benefits of policy options, as requested by the G20.
- The action agenda that was tabled by the Chinese Presidency goes a step beyond the REmap analysis and calls for a G20 aspirational target. During the side event it was generally agreed that renewables are a key component of a broader portfolio of energy options that can be deployed to meet policy objectives.
- Strong support for the IEA and IRENA to continue joint development of the renewable energy policies database.
- The IEA GIVAR programme was welcomed, as was IRENA's Innovation Week in May 2016 on power sector transformation and work on planning methodologies for high shares of VRE.
- Risk mitigation was indicated as an important theme, and several countries stressed the importance of engaging private sector financing institutions and institutional investors. In preparation of next steps, IRENA proposed organising a conference on risk mitigation for renewables investments. In addition, for some countries, the risk mitigation facility falls under the jurisdiction of the ministry of finance. There was therefore general recognition that further development of such activity touches upon other G20 working groups.
- The importance of a systems approach was emphasised. For example, for the power sector, there is a need to address systems integration cost as well as sustainable, affordable and secure feedstock availability for bioenergy development.

It was recommended that the proposed Renewable Energy Action Plan build upon the Toolkit.

MEETING

G20 Energy Ministerial Breakfast Meeting, Beijing, 30 June 2016

G20 TOOLKIT IMPLEMENTATION PROGRESS

About 20 participants, including 2 heads of delegation (Brazil and Canada) and international organisations such as the IEA, the Energy Charter and the International Gas Union (IGU), were present.

IRENA presented the progress thus far, with a focus on cost reduction analysis for the G20, risk mitigation and REmap for the G20.

Progress achieved under the Chinese Presidency between October 2015 and June 2016 was noted as, but not limited to, the following:

Action Area 1: Cost and Cost Reduction

- IRENA publication: *The Power to Change: Solar and wind cost reduction potential to 2025*

Action Area 2: Best Practice Exchange on Policy Frameworks and VRE Integration

- Mexico and China update to IEA/IRENA renewable energy policies database
- IRENA Innovation Week: The Age of Renewable Power
- IEA GIVAR programme

Action Area 3: Risk Mitigation Facility

- IRENA publication *Unlocking Renewable Energy Investment: The role of risk mitigation and structured finance*

Action Area 4: Country Technology Potentials and Roadmaps

- Paper: *G20 Toolkit for Renewable Energy Deployment: Country options for sustainable growth based on REmap*
- Online dashboard of G20 country technology potentials and roadmaps

Action Area 5: Accelerate Modern Bioenergy Deployment

- Paper: *Boosting Biofuels: Sustainable paths to greater energy security*
- Workshop in Rome, 17 May, "Mobilising Sustainable Bioenergy Supply Chains: Opportunities for Agriculture"

Six concrete proposals were made on how the G20 could translate Toolkit analysis into action. They were:

- Increased cost data collection and analysis
- Identification of measures on how to implement global cost reduction potentials
- Organisation of a conference on risk mitigation and structured finance
- Acceleration of renewable energy for greenhouse gas mitigation
- Enabling markets and infrastructure
- Focus on innovation for renewables

During this breakfast meeting, the IEA also presented on the implementation of the Toolkit. Topics included the IEA/IRENA policies database, VRE integration and the IEA Bioenergy Technology Collaboration Programme (TCP).

The G20 action proposals were put forth for discussions, during which the Energy Charter expressed interest in working with IRENA on some of the identified areas. For example, on risk mitigation the Energy Charter could provide assistance that can reduce project risk and therefore reduce the capital costs.

On cost reduction, the question of investment timing was raised in light of rapidly falling costs. This generated an interesting discussion among the participants.

Conclusion

The *G20 Toolkit of Voluntary Options for Renewable Energy Deployment* is an important step for the global energy transition. Under the G20 Chinese Presidency, tremendous strides have been made in the course of 2016 in the five action areas, and plans have been put in place to strengthen renewable energy efforts further, building upon the latest outcomes and findings. The international organisations, co-ordinated by IRENA, will continue to support the G20 in further implementation of the Toolkit.

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