IRENA
International Renewable Energy Agency

IRENA INNOVATION WEEK

Conclusions from IRENA's first Innovation Week, 10-13 May 2016 in Bonn

1. The technology to push a global renewable energy transformation in next two decades is already here. But more innovation is needed in policy formulation and business models.

Innovation has created technologies that can transform the power sector from fossil fuels to renewables over the next twenty years. This includes advances in material sciences, hardware and software, technical systems configurations or "architecture", and smart grids.

But technology is not sufficient. Rapid innovation is still needed to create the business practices and policy frameworks to make that happen, both at a ***systemic level*** - ie. new business models, market design, regulation and policy instruments, and financing – and at the ***operational level*** – such as consumer engagement, supply side management and demand response.

Realms of Innovation necessary for Renewable Energy

- Technological innovation, such as from material sciences, hardware and software, technical systems configurations or "architecture", smart grids and grid services.
- Systemic innovation, such as new business models, market design, regulation and policy instruments, institutional and policy frameworks, financial instruments.
- Operational innovation in system operation and management that result from advances in ICT, including consumer engagement, supply side management, demand response and web-enabled "virtual power plants".

2. Markets need to adapt as renewable energy takes a greater share, with new regulatory approaches and policies to ensure its long-term success.

Markets need to innovate to meet the specific needs of renewable energy, but views vary on how quickly that should happen. Some experts see speed as essential to fostering growth; others urge caution, stressing the importance of continuity, and keeping the lights on.

Real-time power pricing in combination with smart meters and smart equipment enable market-based demand responses, and novel IT-based services for power producers, consumers, utilities, and businesses allow for a systemic transformation. Reverse auctions for new renewable power generation capacity can drive ever new lows in investment and operational cost.

New regulatory approaches and policies are needed to support new markets (and to improve existing markets) for power, capacity, storage and other grid services. Standards and quality assurance will be essential in emerging markets.

3. The relationship between information technology and renewable energy is essential, but the full scope of complementarities is yet to be fully understood.

China has already installed 230 million smart meters, and many other countries are unrolling similarly ambitious schemes. The evolving nexus between information technology and the power sector will be a defining feature of the energy transformation, enabling for the first time a systems approach to power supply and demand, more sophisticated energy management systems, and adding the flexibility essential to integrating variable renewables.

But there is little certainty on how this will transpire in practice. Important questions remain regarding the optimal functionality and integration strategies for smart meters and smart appliances. New challenges, such as cybersecurity, are expected to emerge.

Innovation context: Low vs high variable renewable energy share

- **Low VRE**: Up to 15-25% share, no major integration problems. Requires some extra fossil fuel flexibility, more interconnectors.
- **High VRE**: 25%+ share, innovation requirement grows considerably. Many more interconnectors, demand-side management, sector coupling, storage/curtailment. With highly variable prices, low load hours in fossil plants, growing investment challenges, fundamental changes are needed to market structure.

4. Electricity storage is integral to the renewable transformation, with diverse views on forms it will take.

Electricity storage is a core feature of the renewable transformation, but expert opinion on its future diverges significantly. Grid-based batteries are growing fast, while home based batteries (which allow maximised self-consumption and autonomy) offer interesting innovation opportunities whose market potential is not yet well understood.

A massive uptake of electric vehicles offers the potential of significant battery storage capacity and new demand side flexibility, as well as growth in overall electricity demand. Thermal storage (eg ice) is also proving effective in shaving the peaks and filling the valleys of power demand, while spinning mass and pump storage (of water at altitude) still dominate energy systems for short-term and medium-term storage.

5. Innovation can be found at all scales, from micro-grids to continental super-grids, from rich to poor.

Some of the most exciting innovations can be found in mini and micro-grids, which can bring access to modern energy for the first time to remote and underdeveloped communities. At the other end of the scale, continental-scale 'super-grids' are now envisioned, connecting time zones, hemispheres, and geographies with very different availabilities of renewable energies.

6. Flexibility is key; context-relevant solutions essential

Flexibility is needed in policy design, as the end points will differ by country, and the pathways to get there will vary. Different innovation contexts shape options for technology and operational choices just as much as the availability of resources. Rapidly growing power systems can leapfrog, for example, through power systems design optimized for flexibility, while more mature markets will need to work with incumbents. In remote or island systems, the economics are favourable to rapid and ambitious change, but capacity is limited.