IRENA
INNOVATION WEEK
solutions for a renewable-powered future

IRENA
International Renewable Energy Agency

PLENARY SESSIONS

FUTURE GRIDS: GETTING BIGGER AND SMALLER

Session overview

Historically power systems have evolved based on the geographical location of demand, generation and the available technology. Today we are witnessing a more co-ordinated planning of grids at the international, national, regional and local levels, driven mainly by the need to ensure security of supply and to better integrate variable renewable energy (VRE). Interconnections between national systems have become more important to allow for the exchange of power as the renewable share increases.

At the same time increasing decentralised generation, innovation in storage technologies as well as the digitalisation of the power sector have been drivers towards more active management of the distribution grid, and towards microgrids and autonomous power systems. It is evident that in the medium term, electricity grids will evolve into a co-existence of super-grids, regional power systems, microgrids and autonomous grids. The future energy system will be digital and renewable. The question is whether the balancing of demand and supply will be done in very large or in rather small grids.

This session focused on how grids are evolving to increase the share of renewable energy in the system. The panel discussion underlined the factors influencing the development of both bigger and smaller grids, the implications for the deployment of renewable energy, and the actions that need to be taken for the different concepts to co-exist. The session was moderated by **Konstantin Staschus (Chief Innovation Officer, ENTSO-E and Director, Ecofys/Navigant Germany)** and comprised four introductory presentations followed by a panel discussion.

Presentation 1:
Introduction and presentation on future grids – Getting bigger and smaller

Konstantin Staschus (Chief Innovation Officer, ENTSO-E and Director, Ecofys/Navigant Germany began the session with an introduction on how both bigger and smaller grids can contribute to the integration of more renewable energy in the system. He described how reliability and trading benefit from interconnection between countries and how microgrids support the resilience and electrification of remote areas. The ENSTO-E eHighway 2050 study gives examples where continent-scale grids can be useful and concludes that strong new interconnections from the periphery of Europe towards the centre will be needed. The CIGRE Global Electricity Network feasibility study shows how a global grid can further allow more integration of VRE, reduce the use of fossil fuels and save costs. Coherent price signals and a proper co-operation between transmission and distribution system operations will be key to progress towards the grid of the future.

Presentation 2:
Super-grids and their influence in facilitating the deployment of renewable energy globally

Xiangzhang Lei (Global Energy Interconnection Development and Cooperation Organization (GEIDCO)) described how a global energy interconnection, through large-scale high-voltage electricity networks and smart grids, could reduce environmental pollution and promote sustainable development. In China ultra-high-voltage lines are used to transport abundant wind in the north to the demand areas around Beijing. To efficiently benefit from large amounts of renewable energy in remote areas, high-voltage transmission lines are needed to minimise transport losses.

Presentation 3:
Challenges and opportunities for renewable energy deployment in micro-grids

Vimal Mahendru (Ambassador, International Electrotechnical Commission (IEC) India and President, Legrand-India) described how the implementation of local microgrids can help to achieve the United Nations' Sustainable Development Goal 7 (Ensure access to affordable, reliable, sustainable and modern energy for all). Rural electrification through very small grids in remote areas can lead to significant benefits for local merchants and craftsman.

Presentation 4:
Falling renewable electricity cost and the impact on grid operation

Martin Keller (Laboratory Director, National Renewable Energy Laboratory (NREL)) presented talked about how the rising competitiveness of renewable energy generation and declining storage costs are leading to increased capacity of distributed energy resources. As controls for microgrids get cheaper, microgrid capacity is growing by over 500 megawatts every year. The grids of the future are autonomous energy systems that use advanced control methods and big data in order to optimise grid management and communication.

Highlights from the discussion:

- **Why smaller?** Small grids are needed both to electrify remote areas and to enhance the resilience of larger systems. Since the largest share of renewable energy sources is connected at the distribution grid level, intelligent microgrids can reduce curtailment by allocating energy intelligently on the distribution system and at the connections to the transmission system. Falling costs for distributed energy resource capacity will further increase the number of small grids.
- **Why bigger?** A cost-effective way to balance regional surpluses (or deficits) can be to transport electricity to (from) another region where the energy is needed (or abundant) and where consumers are willing to pay for it. As GEIDCO and CIGRE point out, continental or global grids allow for more integration of VRE, reduce the use of fossil fuels and save costs.
- **The future is a grid of grids.** The key to efficient load balancing will be the optimal interaction between the different grid levels. This needs fair trading rules that also include environmental and social factors. While ultra-high-voltage lines connect the urban centres, consumers in remote areas should not be neglected. Coupling with other energy sectors (such as gas, heating and mobility) will create new challenges as well as opportunities for the way energy is transported and distributed in the grid. To accomplish this, joint planning together with the heating and transport sectors is needed**.**
- **Business models for emerging companies and utilities are going to change.** Market price formation is an important challenge of future grids. Coherent price signals will be important to guide transmission and distribution system operators. Business models that integrate both smaller and bigger grids must determine how costs can be shared among the different actors in the system. Economic benefits for sector coupling (e.g., with the heating or transport sectors) must be created to not just rely on electrical grid upgrades but make use of the potential for storing and shifting energy in other sectors.

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