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PANEL
ENERGY/BIO

Energy Efficiency Planning and Green Energy

MODERATOR:
Michael Byalsky, The Hebrew University of Jerusalem, Israel

Ideas | Overview

- http://www.ashoka.net/knowledgebase/energyefficiencykb.html
- **Energy efficiency has proved to be a cost-effective strategy for building economies without necessarily increasing energy consumption**
- Rocky Mountain Institute:
  "…there are abundant opportunities to save 70% to 90% of the energy and cost for lighting, fan, and pump systems; 50% for electric motors…"

Some visions

What is Energy Efficiency?

http://www.ashoka.net/knowledgebase/energyefficiencykb.html

- **There are many definitions of Energy Efficiency put forth by various organizations. Some of these definitions are provided below:**
- **Energy Efficiency refers to programs that are aimed at reducing the energy used by specific end-use devices and systems, typically without affecting the services ...** www.pplweb.com/glossary.htm
- **Energy efficiency refers to products or systems designed to use less energy for the same or higher performance than regular products or systems ...** www.mtpc.org/cleanenergy/energy/glossaryefficiency.htm
- **Refers to products or systems using less energy to do the same or better job than conventional products or systems. Energy efficiency saves energy, saves money on utility bills, and helps protect the environment by reducing the demand for electricity ...** www.epa.gov/greenpower/whatis/glossary.htm

Perspective

- http://ec.europa.eu/energy/en/topics/energy-efficiency
- **“The EU has set itself a 20% energy savings target by 2020 when compared to the projected use of energy in 2020 – roughly equivalent to turning off 400 power stations.”**
- **“At an EU summit in October 2014, EU countries agreed on a new energy efficiency target of 27% or greater by 2030.”**
- **“According to the Energy Efficiency Communication of July 2014, the EU is expected to achieve energy savings of 18%-19% by 2020 – missing the 20% target by 1%-2%. However, if EU countries implement all of the existing legislation on energy efficiency, the 20% target can be reached without additional measures. "**

Panelists

Moderator

Michael Byalsky, The Hebrew University of Jerusalem, Israel

Panelists

- Steffen Fries, Siemens AG, Germany

  [Importance of data integrity and confidentiality for Demand/Response Systems, basically addressing the need for protection of metering information and control data between a control center (could be a virtual power plant) and the decentralized energy resources]

- Antonio Moreno-Munoz, Universidad de Cordoba, Spain

  [Energy customers versus ratepayers: implications and possible evolution]

- Vanesa Cackovic, Ericsson Nikola Tesla d.d., Croatia

  [The communication part of the future smart grids is something that if of interest to me: meaning that lots of new energy sources and new behavior of current entities will introduce new demands for communication technologies and lots of non-linearity in the network, so the communication part is one very important aspect to make the whole smart grid network working properly]

- Florian Maier, Fraunhofer Institute for Industrial Engineering IAO, Germany

  [I suggest to contribute something to the topic of the relevance of sensordata for energy management systems and technical prerequisites for collecting huge amounts of sensor data]

Open discussion

Discussion

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The Cyber Security Cornerstone in Smart Energy Systems

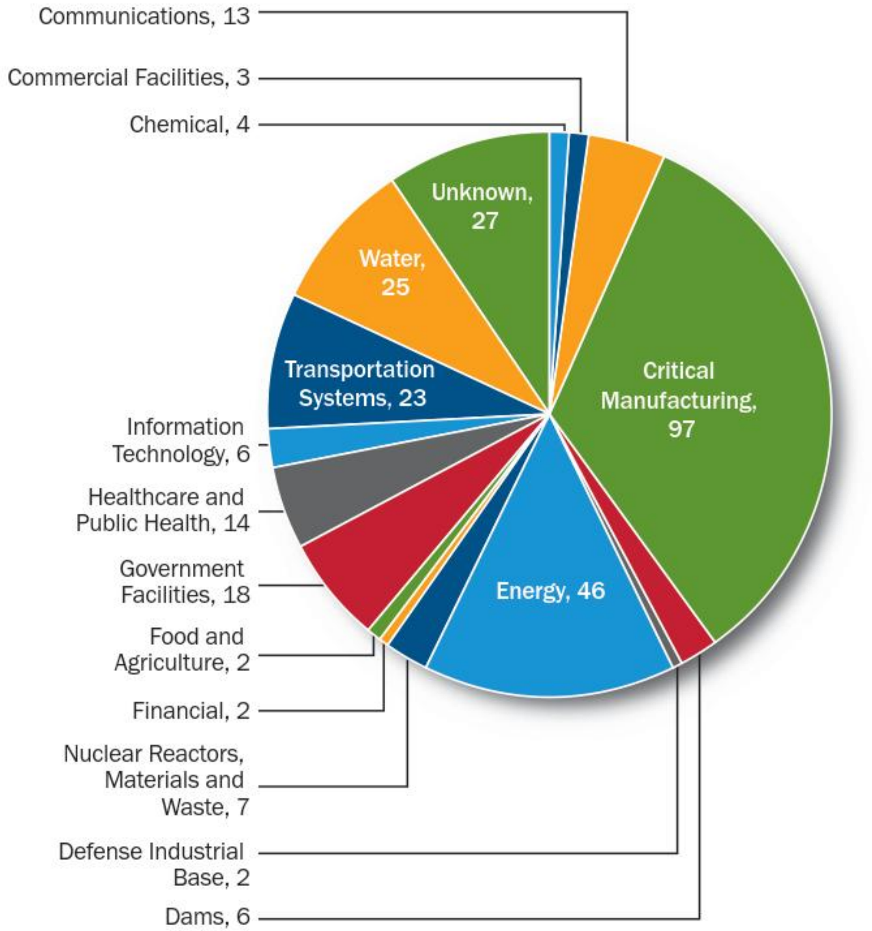
June 29th, 2016

Steffen Fries (steffen.fries@siemens.com), Siemens AG, CT RDA ITS

What makes Security in Critical Infrastructures like the Smart Grid so important?

SIEMENS

The Energy Sector is a Prime Target.



Source: ICS Report: Year in review 2015
Numbers represent responses out of 295 participants.

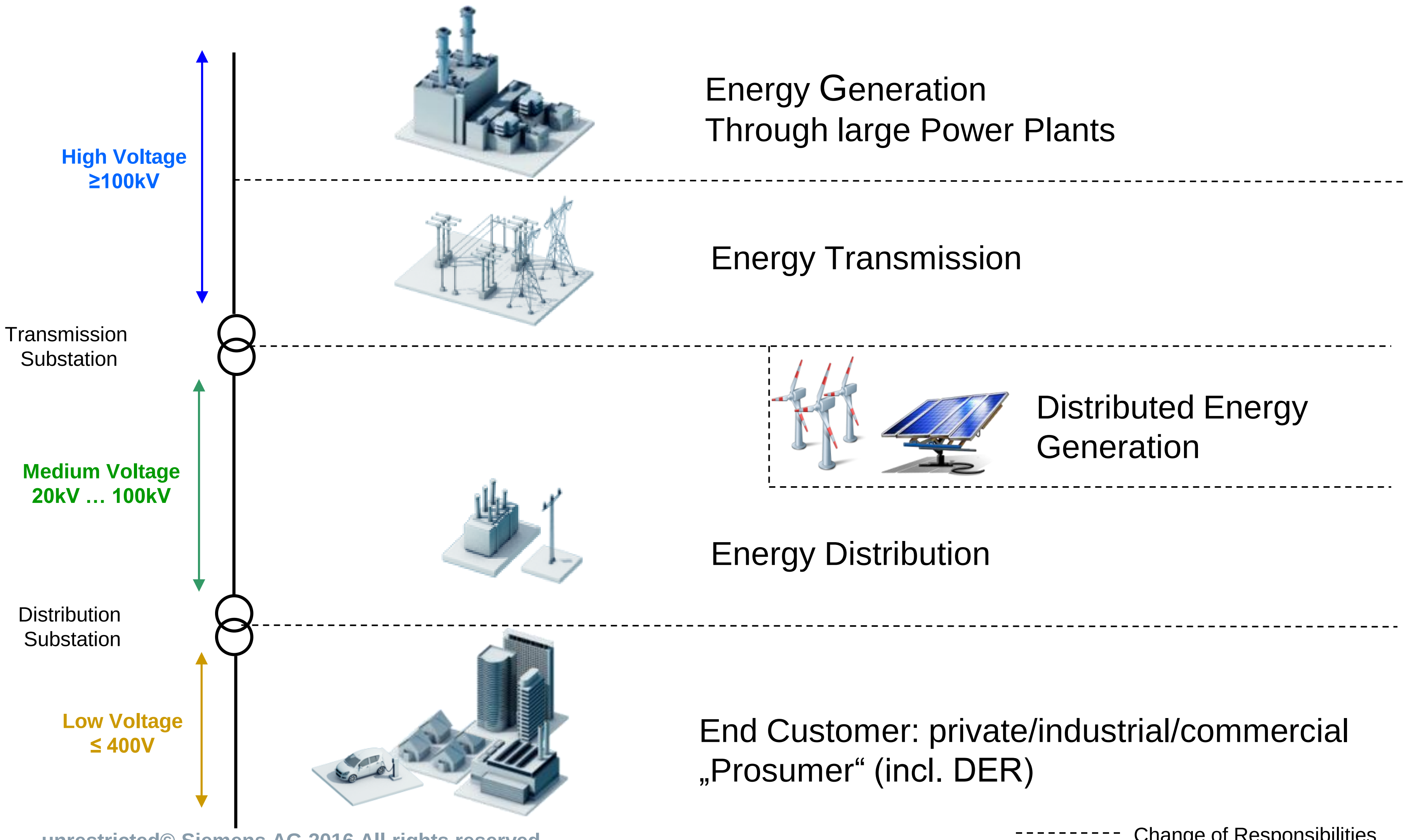
Security incidents can affect target solution and connected (critical) assets

- Performance degradation
- Loss of system availability & control
- Loss of privacy
- Capturing, modification or loss of data
- Reputation (company image)
- Environmental impact
- Financial loss
- Loss of health/life

Cyber Security ensures reliable operation of critical infrastructures

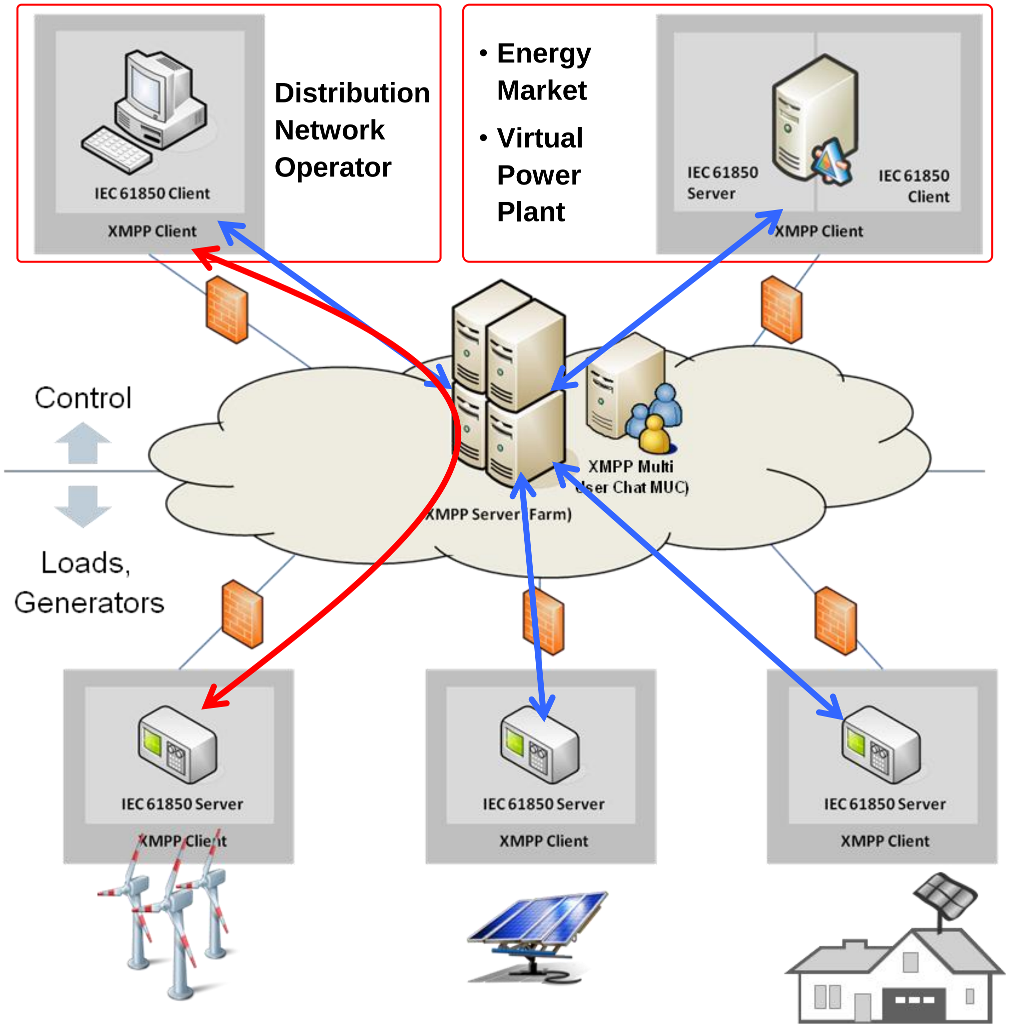
Overview of Structure and Distribution of Responsibilities in the Power Grid

SIEMENS



Enabling Energy Services
Example 1: DER Integration

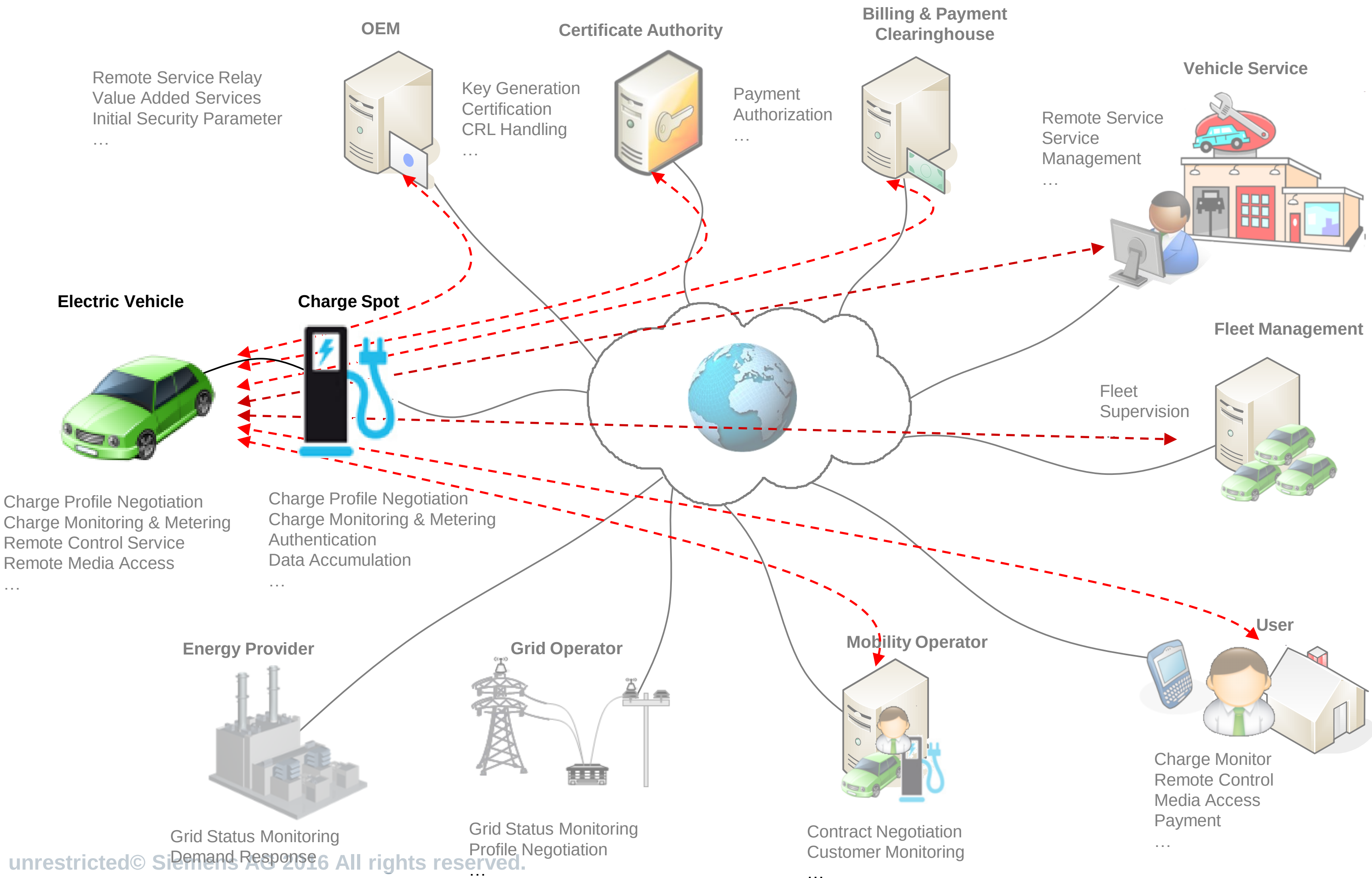
SIEMENS



Characteristics

- Communication uses public and private networks
- DER Communication controller likely to be operated on customer premises
- Equipment most likely not owned by the operator
- Resources and loads are dynamic and need to be known at the control center (DNO) to ensure grid stability
- Smart Energy Market offers Demand Response handling based on market mechanisms
- Security is a necessary prerequisite to support a reliable system operation

Enabling Energy Services
Example 2: Vehicle-to-Grid Integration

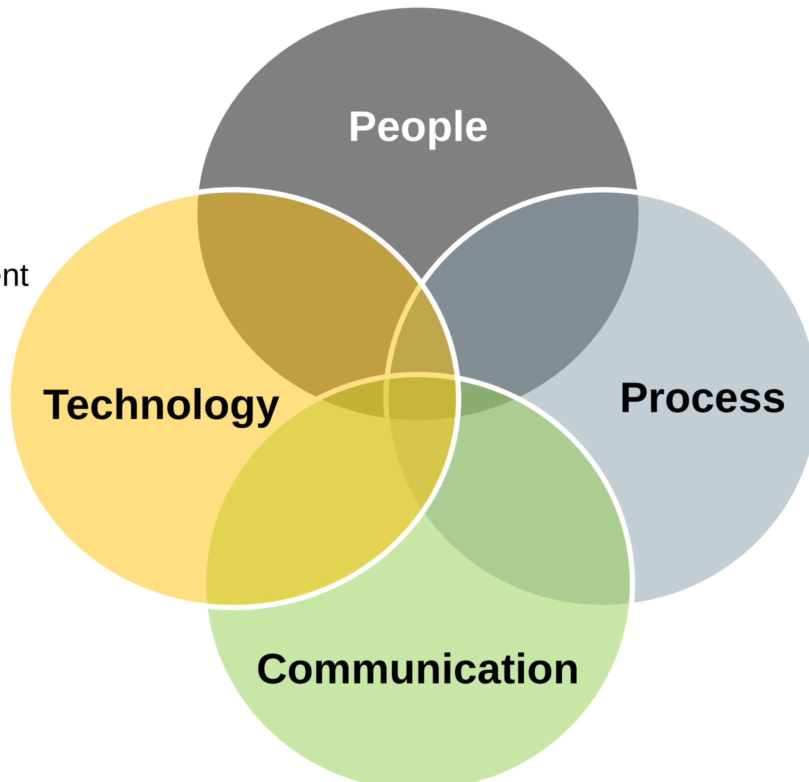


Data exchanged in both Examples has a Security Impact

Information asset	Description, potential content	Security relation
Customer ID and location data	Customer name, identification number, schedule information, location data	Effects on customer privacy
Meter Data	Meter readings that allow calculation of the quantity of electricity consumed or supplied over a time period and may be used for controlling energy loads but also for interactions with an electricity market.	Effects on system control and billing
Control Commands	Actions requested by one component of other components via control commands. These commands may also include Inquiries, Alarms, Events, and Notifications.	Effects on system stability and reliability and also safety
Configuration Data	Configuration data (system operational settings and security credentials but also thresholds for alarms, task schedules, policies, grouping information, etc.) influence the behavior of a component and may need to be updated remotely.	Effects on system stability and reliability and also safety
Time, Clock Setting	Time is used in records sent to other entities. Phasor measurement directly relates to system control actions. Moreover, time is also needed to use tariff information optimally. It may also be used in certain security protocols.	Effects on system control (stability and reliability and also safety) and billing
Access Control Policies	Components need to determine whether a communication partner is entitled to send and receive commands and data. Such policies may consist of lists of permitted communication partners, their credentials, and their roles.	Effects on system control and influences system stability, reliability, and also safety
Firmware, Software, and Drivers	Software packages installed in components may be updated remotely. Updates may be provided by the utility (e.g., for charge spot firmware), the car manufacturer, or another OEM. Their correctness is critical for the functioning of these components.	Effects on system stability and reliability and also safety
Tariff Data	Utilities or other energy providers may inform consumers of new or temporary tariffs as a basis for purchase decisions.	Effects on customer privacy and also competition

Cyber Security needs a Holistic Approach
One Key Element for a reliable Smart Energy Grid

- Security Education
- Process Awareness



- Identity and Access Management
- Secure Connectivity
- Situational Awareness
- Monitoring
- Eventing and Alarming

Vendor
- Secure Product Development
- Patch Management

Integrator
- Security System Design
- Supply Chain Security

Operator
- Asset Management incl. Security
- Security Policy Enforcement
- Key Management Lifecycle
- Patch Management

- Engineering
- Metering & Measurement
- Control and Operation
- Auditing

Any Challenges left?

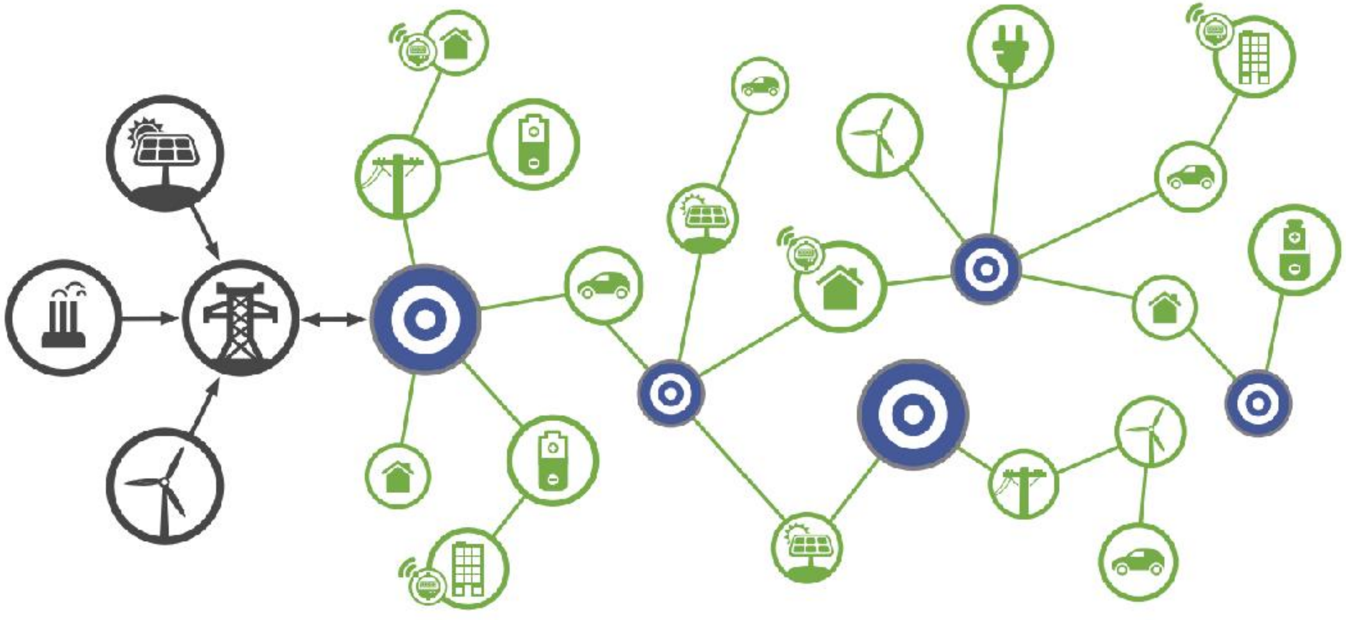
- **Security is ideally done by design**
  - In Smart Energy Grids a lot of existing technological approaches can be reused

    → they need the adaptation to the target environment

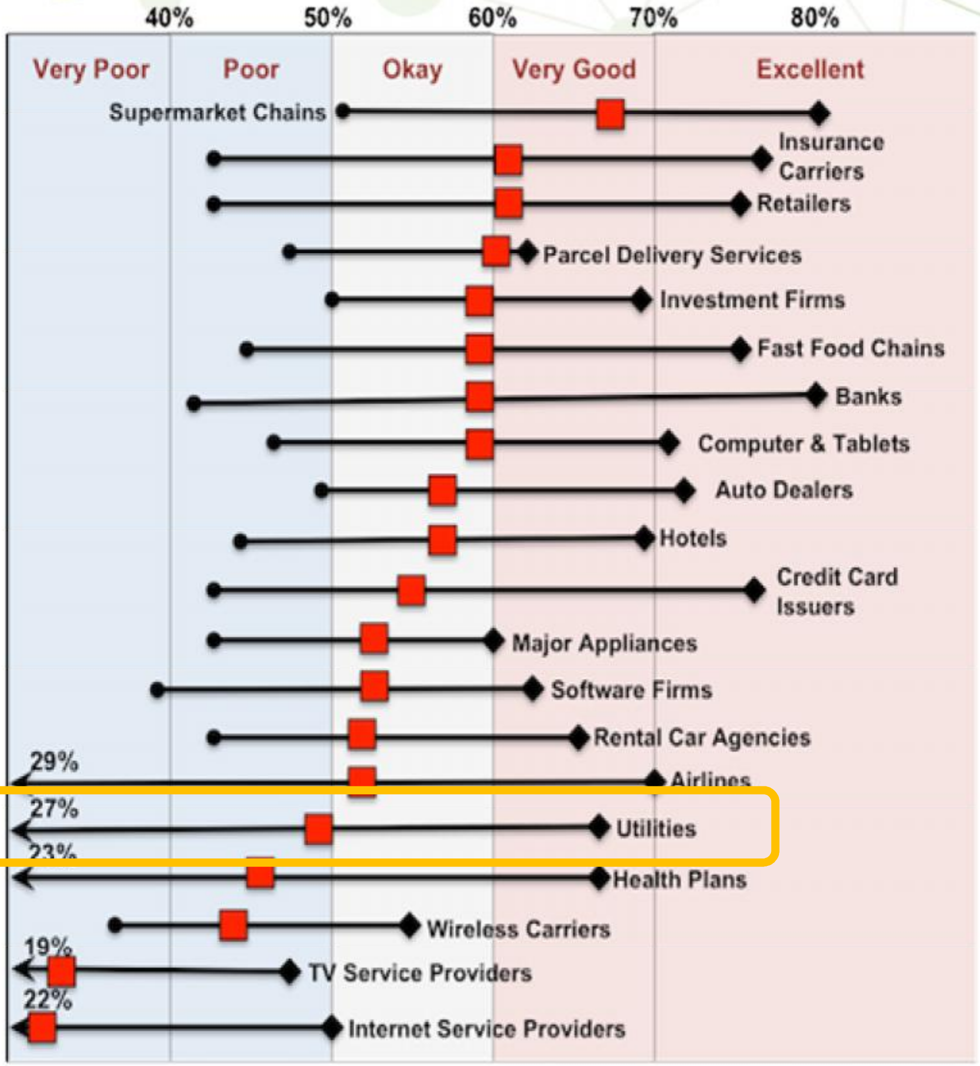
- **Challenges still exist (examples)**
  - Performance and latency when used in constraint devices by still providing appropriate protection
  - Storage of critical /sensitive information (long term keys, root of trust, policies, …)
  - Integration of cryptography into systems (design, infrastructure support, long term stability, …)
  - Connected processes (personnel, data / system / service life cycle …)
  - Business cases (ownership, …)

- **Security is a process, a way, not the final goal**

ENERGY CUSTOMERS VERSUS RATEPAYERS
Implications and possible evolution



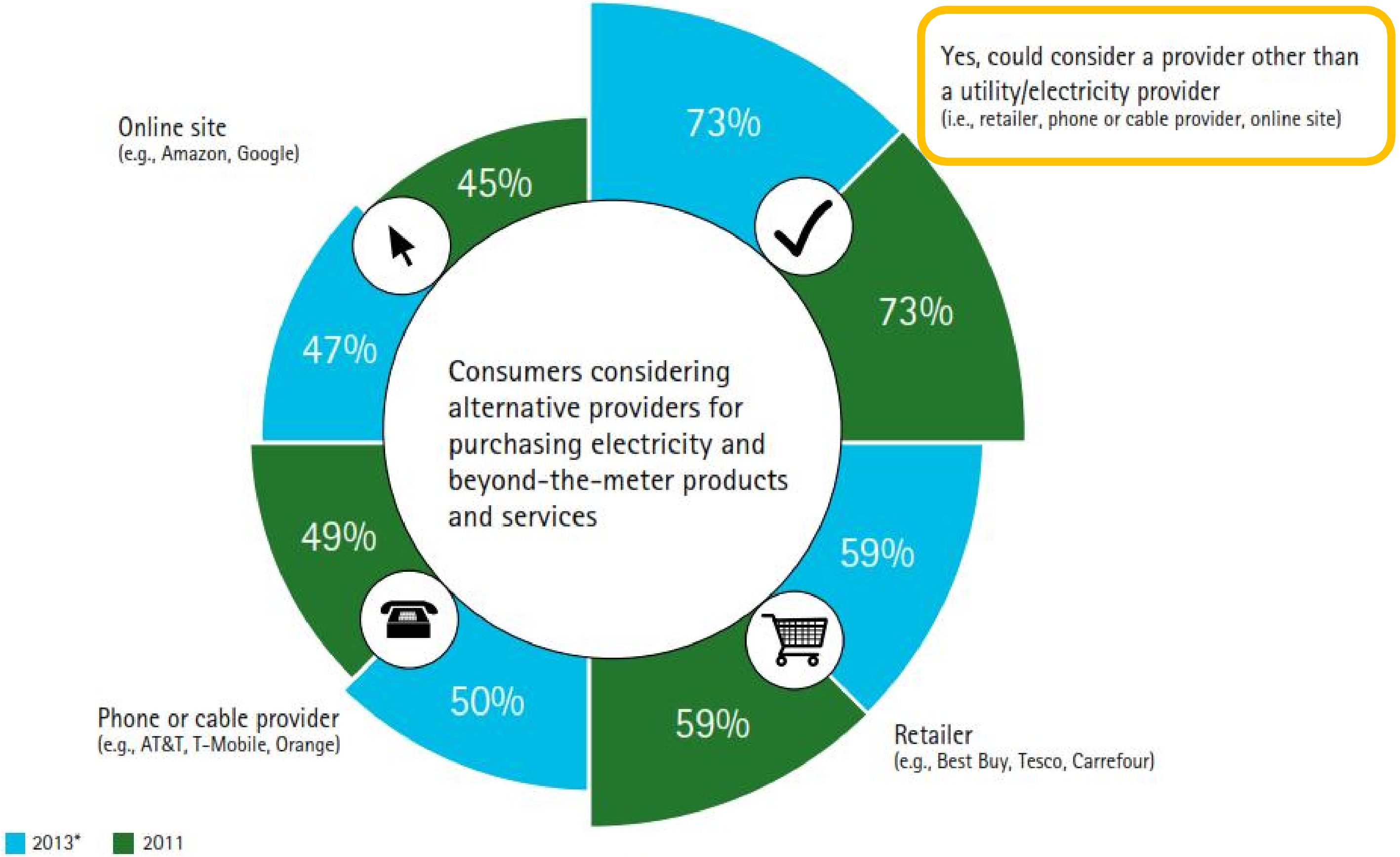
2015 Temkin Trust Ratings



Utilities were ranked among the lowest for customer experience, across all sectors and markets

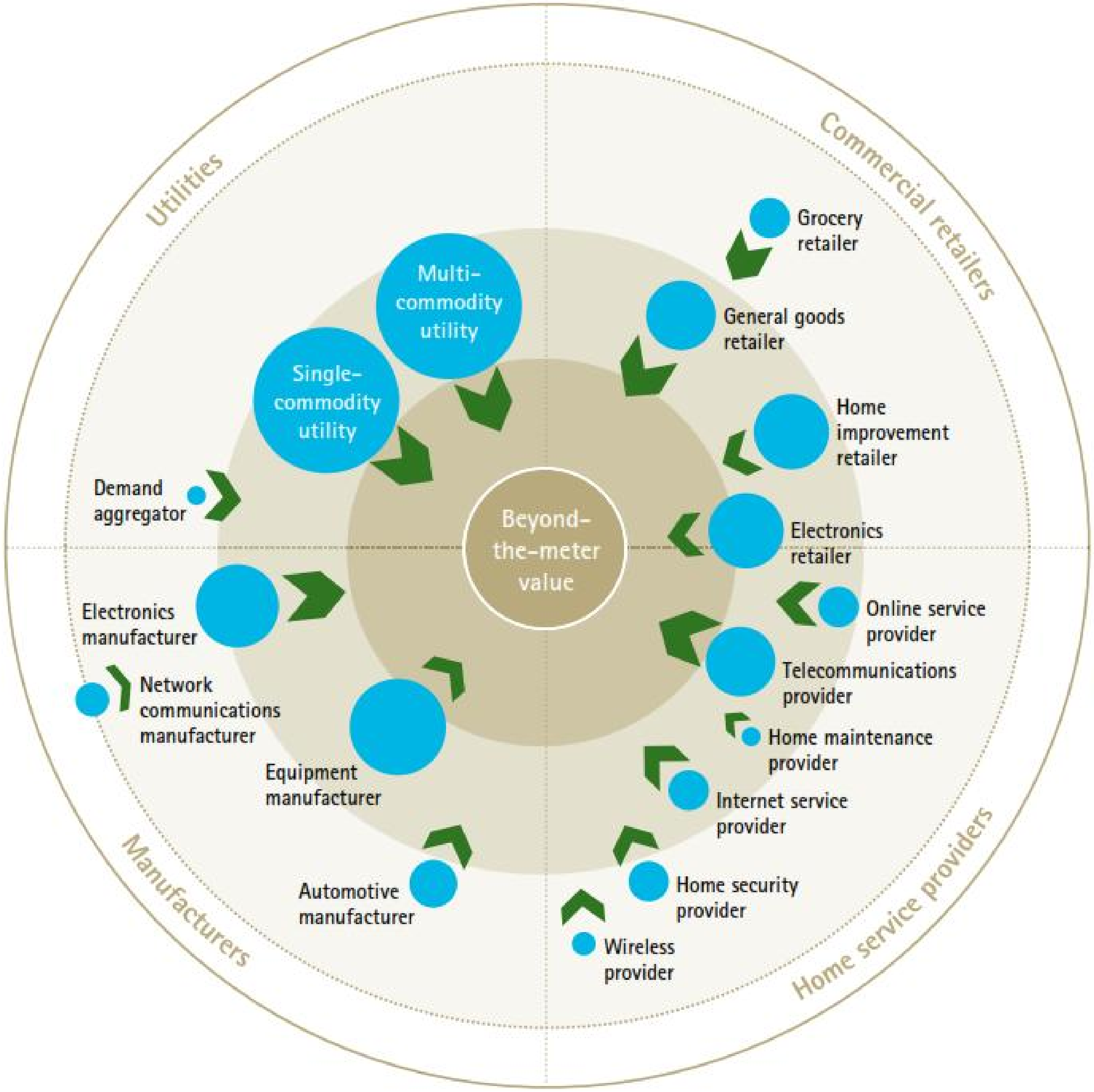
Consumers show significant interest in alternative providers.

You may currently, or in the future, have new companies offering you electricity, energy-efficient products (i.e., smart thermostats), and/or related services (i.e., customized information on your electricity consumption) on top of their traditional products and services. Would you consider purchasing electricity, energy-efficient products, and/or related services from the following providers:



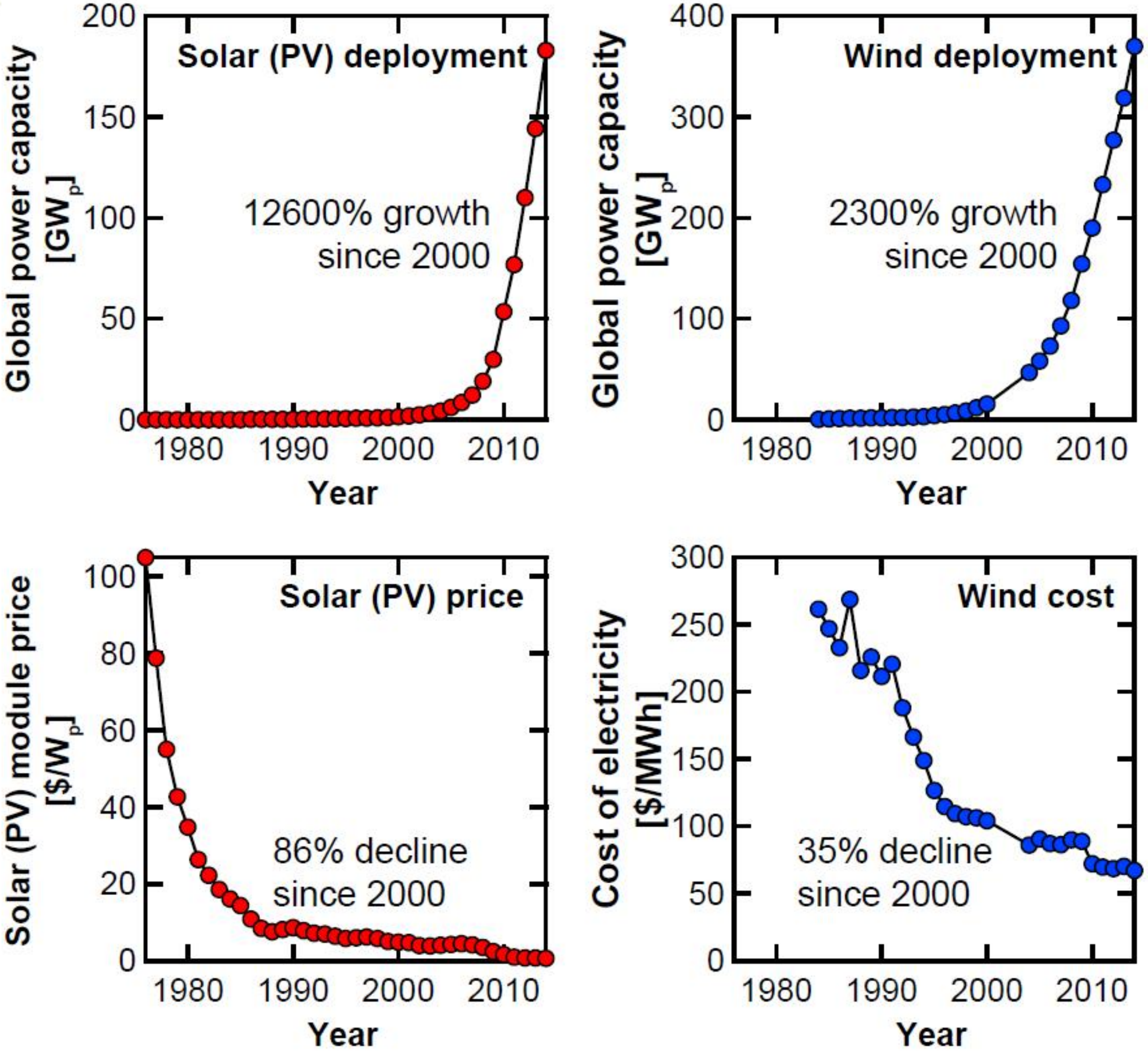
https://www.accenture.com/th-en/insight-new-energy-consumer-architecting-future

New players present opportunities and threats to a utility's consumer base



https://www.accenture.com/us-en/insight-new-energy-consumer-handbook

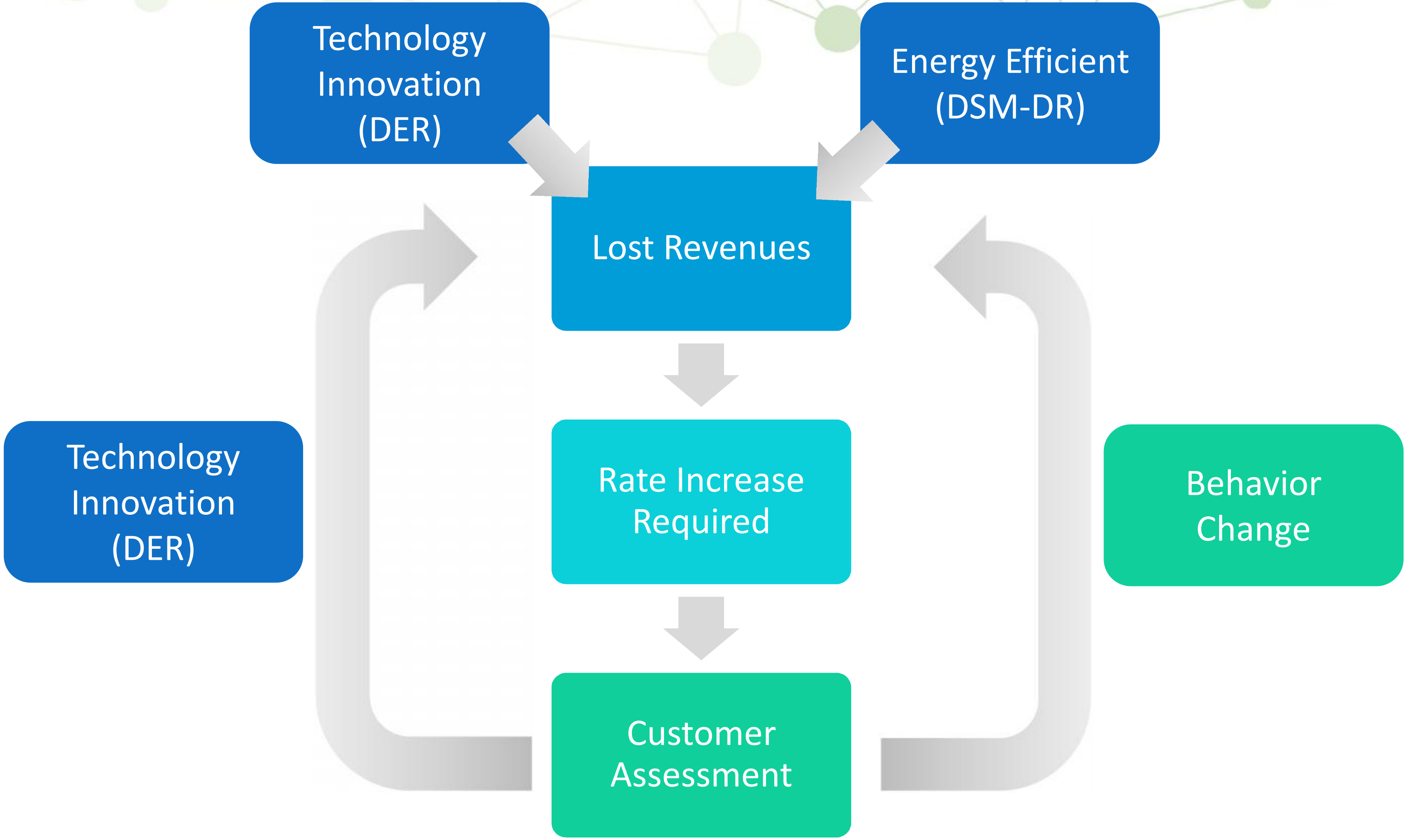
Solar and wind energy costs have fallen as their markets have grown



Trancik, J. E., Jean, J., Kavlak, G., Klemun, M. M., Edwards, M. R., McNerney, J., ... & Needell, Z. A. (2015). *Technology Improvement and Emissions Reductions as Mutually Reinforcing Efforts: Observations from the Global Development of Solar and Wind Energy*. MIT.

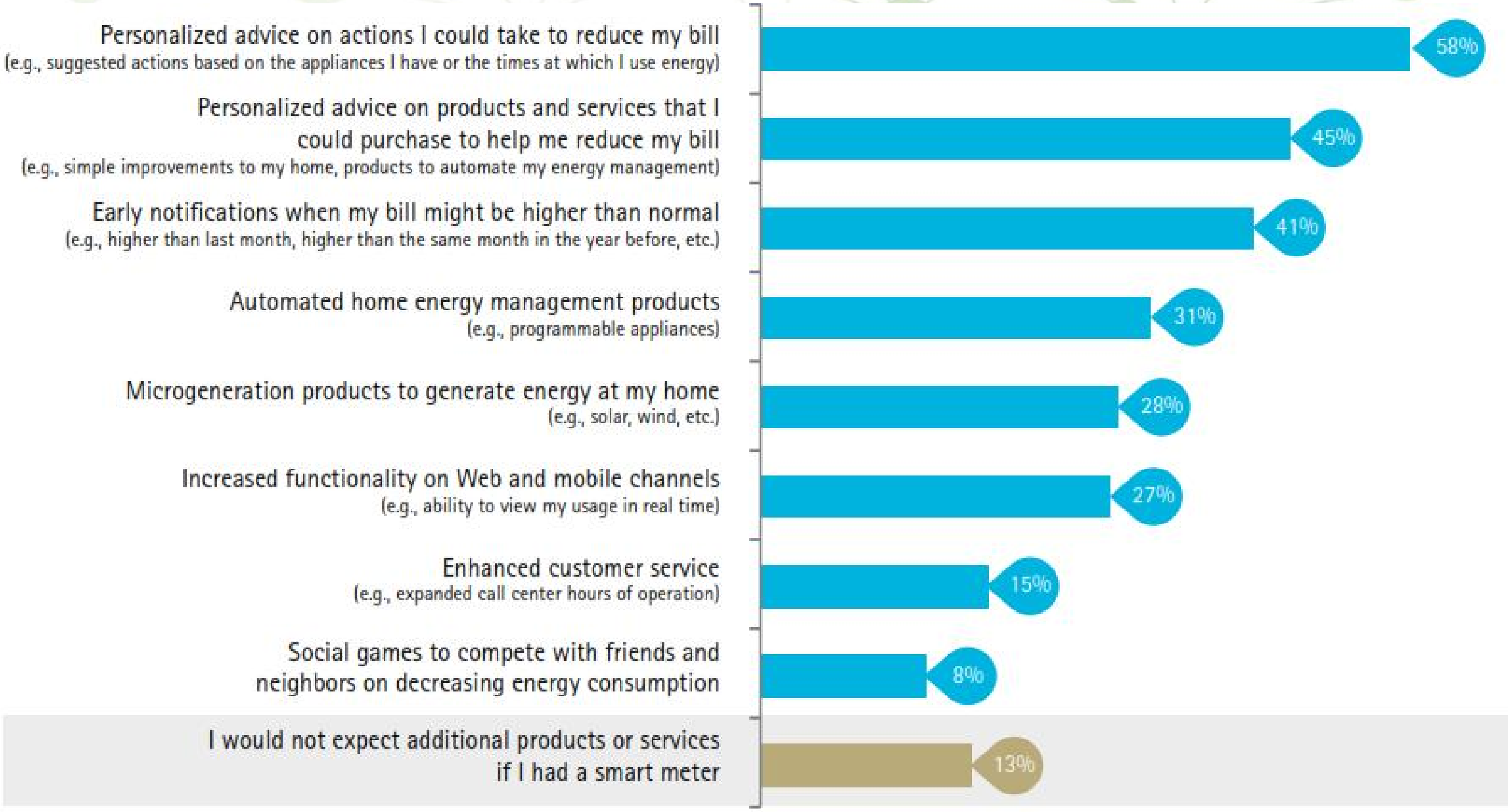
EEI's Depiction of Vicious Cycle from Disruptive Forces

DER Erodes Traditional Utility Business Model



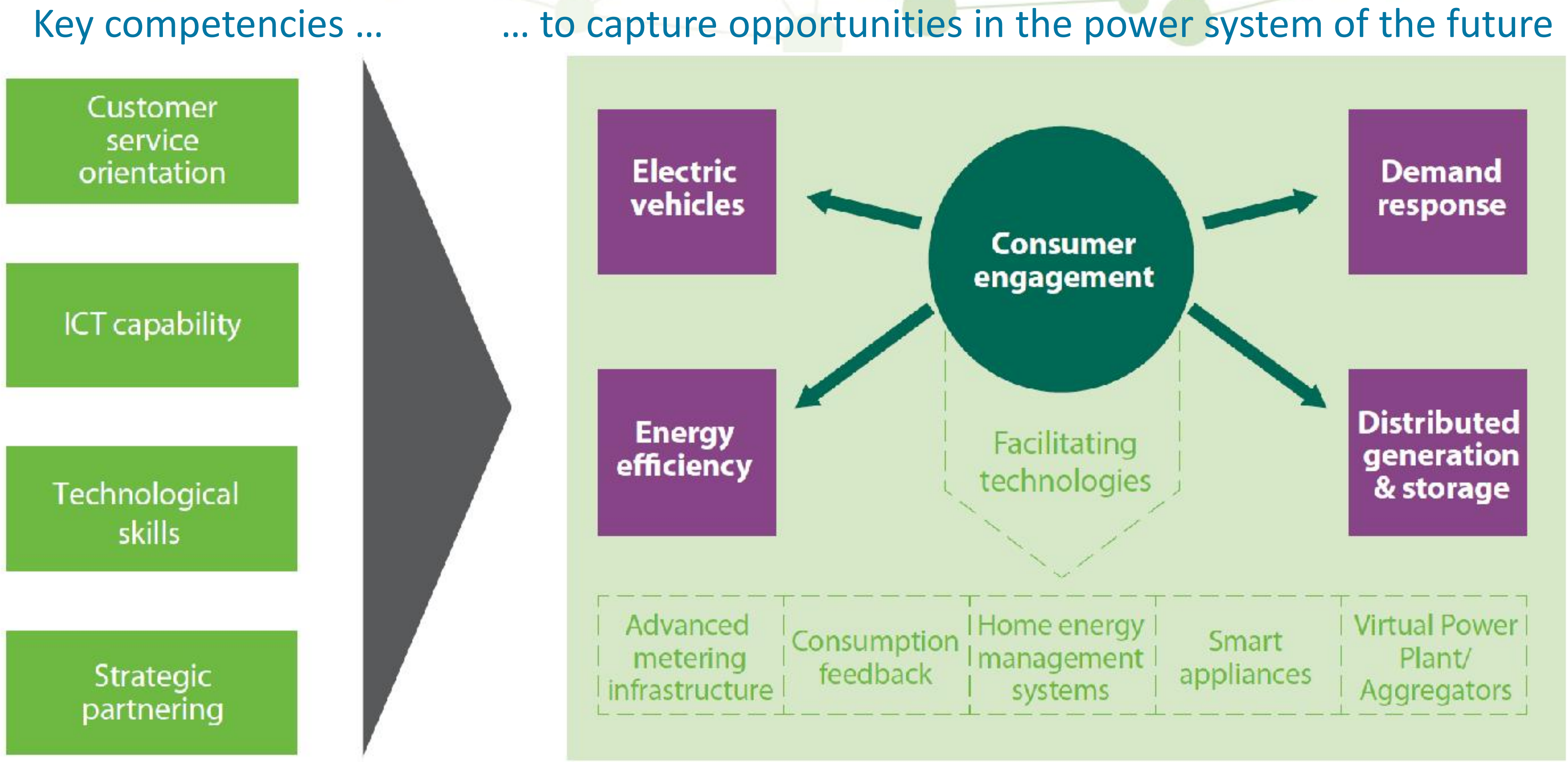
Kind, P. (2013). *Disruptive challenges: financial implications and strategic responses to a changing retail electric business*. Edison Electric Institute.

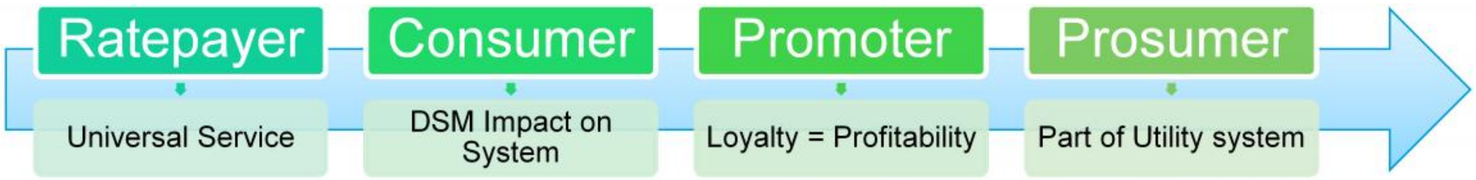
Consumers expect additional services along with a smart meter



https://www.accenture.com/th-en/insight-new-energy-consumer-architecting-future

Utilities will need to develop new competencies to avoid grid defection





Satisfying the new energy consumer.

Today's utility customer expects similar treatment and choices that they receive from other advanced service providers.

Personalization and connectedness are becoming more important factors for consumers. The level of service that has suddenly become expected as the norm includes:

- Mobile applications that allow instant access and analysis of their bill and energy usage;
- Easy and successful communication with the utility on a wide range of issues and questions;
- Automatic and one-touch transactions for bill payment, services selection, and even energy control choices;
- Assistance in a wide range of Energy demand management (DSM-DR) and beyond-the-meter services;
- Underscore he ancillary services that prosumers can offer to the utility business model, leasing directly customer rooftops for solar generation.
- Ongoing updates and notifications of utility news, conditions, operations, and local construction projects;
- Instant and reliable updated communications before, during, and after storms.

CONTACT

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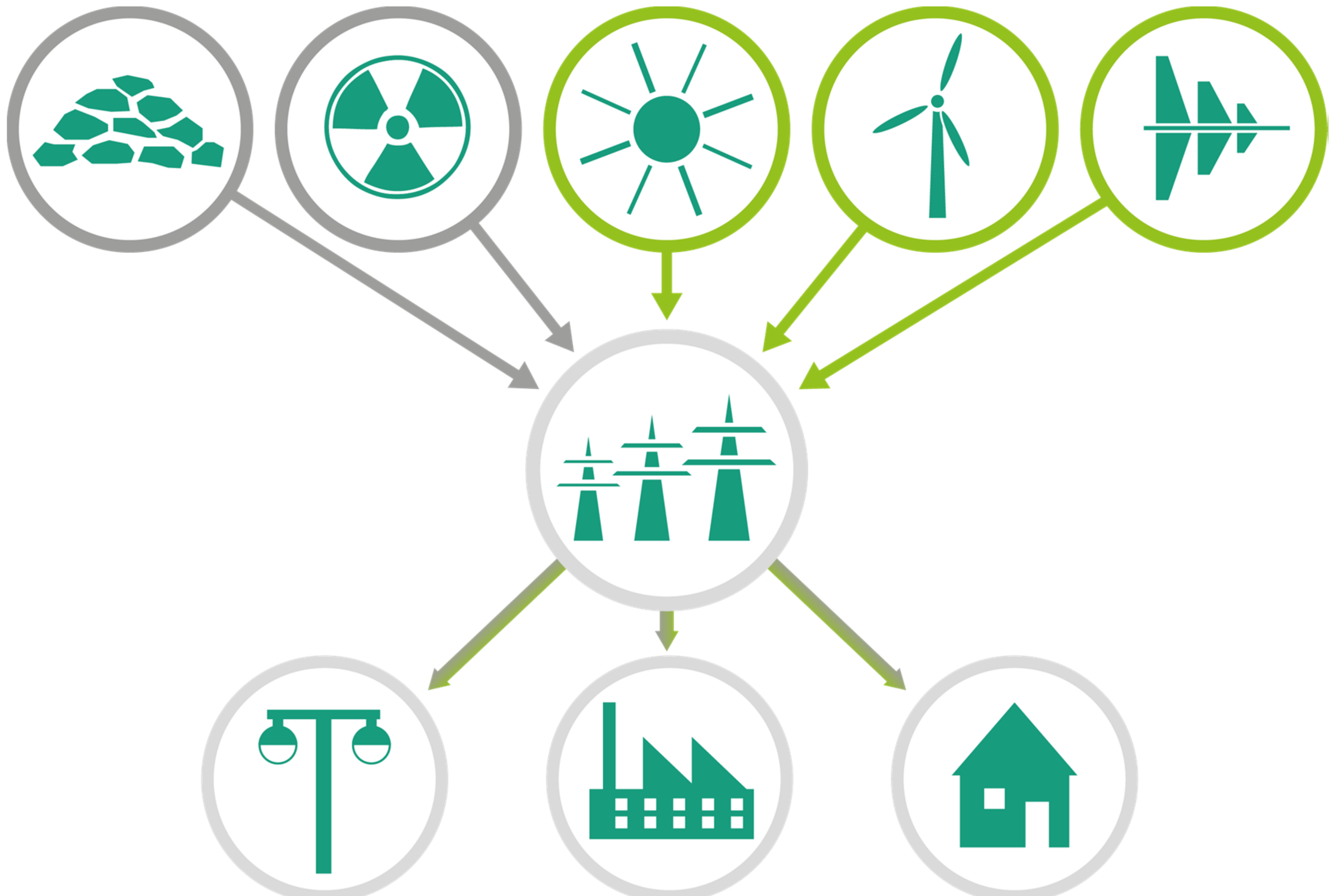
ENERGY EFFICIENCY PLANNING AND GREEN ENERGY

Panel Contribution IARIA Energy 2016

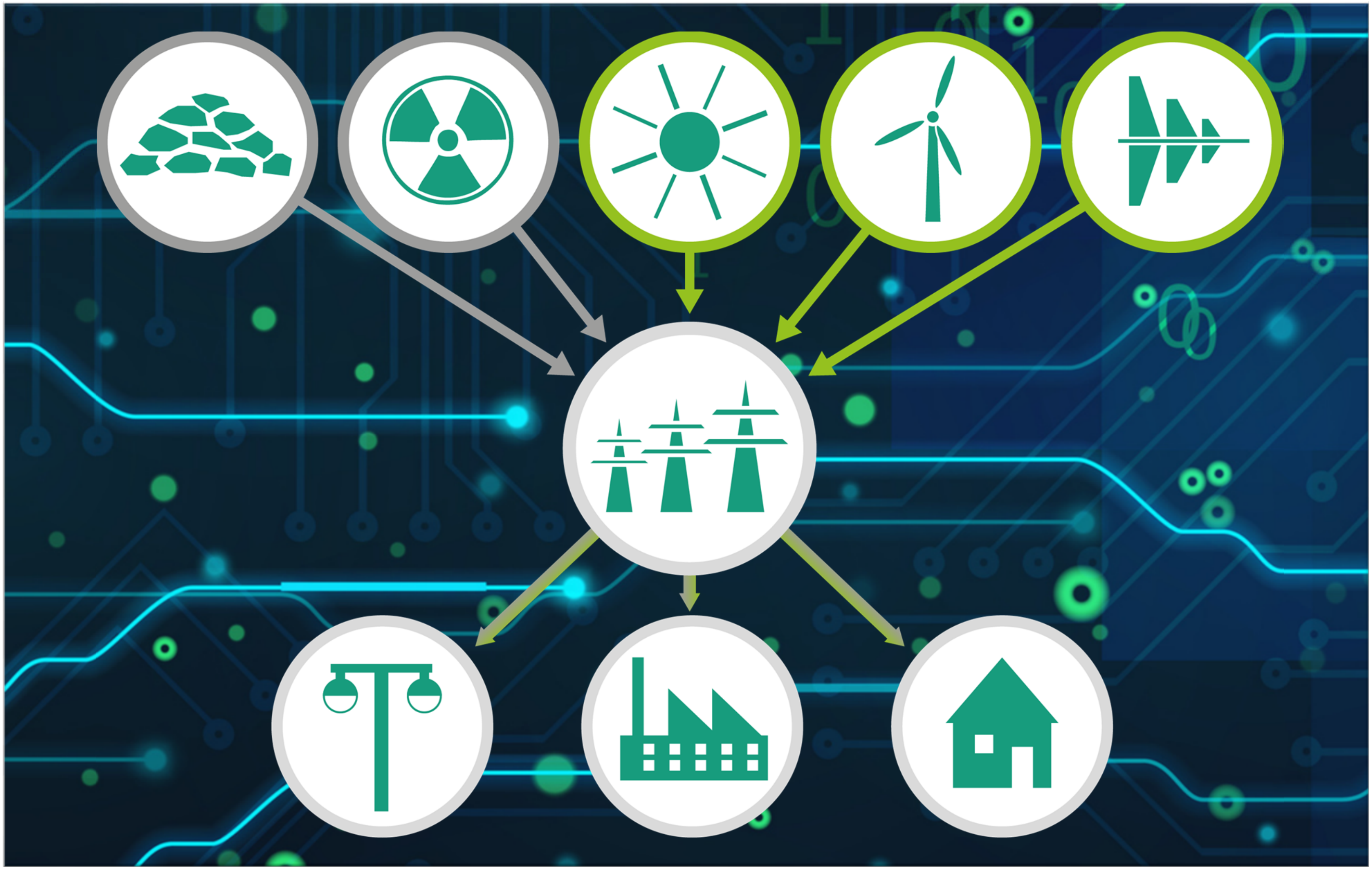
University of Stuttgart
Institute for Human Factors and Technology Management IAT

Fraunhofer IAO

What is missing?



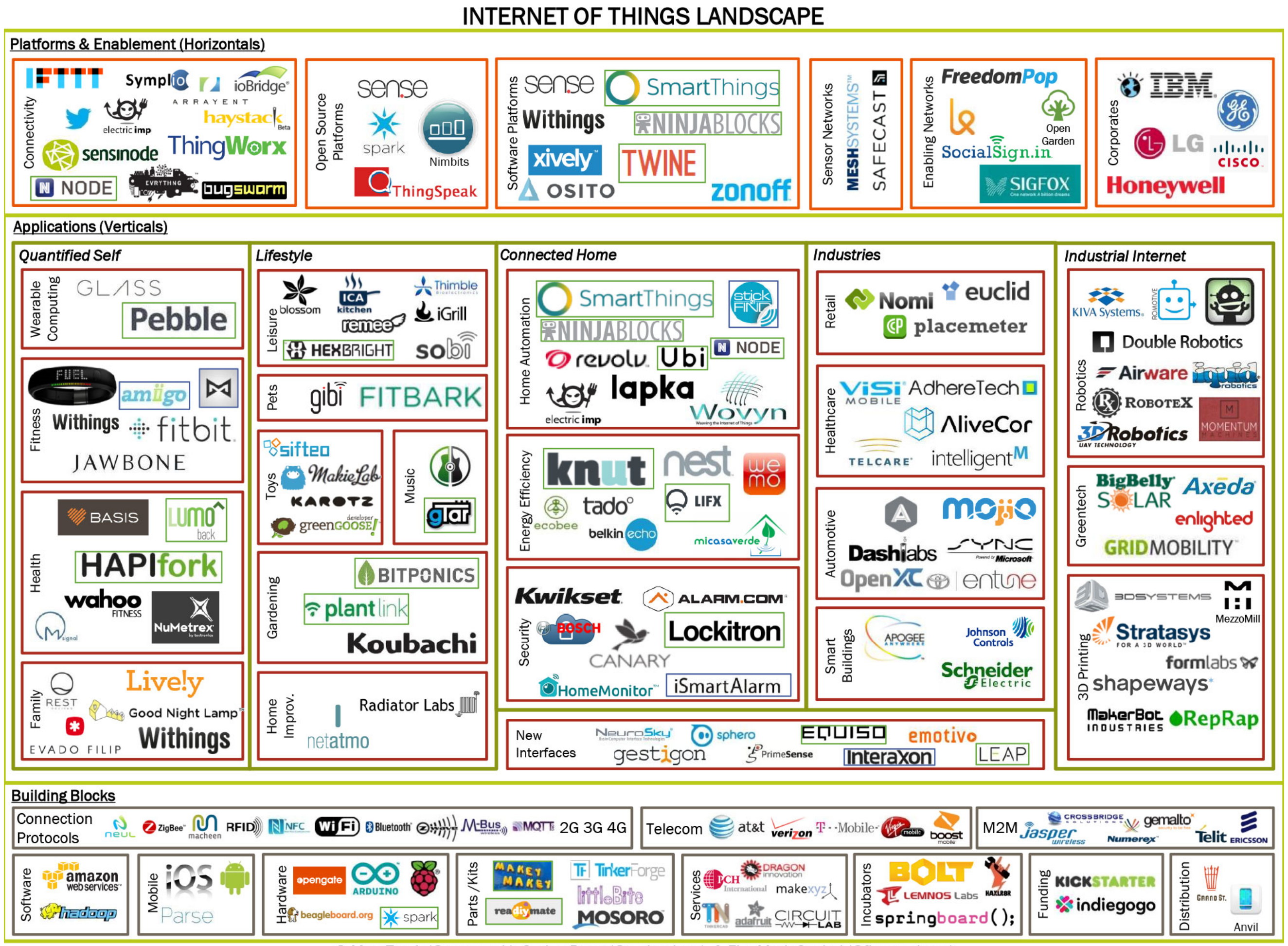
Adding intelligence to the system…



Smart IT systems will play a crucial part in creating a sustainable energy system

- Households:
  - When should I recharge my electric vehicle?
- Public services:
  - How can street lights be switched off if not needed?
- Industry:
  - How can we merge production planning system with energy management systems?
  - Which signals can we use to express flexibility?
  - How do we create smart products which react to changing energy system states?

Challenge is to select economically efficient solutions



Source: http://techcrunch.com/2013/05/25/making-sense-of-the-internet-of-things/

University of Stuttgart
Institute for Human Factors and Technology Management IAT

Fraunhofer IAO

PANEL ON ENERGY/BIO

TOPIC: ENERGY EFFICIENCY PLANNING AND GREEN ENERGY

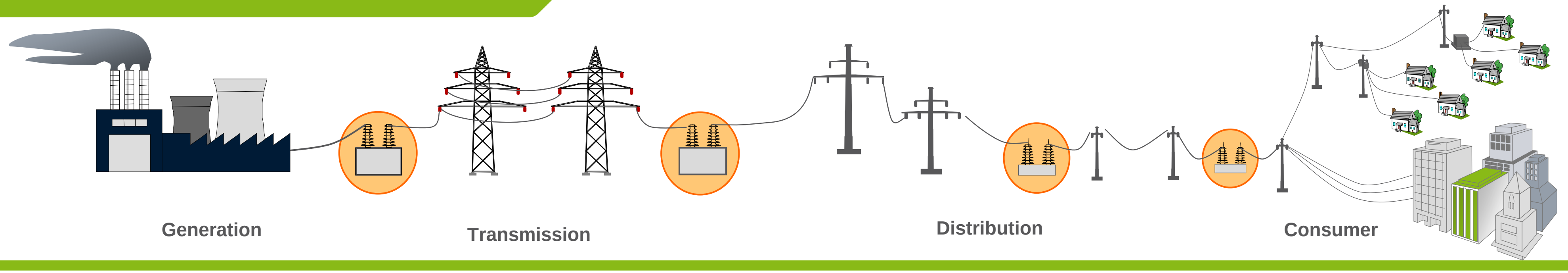
Vanesa Čačković, Ericsson Nikola Tesla, Croatia

NEW ENERGY & UTILITY REALITY

1. Customers – participating and active
2. Assets – connected and intelligent
3. Grids – dynamic and automated
4. Data – turned into value-add information
5. Platforms – economics and scale
6. Capabilities – on-demand
7. Secure – resilient and trusted

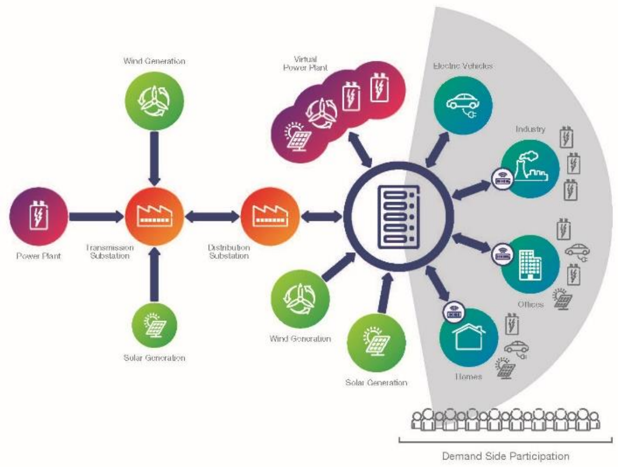
THE ENERGY SYSTEM TRANSFORMATION

TODAY: ENERGY RESOURCES CENTERED



EXPECTED: DISTRIBUTED AND PARTICIPATIVE

- Non linear model
- More focus on customer concerns, quality, security of supply
- New market participants

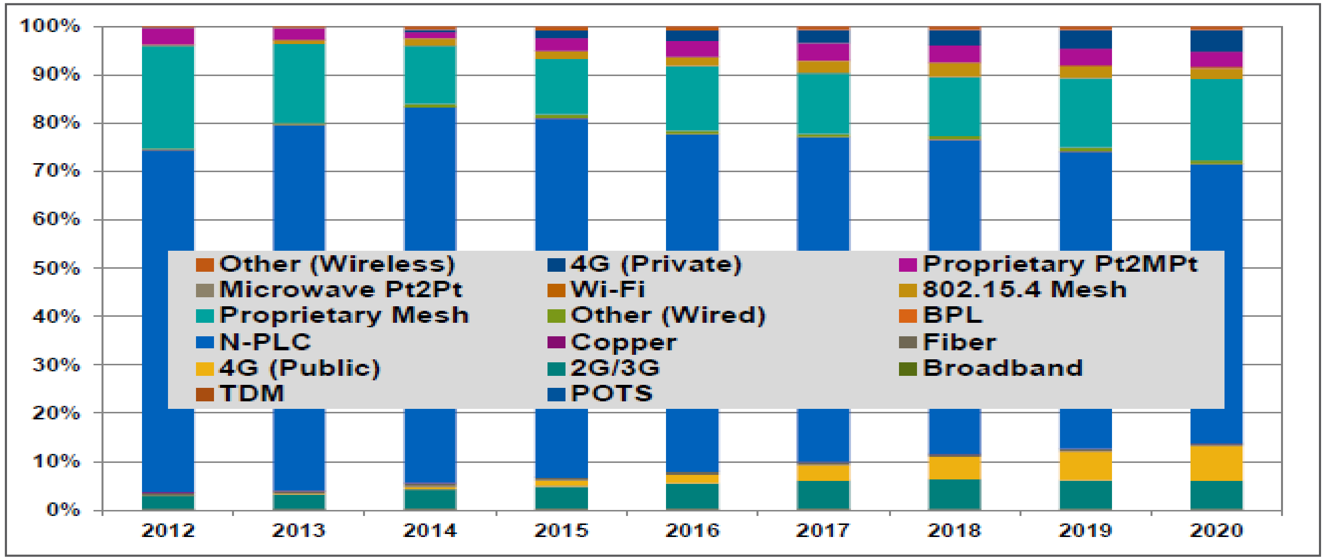


- New management models; transparency and non discriminatory access
- New products and services

TECHNOLOGY TRENDS FOR SMART GRID COMMUNICATIONS

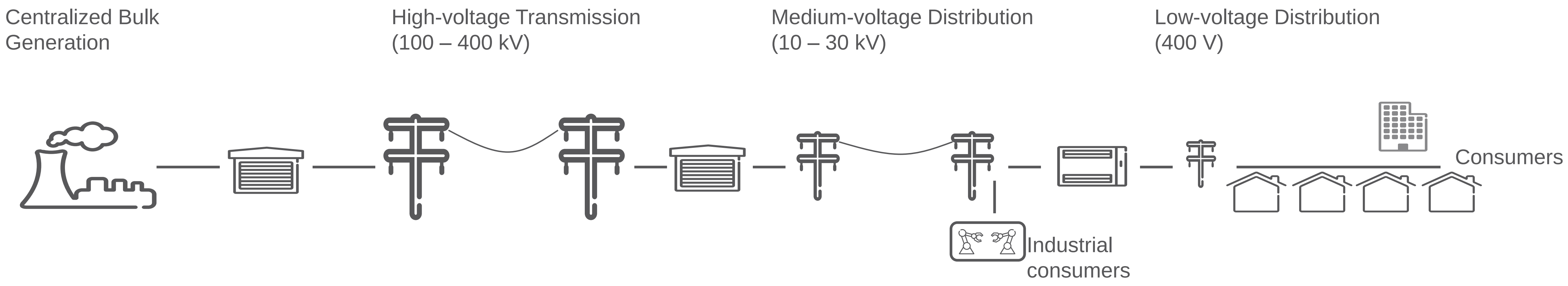
- About 70% of the market for communication nodes for TSO/DSO consists of narrowband PLC (including Prime and PLC-G3 protocols) modules and gateways; due to large metering projects in Europe and Asia, the share of PLC connections remains high in 2020 (about 58%)
- Generally speaking the industry will move towards standard solutions, mostly wireless as the use of operated wired solutions decrease significantly; Wireless mesh (proprietary and 802.15.4) will keep a significant share between 15% and 20%, driven by meter deployment but also distribution automation
- The total number of nodes connected via 2G/3G/4G will supposedly grow from 4% today to 18% in 2020 (with 75% of cellular connections being provided by public cellular operators)

Communication nodes shipment (in volume) 2012-2020

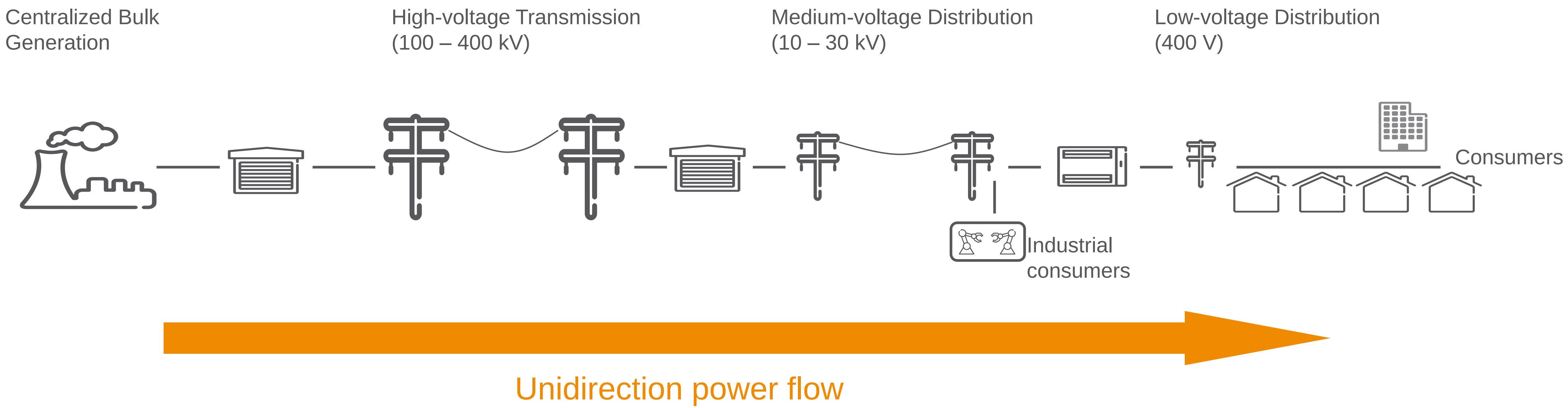


- **Narrow band PLC decreasing 78% > 58%**
- **Wireless mesh: constant in the range 14% to 19%**
- **Public cellular (2G/3G/4G) growing 5% to 13%**
- **Private 4G growing 1% to 4%**

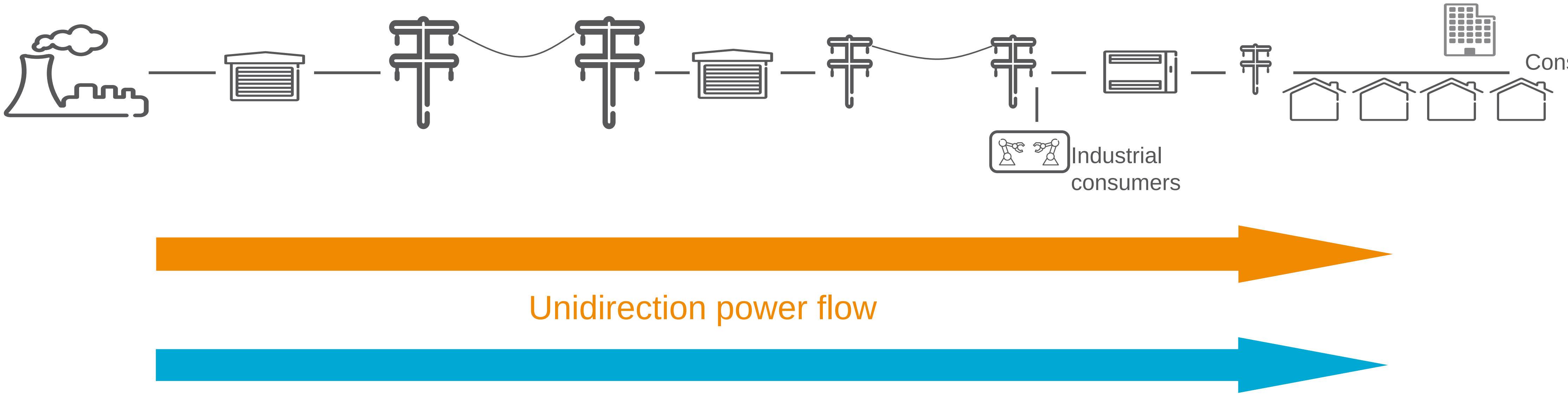
POWER GRID TODAY



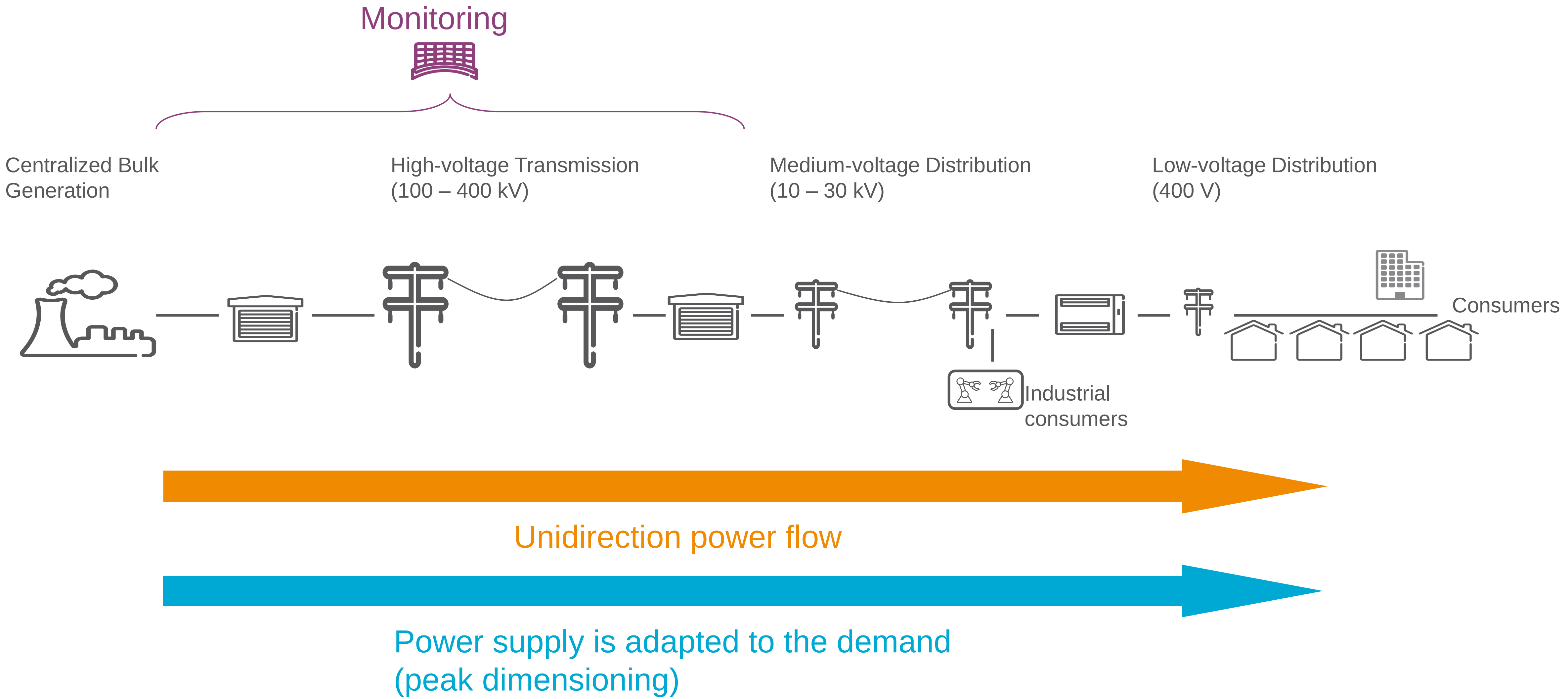
POWER GRID TODAY



POWER GRID TODAY



POWER GRID TODAY



MOTIVATIONS FOR POWER GRID TRANSITIONS

Sustainability

EU 20-20-20 targets for 2020

- 20% reduction of CO_2 emissions
- 20% renewable energy sources
  (Germany: 30% in 2020 and 50% in 2050)
- 20% efficiency increase

Security of supply

- Increase grid robustness and resilience
- Integration of different generators (centralized and distributed)

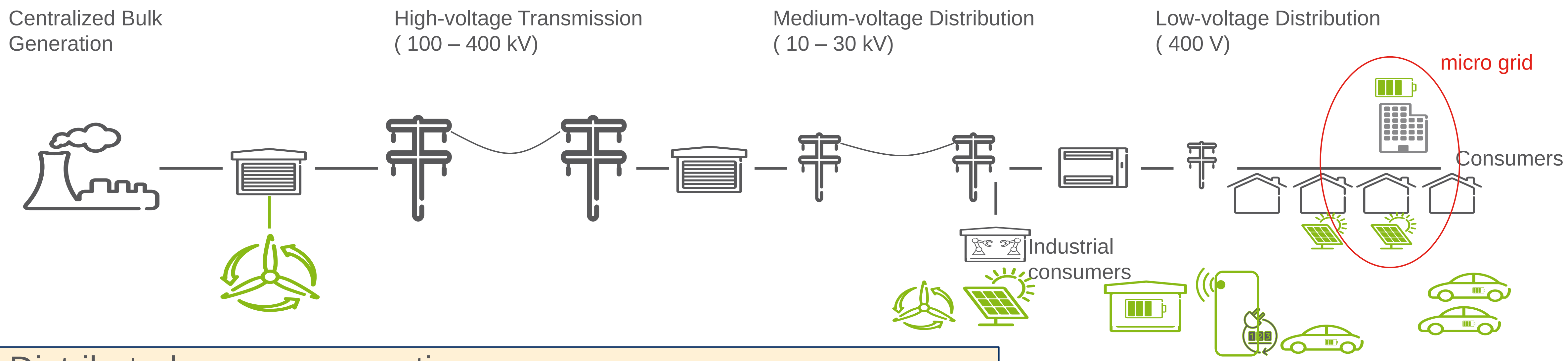
Market Competition

- Better management of supply and demand
- New market opportunities and increased efficiency of the market
- Empowerment of consumers

Technology evolution

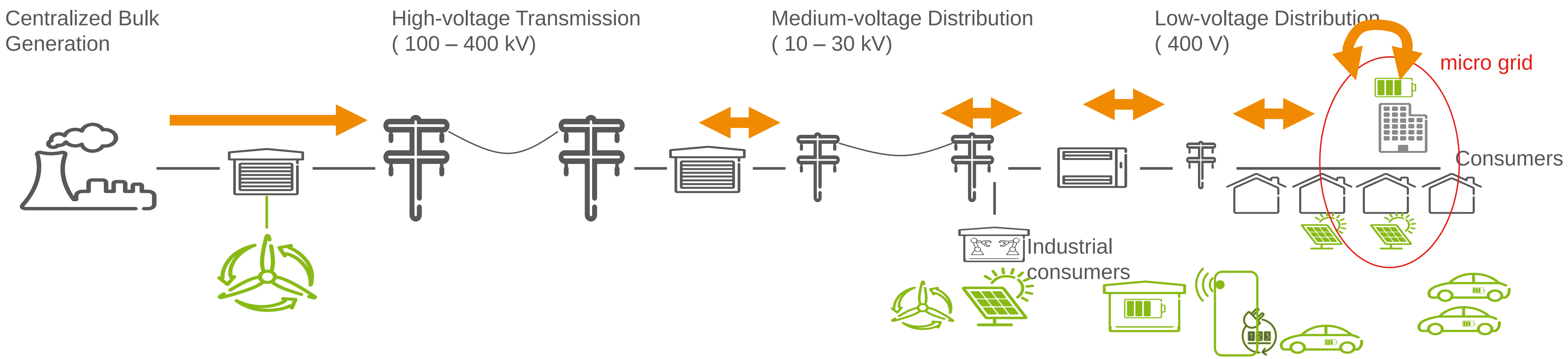
- Renewable energy sources
- Electric vehicles
- Distributed energy storage
- …

SMART GRID – NEW DIRECTIONS



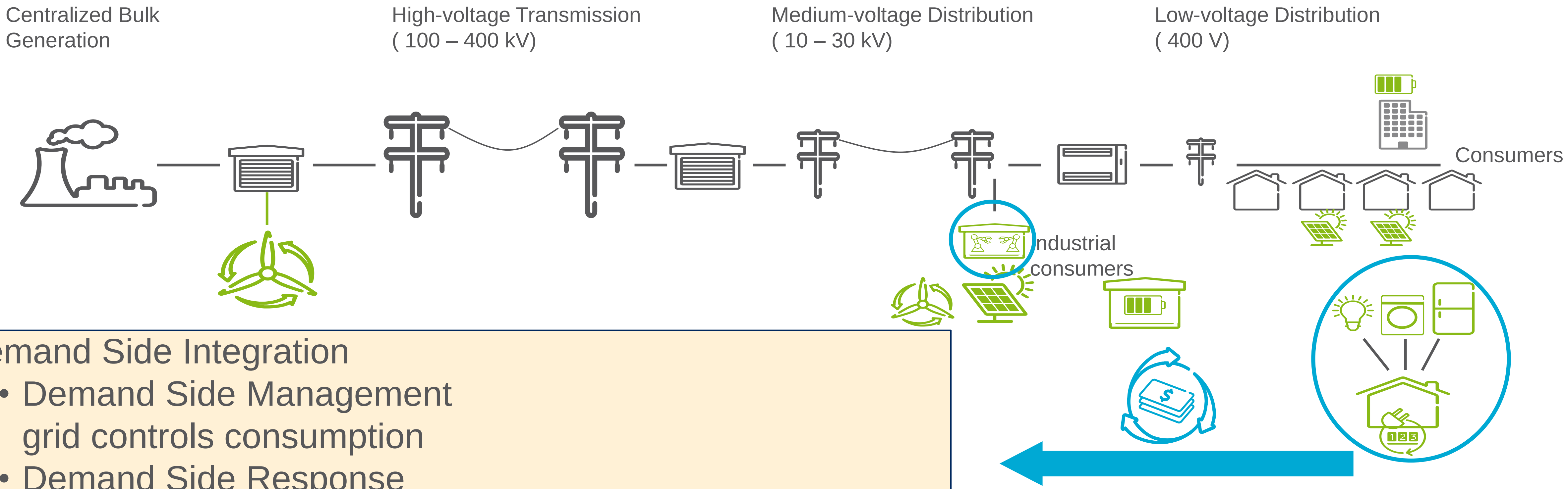
- Distributed energy generation
  - wind farms, photovoltaic, combined heat power, …
- Consumers ➔ Prosumers
  - consumer and producers
- Distributed energy storage
- Micro grids and local automation
- Electric vehicles and charging system

SMART GRID – NEW DIRECTIONS



Fluctuating & bi-directional power flows

SMART GRID – NEW DIRECTIONS

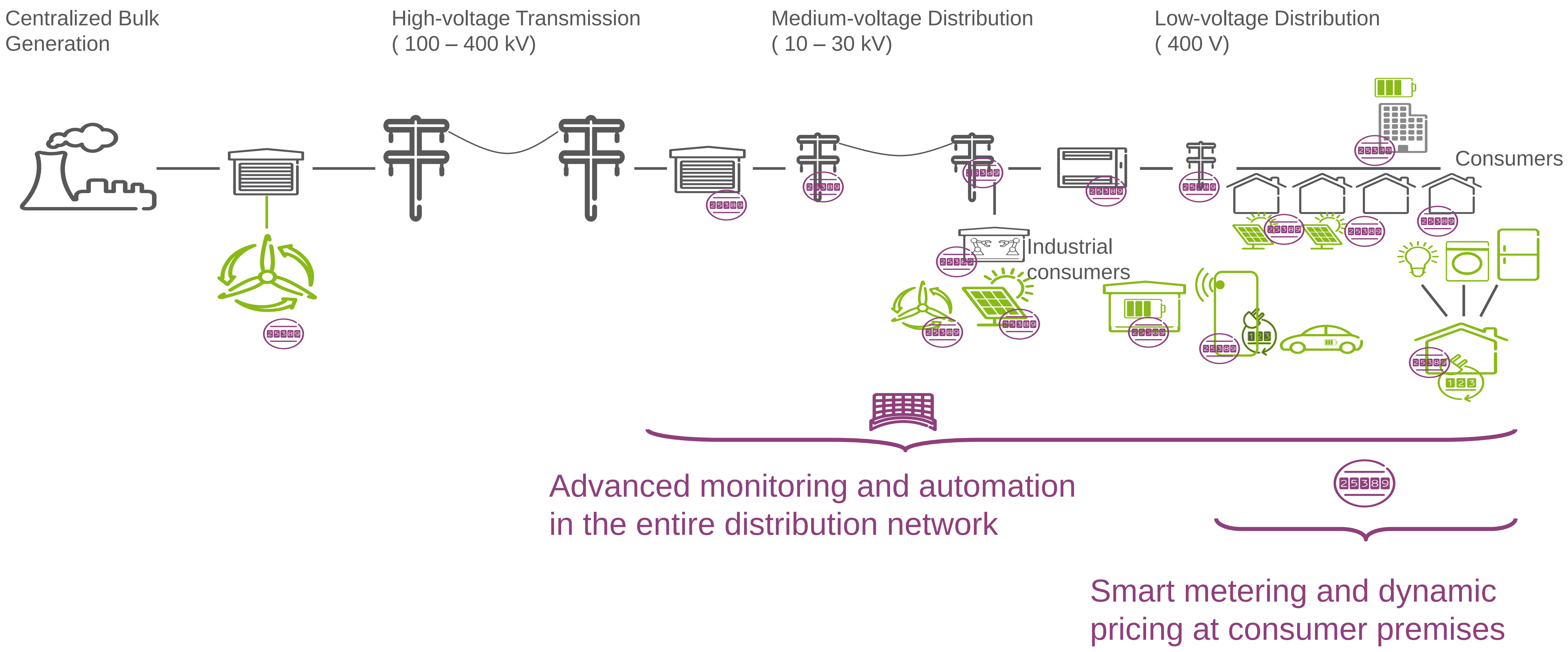


Power demand is adapted / deferred according to supply

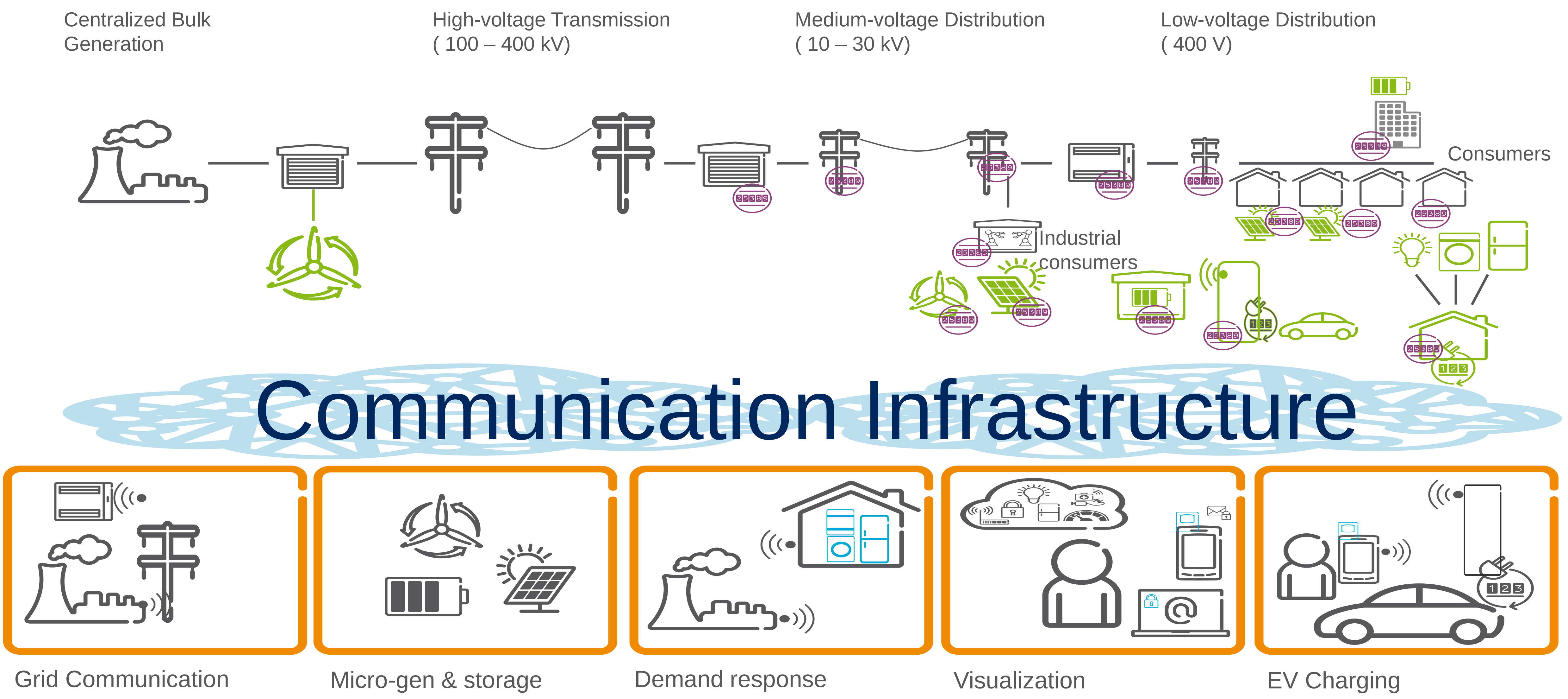
- Demand Side Integration
  - Demand Side Management
    grid controls consumption
  - Demand Side Response
    grid steers consumption via dynamic pricing
    (dynamic market place)

INCREASINGLY SINGING & DANCING …

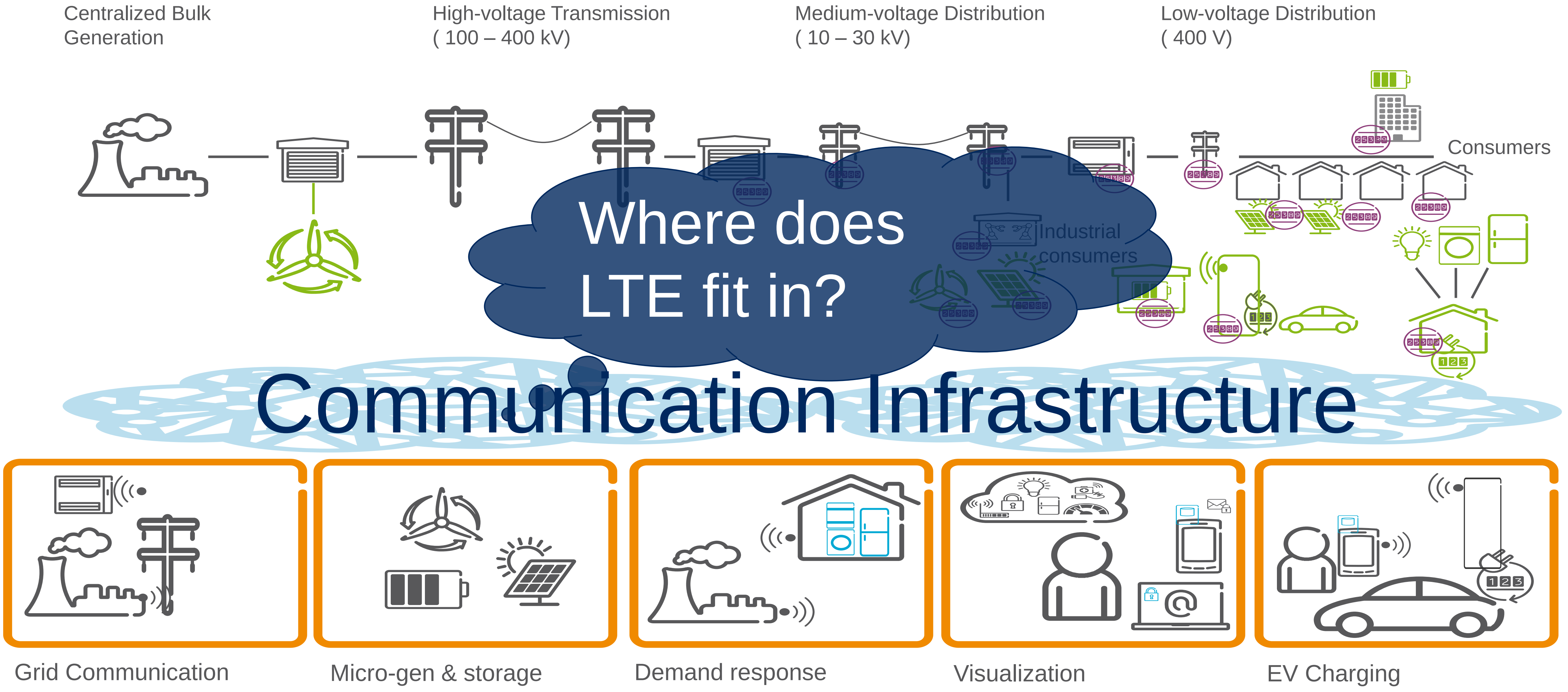
SMART GRID – REQUIREMENTS



SMART GRID – COMMUNICATION



SMART GRID – COMMUNICATION



MANY NETWORKING TECHNOLOGIES - (NO SILVER BULLET)

FIBRE
- Bandwidth/Latency
- Cost/Time to deploy

GPRS
- Low Cost
- Bandwidth/high latency

PLC
- Physical in place
- Bandwidth/Attenuation

KEY CHALLENGE: Seamlessly integrating ICT with the power delivery system

3G
- Significant bandwidth
- Medium latency

RF MESH
- Inexpensive
- Low power/unlicensed spectrum and high latency

4G: WIMAX
- Bandwidth/designed for data
- Technology orphan

4G: LTE
- Very low latency/quality of service provisioning/secure ecosystem/bandwidth
- Coverage/spectrum allocation

CAN LTE MEET INDUSTRY REQUIREMENTS?