



Hydrogen – From the Molecule to Business

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Hydrogen Economy

- Business Today & Tomorrow
- Value Chain
- Enablers

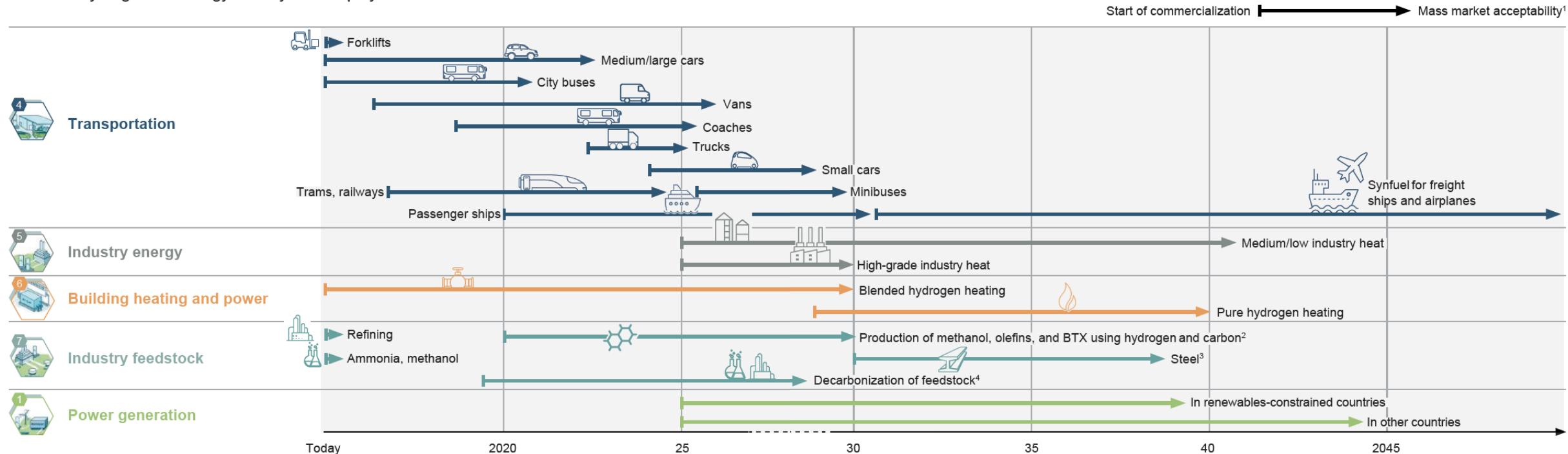


- Hydrogen technology is not new
- Production & consumption of hydrogen: > 55 Mt
- In wide range of industrial processes



Hydrogen applications ready to be deployed

Exhibit 7: Hydrogen technology is ready to be deployed



1 Defined as sales >1% within segment in priority markets

2 Market share refers to the amount of production that uses hydrogen and captured carbon to replace feedstock

3 DRI with green hydrogen, iron reduction in blast furnaces, and other low-carbon steel making processes using hydrogen

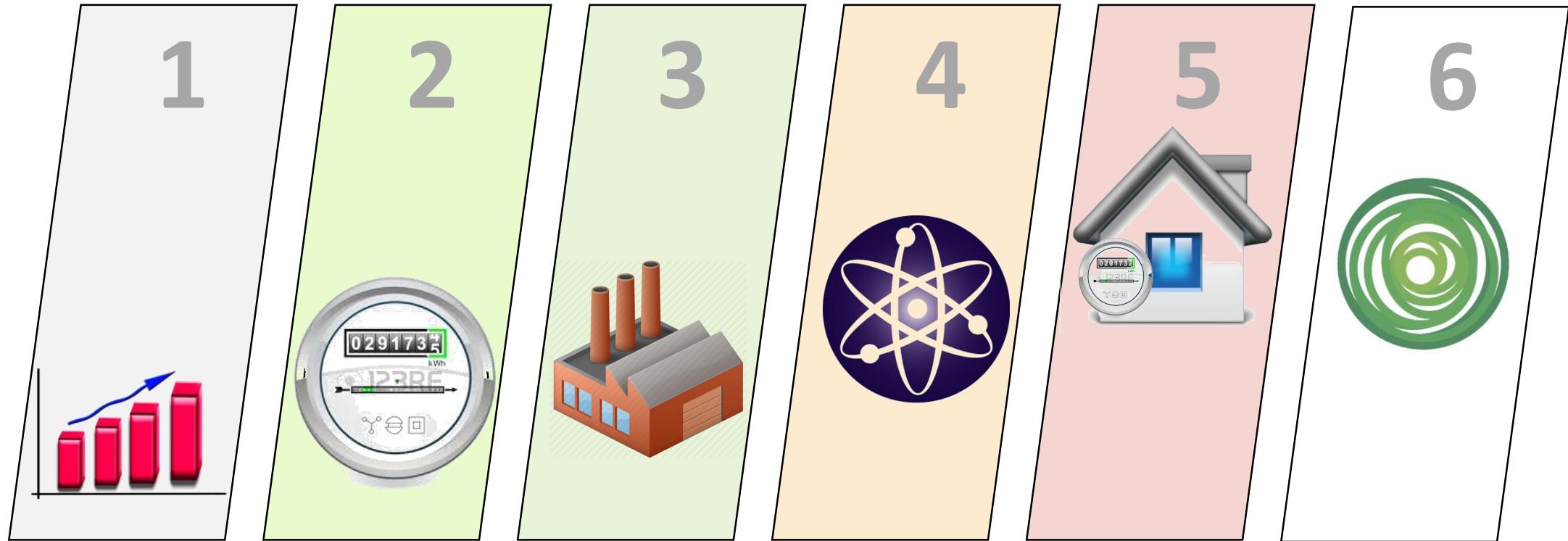
4 Market share refers to the amount of feedstock that is produced from low-carbon sources

SOURCE: Hydrogen Council

Source: Hydrogen Council



Paradigm shifts – Here: Power Generation



Business
Model

Revenue
Model

Generation

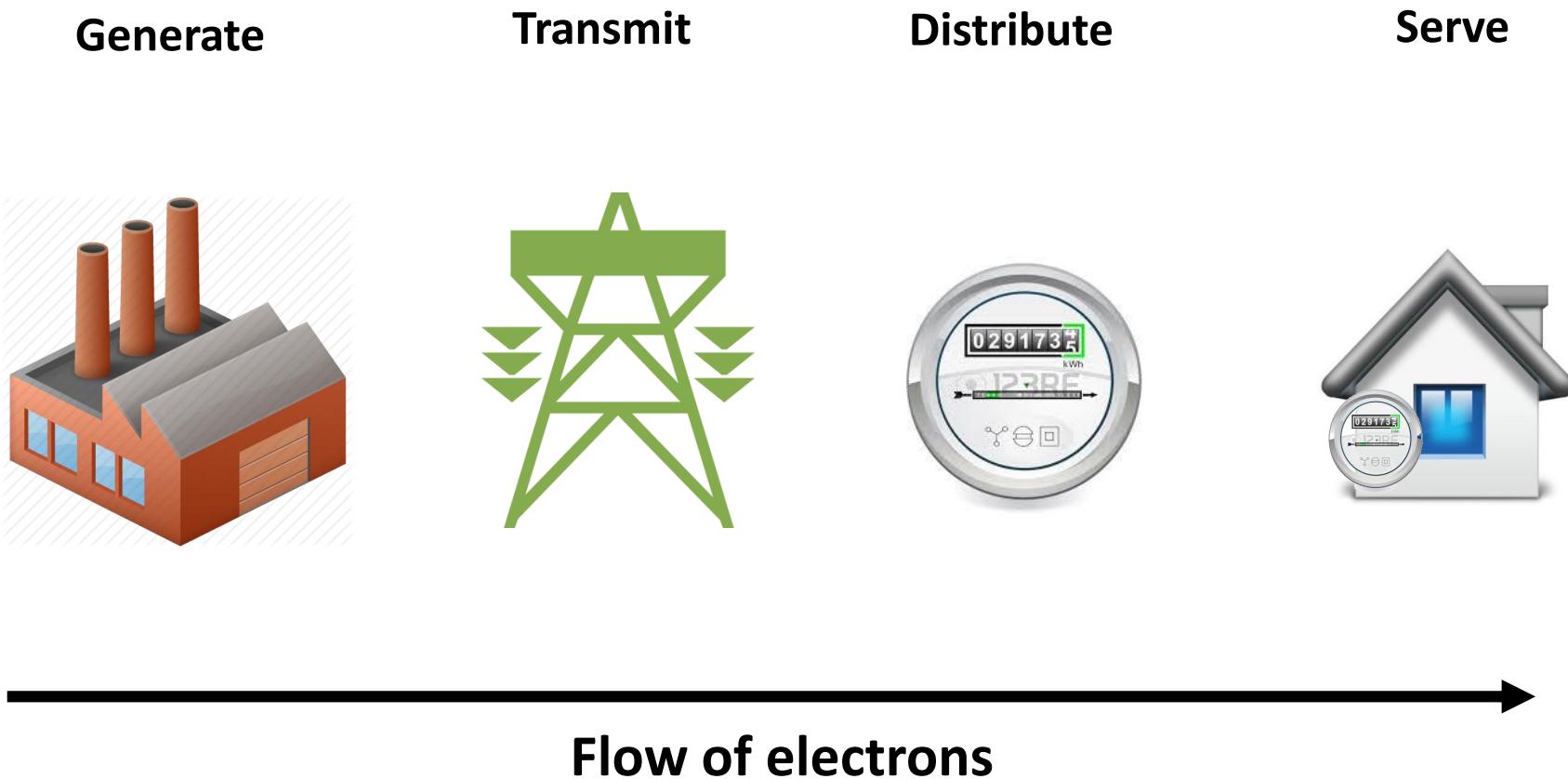
Science of
Hydrogen

Customer

Eco
System



Traditional utility model

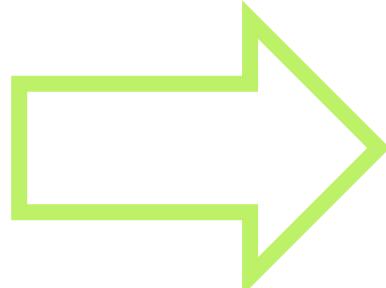


Paradigm shift: Generation

Emergence of Distributed Energy Resources



**Large scale,
fossil fuel-based,
centralized generation**



**Small scale, renewables
distributed generation**



European
Commission



Smart grid basics

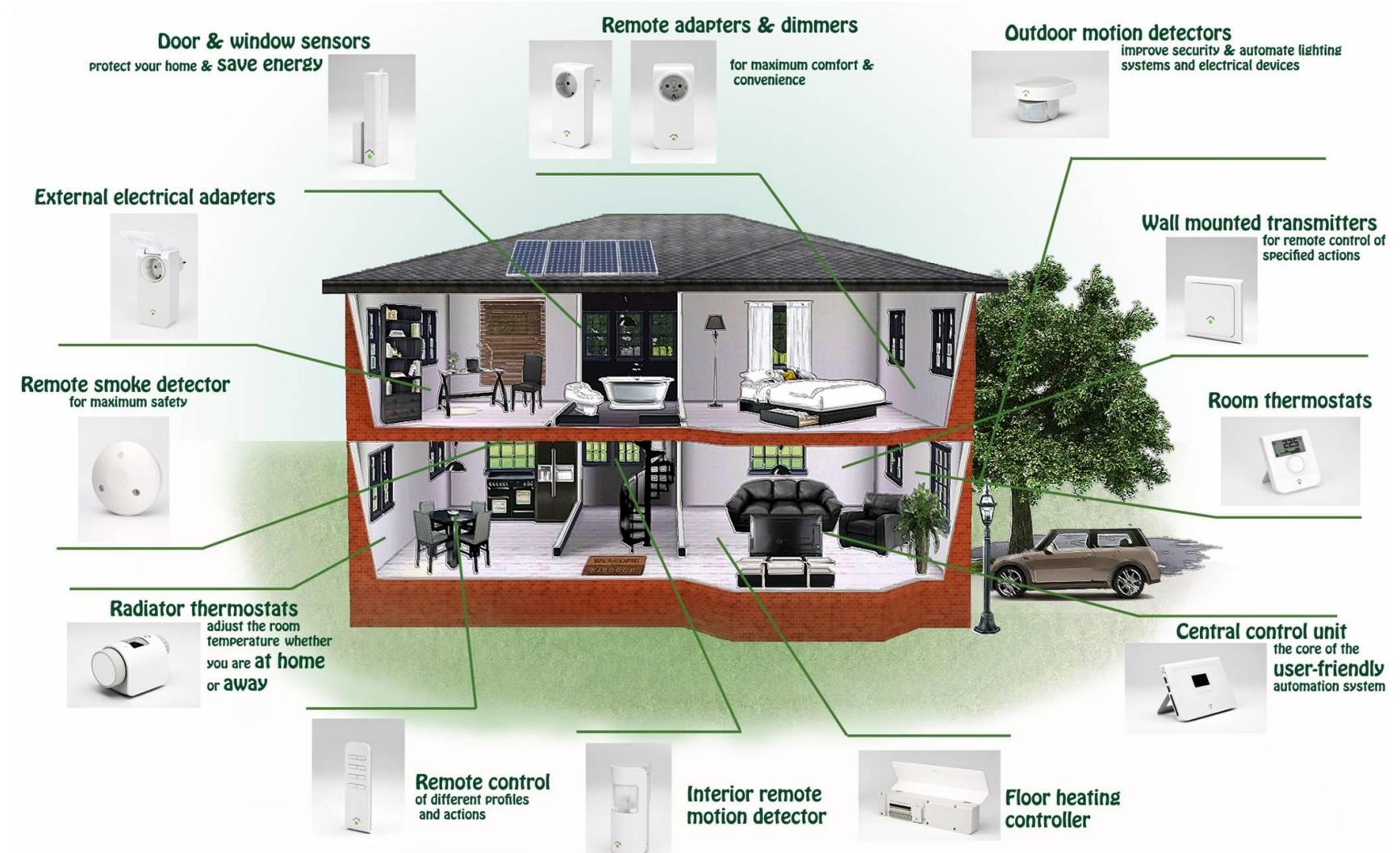
Bi-directional electron flow + information about the electrons



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Internet of Things and Smart Devices



Technological evolution

Over the past 10 years, we have seen technological advances in the energy space that are fundamentally changing what is possible to do...

Smart Grid

- › Grid infrastructure advances enabling two-way communication between things connected to the grid and the utility

Distributed Energy Resources (DERs)

- › Smart devices (thermostats, water heaters, in-home energy displays, ...)
- › Distributed generation (both small- and large-scale) – solar, wind, biomass, tidal, ...

Advanced Tele-communications

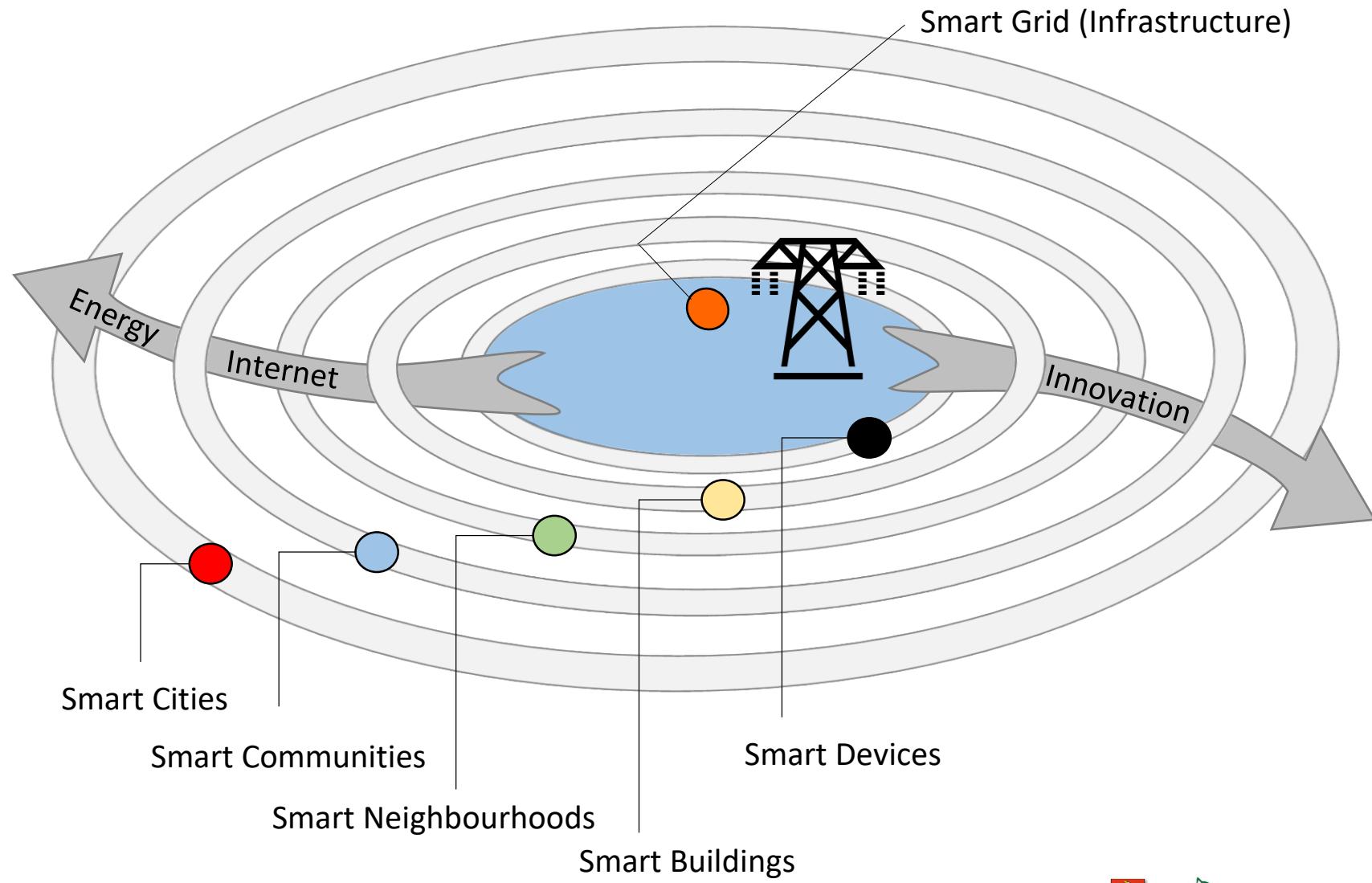
- › High-speed, standardized, connections
- › Real time sensors
- › Wireless connectivity
- › Internet of Things

Grid Management

- › Virtual power plants
- › Distribution
- › Advanced outage management
- › Automatic connect/disconnect
- › Big data analytics



Innovation opportunities abound



European
Commission



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Enablers

- Technologies, ready for roll out
- Customer need = demand
- Entrepreneurs & companies willing and capable to exploit those technologies
- Legal framework & regulations



Business Cluster - Hydrogen

- Business opportunities
- Think global, act local
- Community as strategy and driver
- Communication





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