

IRENA INNOVATION WEEK ²⁰¹⁸

Innovation Landscape for Renewable Power Integration

Opening IRENA Innovation Week 2018

5 September 2018
Bonn, Germany

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% **37%**
Solar PV CSP



15% **12%**
Offshore
Wind Onshore
Wind

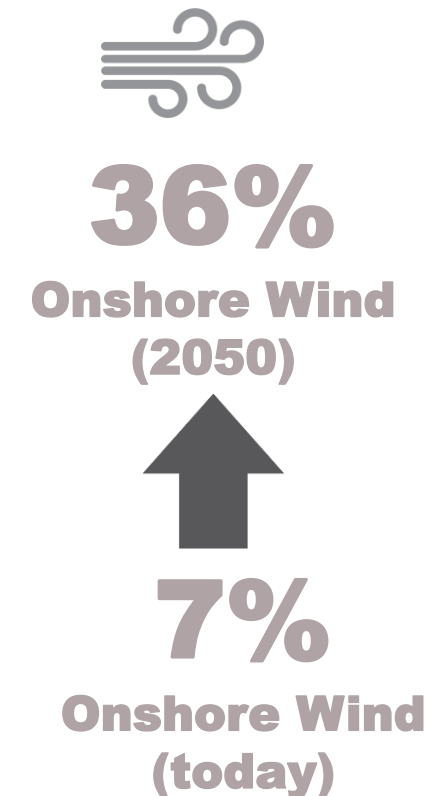
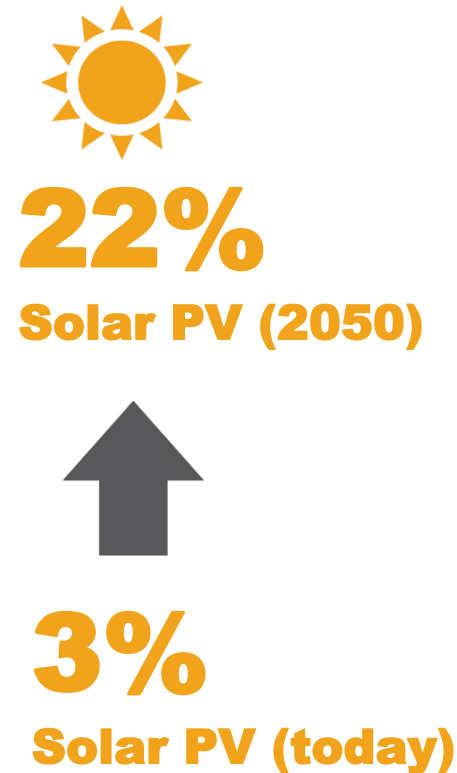


- All renewable power options will compete with fossil fuels on price by 2020
- Wind and PV are abundant and available in most countries

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

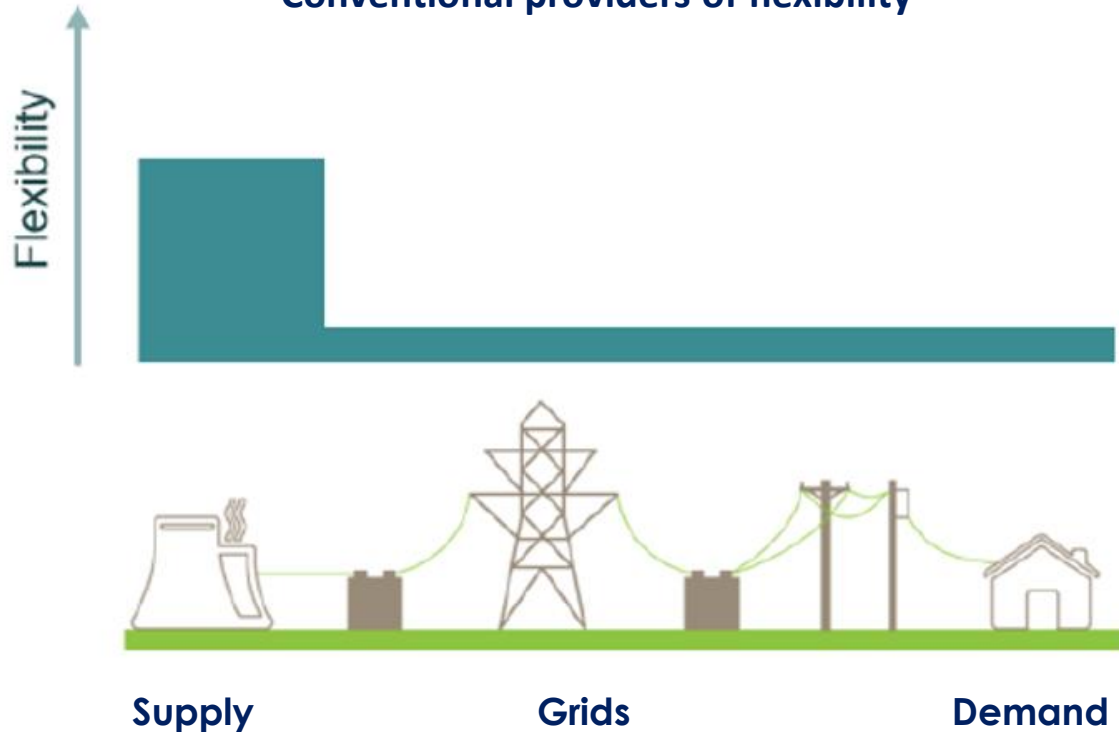
- Electricity production would double between 2015 and 2050
- Renewables generating 85% of total electricity in 2050
- Share of wind and PV in electricity sector would increase from 10% today to 60% in 2050
- Wind and PV are variable energy sources – addressing variability is crucial to achieve the needed 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



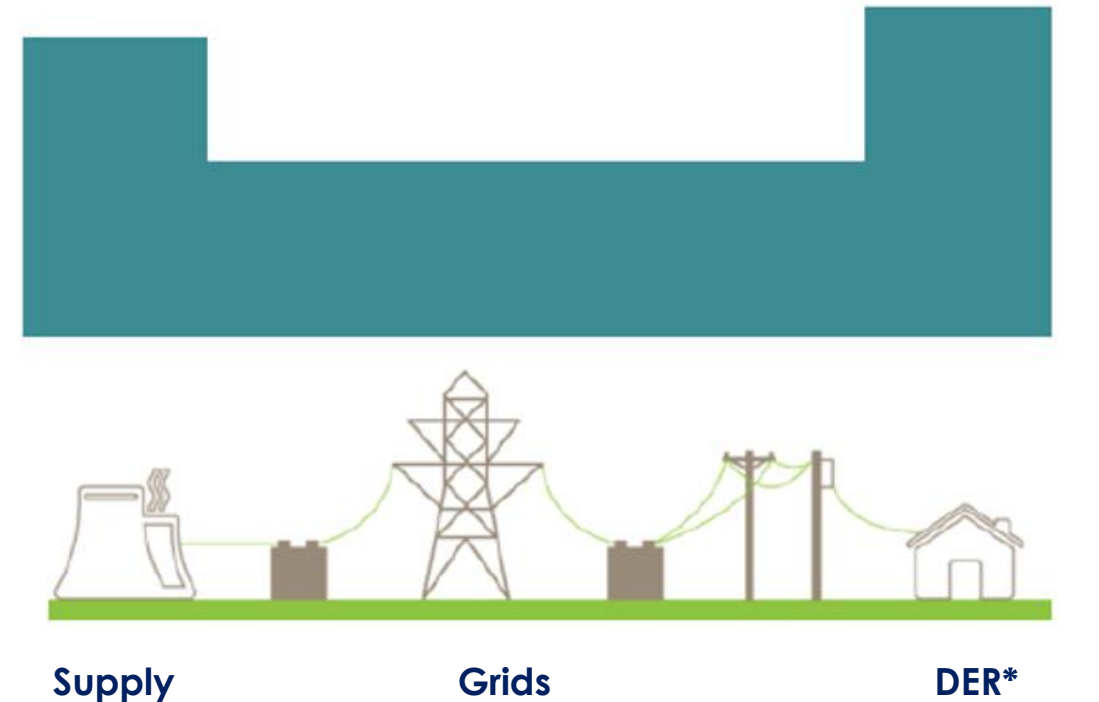
Innovation unlocking flexibility across whole power system

Conventional providers of flexibility



- Flexibility sources:
- Flexible generation

Emerging providers of flexibility

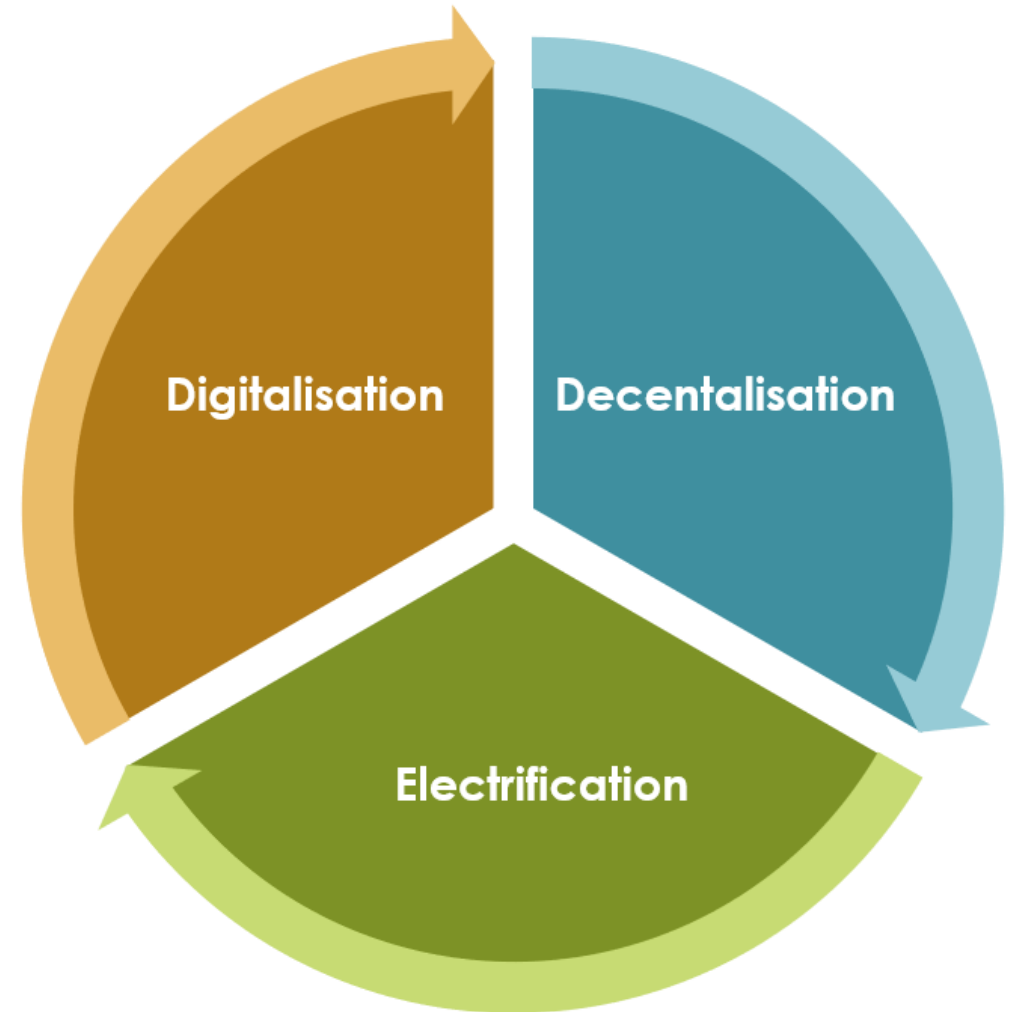


*Distributed Energy Resources
(demand, distributed generation, small battery etc.)

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

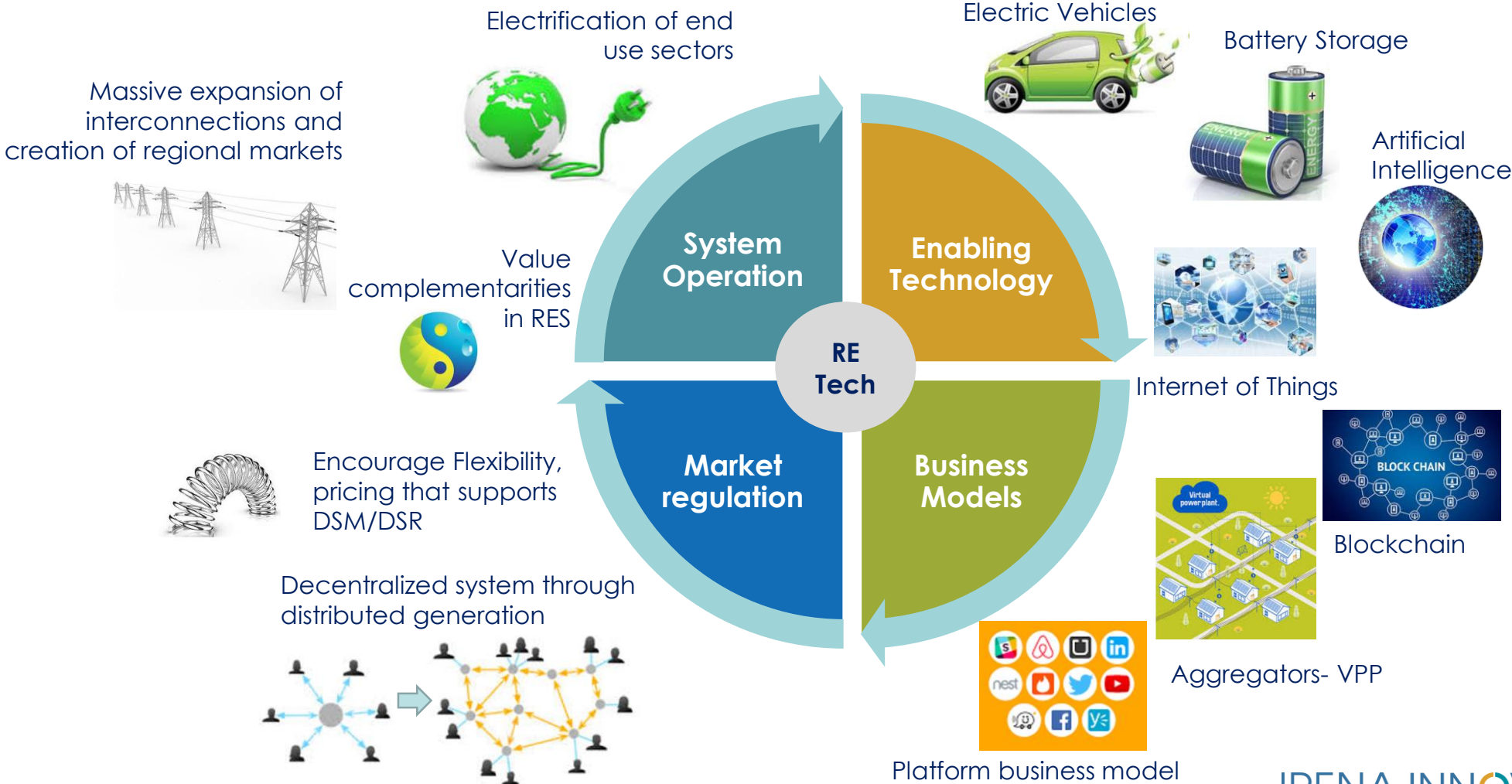
Innovative solutions to increase power systems flexibility propelled by three trends

- **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*

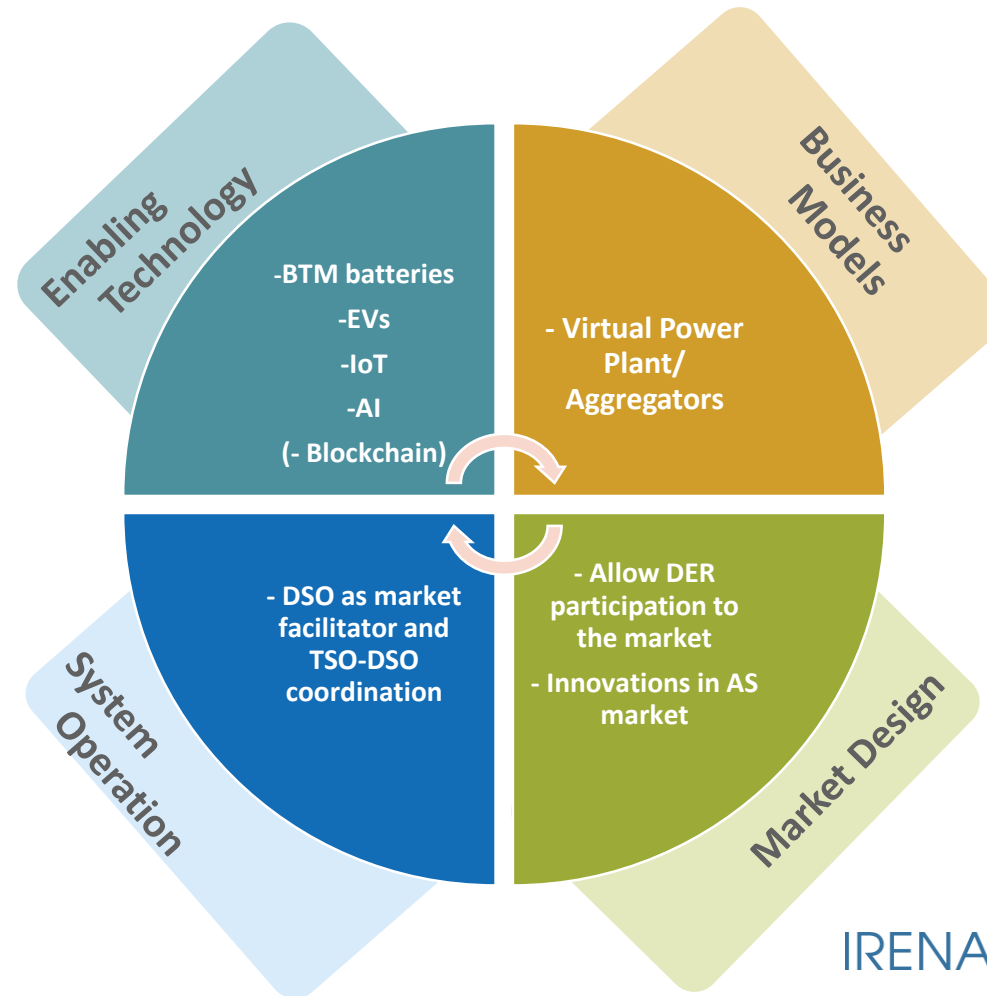
- 27 Innovations grouped under four dimensions
- Which solutions are suited to which context?

Solutions come from interactions between different innovations

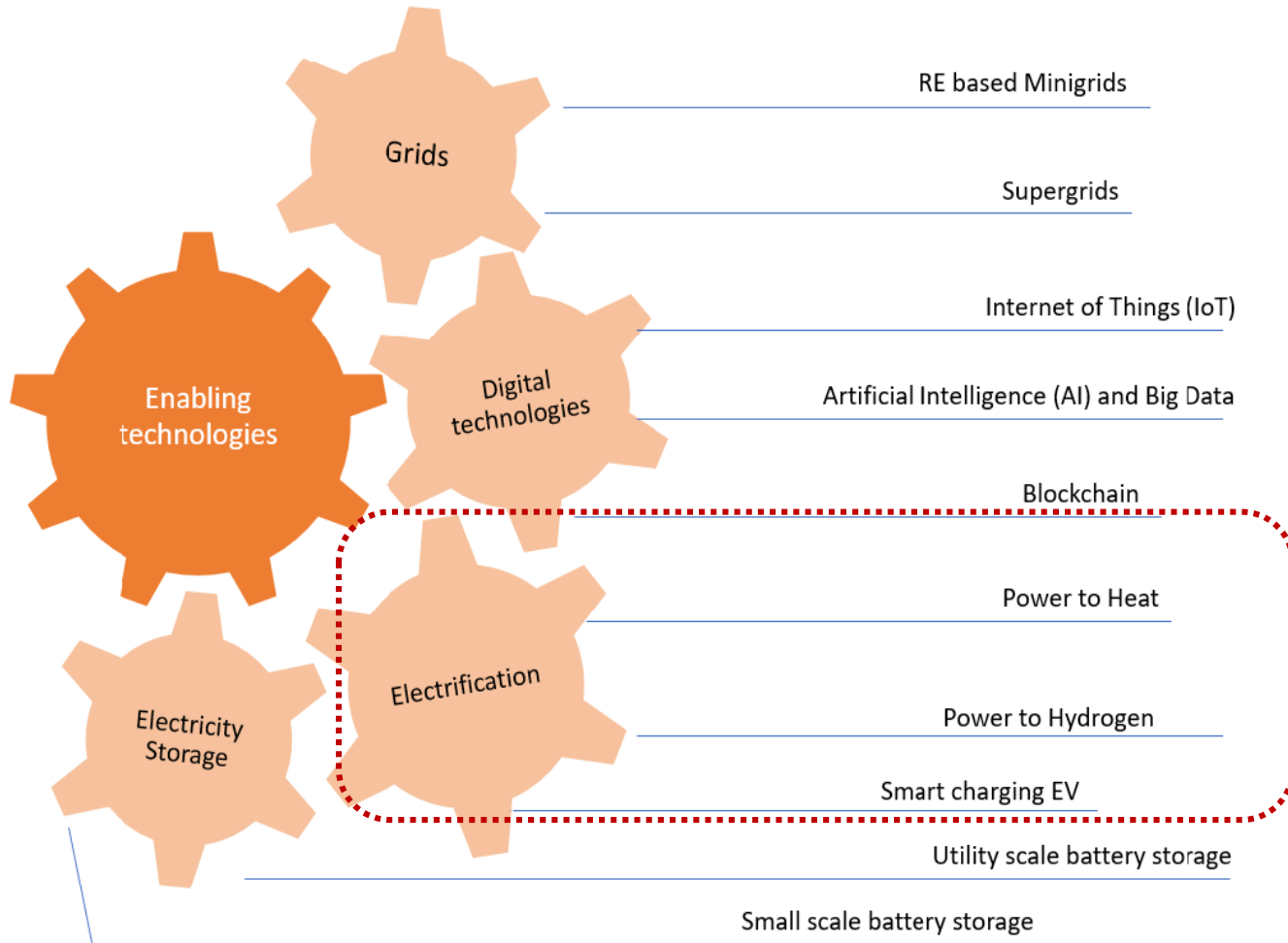
Innovations do not emerge in isolation. Synergies between innovations result in the needed to form real solutions

Example of solution:

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



Electrification in the landscape report



Report to be launched early 2019

Considerations around electrification

- RE electricity is at the core of energy transition as 1) the vector to decarbonize end-use sectors and 2) a sources of flexibility
- Our analysis indicates that electricity share in total final energy consumption will grow from 20% in 2015 to 50% by 2050. Other studies indicate up to 60%
- Power to X, with renewable hydrogen as main carrier, may play an important role as long-term (seasonal) flexibility option
- Coupling end-use and power sectors through electrification needs a smart approach, otherwise may hinder the transformation of the power sector
- Landscape report – close look to smart charging of EVs, Power to Heat and Power to Fuels (hydrogen)

IRENA INNOVATION WEEK ²⁰¹⁸

Thank you!