

Innovations for High-Share VRE Power Systems

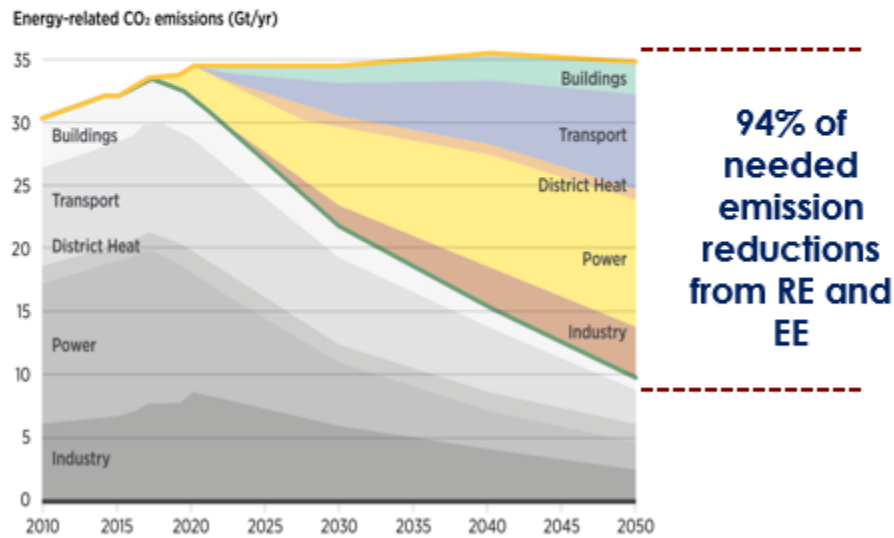


Dolf Gielen
Director, Innovation and Technology
REvision webinar, Tokyo, 4 March 2020

- **Policy imperatives**

- Sustainable Development and Economic Growth (SDGs)
- Climate and Environmental agenda (Paris Agreement)

Annual energy-related CO₂ emissions and reductions, 2015-2050 (Gt/yr)



- **RE Strong Business case**

- Policy frameworks, business and technology innovation
- Dramatic cost reduction

Cost reduction (2010 - 2018)

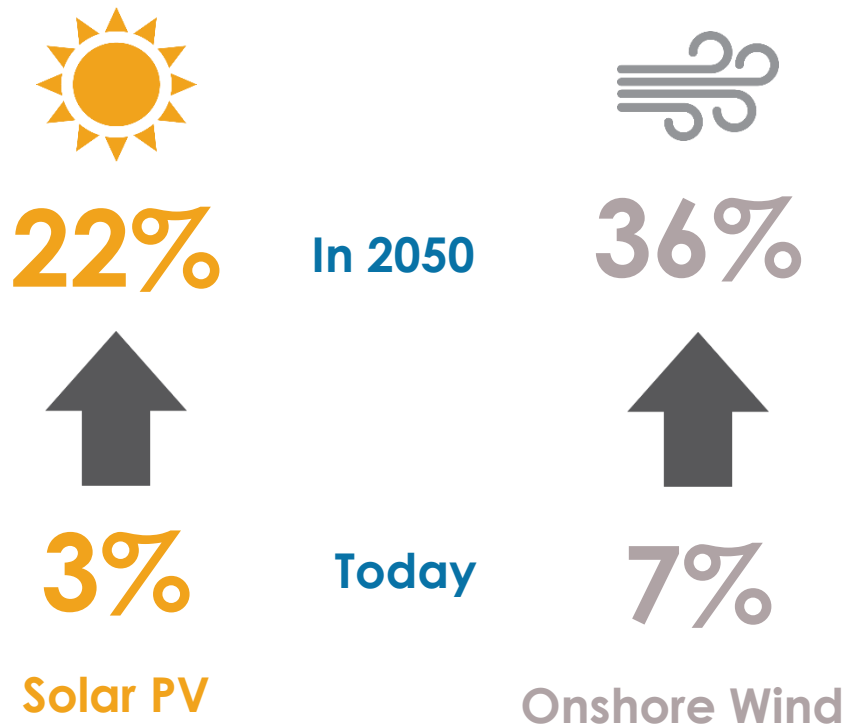
Solar PV



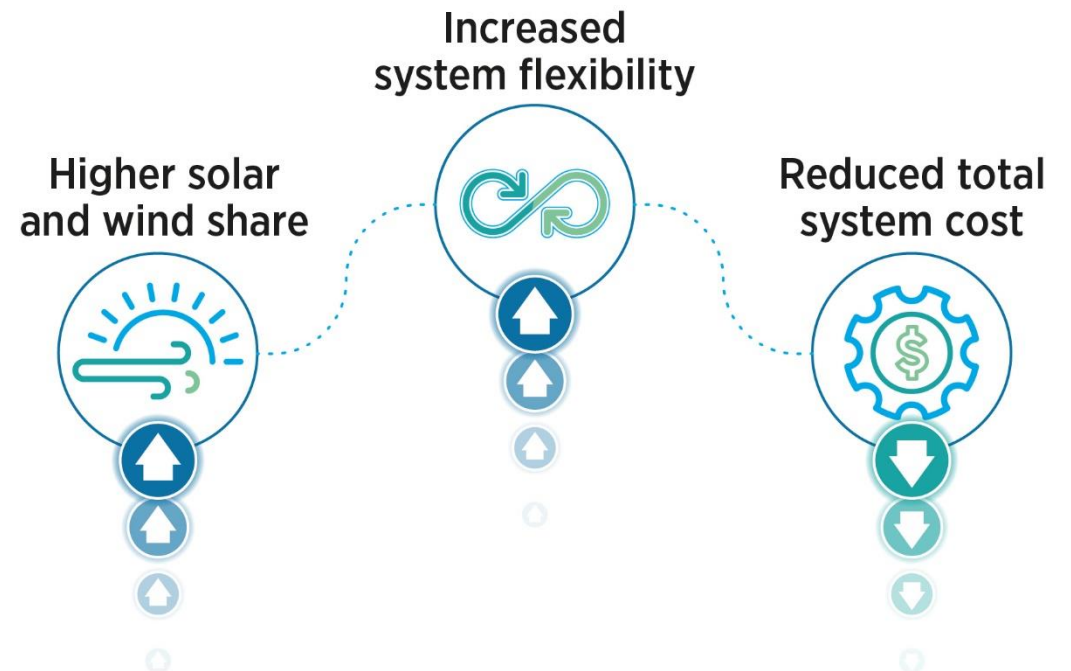
Onshore Wind

Wind and PV at the core of the energy transition

Onshore Wind and Solar PV electricity shares in the generation mix

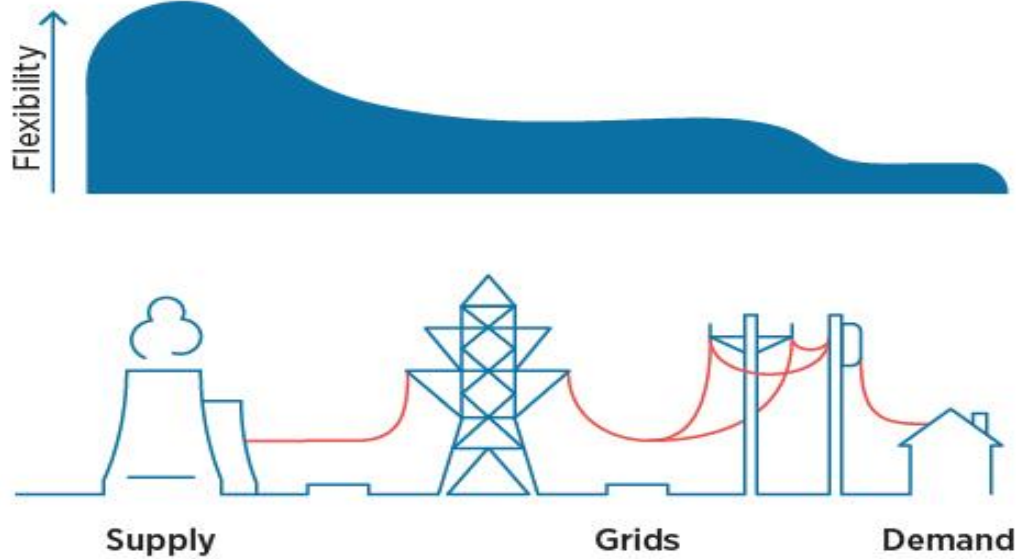


- Wind and PV are **variable energy sources** – addressing variability is crucial for high deployment.
- Today’s challenge – **integrating high shares of wind and PV** in power systems.
- **Power-system flexibility** is key to the cost-effective use of renewables.



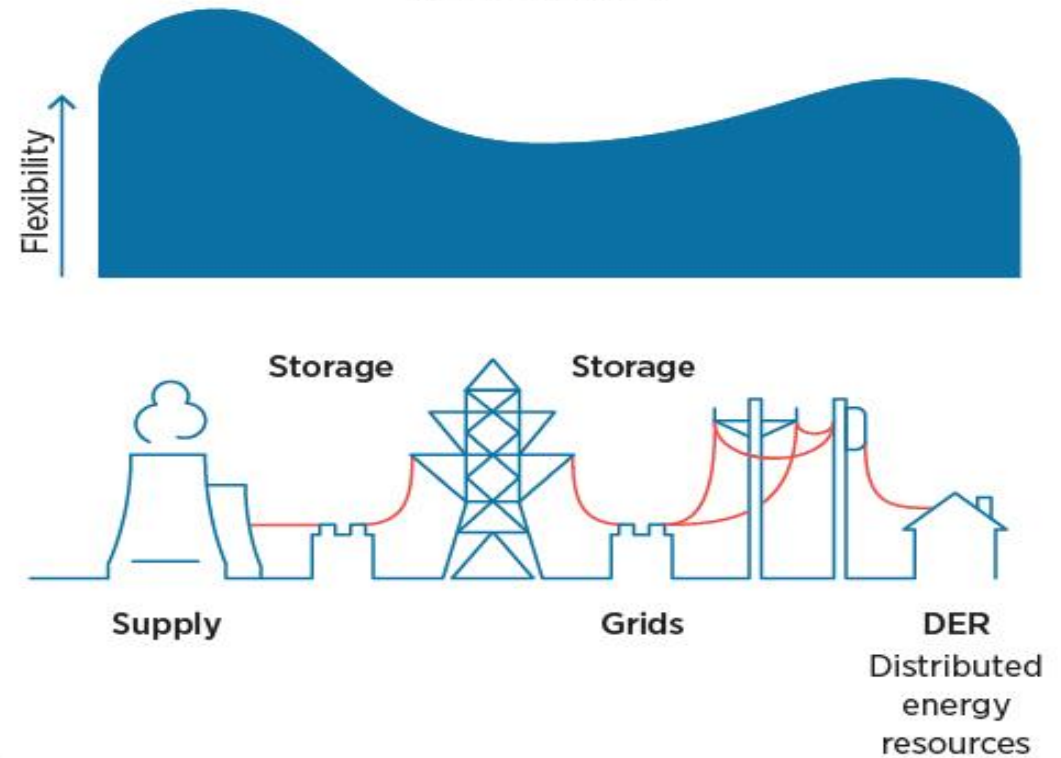
Innovation unlocks flexibility across whole power system

Flexibility providers in the current power system



Flexibility sources: Flexible generation

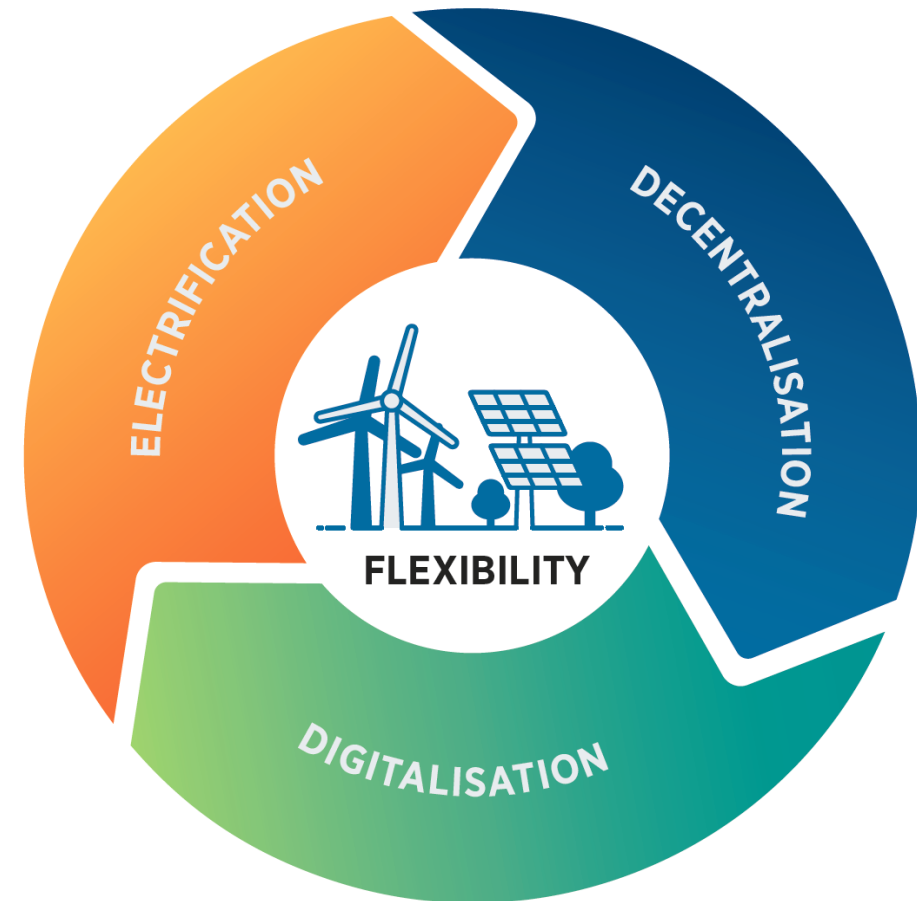
Flexibility providers in the future power system



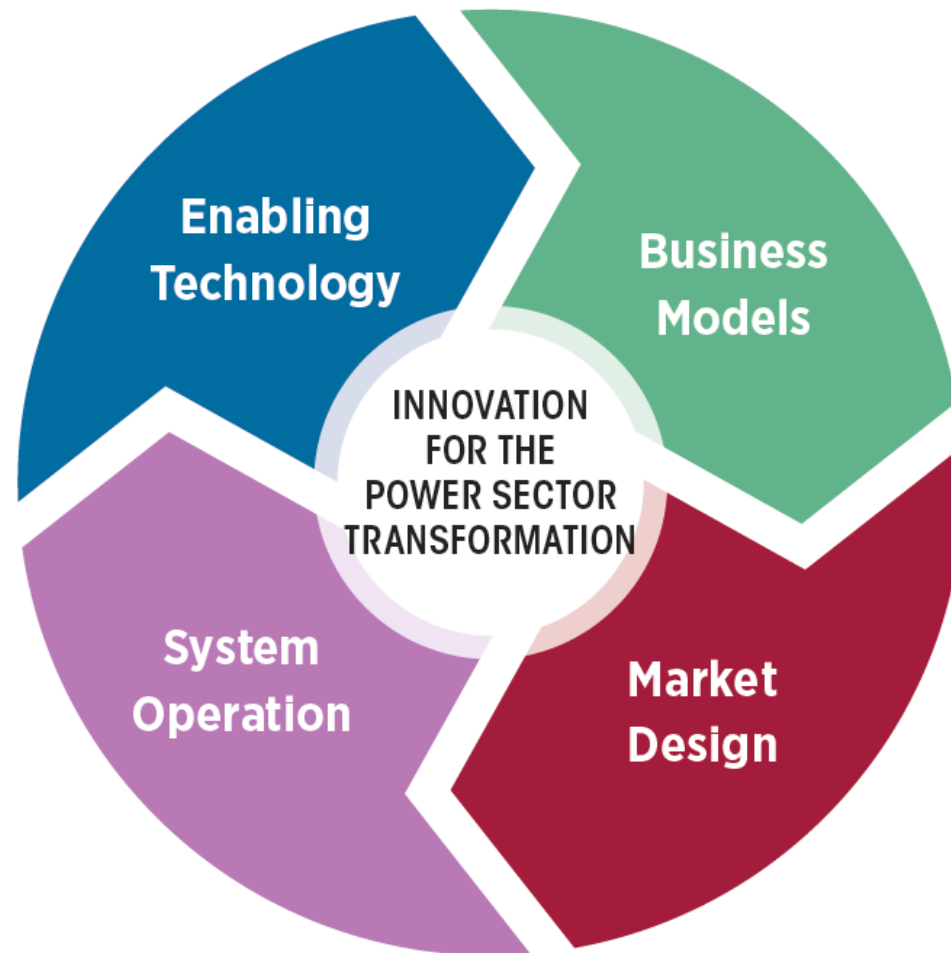
Flexibility sources: Flexible generation; Regional interconnections and markets; Demand response; Storage; Power to X

Innovative solutions to increase power systems flexibility driven by three trends

- **Decentralisation –impact on supply side-**. Wind and PV is largely centralized today but distributed generation - notably rooftop PV, ~ 1% of all electricity generation today – is growing bringing new flexibility opportunities at demand side
- **Electrification –impact on demand side-**. It plays in two ways, may decarbonize end-use sectors through renewable electricity and, if done in a smart way, become a flexibility source to integrate more renewables in power systems
- **Digitalisation –impact on system integration-**. Key enabler to amplify the energy transformation by managing large amounts of data and optimizing systems with many small generation units



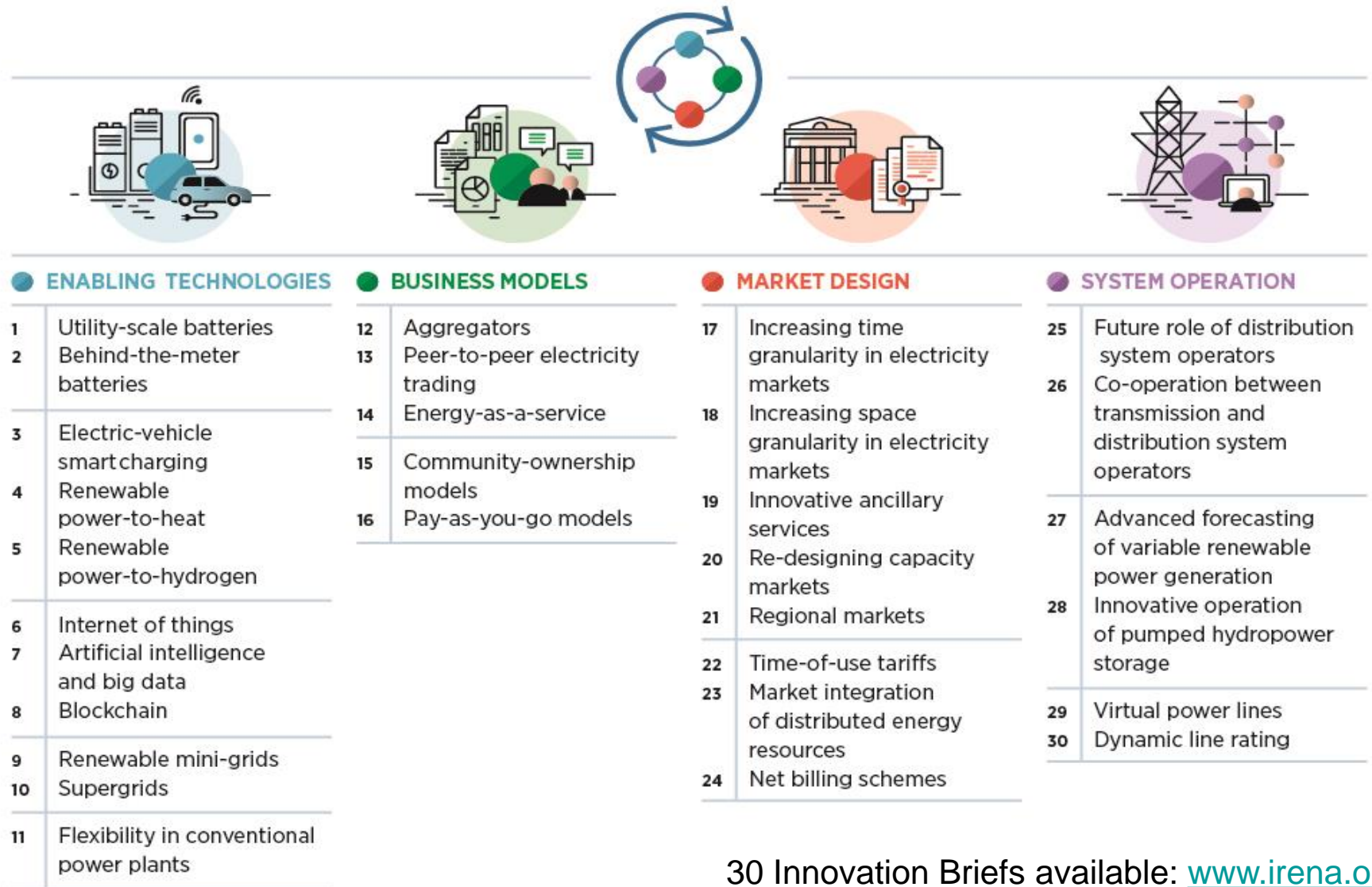
Four dimensions of power system innovation



Systemic innovation for RE integration



February 2019



30 Innovation Briefs available: www.irena.org

Innovation landscape for power sector transformation

EVs and smart charging



Storage

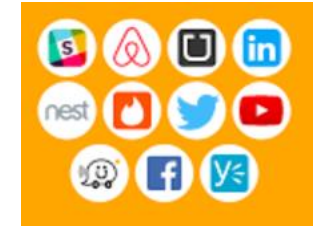
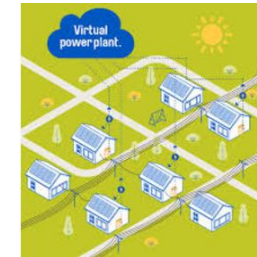


Artificial Intelligence



Platform business model

Aggregators- VPP



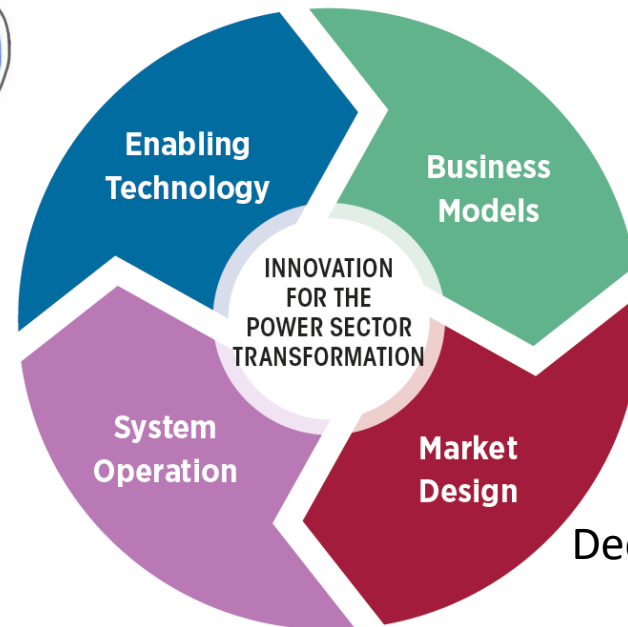
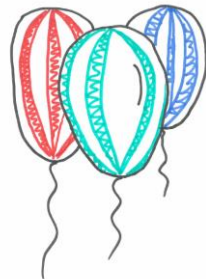
Digitalisation - IoT



Blockchain



Hydrogen, PtX



Encourage Flexibility, pricing that supports DSM/DSR



Massive expansion of interconnections and supergrids

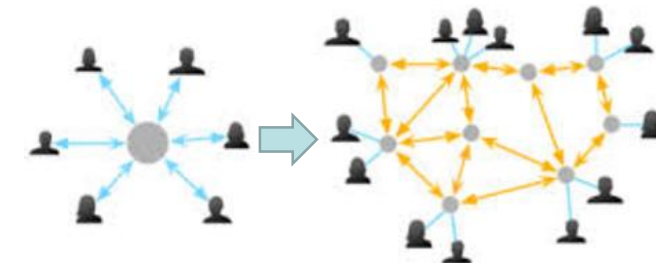


Electrification of end use sectors



Decentralised system and Distributed generation

Value complementarities in VRE



Combining innovations into solutions – 11 solutions



SUPPLY-SIDE FLEXIBILITY SOLUTIONS

I	Decreasing VRE generation uncertainty with advanced generation forecasting
II	Flexible generation to accommodate variability

GRID FLEXIBILITY SOLUTIONS

III	Interconnections and regional markets as flexibility providers
IV	Matching RE generation and demand over large distances with Supergrids
V	Large-scale storage and new grid operation to defer grid reinforcements investments

DEMAND-SIDE FLEXIBILITY SOLUTIONS

VI	Aggregating distributed energy resources for grid services
VII	Demand-side management
VIII	RE mini-grids providing services to the main grid
IX	Optimising distribution system operation with with distributed energy resources

SYSTEM-WIDE STORAGE FLEXIBILITY SOLUTIONS

X	Utility-scale battery solutions
XI	Power-to-X solutions

Priority solutions based on country/system context

Need to apply the innovation toolbox in a national context



3 days of
discussions

18 sessions
in 3 tracks

Over 80 expert
speakers

Over 350
participants

Over 70
countries

Aim was to: **inspire & inform** decision makers; **showcasing solutions** from around the world

Sessions were informed by past and ongoing IRENA analysis.



**IRENA Innovation Week 2020: Sector Coupling
8-10 September, Bonn, Germany**