



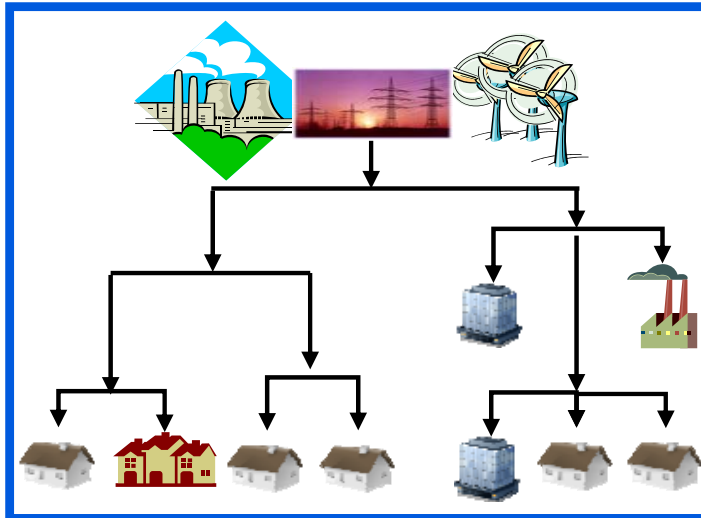
Karl Elfstadius, ABB Smart Grid Program Mmanager / SMART GRID – TAIWAN, 2009-04-08

# Smart Grid Overview

# Evolution of grid design

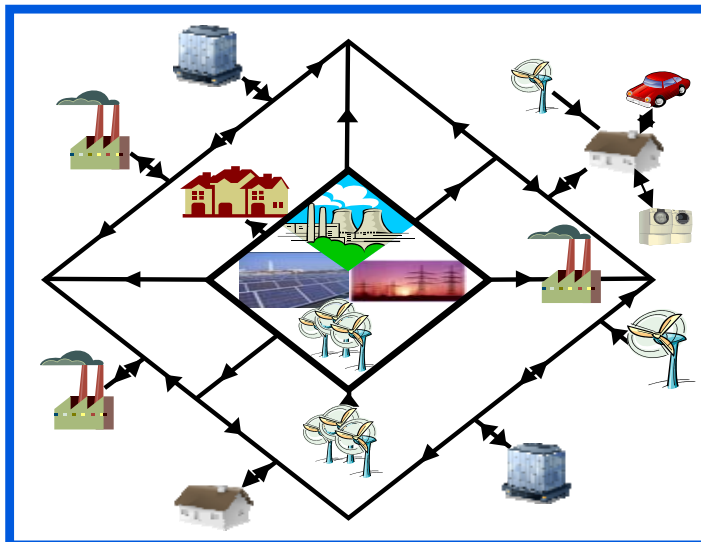
## From traditional to future grids

traditional grids



- Centralized power generation
- One-directional power flow
- Generation follows load
- Operation based on historical experience
- Limited grid accessibility for new producers

future grids



- Centralized and distributed power generation
- Intermittent renewable power generation
- Consumers become also producers
- Multi-directional power flow
- Load adapted to production
- Operation based more on real-time data

# ABB's view on Smart Grid

## - more than IT and smart meters!



A SmartGrid is an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies.

Source: European Technology Platform SmartGrids

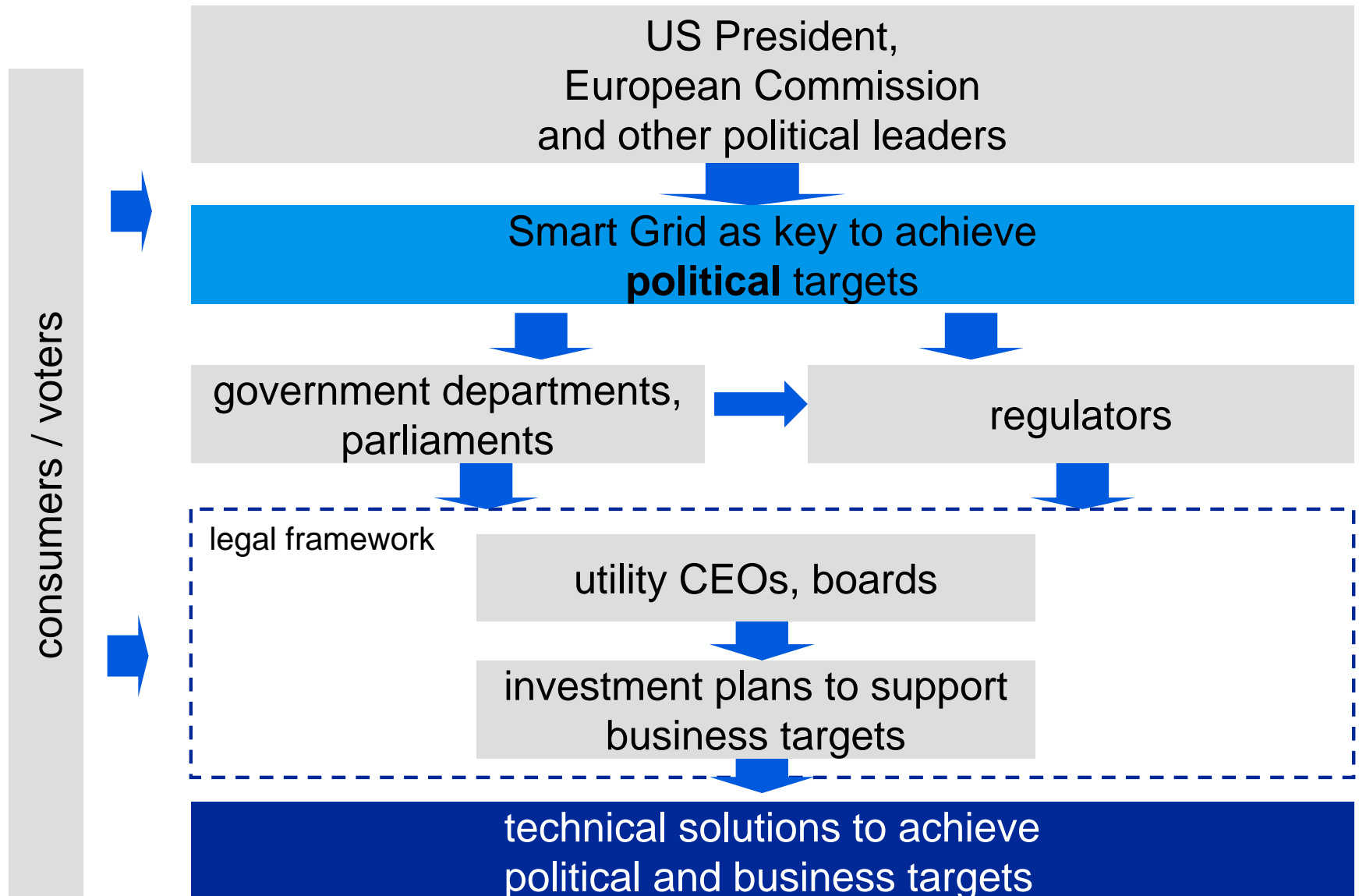
A Smart Grid is self-healing, enables active participation of consumers, operate resiliently against attack and natural disasters, accommodate all generation and storage options, enable introduction of new products, services and markets, optimize asset utilization and operate efficiently, provide power quality for the digital economy.

Source: US Department of Energy

Smart Grid is a vision of the future evolution of the entire power network. It involves both transmission and distribution and focuses on the integration of renewable and distributed generation, the reliability and efficiency of the grid. Further, it includes the demand response and the potential of new technologies such as large scale integration of electric vehicles. Smart Grid includes both automation/IT and controllable power devices in the whole value chain from production to consumption.

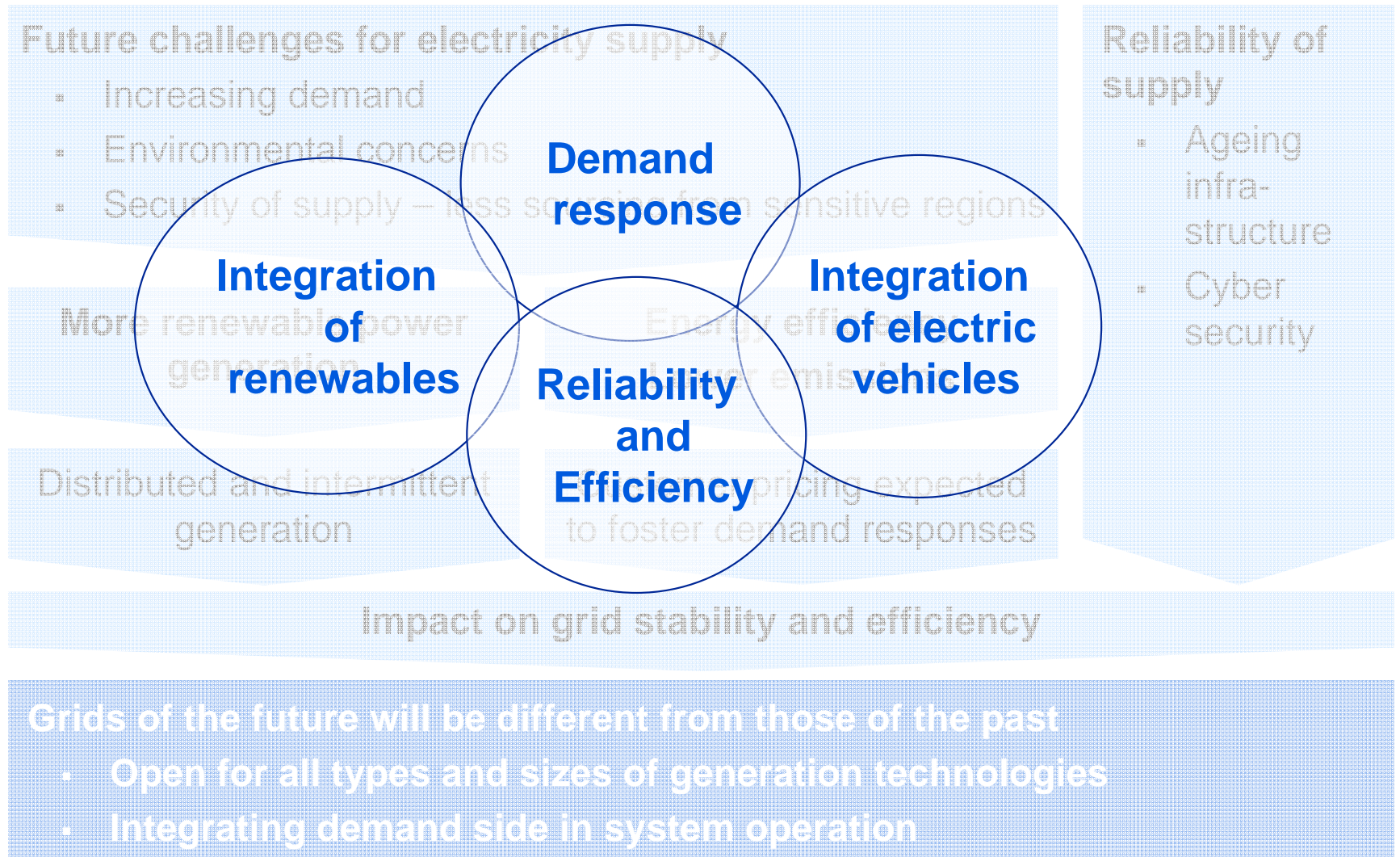
# But Smart Grid is also a political issue

## Many players need to be informed consistently



# Business drivers

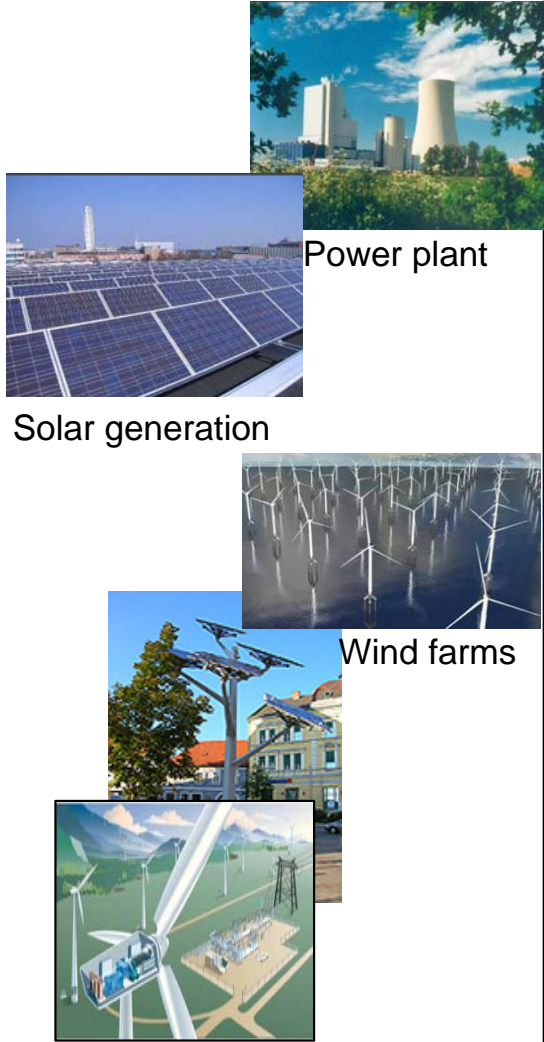
## Four main areas of emphasis



# ABB's Smart Grid

## Integration from supply to demand

### Production



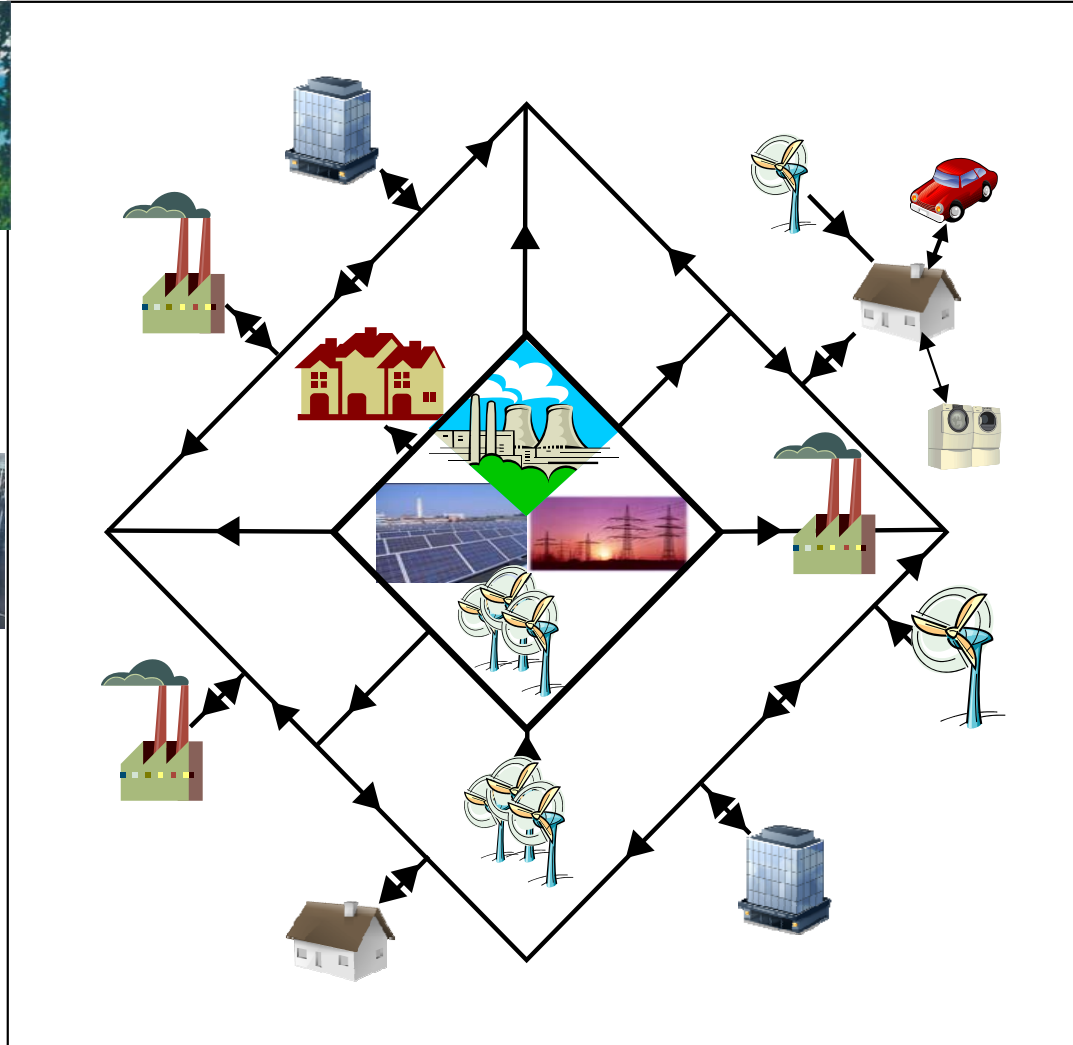
Power plant

Solar generation

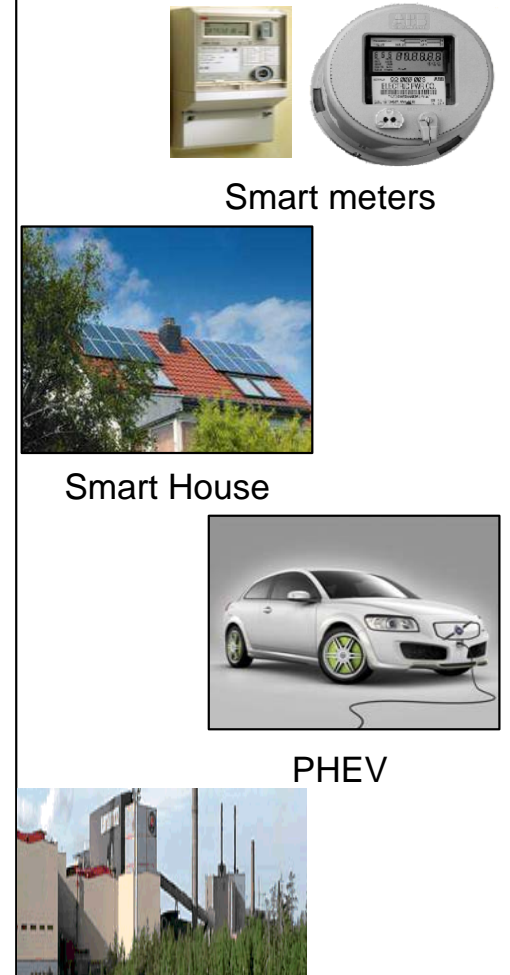
Wind farms

Distributed Generation

### Smart Grid



### Consumption



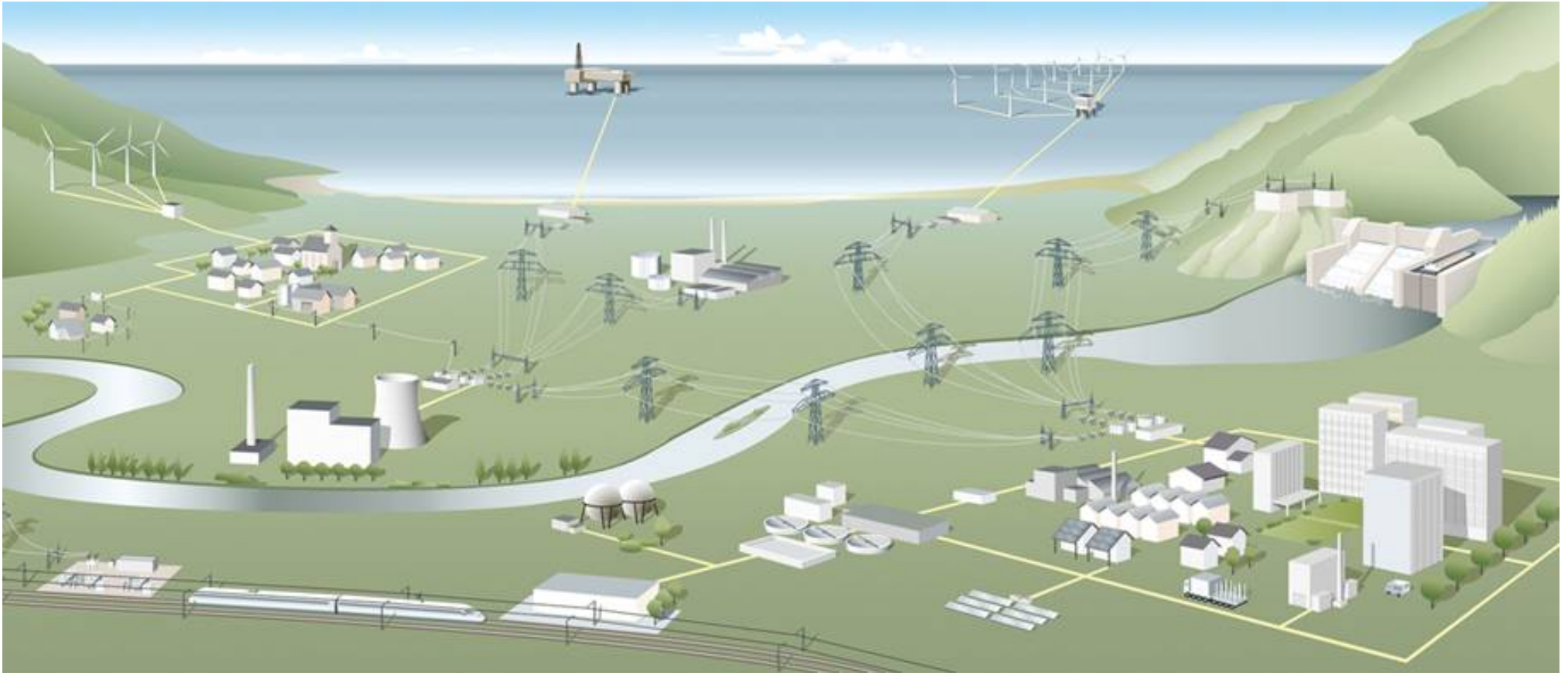
Smart meters

Smart House

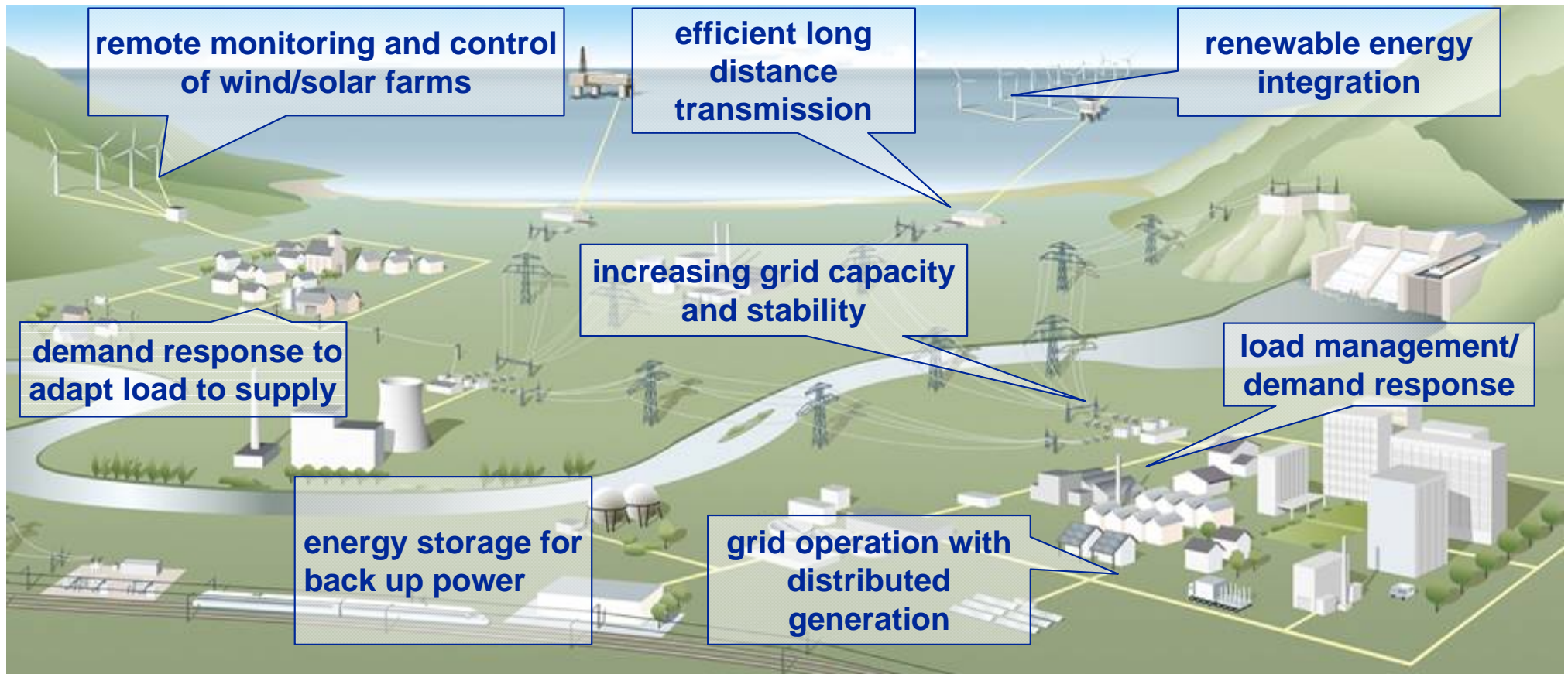
PHEV

Industry

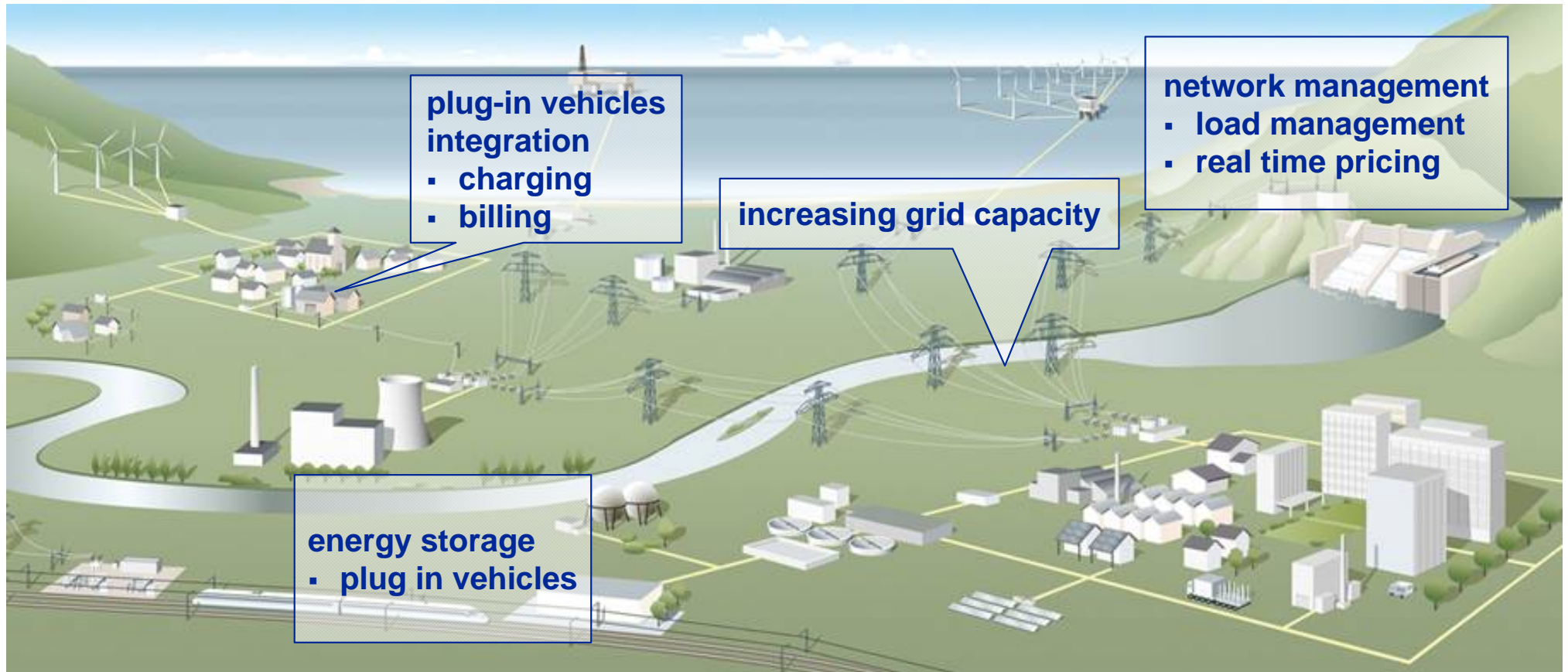
# Smart Grid - more specific



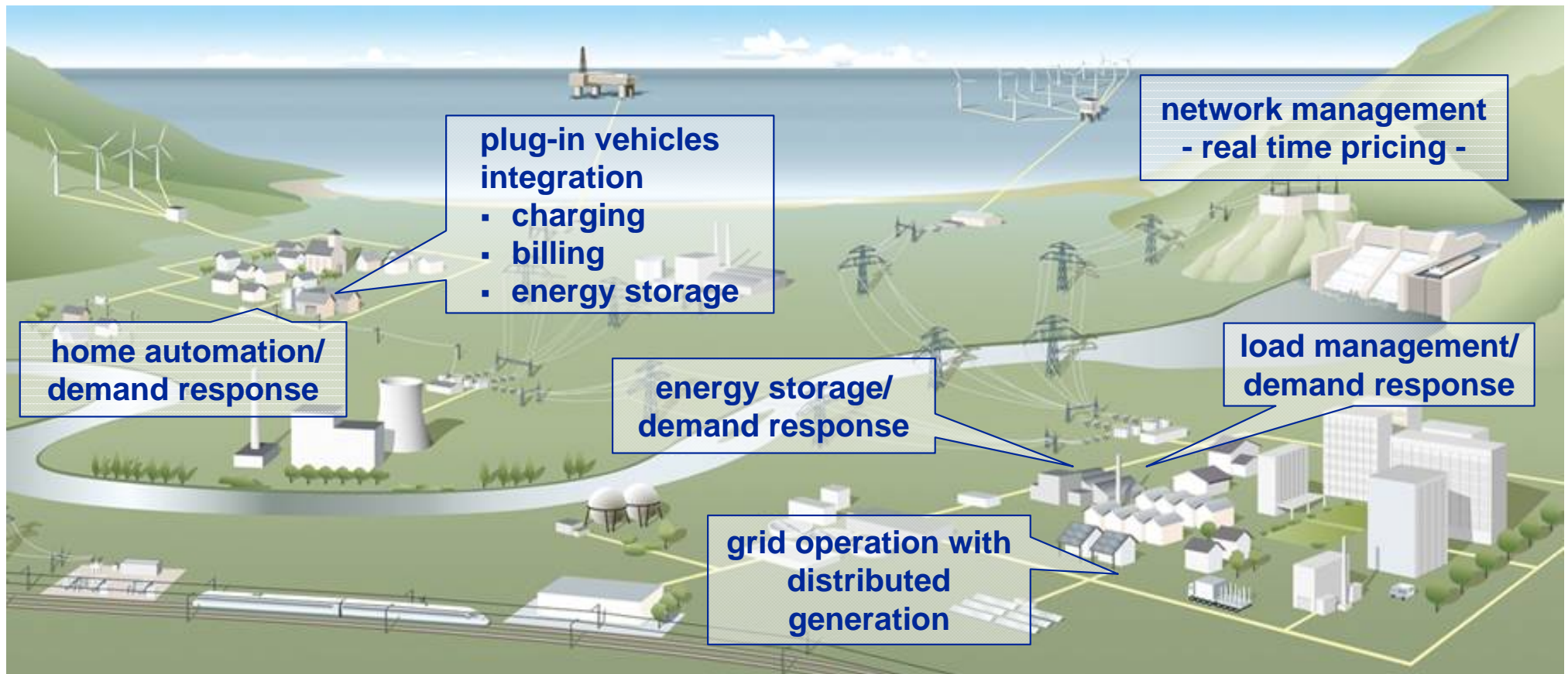
# Smart Grid - more specific Applications supporting integration of renewables



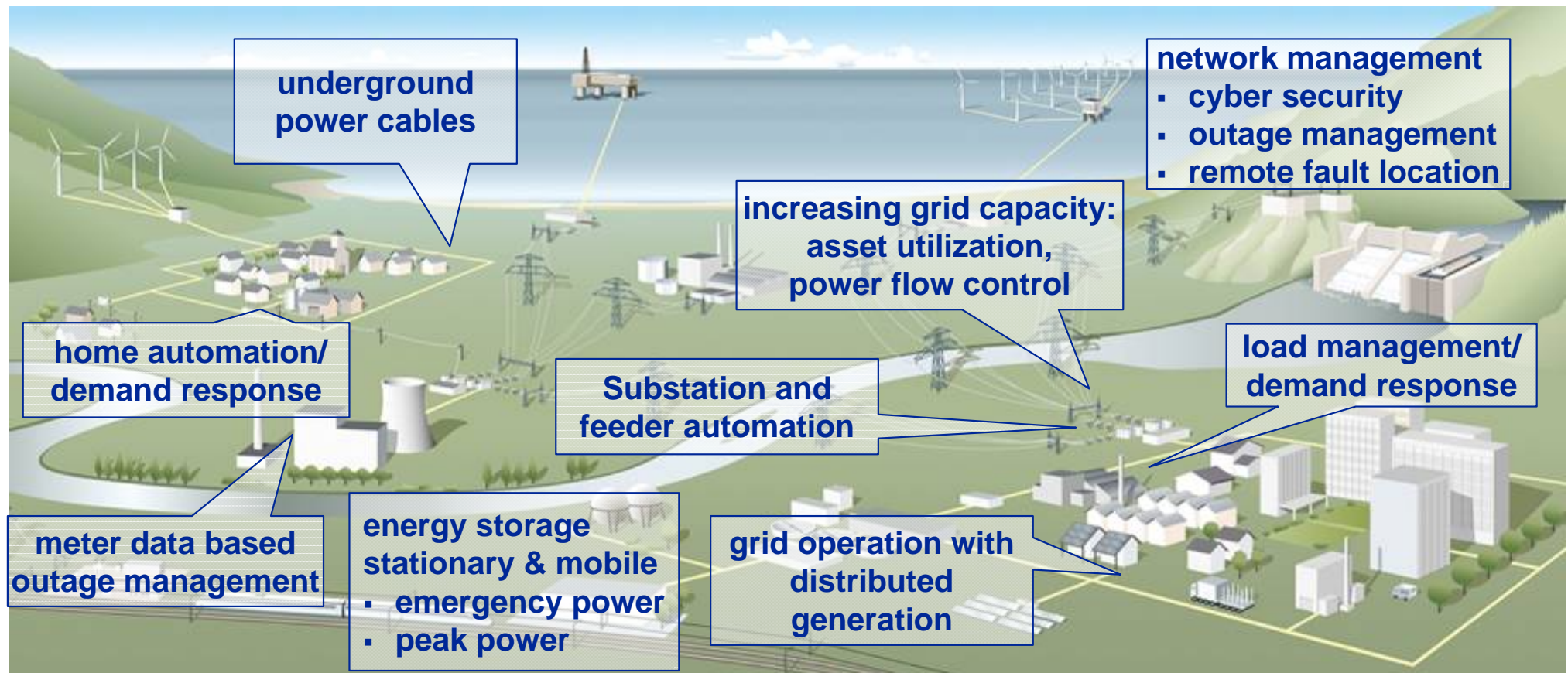
# Smart Grid - more specific Applications supporting integration of electric vehicles



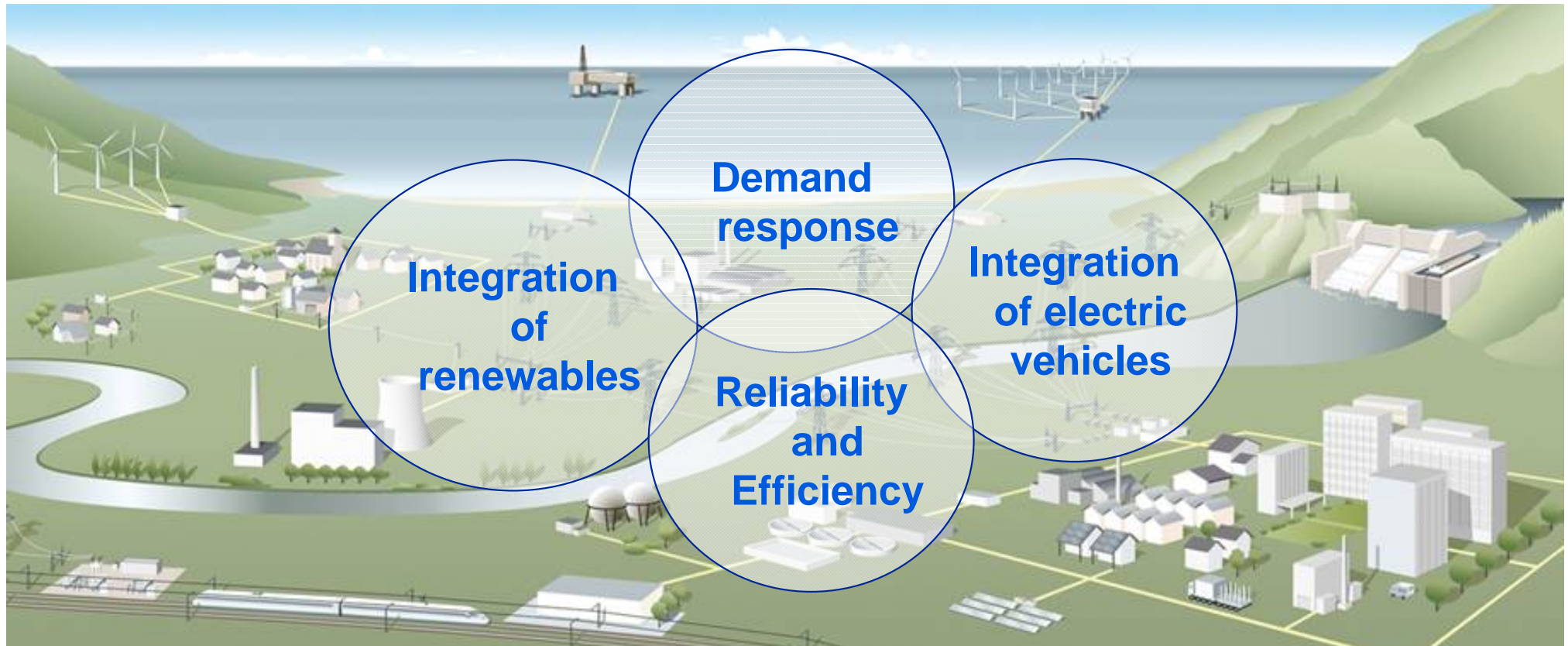
# Smart Grid - more specific Applications supporting demand response



# Smart Grid - more specific Applications supporting reliability and efficiency



# Smart Grid - more specific Integration from supply to demand



- Smart Grid is more than only smart meters.
- Smart Grid includes both transmission and distribution.
- Smart Grid includes both automation/IT and power devices.

# Smart Grid Solutions

## Integration of renewables



- **Network management**
  - SCADA for control and monitoring of wind/solar farms
  - SCADA/EMS enhanced security applications to account for intermittent renewable generation
  - Support demand response based on real time pricing to compensate intermittent production
  - SCADA/DMS dispatch applications for distributed generation.
- **Stationary and mobile energy storage** to compensate intermittent production
- **Flexible AC Transmissions (FACTS)** and **MV STATCOM** for voltage control (comply with grid code) and increased grid capacity
- **High Voltage DC (HVDC)** for efficient long distance transmission.
  - Cost effective and environmentally friendly underground cable connection of wind/solar farms
  - Provide transmission capacity to even out variations in renewable production

# Smart Grid Solutions

## Integration of plug-in electric vehicles



- **Charging infrastructure**
  - different charging time options
  - billing system for mobile customers
  - Internet/mobile telecom
- Different payment systems/business models under evaluation with different impact on measuring and settlements
- **Network Management**
  - Load management
    - charge at times of overcapacity
    - use vehicles as consumer storage
    - provide voltage control for distribution grids
  - Real time pricing to support demand response

# Smart Grid Solutions

## Demand response



- **Gateways** with bi-directional communication for consumer interaction

- Smart meters/AMI
- Internet/mobile telecom
- Customer service systems including billing



- **Network Management**

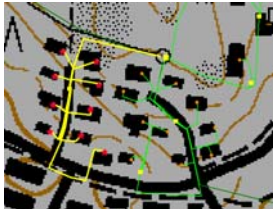
- Improved load management
- Real time pricing to support demand response
- Integration with smart house solutions
- Integration with industrial energy management solutions



# Smart Grid Solutions

## Reliability and efficiency

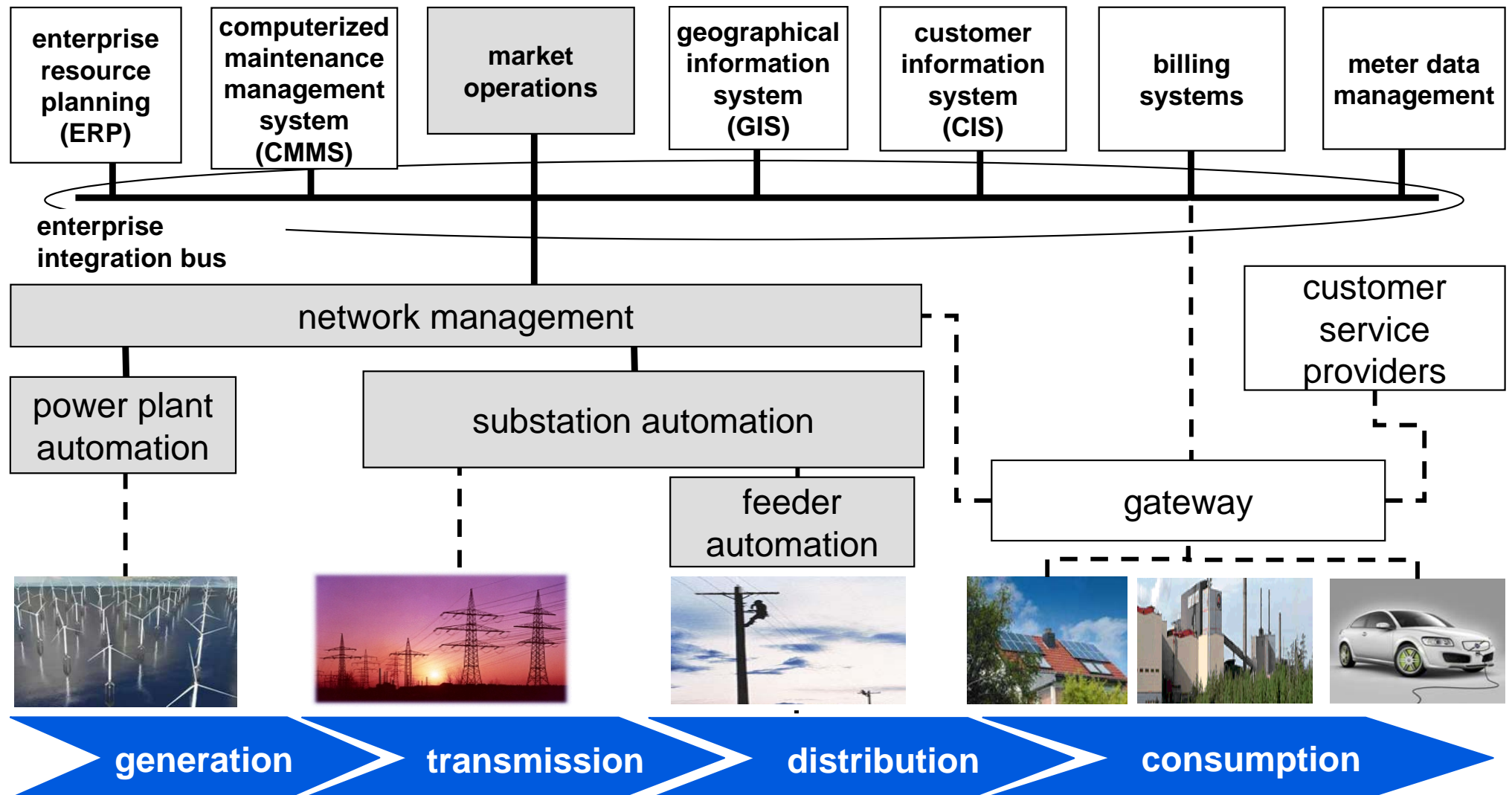
- **Network Management**



- Improved outage management based on
  - meter data instead of trouble calls for remote fault location, isolation, restoration and crew management
  - Increased stability and reduced losses by network control applications incl volt/VAR optimization
- Optimal mix between local and regional production
- Cyber security applications
- **Substation and Feeder Automation**, to increase reliability and provide faster switching
- **Asset management** for improved maintenance and asset utilization
- **Underground power cables** for increased reliability
- **Energy storage**, e.g. for peak, emergency and back up power
- **FACTS and HVDC** for increased stability and reduced losses.

# Smart Grid Solutions

## Automation/IT configuration



# ABB Smart Grid Portfolio

## Production



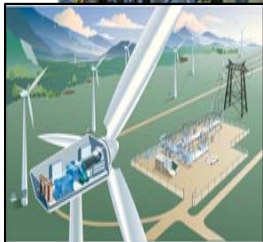
Power plant



Solar generation



Wind farms



Distributed Generation

## Smart Grid

- **Network Manager** for market operation system including real time pricing and control centers including wide area monitoring, outage management, power applications for wind/solar integration,
- **Substation and Feeder Automation** including IEC 61850
- **Utility Communication Systems** for Power Line Carrier, optical fibre and wireless communication
- **FACTS** for increased grid stability and grid code compliance of renewable production
- **SVC Light Energy Storage** for stationary battery storage
- **HVDC Classic and HVDC Light** for efficient long distance transmission
- **Integration of**
  - **Wind and Solar Power Production**
  - **Electric Vehicles** including outlet boxes for charging, demand response and communication
  - **Smart Meters** for demand response and improved outage management, network planning, quality monitoring
  - **Industrial Energy Management Systems** for demand response
  - **Smart house devices** for demand response

## Consumption



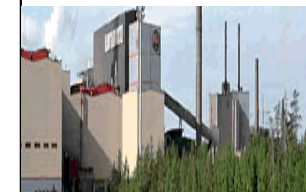
Smart meters



Smart House



PHEV



Industry

# Smart Grid solutions with existing portfolio

## Examples:



### Nord E.ON 1 – HVDC Light®

- 400 MW HVDC Light® system,  $\pm 150$  kV
- 128 km sea cable, 75 km land cable
- Turnkey delivery including platform



### Karnataka, India – Network Manager

- One integrated solution using Network Manager SCADA/EMS/DMS system
- Satellite & leased line communication for complete Karnataka State covering more than 867 locations
- Integrated Energy Audit & Energy Billing solution

# New solutions require pilot projects

## ABB involved in many active pilot projects, examples:



### MEREGIO – Minimum Emission REGION

- Customer: EnBW, Germany
- Complete IT system for two distribution networks in Baden-Wurttemberg, Germany.
- Develop emission certification concept
- Optimize spinning reserves with battery storage
- Reduce transmission losses with local production
- Demand response - real time price information
- Optimize consumption – home automation
- Pilot implementation 2010-2014



### SVC Light® energy storage

- Customer EDF Energy, UK
- Battery Storage - System Voltage 11 kV
- Active Power 200 kW during 1 hour,
- Back up power for intermittent renewable production
- Emergency power
- Peak power
- Pilot in service 2009

# Conclusions



- Smart Grids are prerequisite to reach political targets such as environmental, efficient energy and secure supply.
- Implementation of Smart Grids is an evolution of the existing grids.
- ABB's knowledge in line with system and product needs for Smart Grids.
- Many requirements, like increased efficiency and reliability can be addressed by today's products
  - Outage management based on meter information instead of trouble calls
  - FACTS and HVDC installations
- Some requirements, like full scale integration of renewables and electrical cars, need new solutions based on pilot installations for test and demonstration:
  - Electrical storage
  - Demand response
  - Charging infrastructure
- Industry standardization required.
- The Smart Grids challenges and technologies should attract many young engineers to the power industry.

**Power and productivity  
for a better world™**

**ABB**