

IRENA INNOVATION WEEK <sup>2018</sup>

# 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%**  
Solar PV

**37%**  
CSP



**15%**  
Offshore  
Wind

**12%**  
Onshore  
Wind

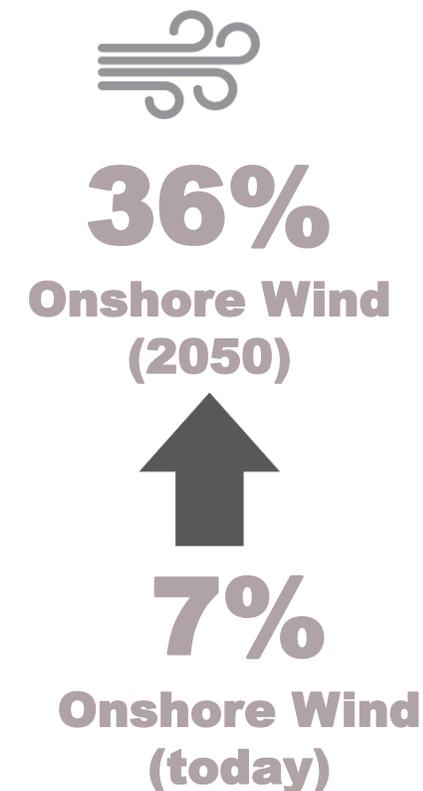
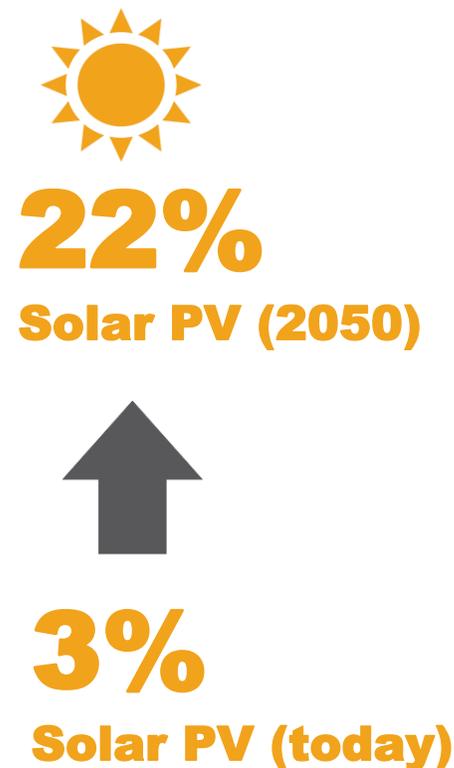


- All renewable power options will compete with fossil fuels on price by 2020
- Wind and PV are abundant and available in most countries

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

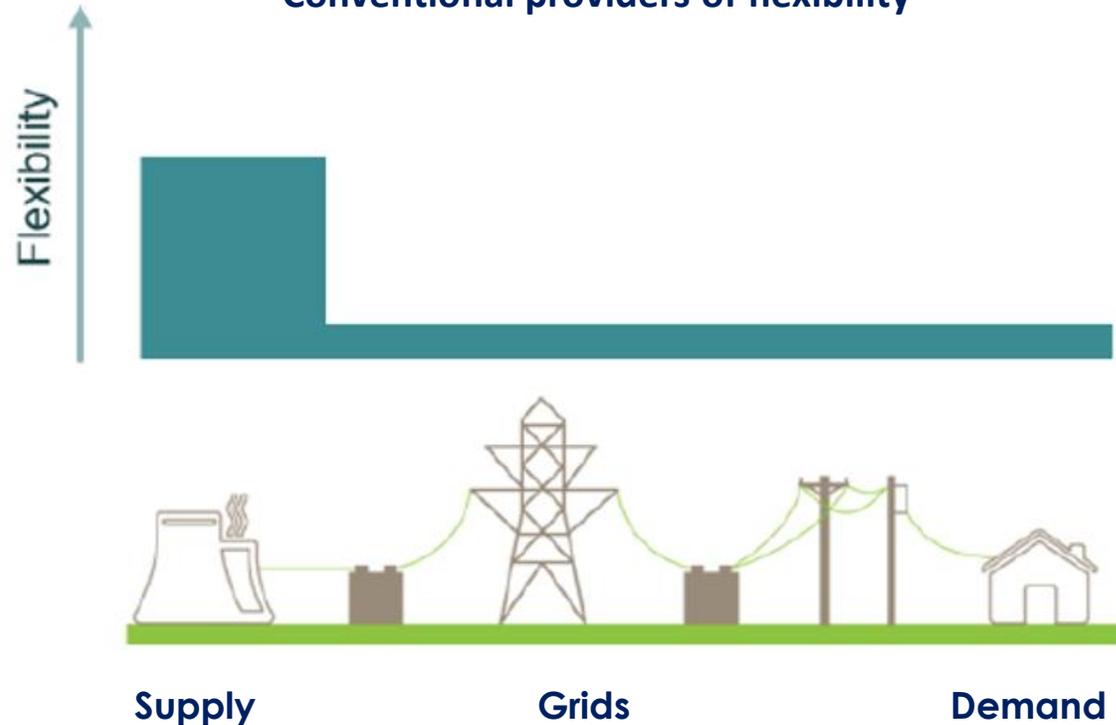
- Electricity production would double between 2015 and 2050
- Renewables generating 85% of total electricity in 2050
- Share of wind and PV in electricity sector would increase from 10% today to 60% in 2050
- Wind and PV are variable energy sources – addressing variability is crucial to achieve the needed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

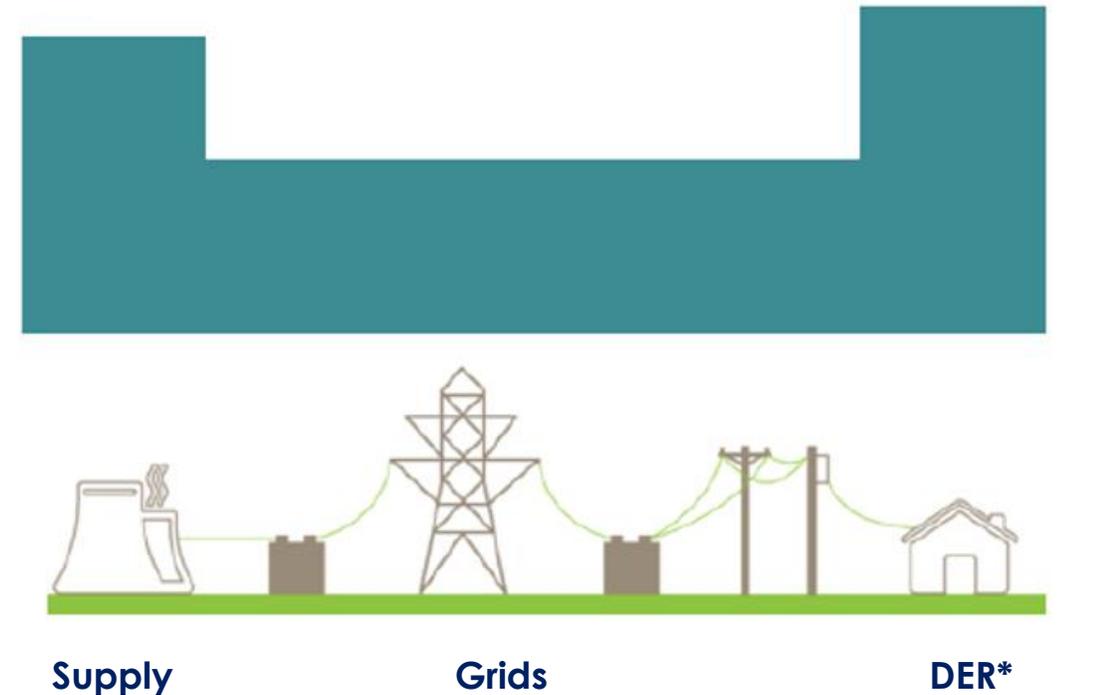


# Innovation unlocking flexibility across whole power system

Conventional providers of flexibility



Emerging providers of flexibility



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

Flexibility sources:

- Flexible generation

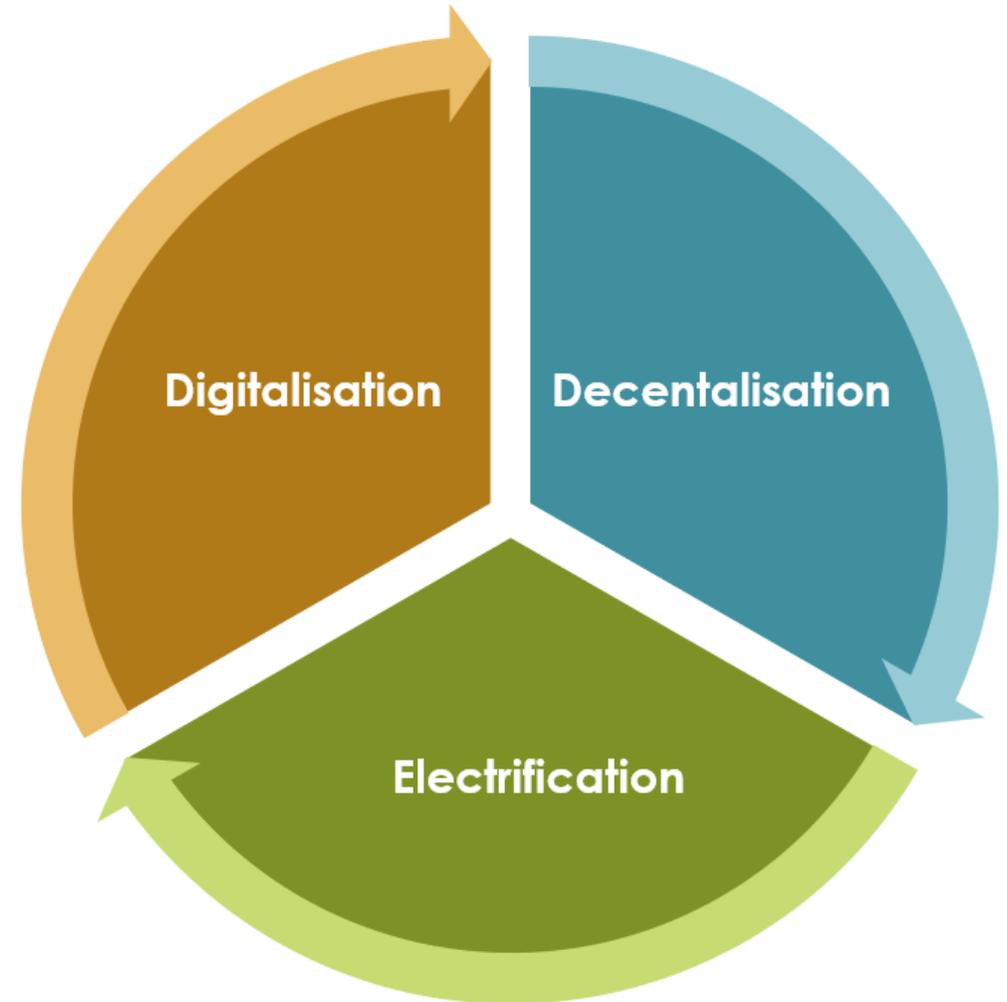
Flexibility sources:

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

# Innovative solutions to increase power systems flexibility propelled by three trends

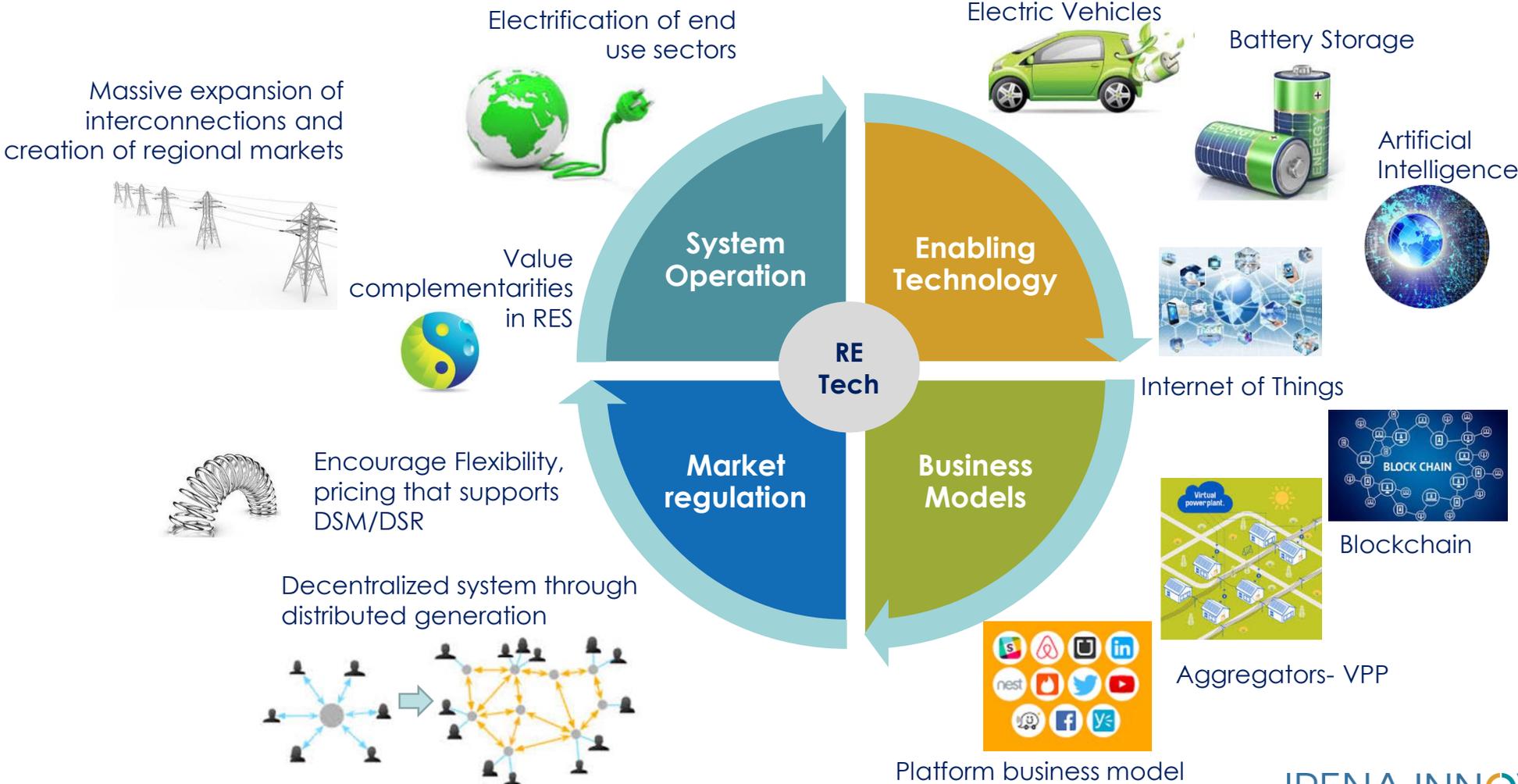
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- **Decentralisation.** Wind and PV is largely centralized today but distributed generation - notably rooftop PV, ~ 1% of all electricity generation today – is growing bringing new flexibility opportunities at demand side
- **Digitalisation.** Key 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*

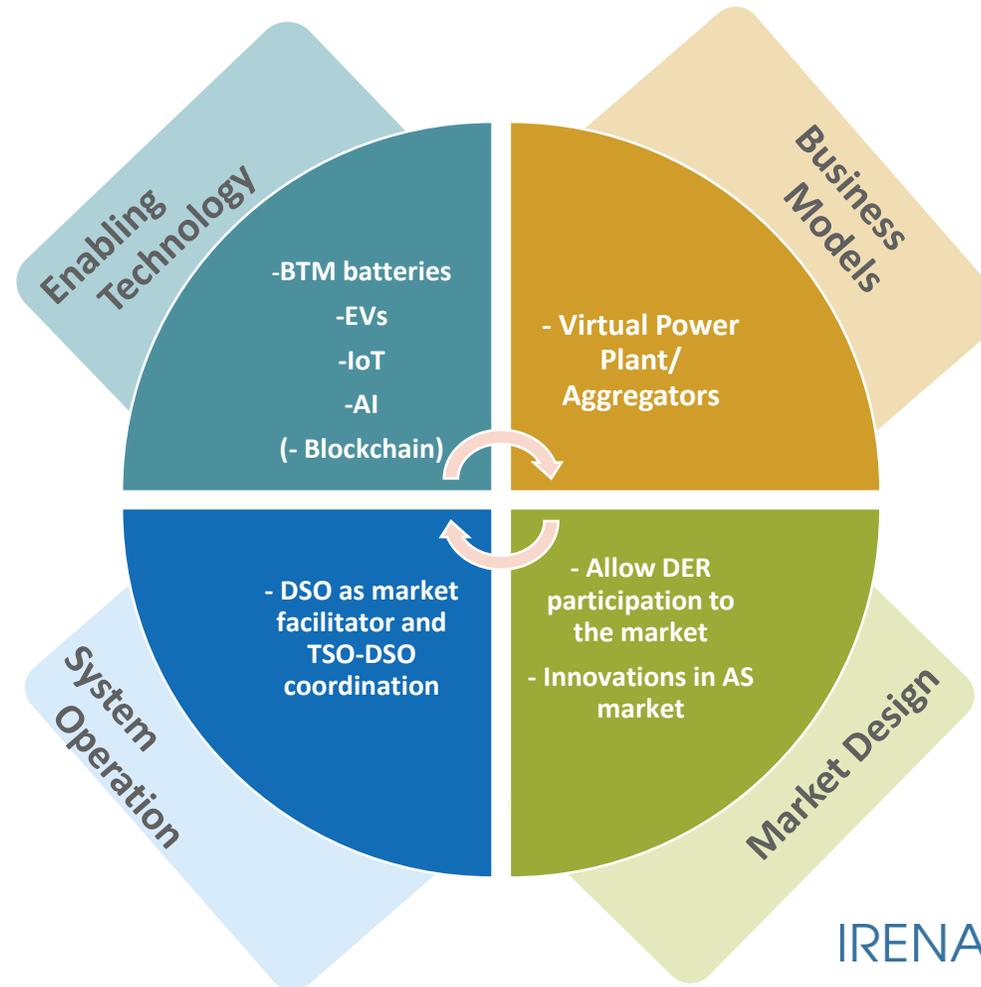
- 27 Innovations grouped under four dimensions
- Which solutions are suited to which context?

# Solutions come from interactions between different innovations

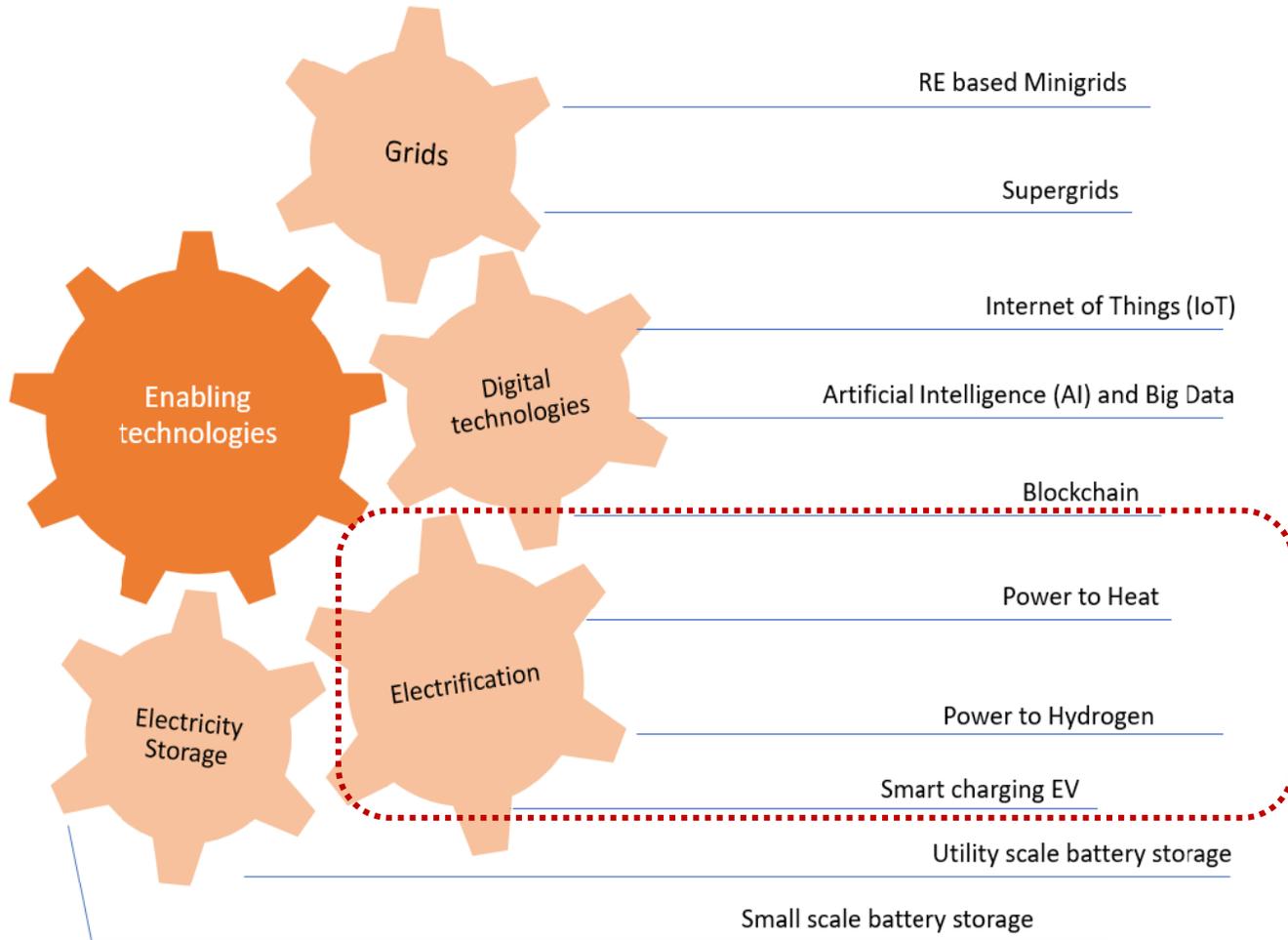
Innovations do not emerge in isolation. Synergies between innovations result in the needed to form real solutions

## 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)

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**Thank you!**