European Utility Week

IRENA
International Renewable Energy Agency

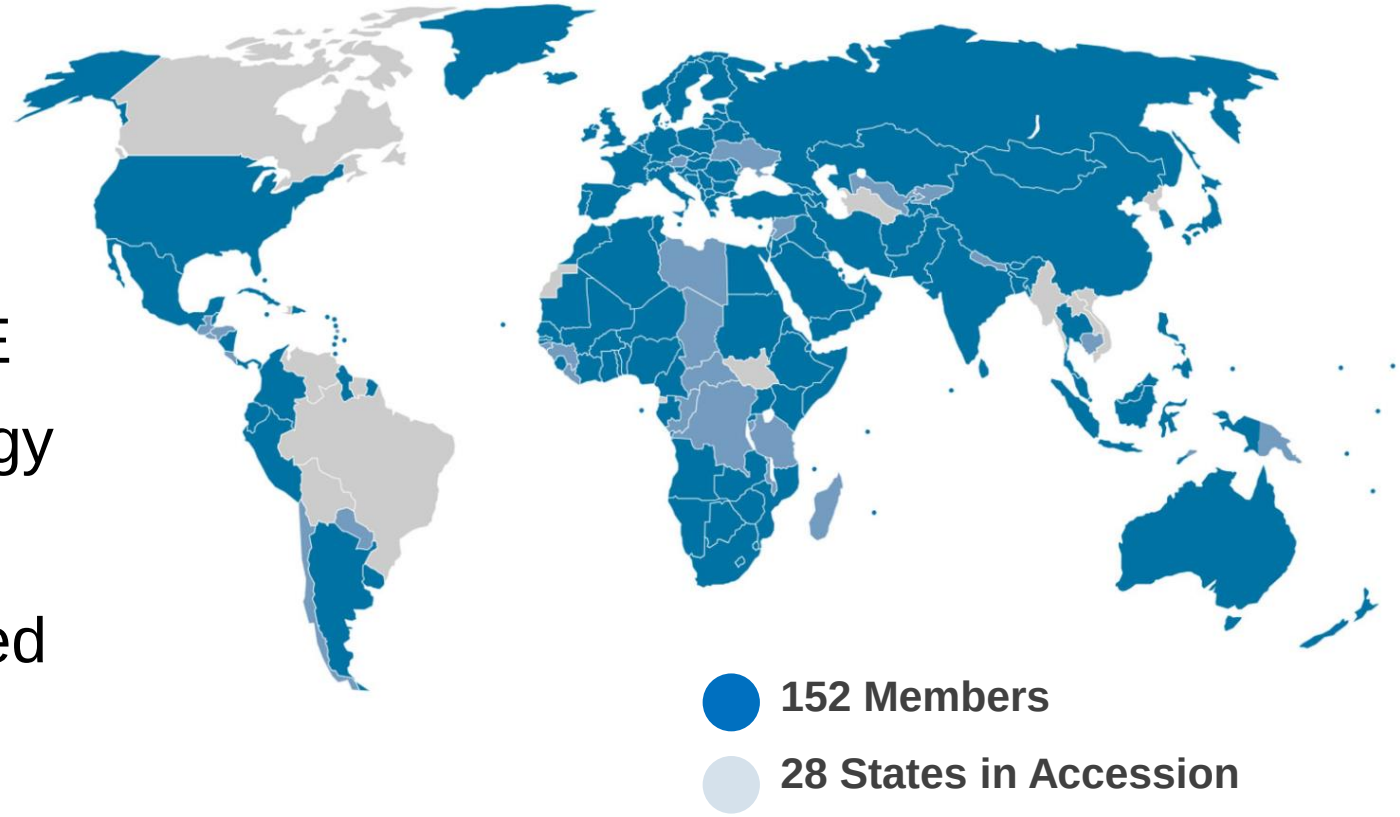
Spreading Innovation for the Power Sector Transformation Globally

Amsterdam, 3 October 2017

About IRENA

IRENA
International Renewable Energy Agency

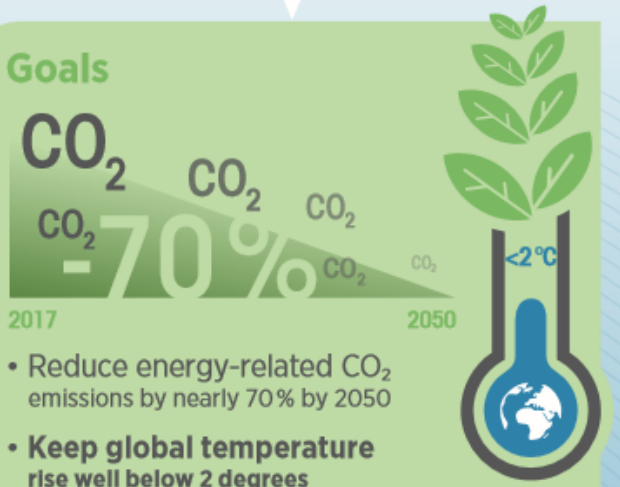
- Inter-governmental agency established in 2011
- Headquarters in Abu Dhabi, UAE
- IRENA Innovation and Technology Centre – Bonn, Germany
- Permanent Observer to the United Nations – New York



Mandate: Assist countries to accelerate renewable energy deployment

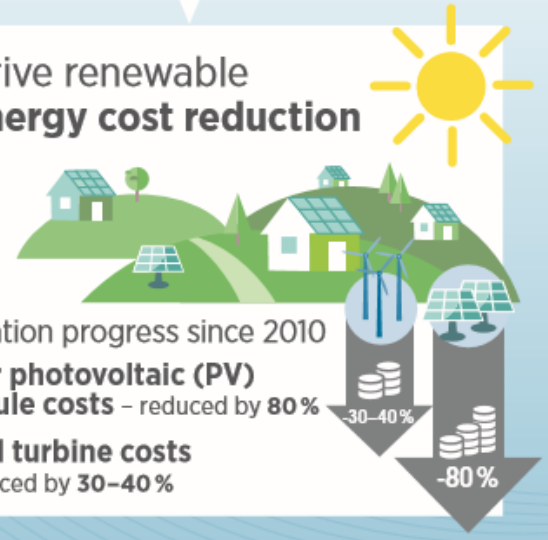
Innovation to Decarbonise the Energy Sector

Goals



- Reduce energy-related CO_2 emissions by nearly 70% by 2050
- **Keep global temperature rise well below 2 degrees**

1 Drive renewable **energy cost reduction**



- Innovation progress since 2010
  - **Solar photovoltaic (PV) module costs** – reduced by **80%**
  - **Wind turbine costs** – reduced by **30–40%**

2 Enhance **technology performance**

- **Today's renewable energy technologies:**
  - Need to grow renewable energy share 1.2% yearly to reach 2050 climate goals
  - Could provide 2/3 of the world's primary energy supply
- **What about the remaining 1/3?**

3 Integrate high shares **of renewable energy in power systems**

- **Enabling** technologies
- New ways to **operate** systems
- Innovative **business** models + **market** designs

4 Create new **breakthroughs** for end-use sectors

- **Find affordable, scalable solutions**
  - **Develop low-carbon technologies for:**
    - aviation
    - heavy industry
    - road transport
    - shipping

Action **needed now:**

- **Governments** – encourage private sector innovation
- **Developing new technologies** – requires decades
  - **R&D → demonstration → market**
- **Innovation goes beyond technology**
  - creating new businesses; system integration; wealth creation

Accelerating Energy Transition

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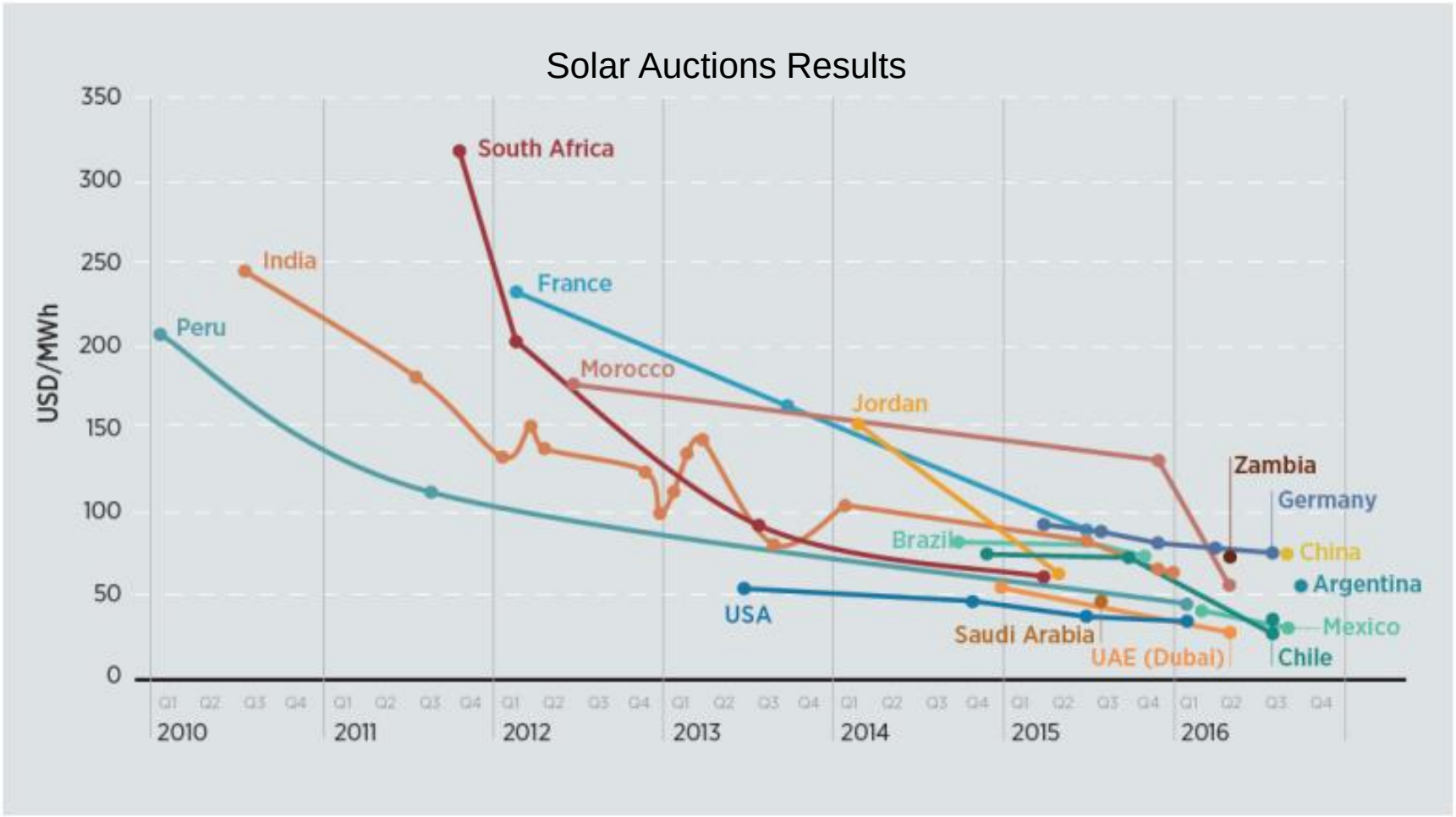
Renewable power already has a strong business case…

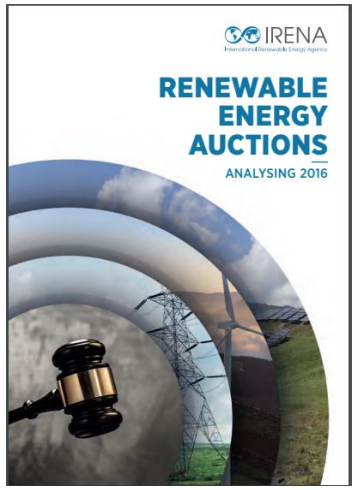


Wind Turbines -30-40%

Solar module -80%

Renewable Energy Auctions

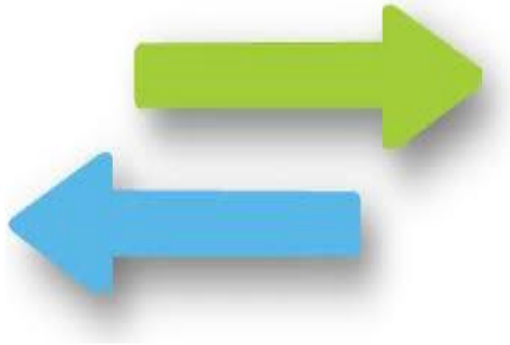
Analyzing 2016



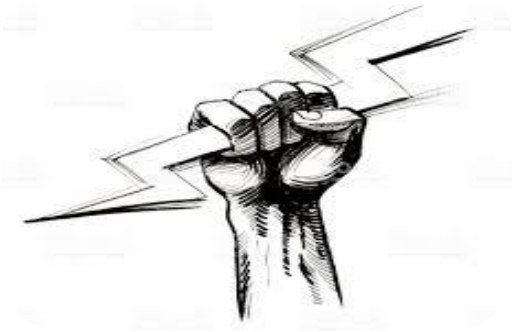
…but materialising its potential require additional efforts in system integration

The power sector paradigm changes, creating challenges to integrate high share of variable renewable energy in the system

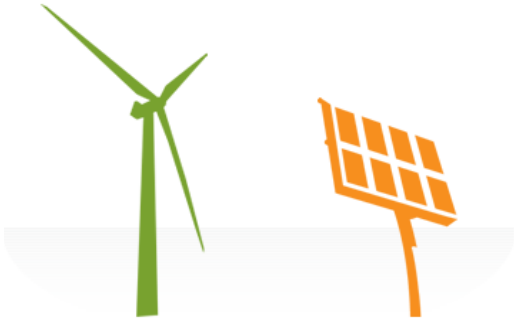
Generation becomes more **decentralized**



The flow of electricity becomes **bi-directional** at certain moments in time



The role of **consumers** changes, having an increasingly active role



The traditional **base-load generation** concept disappears

The system requires **flexibility**

No lack of innovations – but what is relevant for the local context?

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We need to map and understand the implications of these innovations for the power sector

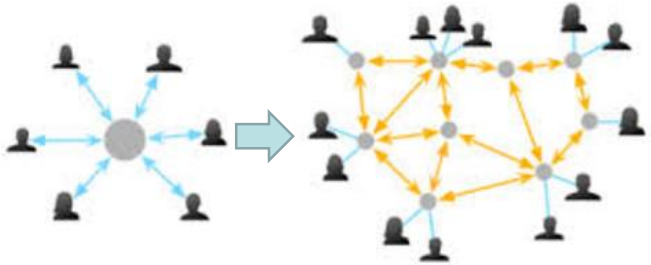
Electrification of other sectors

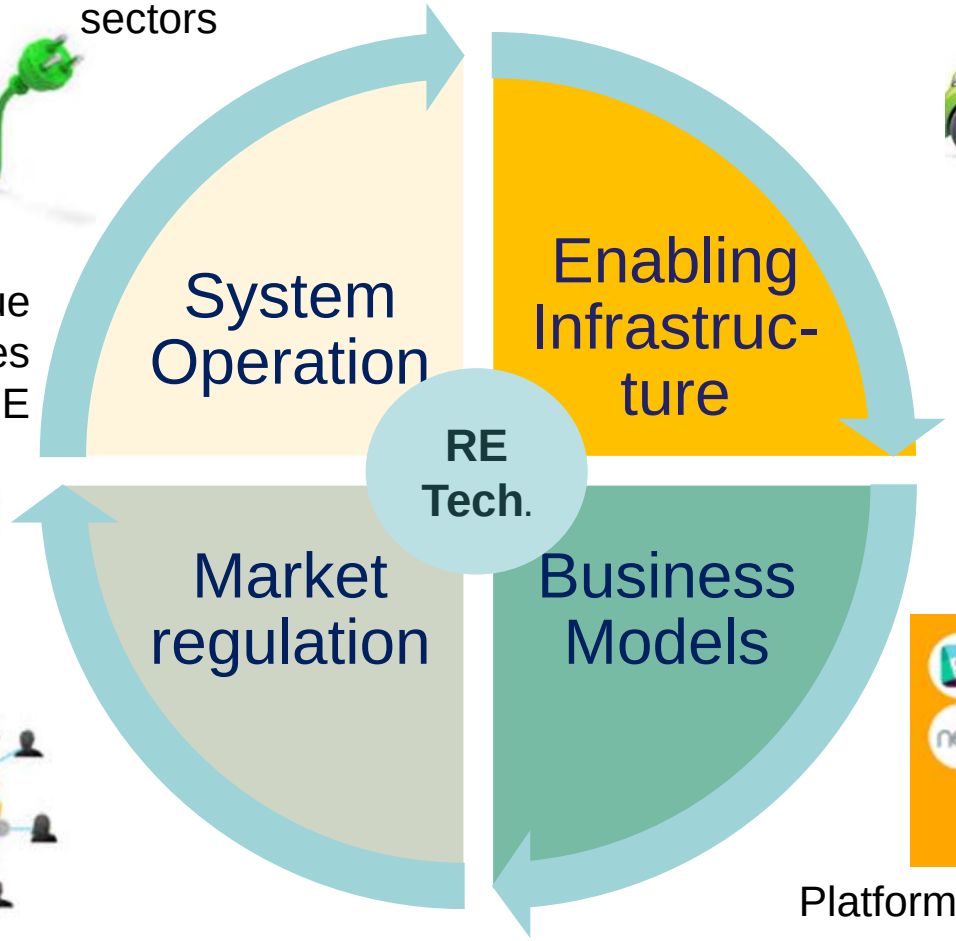
Value spatial complementarities - interconnections

Value complementarities in VRE

Encourage Flexibility

Decentralized system





Electric Vehicles

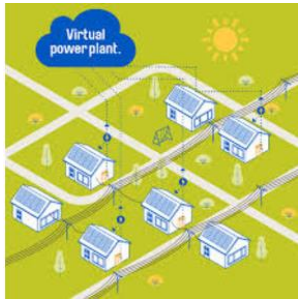
Digitalization - IoT

Platform business model

Storage

Blockchain

Aggregators- VPP



Emerging Innovations Power Sector Transformation – E-mobility

Storage and Electric Vehicles Smart Charging (mobile storage)

Provide flexibility to the grid

Grid Services:

- Primary and secondary reserves:
  - Enhanced Frequency Response
  - Frequency Containment Reserve
  - Frequency Restoration Reserve
- Energy Shifting

Behind-the-meter:

- Solar self consumption
- Community Storage
- Increased Power Quality
- Peak shaving

Grid to Vehicle (G2V):

- Load management: peak shifting

Vehicle to Grid (V2G):

- Primary and secondary reserves
- Other ancillary services
- Energy shifting

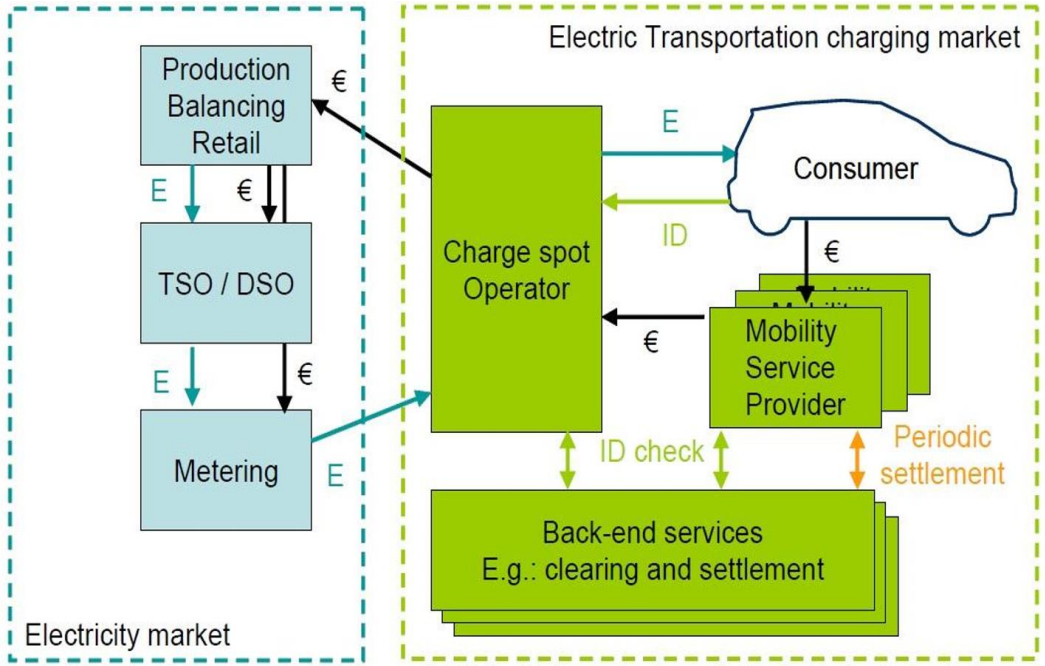
Vehicle to Home (V2H):

- Solar self consumption
- Increased Power Quality
- Peak shaving

But what's needed to implement e-mobility projects? – new roles for stakeholders

E-mobility and smart charging requires the participation of many actors with coordinated responsibilities and roles, contributing to the creation of an e-mobility market, integrated with the electricity market

- DSO have to balance fluctuating power requests and injections from decentralised renewable generation.
- Energy supply retails seek to use smart charging, as a measure to support their power plants portfolio strategy, and as a possible revenue stream coming from ancillary services sold to the DSO



Source: Cired Paper 2011- "Charging electric vehicles in a liberalized electricity market"

- E-Mobility customers' must be engaged
- Charging Spot Operators need considering charging requests from consumers and optimizing their costs based on electricity market signals
- E-Mobility Service Provider requests charging access following requests by their e-mobility customers.

What else is needed? – Adapting regulation

Regulatory adaptations need to take place along the entire supply chain of the power sector

- **Retail market:**
  - KEY: Understand customer behaviour and create awareness of the possibilities to use load management
  - Customer support and empowerment, through efficient price signals or other load management schemes
- **Distribution**
  - Incentivise distribution system operators (DSOs) and electric mobility market participants to invest in smart charging solutions and services, including innovative grid fees, ICT infrastructure financing models, and others
- **Wholesale market**
  - The wholesale processes should be adjusted, so that customers can offer their flexibility to the market, both in terms of stored energy and control reserve services.
  - Aggregators could play an important role here

One more innovation
Blockchain: No middleman

By promoting P2P trading and though emerging cryptocurrencies, blockchain incentivizes growth in decentralized generation

Through smart contracts, blockchain makes distributed grid management easier

Prosumers generate power beyond their needs and feed it into the grid through a blockchain-enabled e meter

The flow of electricity is automatically encoded in the blockchain

Algorithms match buyers and sellers in real time based on preferences and encode smart contracts into blockchain

Smart contracts execute when electricity is delivered, transferring payment in cryptocurrency from buyer to seller

Other nodes in the network verify the transactions

Applied to larger interconnected grids, might lead to:

- No need for retailers
- No need for system operators - If smart contracts secure frequency and voltage control as well as balancing the grid system as a whole

What's needed to implement blockchain in power sector?

- **Hardware**
  - Smart Grid, Smart Metering
  - Multiple Blocks – producers and consumers
  - Traditional processing platforms
- **Software**
  - Blockchain support software
  - Smart Contracts and Cloud platform
- **Communication protocol**
  - Agree and develop common interoperable standards along with data storage and identity, smart contract and record ledger

Continuous approach to build an innovation network for energy transition

Three days conference:

- 200+ experts from public and private sector
- Discussions across the complete innovation life cycle, from R&D to commercialization

Based on ‘real-life’ case studies on emerging non-technology innovations

- Identification of replicable and implementable innovations
- Analysis of case studies, lessons learnt

Track the energy transformation, monitor the progress, map new innovations

We invite you to engage!

Spreading Innovation for the Power Sector Transformation Globally

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Today's session objective:

Better understand the promising innovations that aid the power sector transformation and how this innovations can be replicated and scaled up in other geographical regions in order to accelerate the energy transition

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We invite you to engage!

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