IRENA INNOVATION WEEK 2018

Innovation Landscape for Renewable Power Integration

Opening IRENA Innovation Week 2018

5 September 2018
Bonn, Germany

IRENA
International Renewable Energy Agency

Renewable power rapidly becoming competitive

Cost reduction in the period 2010 - 2017

73% Solar PV

23% Onshore Wind

Expected cost reduction in the period 2015 - 2025

54% Solar PV

37% CSP

15% Offshore Wind

12% Onshore Wind

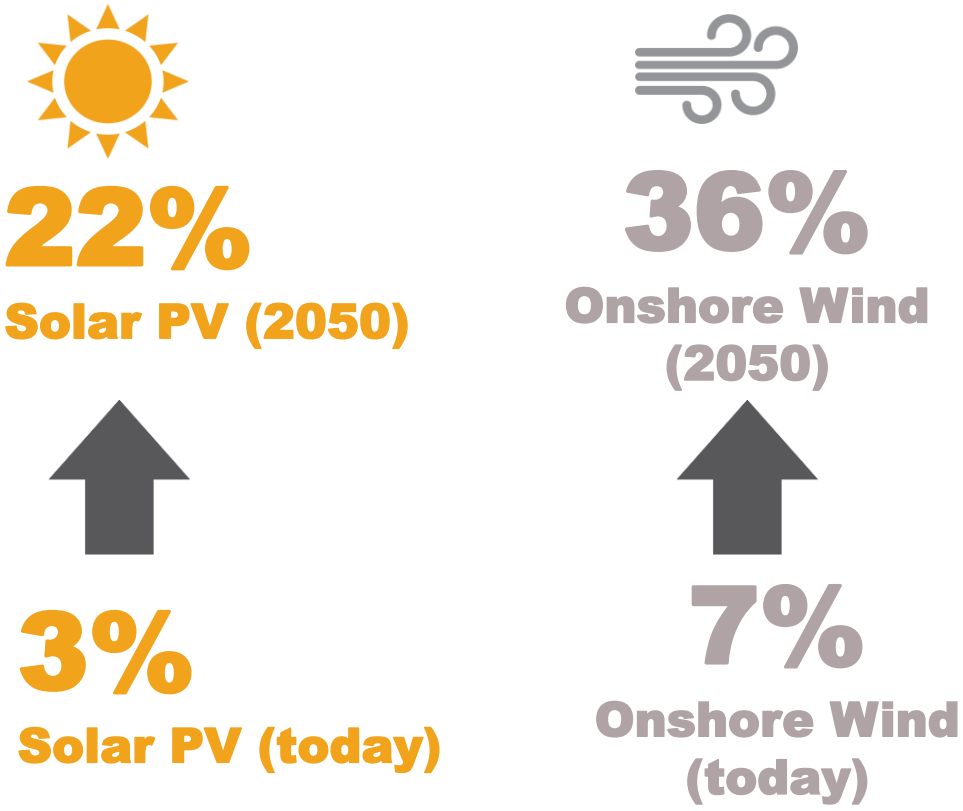
- All renewable power options will compete with fossil fuels on price by 2020
- Wind and PV are abundant and available in most countries

Source: IRENA (2018), Renewable Power Generation Costs in 2017, International Renewable Energy Agency

Implication: Wind and PV at the core of the energy transition

- Electricity production would double between 2015 and 2050
- Renewables generating 85% of total electricity in 2050
- Share of wind and PV in electricity sector would increase from 10% today to 60% in 2050
- Wind and PV are variable energy sources – addressing variability is crucial to achieve the needed deployment
- **Next stage is integrating such a high share of wind and PV in power systems**

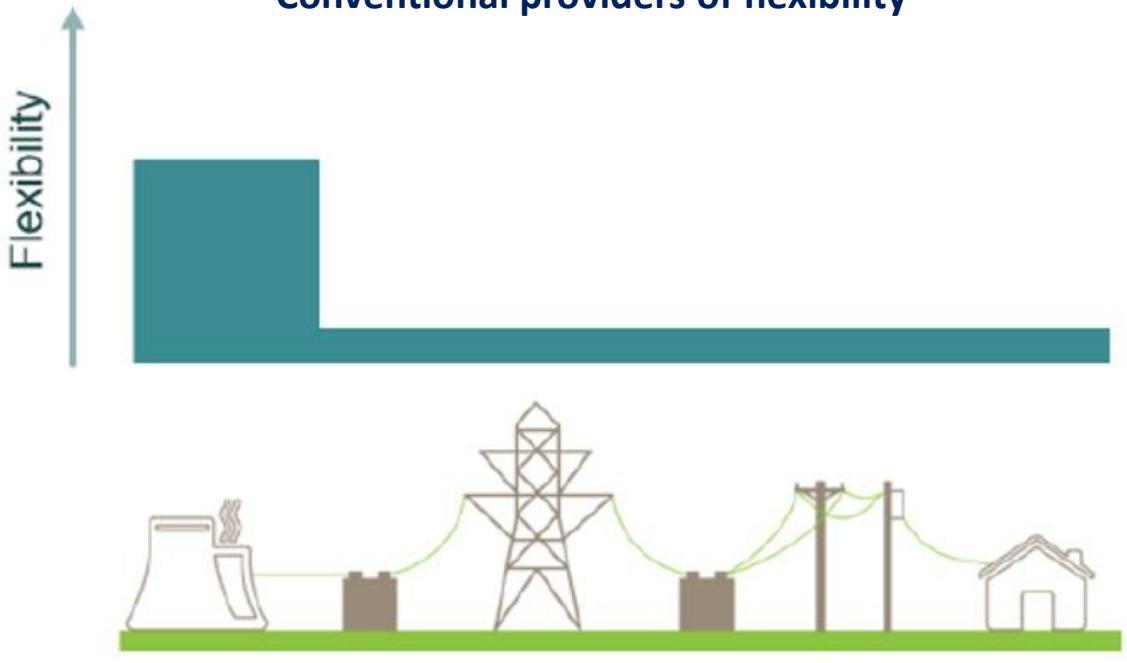
Wind and PV electricity share in generation mix 2015 and 2050



Source: IRENA (2018), Global Energy Transformation: A roadmap to 2050

Innovation unlocking flexibility across whole power system

Conventional providers of flexibility



Emerging providers of flexibility

*Distributed Energy Resources
(demand, distributed generation, small battery etc.)

Flexibility sources:

- Flexible generation

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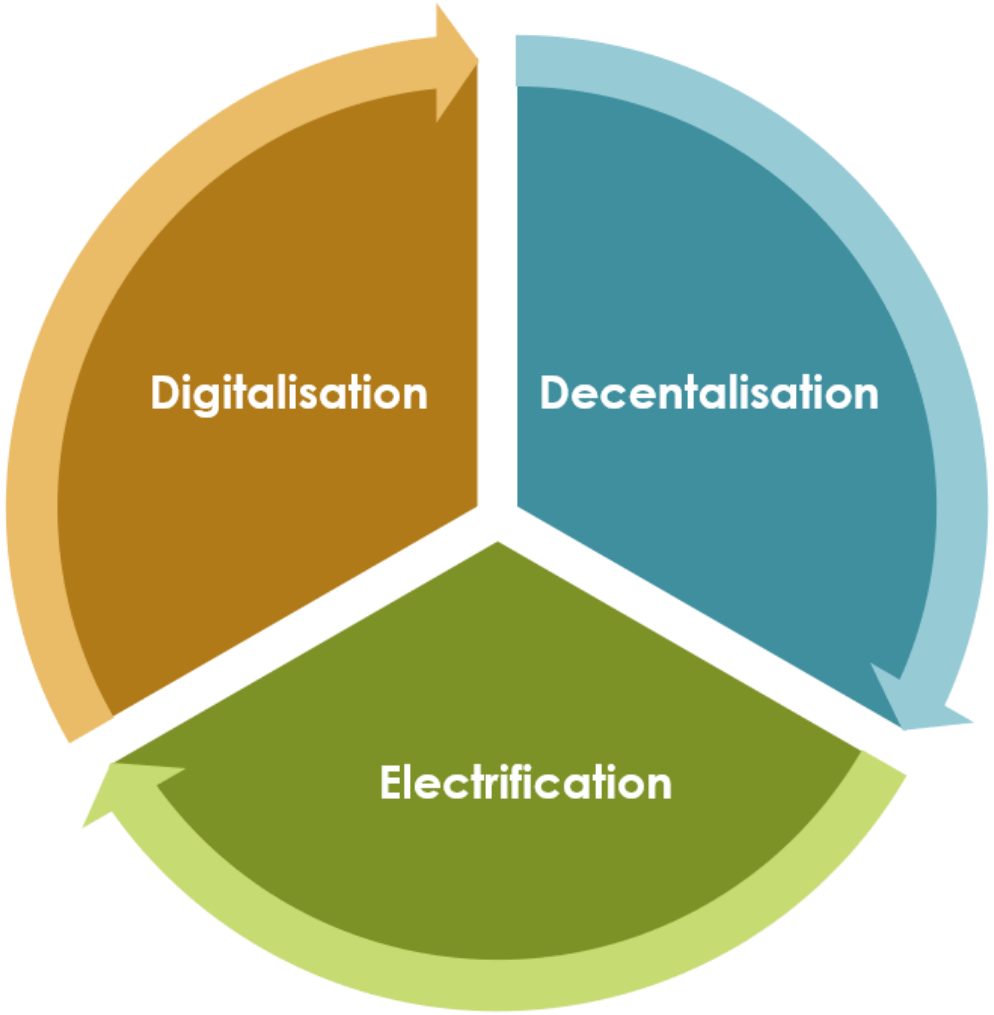
- Flexible generation
- Regional interconnections and markets
- Demand response
- Storage
- Power to X

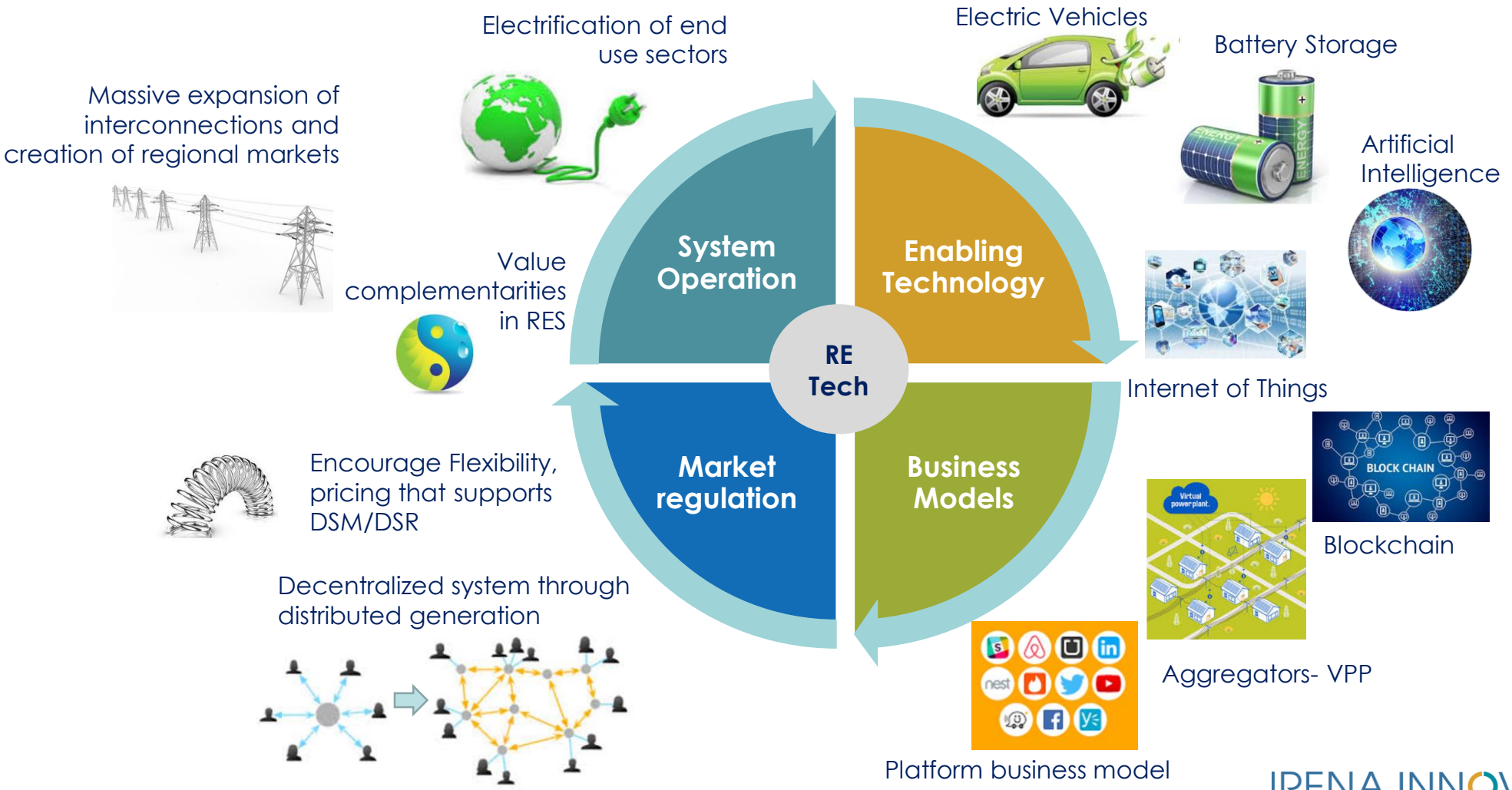
Innovative solutions to increase power systems flexibility propelled by three trends

- **Decentralisation.** 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
- **Digitalisation.** Key enabler to amplify the energy transformation by managing large amounts of data and optimizing systems with many small generation units
- **Electrification.** 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



Numerous innovations are emerging to facilitate wind and PV integration

Innovations come from different dimensions: Enabling technology, Business models, Market design and Systems operation



Innovation Landscape for Renewable-Power Integration

Enabling Technologies

Battery storage
- *Utility-scale battery*
- *Small-scale battery*

Electrification
- *EV smart charging*
- *Power-to-heat*
- *Power-to-hydrogen*

Digitalisation
- *Internet of Things (IoT)*
- *Artificial intelligence and big data*
- *Blockchain*

New grids
- *Supergrids*
- *Renewable-based mini-grids*

Business Models

Empowering consumers
- *Virtual power plants (VPPs)/ Aggregators*
- *Peer-to-peer trading*
- *Energy as a service*

Enabling renewable energy supply
- *Community-shared ownership*
- *Pay-as-you-go plans*

Market Design

Wholesale markets
- *Increase time and space granularity in energy markets*
- *Redefine balancing market products*
- *Innovations in capacity markets*
- *Regional markets*

Retail markets
- *Allow distributed energy resources to participate in markets*
- *Price-based demand-response programmes*
- *Net billing schemes for self-consumption*

System Operation

Accommodating uncertainty
- *Advanced renewable energy generation forecasting*
- *Innovative operation of hydro plants*

Innovative DER operation
- *Expanded role of DSOs in operating distribution systems*
- *DSO as market facilitators and DSO-TSO co-ordination*
- *Virtual power lines*

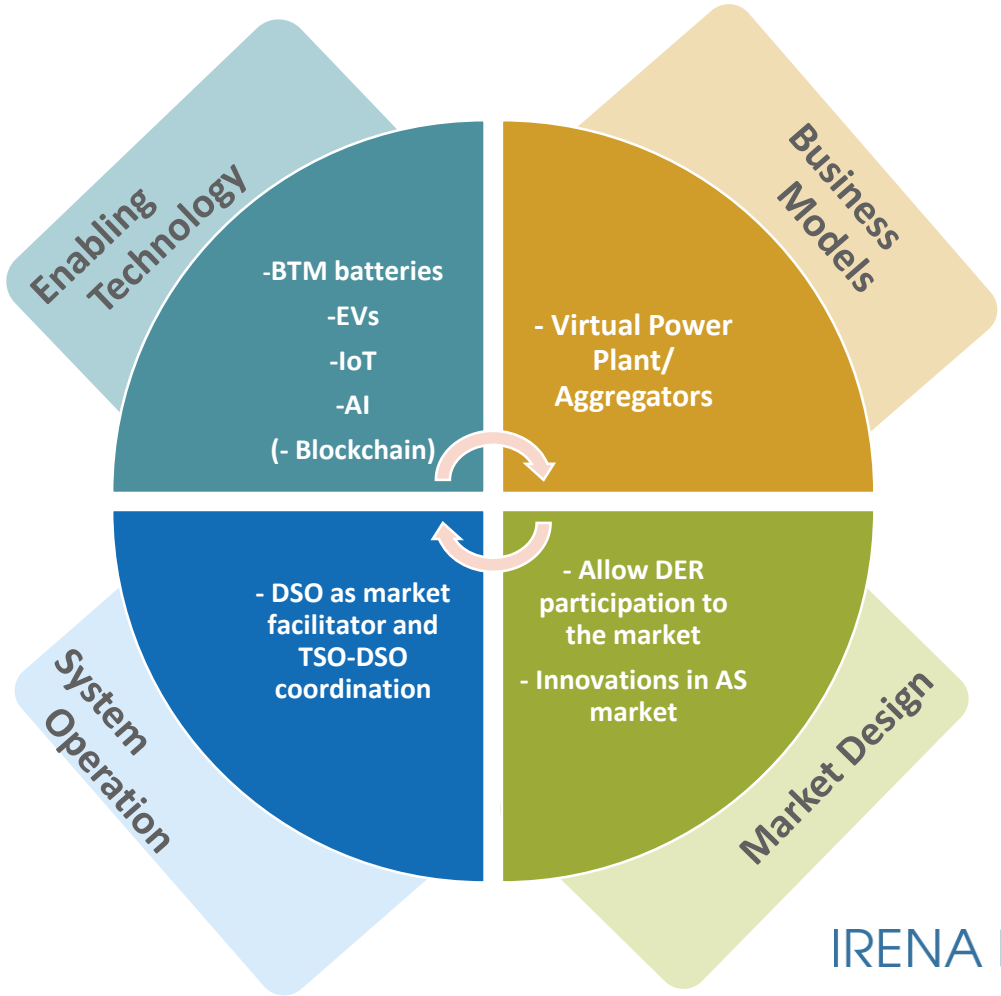
- 27 Innovations grouped under four dimensions
- Which solutions are suited to which context?

Solutions come from interactions between different innovations

Innovations do not emerge in isolation. Synergies between innovations result in the needed to form real solutions

Example of solution:

- **Distributed energy resources (DERs) providing services to the grid**



Digitalisation and Decentralisation

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Considerations

- In 2015 in Germany, 35% of the country's installed renewable energy systems are owned by citizens
- Ongoing studies and pilot projects estimates that digital systems and data analytics can increase RE production, reduce RE curtailments, and O&M costs.
- Decentralisation, together with Digitalisation, are changing power system's paradigm, creating new opportunities for a renewable-powered future
- Some risks and challenges associated need to be better understood and addressed

Thank you!