

**Ministerial Roundtable**  
**‘Towards an Economy Fuelled by Renewable Power:  
Innovation for the Next Stage of the Power Sector Transformation’**  
Seventh session of the Assembly – 14 January 2017

1. The transformation of the power sector is advancing faster than expected, and is poised for further acceleration on the basis of rapidly evolving innovation. Since 2013, renewable energy has accounted for more than half of all new power generation capacity installed worldwide. Less than two decades ago, the share of power generated from variable renewable energy sources, particularly wind and solar photovoltaics, was negligible. This has changed dramatically. In 2015, 47 GW of additional solar photovoltaics capacity and 63 GW of additional wind power capacity were installed, with more than USD 270 billion in investments for these two technologies alone. The annual growth rates for variable renewable energy capacity has ranged between 15% and 25% for the last five years, adding up to a total global installed capacity of 640 GW in 2015.

2. The Ministerial Roundtable on ‘Power Sector Transformation’ at IRENA’s fifth Assembly in 2015 concluded that the technologies to drive the global power transformation are available and affordable. Efforts will now also need to focus on implementing an innovative enabling framework to integrate these technologies at the scale needed.

**New challenges**

3. In some countries, variable renewable power generation exceeds demand at certain points in time. On windy days in Denmark, wind power can produce 116% of the domestic power demand, with a share of as high as 140% being reached in July 2015. In Portugal, wind power produced up to 65% of domestic power demand on some days in December 2015. On 8 May 2016, 95% of Germany’s domestic power demand was supplied by solar photovoltaic and wind power, and exports of electricity surged.

4. This new situation raises the challenge of integrating high shares of variable renewable energy in power systems, not only from the perspective of securing the power supply - no blackouts -, but now also from the perspective of how to manage the surplus power from these sources.

**Innovative flexibility options**

5. To address the challenge of integrating variable renewable energy into power systems, a holistic innovation approach is needed, ranging from innovation in technology to market design and business models. Part of the solution lies in implementing innovative flexibility measures in the power system. These include, for example, additional cross-border interconnections, electricity storage systems, demand side management strategies and advanced weather forecasting.

6. Interconnectors allowed Denmark on 9 July 2015 to export 80% of its renewable power surplus to Germany, Norway and Sweden where this energy can be stored in hydro-pumping storage plants. Increased coordination and integration between neighbouring markets can also be pursued. The Nord

Pool Spot market traded more than 500 TWh of electricity between Nordic countries in 2014. Increased interconnections are being pursued on a national, bilateral and regional scale, as witnessed by the Clean Energy Corridor initiatives presented by IRENA. Among different electricity storage technologies, battery markets have witnessed a major growth in recent years and this growth is projected to accelerate in the coming years. The global market value for battery storage is expected to increase from USD 2.2 billion with a capacity of 1.5 GW in 2015 to approximately USD 14 billion with a capacity of 14.5 GW by 2020.

7. The use of surplus power in end-use sectors also presents itself as an interesting flexibility option. This includes, for example, the electrification of the heat demand of the industry and the residential sectors, as well as the deployment of electric vehicles for the road transport sector. The global stock of electric vehicles reached 1 million vehicles in 2015 and continues to rise rapidly, led by China, Japan, the US, and several European countries. Connecting electric vehicles to power grids can help balancing demand and supply in the system if appropriate charging strategies are implemented.

8. In addition to technological innovation, innovative approaches to market design, regulation and business models will also be needed. The electricity market in Germany, for example, saw negative energy price lower than EUR -130/MWh at certain points in time during days with renewable power surplus. To accommodate such scenarios, market design and regulations need to support investments in generation adequacy and system flexibility. In response, some markets are implementing retail tariff reforms, moving from large electricity blocks, long periods of stable prices and once-a-year meter readings towards real-time prices. Distributed generation is fostering the emergence of new practices where small consumers store their surplus renewable power from solar photovoltaic to use at times when solar irradiation is not available.

### **The innovation agenda**

9. Innovative approaches in market design, regulation and business models, as well as the nexus between renewable power and the electrification of end-use-sectors, such as road transportation, are not yet fully explored. Questions pertaining to this area include:

- What are the main barriers in today's market designs, based on local context, for the rollout of wind and photovoltaic technologies?
- Do current electricity pricing schemes need to be revised to address balancing supply and demand profiles?
- How can information and communications technologies be used to foster the emergence of innovative business models for renewables?
- How will the traditional utility model be impacted by the ICT-power sector convergence?
- What are the interlinkages between the electric vehicle charging patterns and grid parameters to enable more renewables in electricity systems?

10. To further accelerate the global energy transformation, more emphasis needs to be put on these questions. IRENA is analysing possible solutions to the various challenges posed by the integration of variable renewables in power systems to support its Members in their efforts towards a clean, reliable and cost-effective power sector transformation.

11. Decisions makers need to be provided with up-to-date information and analysis on innovative developments and trends in variable renewable energy system integration to be able to design and implement policies which are in tune with the unfolding global energy sector transformation.

### **Questions for discussion**

- Do all the technologies and tools for the power sector transformation exist, and is it only a matter of deploying these? Or are there still challenges that require further analysis and innovative solutions?
- What is the role of coupling the power and end-use sectors in the transformation of the power sector, and what would be the impact of such a coupling?
- What are the best approaches to coordinate a power sector transformation that includes technical, market, regulatory and business aspects?
- Which are the innovation areas that IRENA should analyse in-depth to advise countries in the transformation of the power sector?
- How can IRENA support countries to develop innovation strategies in system integration for the deployment of renewable power?