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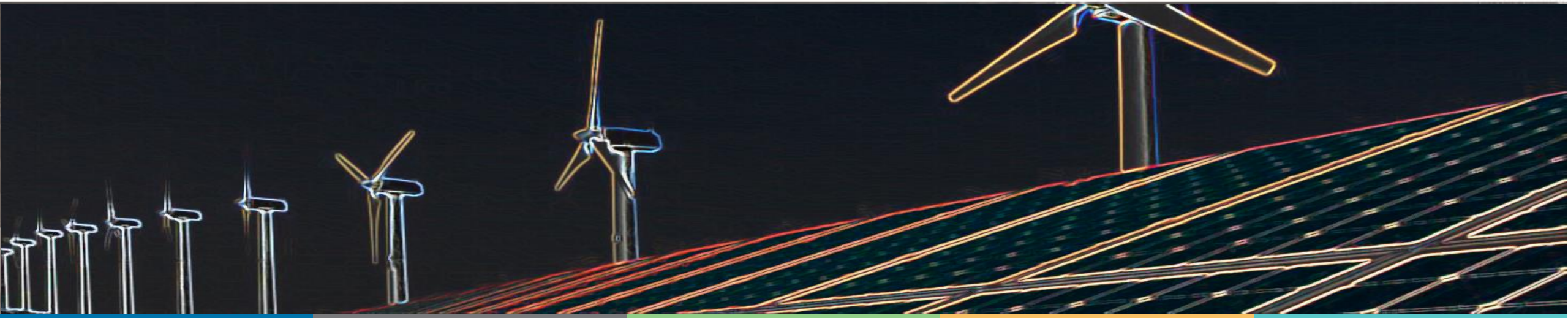


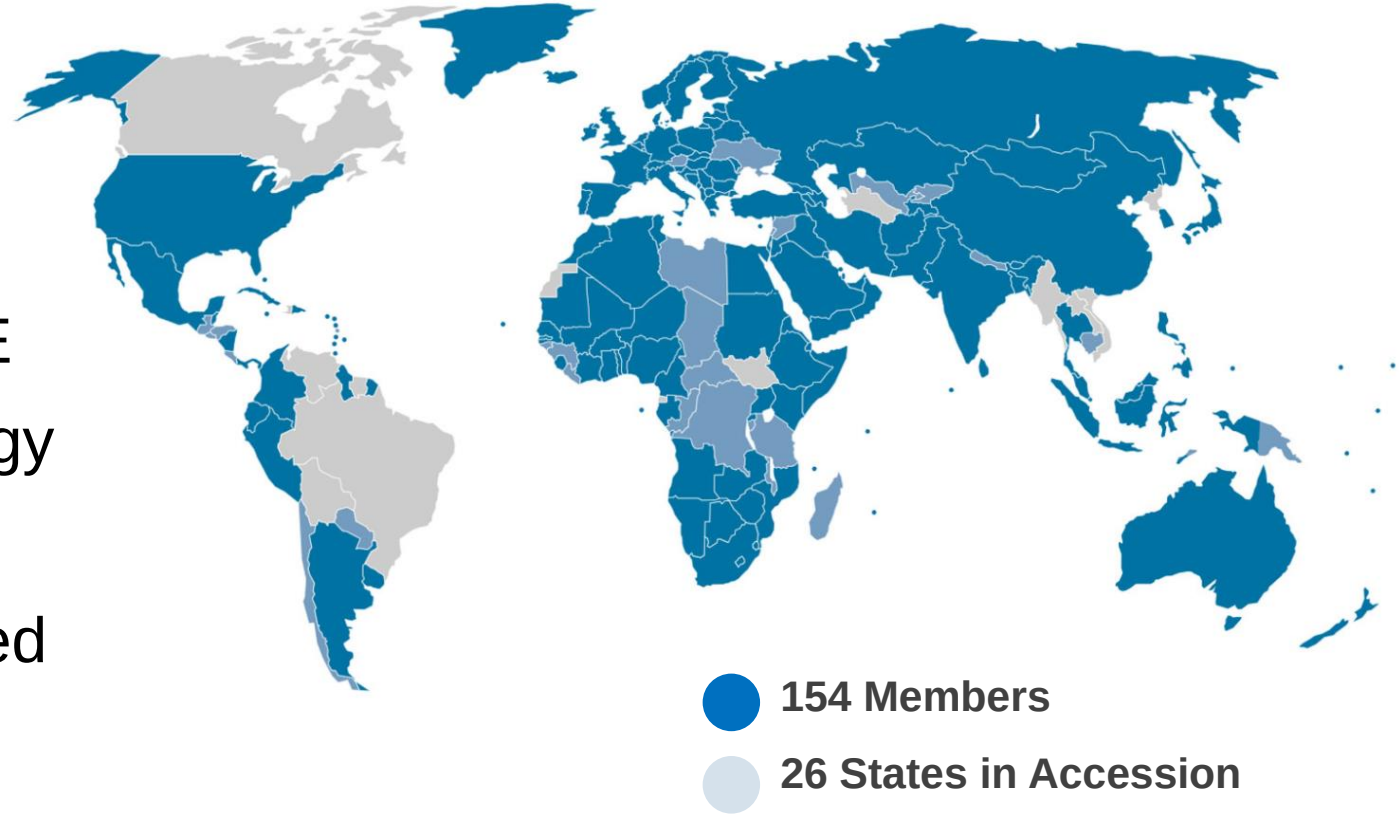
IRENA's perspective on the energy sector transformation Opportunities for Russian in new energy segment

Prof. Dr. Roland Roesch – Deputy Director IITC

AtomExpo Renewable Energy Roundtable
15. May 2018
Sochi, Russia

About IRENA

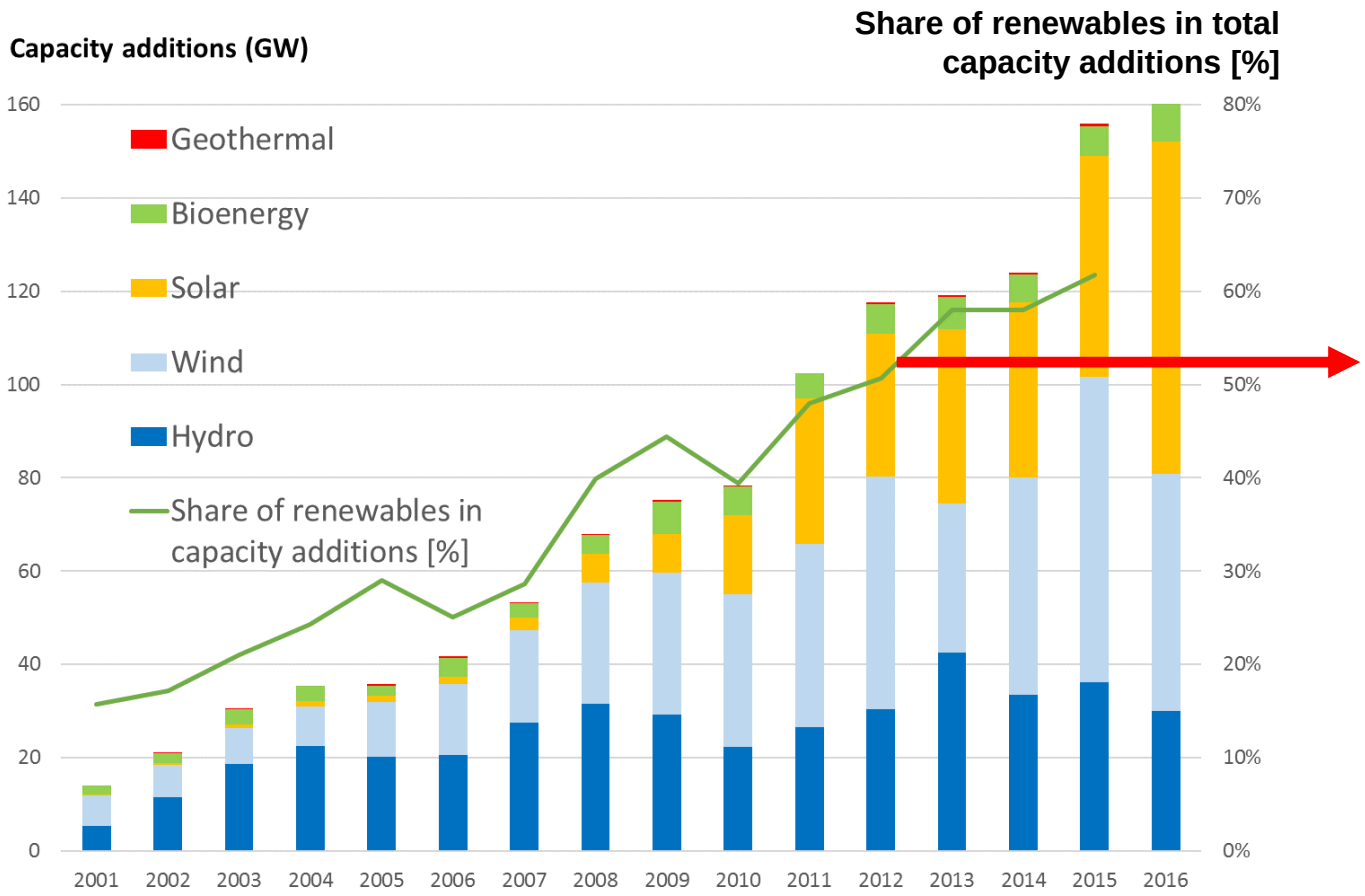
- Inter-governmental agency established in 2011
- Headquarters in Abu Dhabi, UAE
- IRENA Innovation and Technology Centre – Bonn, Germany
- Permanent Observer to the United Nations – New York



Mandate: Assist countries to accelerate renewable energy deployment

1 GLOBAL TRENDS

On-going power sector transformation



Source: IRENA statistics

Since 2012 >50% of total capacity additions

2017

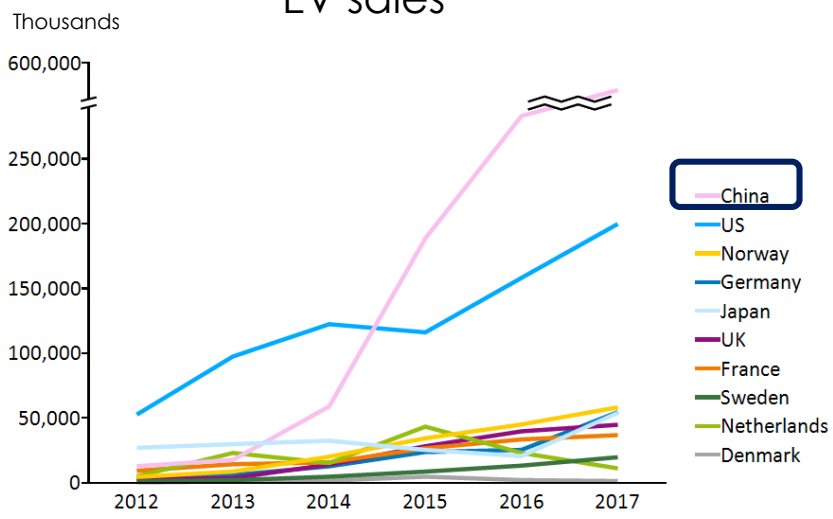
- 95 GW solar PV
- 53 GW wind
- 3 GW biomass

- Around 25% renewable power generation share worldwide
- Growing by 0.7 percentage points per year

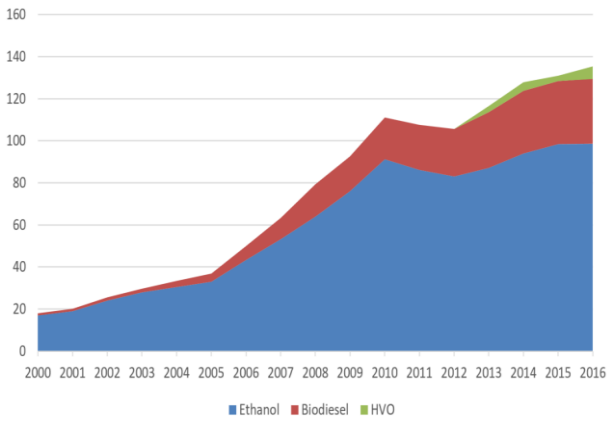
Energy transition in the end use sectors

- Strong growth of electromobility – 1.2 million EVs sold in 2017
- Heat pump sales in the residential sector have been increasing
- New approaches to solar thermal (hybrid systems, storage)
- Corporate sourcing, maximized residential self-consumption
- Sector coupling and Power-to-X
- Continued growth for biogas

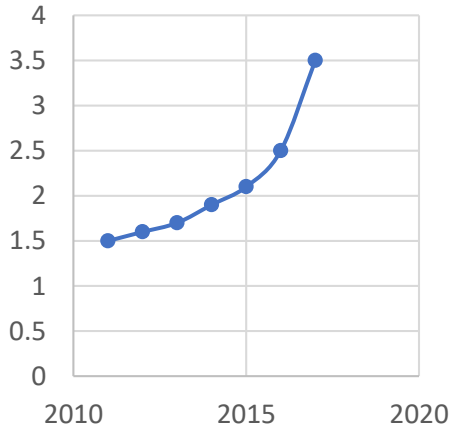
EV sales



Liquid biofuels



Heat pump sales [mln units]



Positive indicators in the end-use sector

2 ECONOMICS

Today's strong business case for renewable power

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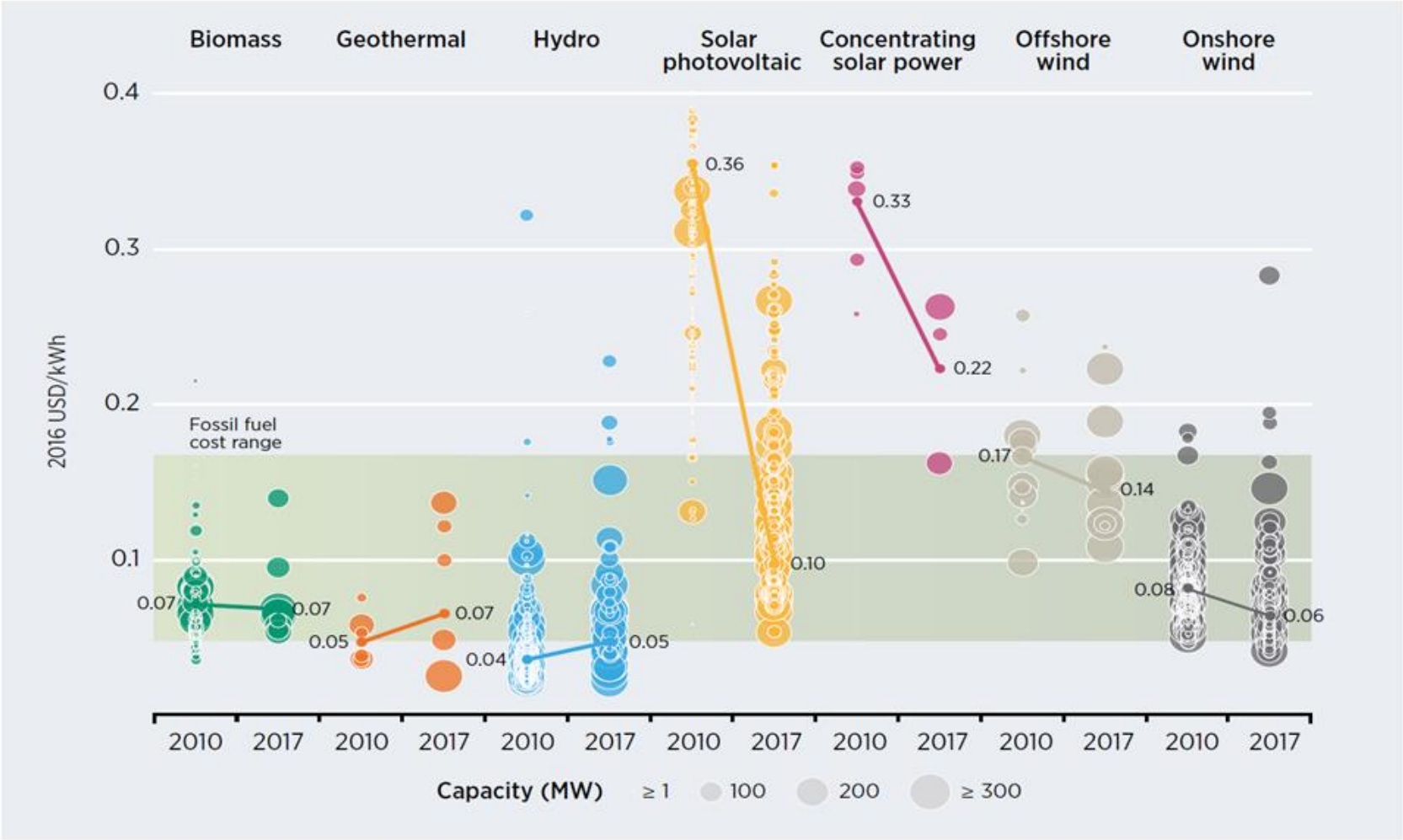
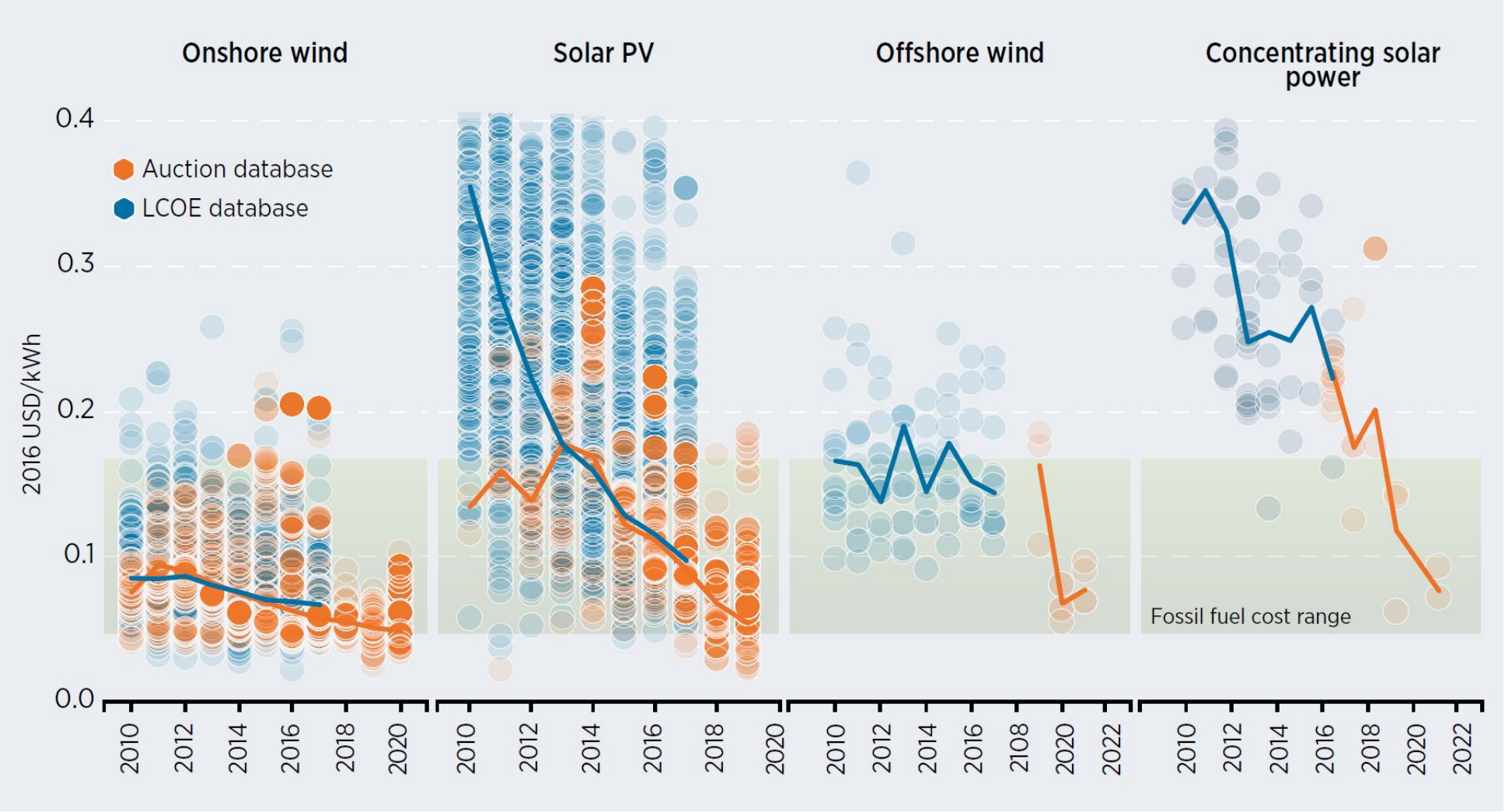
Levelised cost of electricity (LCOE) for renewable power between 2010 and 2016



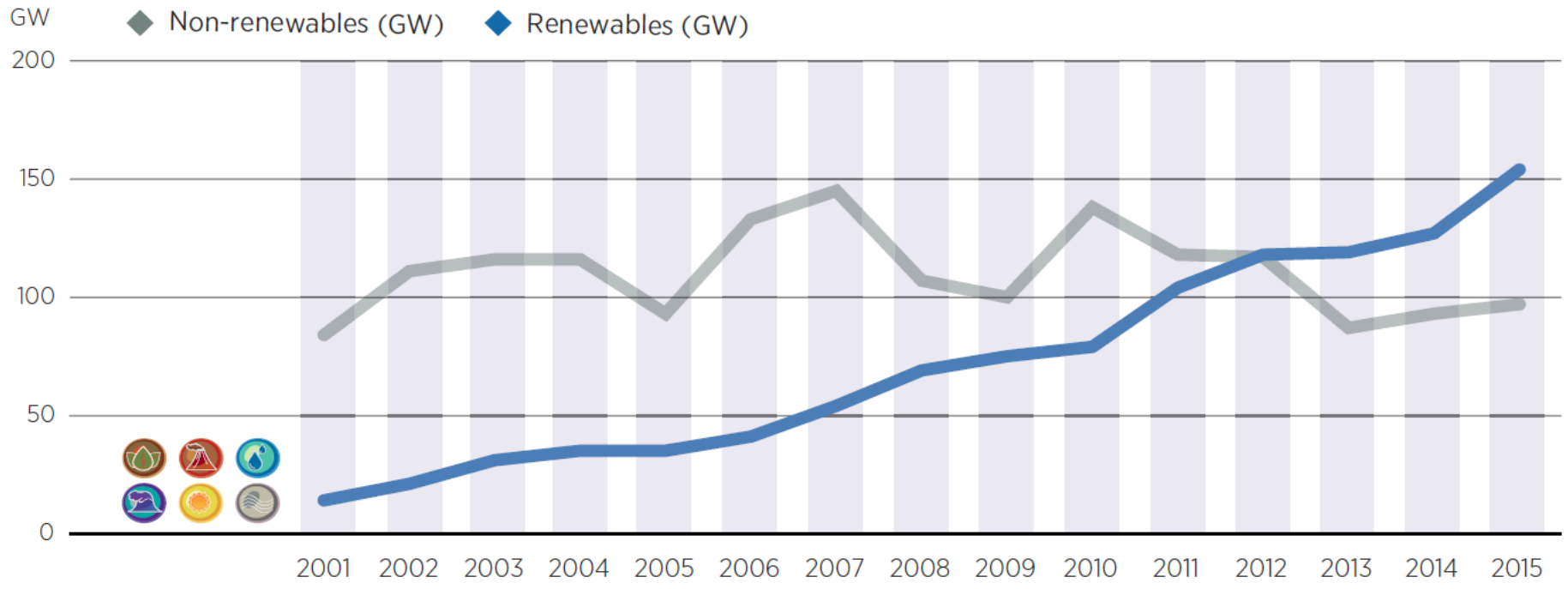
Rapid cost reduction – *PV: 80% reduction in the last 6 years*

Solar & Wind: LCOE/Auction Price Evolution Overview
Continued rapid cost reduction in the coming years



Investments in renewable power have surpassed the ones in fossil fuels

RE represents 60% of the total new capacity investments in the last two years



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Renewables (GW)	14	21	31	35	35	41	54	69	75	79	104	118	119	127	154
Non-renewables (GW)	84	111	116	116	93	133	145	107	100	138	118	117	87	93	97

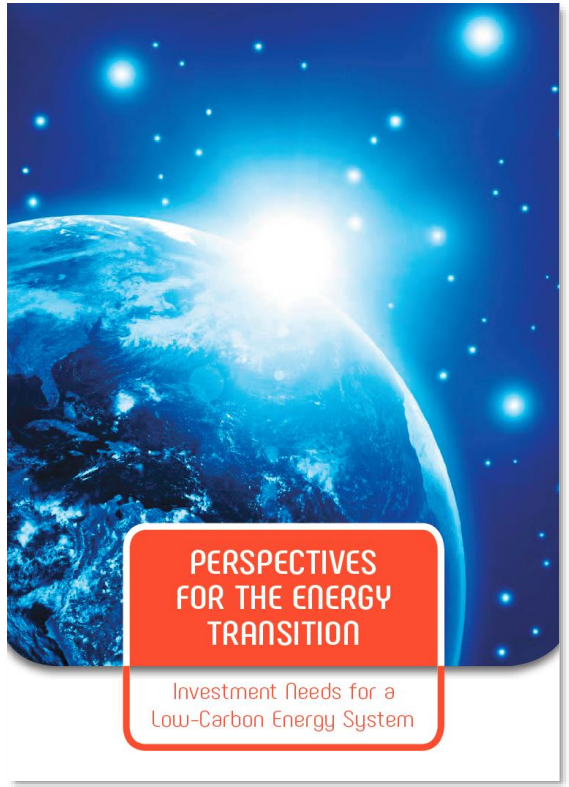
Source: IRENA (2017) Rethinking Energy

2016: **242 USD billion.** Solar PV and wind leading

3 ENERGY TRANSITION NEEDS

Context

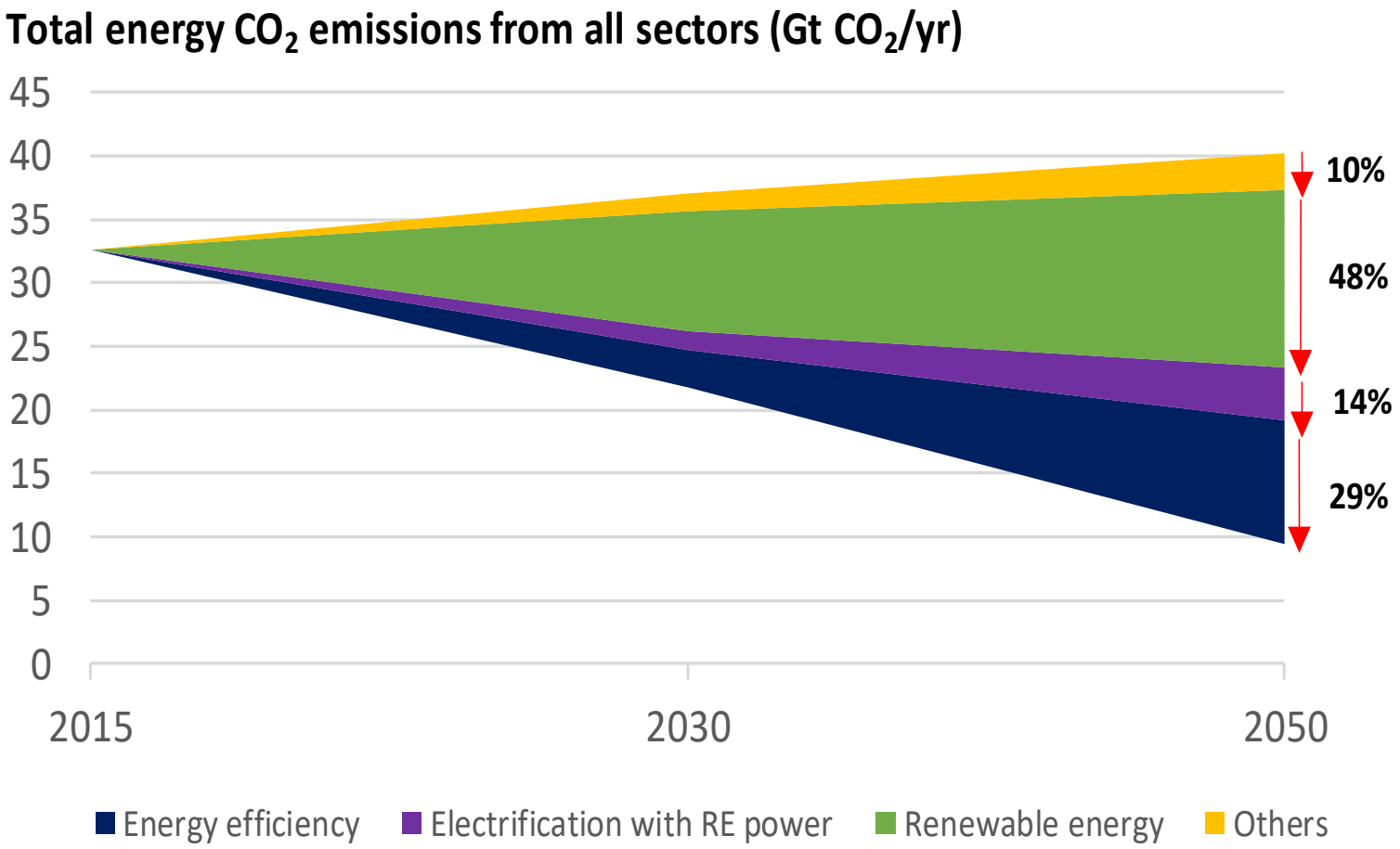
- At the request of the German G20 Presidency
- To inform decarbonization Action Plan discussion in G20
- Study prepared by IRENA in cooperation with IEA
- Publication released March 2017 during Berlin Energy Transition Dialogue



March 2017

Energy accounts for two-thirds of total greenhouse gas emissions

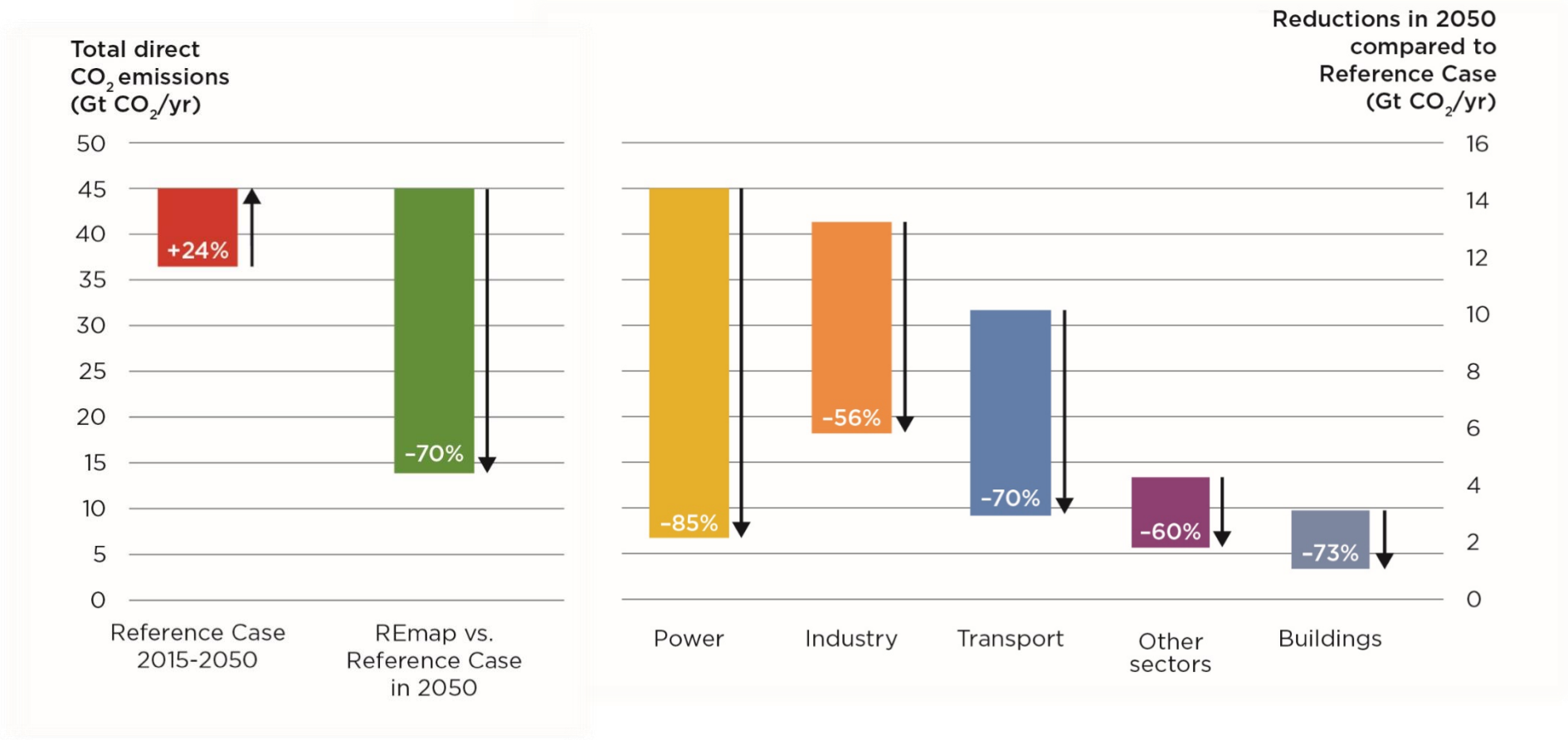
To meet 2°C climate target set at COP 21 in Paris 2015



- Carbon Emissions of energy:
  - needs to fall by 85% in 2015-2050
- Energy-emission budget:
  - 790 Gt CO_2 from 2015 till 2100
  - *At current emissions rate, carbon budget would be consumed by 2040*
  - RE and EE can achieve 90% of emission reductions needed by 2050
  - The growth rate in terms of **renewable share per year will need to increase seven-fold** over past rates

Source: IEA/IRENA (2017) Perspectives for the Energy Transition

CO_2 emissions by sector: REmap relative to the Reference Case

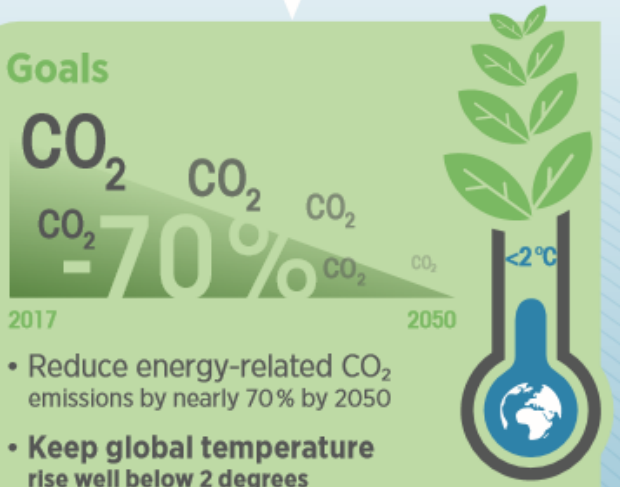


By 2050, total energy-related CO_2 emissions will need to decrease to below 10 Gt. CO_2 emissions from the power and buildings sectors will be almost eliminated.

Industry and transport would be the main sources of emissions in 2050.

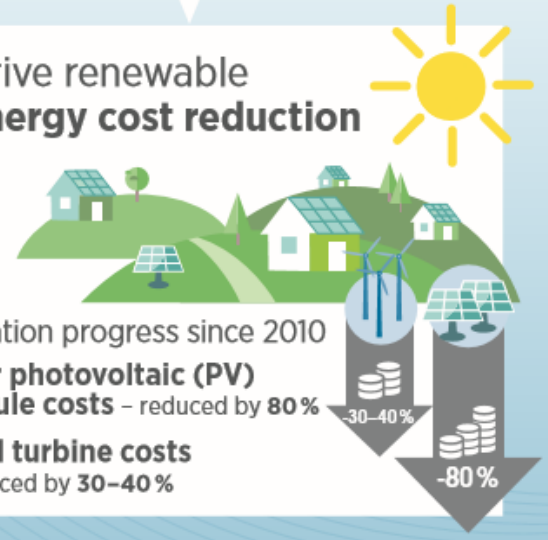
Innovation to Decarbonise the Energy Sector

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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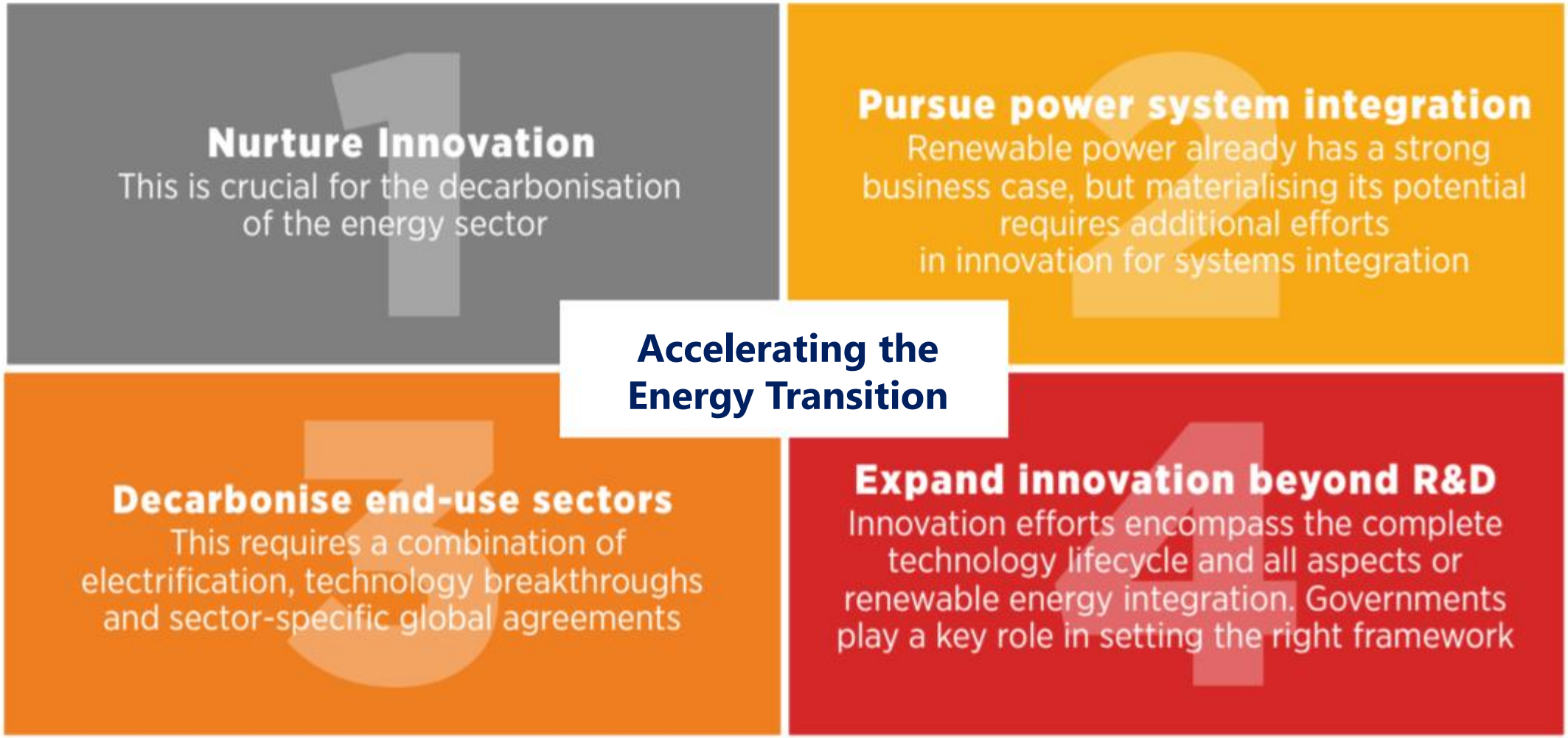
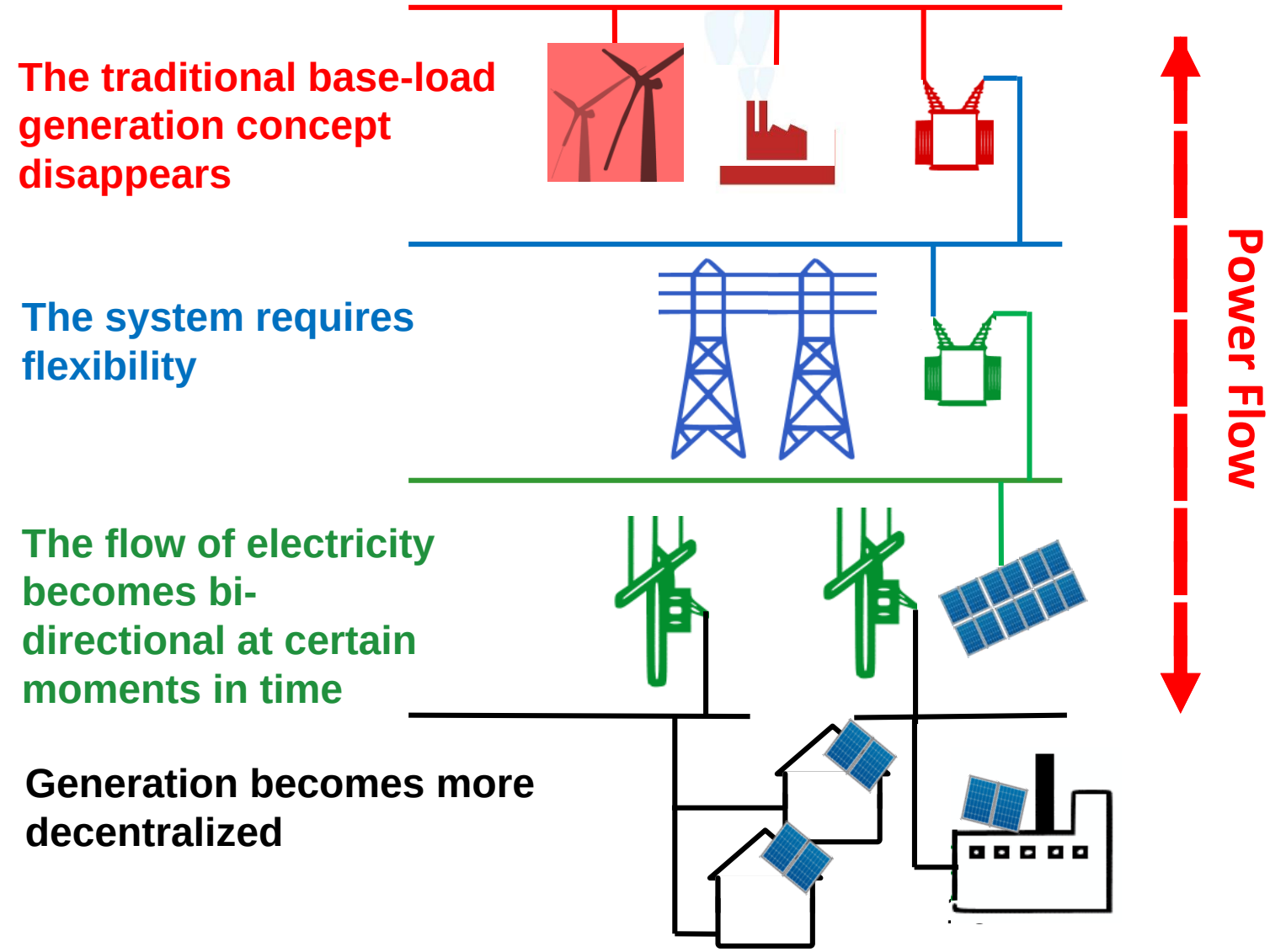
Innovation to decarbonise the energy sector



Source: IRENA (2017) Accelerating the energy transition through innovation

…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



Vision for the Power Sector Transformation

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

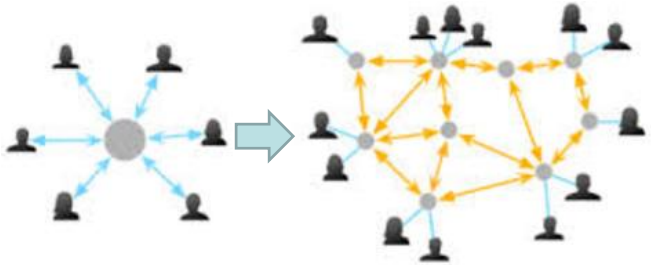
Electrification of other sectors

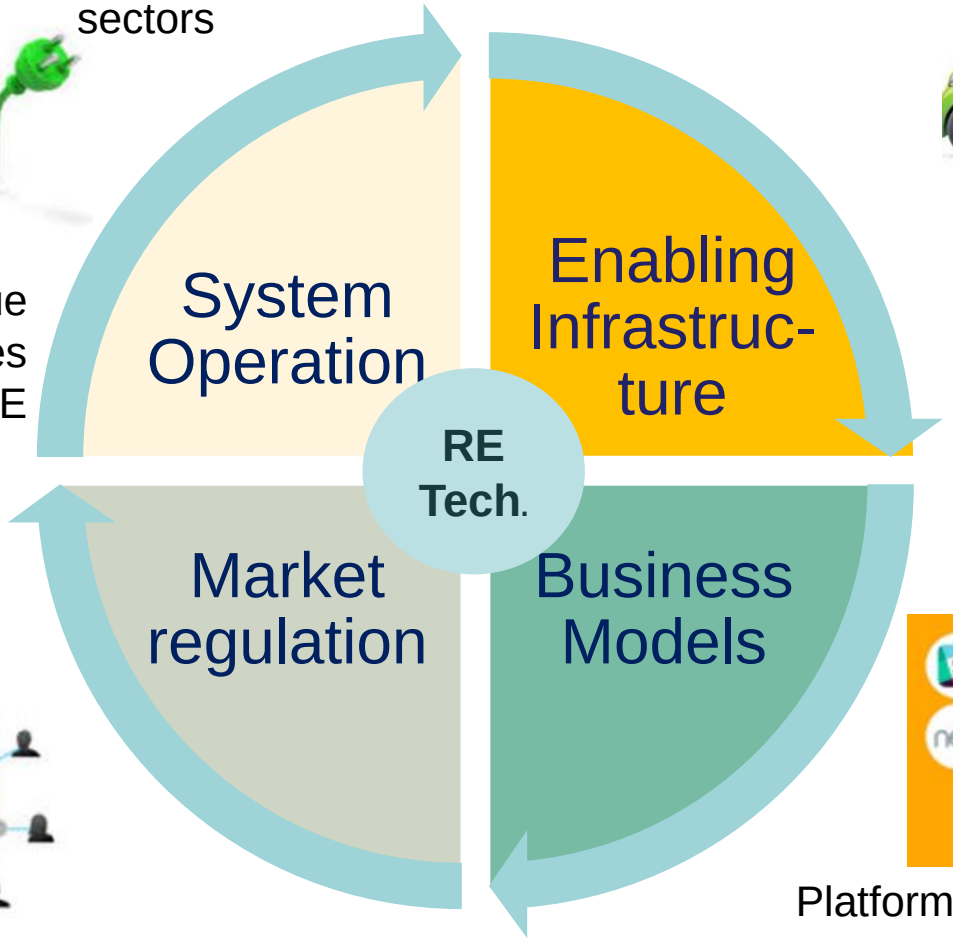
Value spatial complementarities - interconnections

Value complementarities in VRE

Encourage Flexibility

Decentralized system





Electric Vehicles

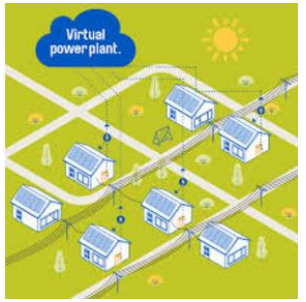
Digitalization - IoT

Platform business model

Storage

Blockchain

Aggregators- VPP



The increasing role of consumer

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The new consumer is also producing, storing, trading energy and managing own load

Distributed generation

Behind the meter storage

Electric vehicles

Smart meters

Digitalisation - Internet of things

Artificial intelligence

Electricity becomes more Decentralised and Democratised

New technologies empower the consumer

Smart Houses : IoT and Artificial Intelligence

- Thermostats, lighting and energy monitoring and controls are increasingly enabled with smart devices that connect with the Internet and can be controlled remotely by smart phones. Adding communication capabilities and remote controls to existing sensors and diagnostics can turn them into an energy management system.
- Artificial intelligence identifies patterns and controls the load, the same way humans would do

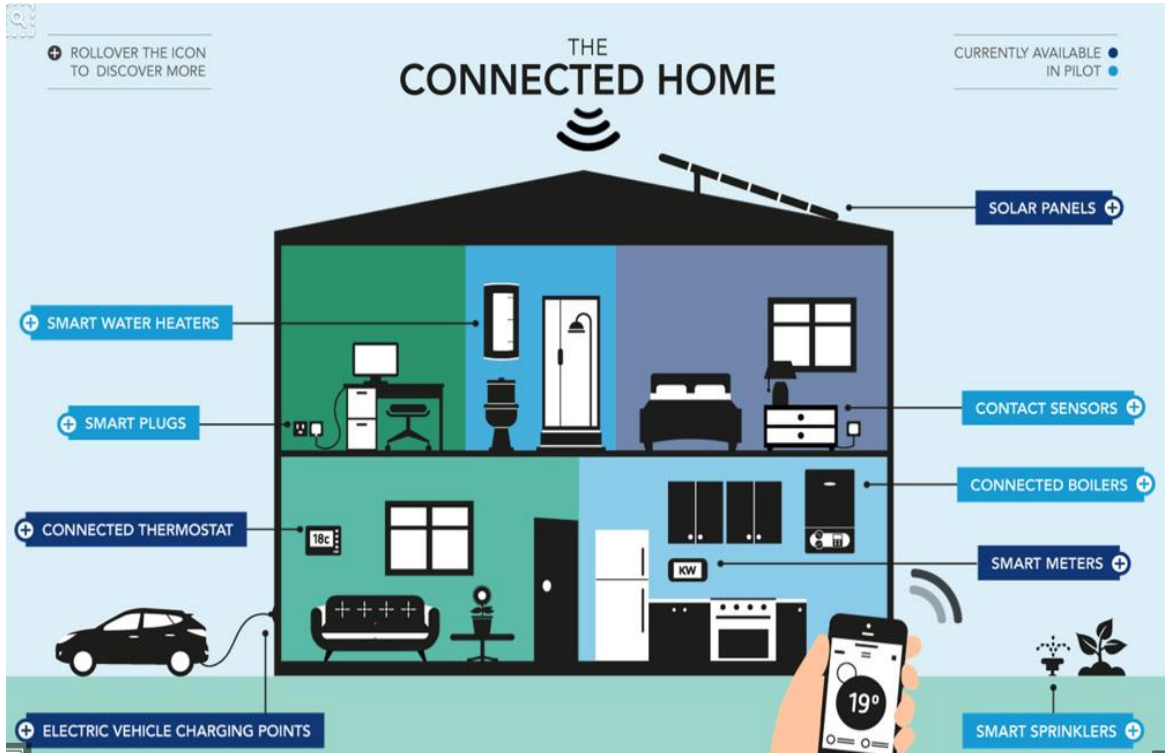


Photo source: https://www.centrica.com/

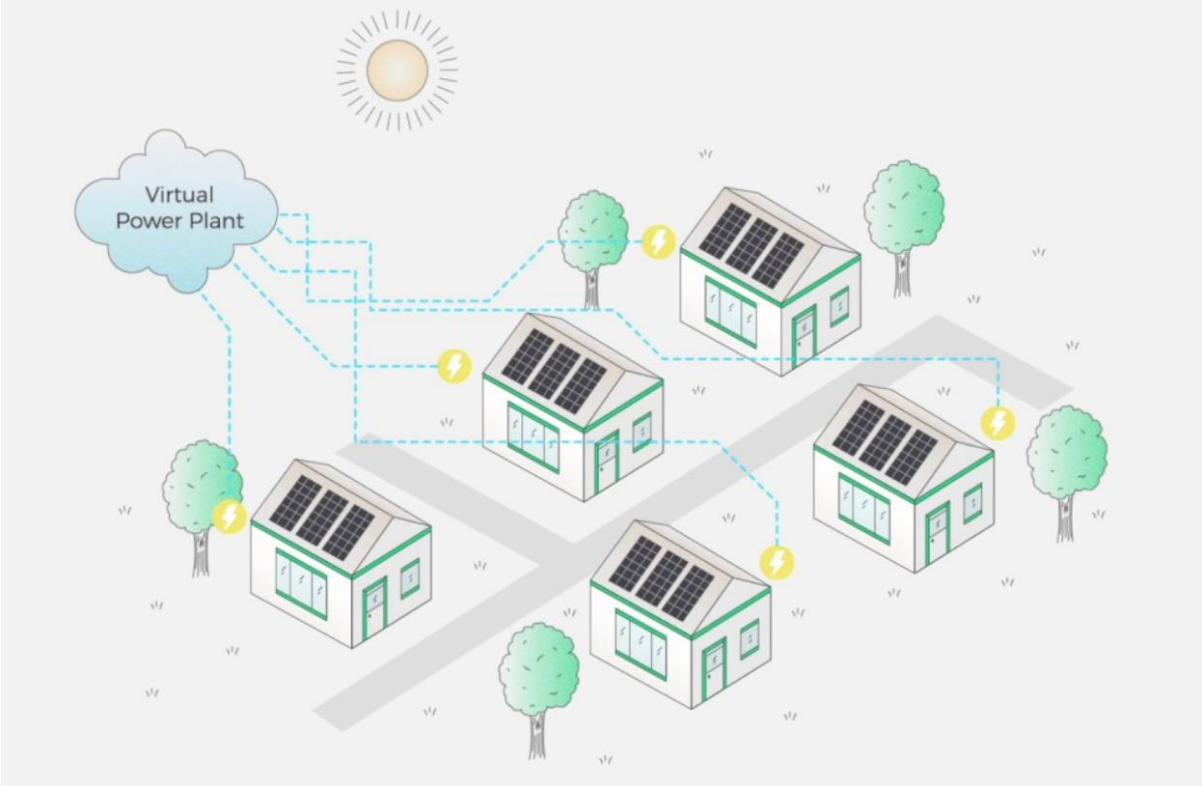
IoT and AI enable demand side management, decreasing consumers' costs by improving energy efficiency and preventing energy waste

New business models empower the consumer

RE aggregator: Virtual Power Plant (VPP)

- VPPs supports distributed RE sources to leverage on the synergies between them and maximize their remuneration
- Virtual power plants allow coordinating previously uncoordinated renewable generation sources. It can provide the much needed flexibility in the system

Aggregators enable distributed technologies (RE plants, storage) to participate in the energy market

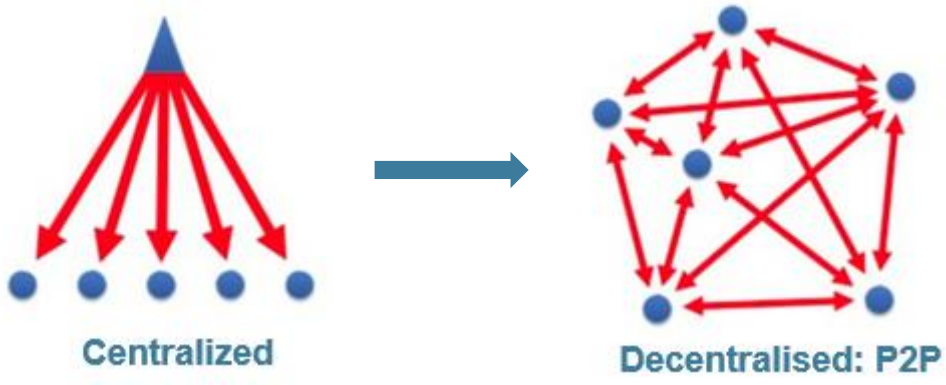


Examples: Next Kraftwerke (Germany, Belgium), CrowdNett project (Eneco Netherlands)

New business models empower the consumer

Peer to peer trading

- Also known as Uber or Airbnb of energy, the platform allows local generators of distributed energy to sell their excess energy at the desired price.
- With increasing number of smart devices, digitalization and increasing distributed generation, platform based models should see a huge potential in terms of market size and demand in the near future.



Platform based model promote Peer to Peer trading, offering a market place for distributed generation

Examples: PowerPeers (Vattenfall in Netherlands), Solar Coin, E.On Cloud Storage

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

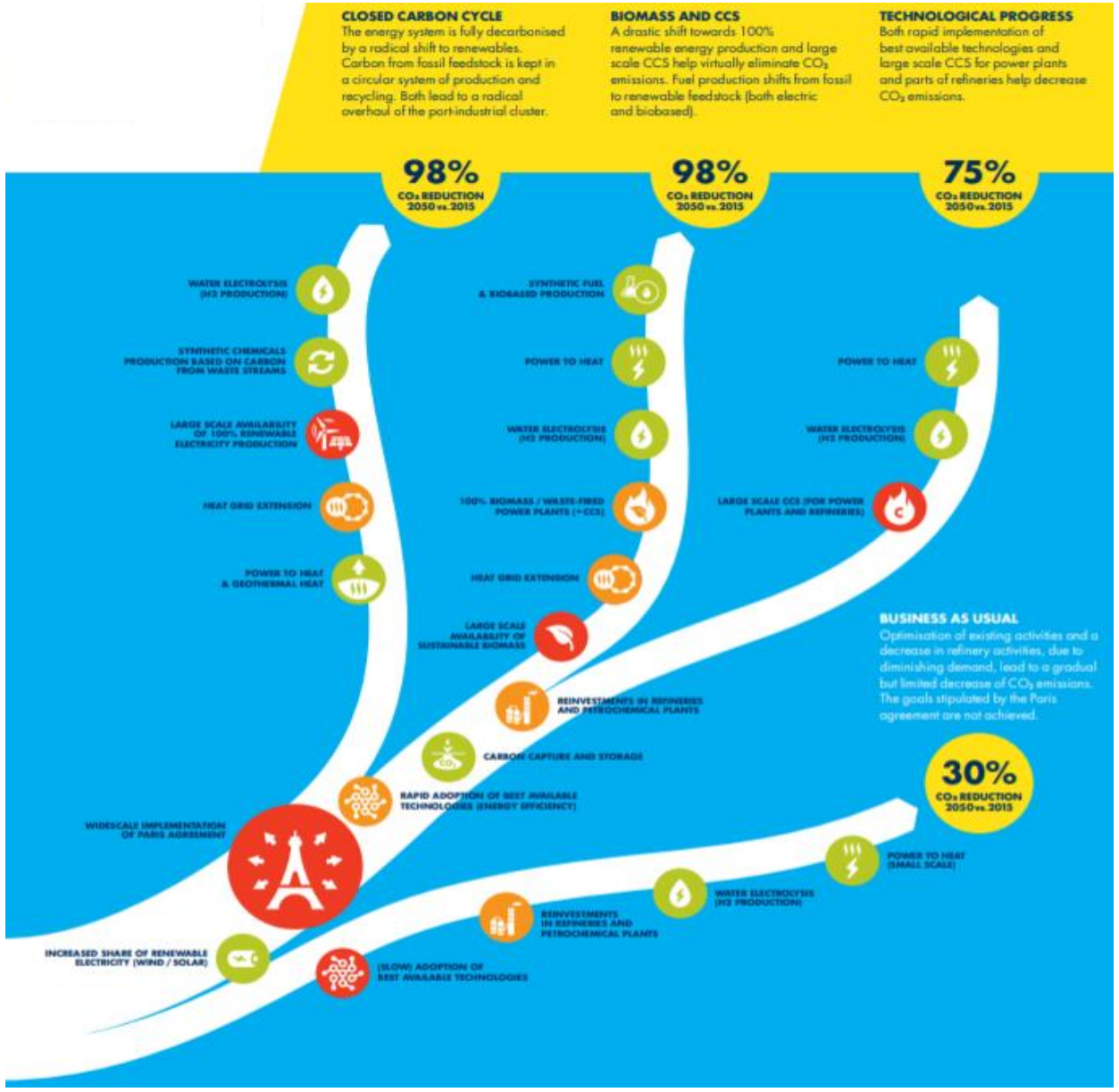
Other nodes in the network verify the transactions

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

4 ENERGY TRANSITION BRINGS NEW BUSINESS OPPORTUNITIES

Energy transition brings new business and industry opportunities



Example: Port of Rotterdam

Assessment of different pathways to decarbonise the Port of Rotterdam while creating new industry development opportunities around those. Opportunities include:

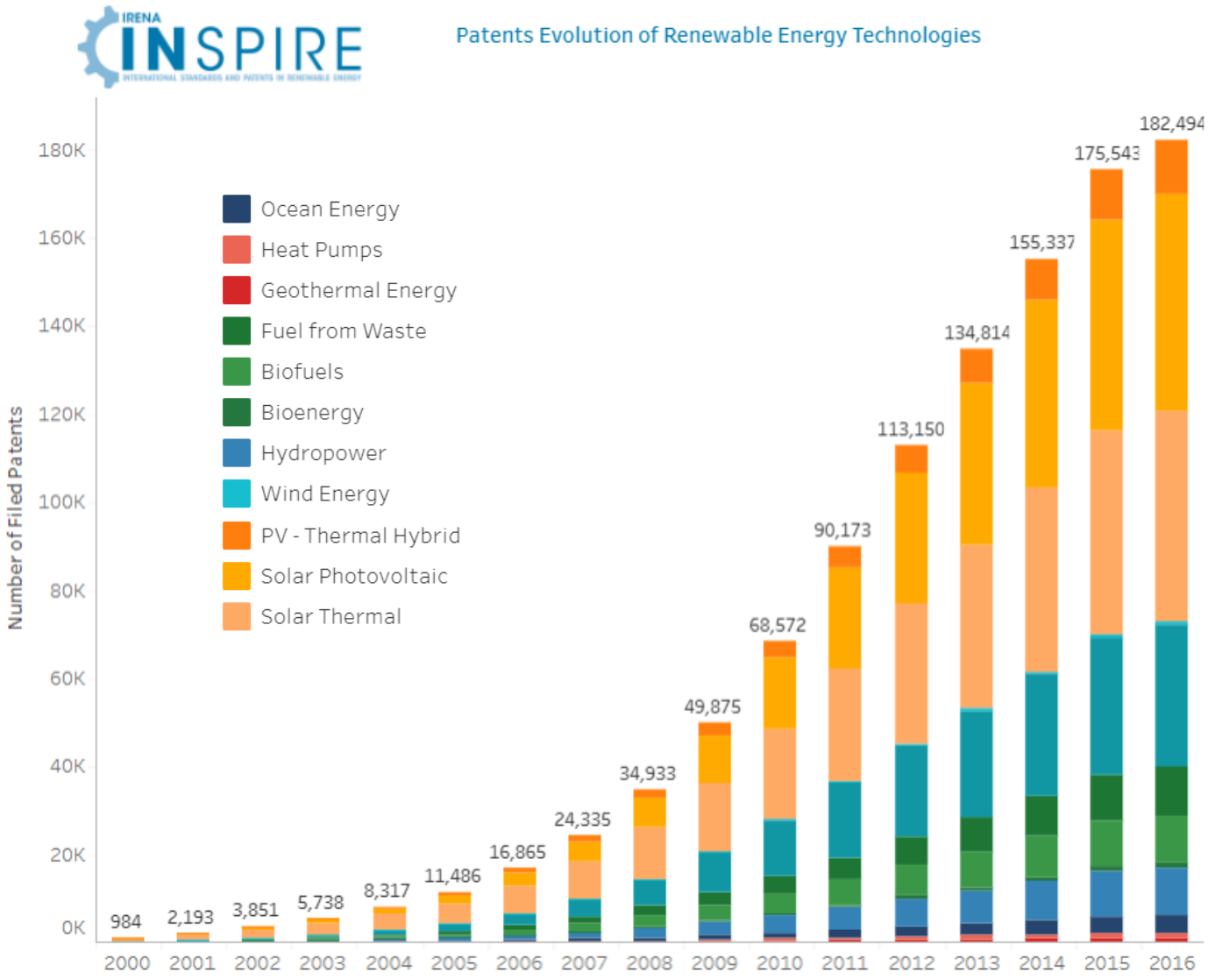
- Bio-based chemistry
- Offshore wind
- Energy storage
- CO_2 transport and storage
- Synthetic fuel production

Investments:

Source: https://www.portofrotterdam.com/en/the-port/energy-transition/bio-based-economy

Patent Activity in China

- Today there are almost **600 000** patents in Renewable Energy
- Solar, wind and bioenergy accounts for **90%** of the patents in renewable energy
- In 2016, China filed **30%** of renewable energy patents globally
- Significant increase in the last decade, **10 times** more patents in comparison to 2006
- China presents more than half of the patents in **Solar Energy**; the major share is in solar PV, followed by solar thermal



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!

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We invite you to engage!

Roland Roesch: rroesch@irena.org

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Arina Anisie: aanisie@irena.org

www.irena.org

New technologies empower the consumer

Smart houses – how to implement?

Hardware

- Smart meters
- Sensors
- Supercomputers
- Other digital technology to convert the electricity grid from servo mechanical to digital connectivity to manage multiple sources of energy flowing to the grid from local generators

Software

- Optimization tools

Communication protocol:

- Agree and develop common interoperable standards (both at physical and ICT layers)

Regulation is key for demand-side management

Retail market

- Efficient, real-time price signals that reflect the cost of the participation of each agent to the electricity market

Distribution

- Incentivise distribution system operators to invest in smart grids and other digital solutions

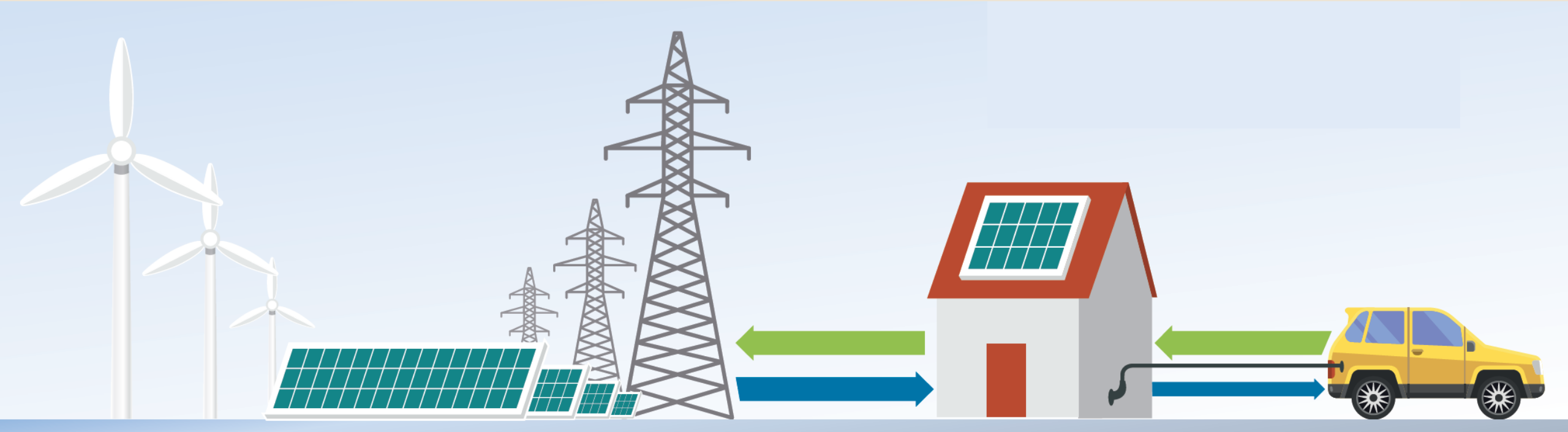
Other policies

- To ensure cybersecurity, data security, avoid misuse of data

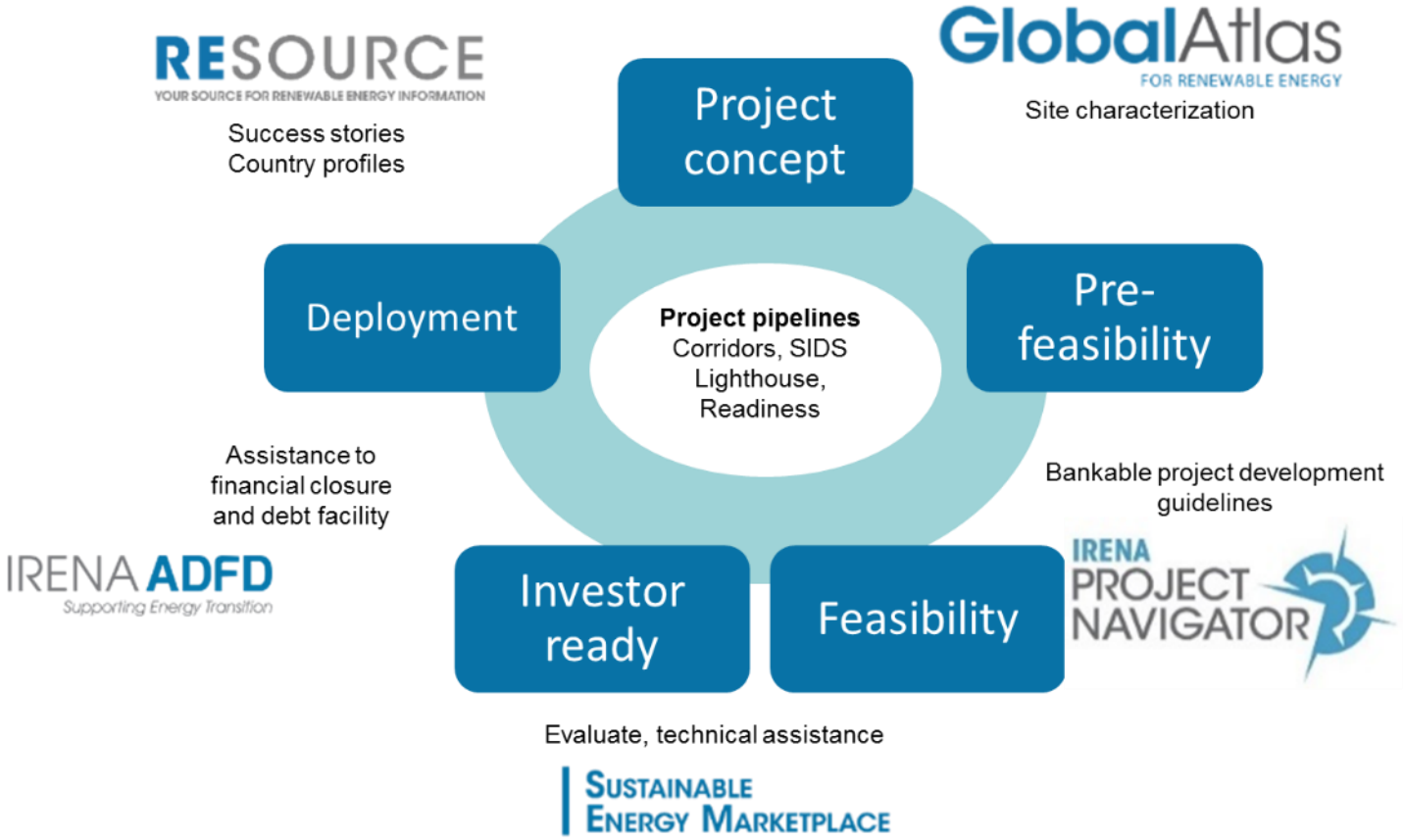
Some take aways

Technological innovations push towards a decentralisation and democratisation of energy, while market designs need to adapt and enable innovative business models emerge

Consumers' role is increasing: their behaviour is key!



IRENA Project facilitation platforms



Access the Project Navigator!

www.irena.org/navigator