Challenges of Smart Grids: Build flexible solutions

SERVE – FR – RT.1b

The new grid equation

3 drivers + 3 accelerators

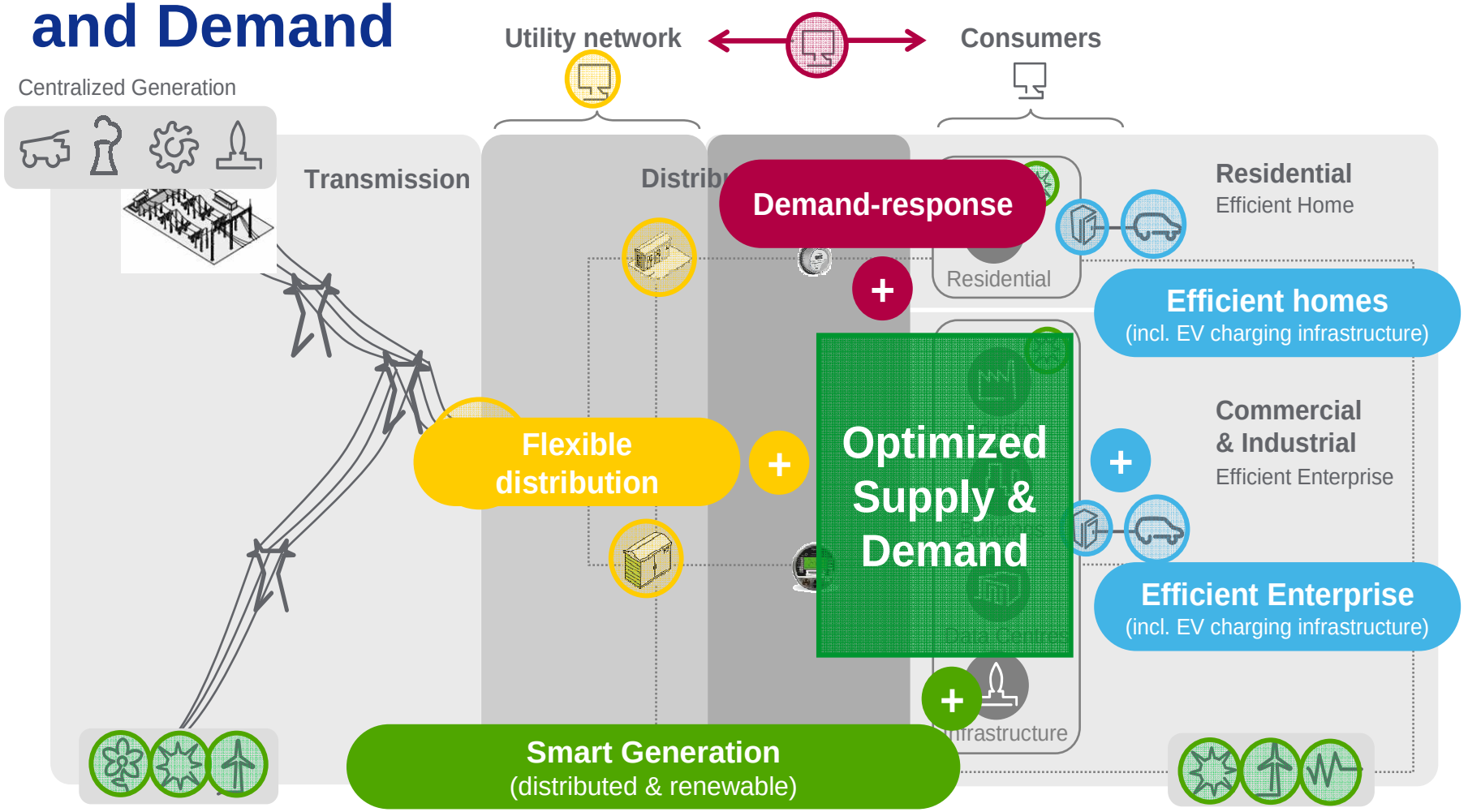
- Growing electricity demand
- Technology availability
- Need to reduce CO_2 emissions
- Active government & regulators
- Constraints on existing networks
- Active end-users

= Pushing for a Smarter Grid

Defining the Smart Grid

- The Smart Grid combines **electricity and IT infrastructure** to integrate and inter-connect **all users** *(generators, operators, marketers, consumers etc)* in order to continue to **efficiently balance demand and supply** over an increasingly complex network.

5 key Smart Grid domains to optimize Supply and Demand



Focus on grid operators: challenges to operate and maintain their network

Increase in base and peak load consumption

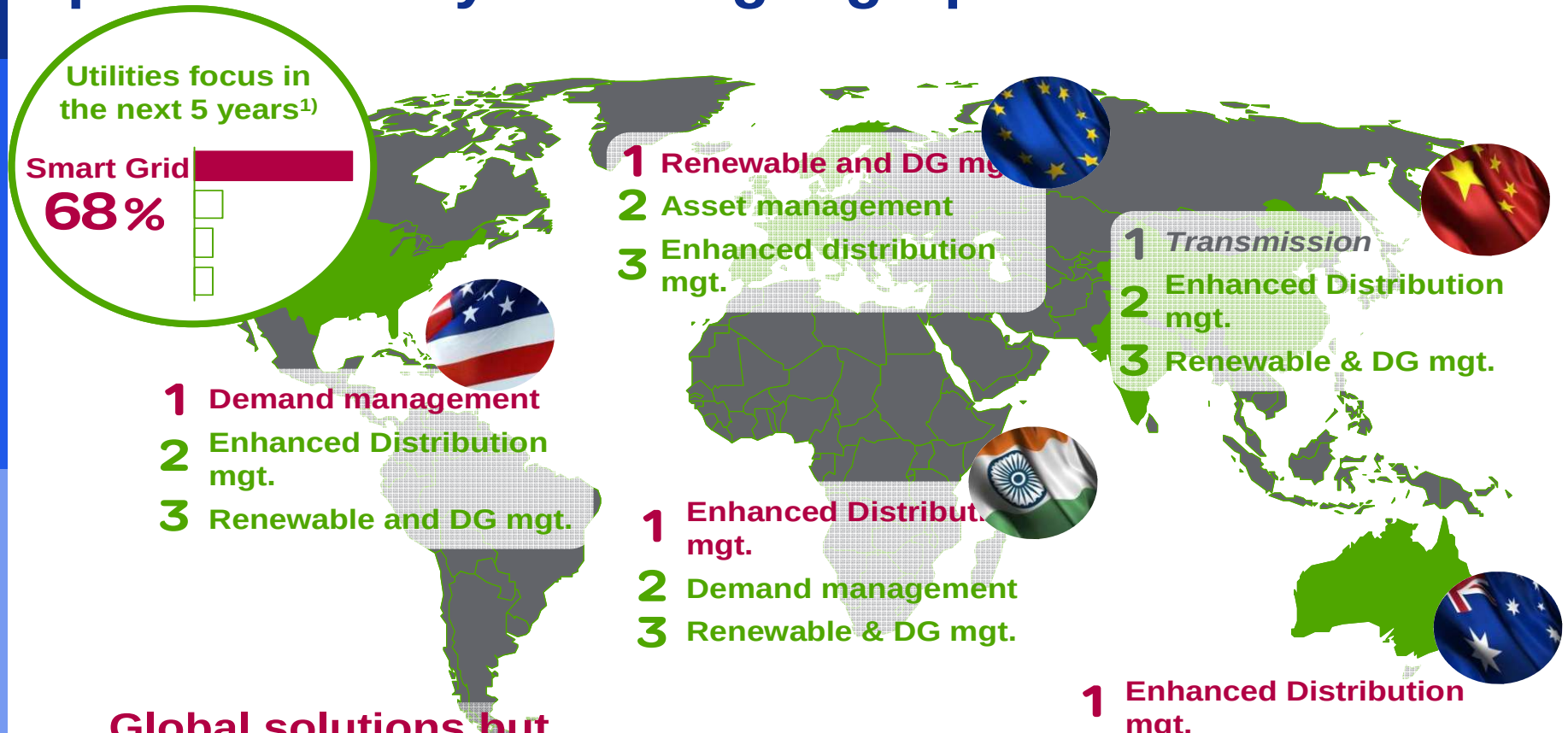
Integration of Renewable/Distributed Generation and EV

Aging networks in mature economies

Increasing pressure from regulators and end-users on grid performance

1. **Advanced network management** (incl. Power quality)
   - More **automation and smarter equipments** are needed to **integrate all new elements** in the network and improve **performance on outages and quality**
2. **Asset management**
   - Utilities need to **optimize their Total Cost of Ownership** and better use their **existing assets**
3. **Renewable & DG mgt.**
   - New energy sources must be safely **connected** to the network and then efficiently **monitored and controlled**
4. **Load Management** (supply-side incl. EV)
   - **Demand behavior** needs to be **monitored / managed** and **losses reduced** to face congestion and consumption growth

Smart Grid is the major focus of Utilities but priorities vary across geographies



Case study: focus on Smart Automation

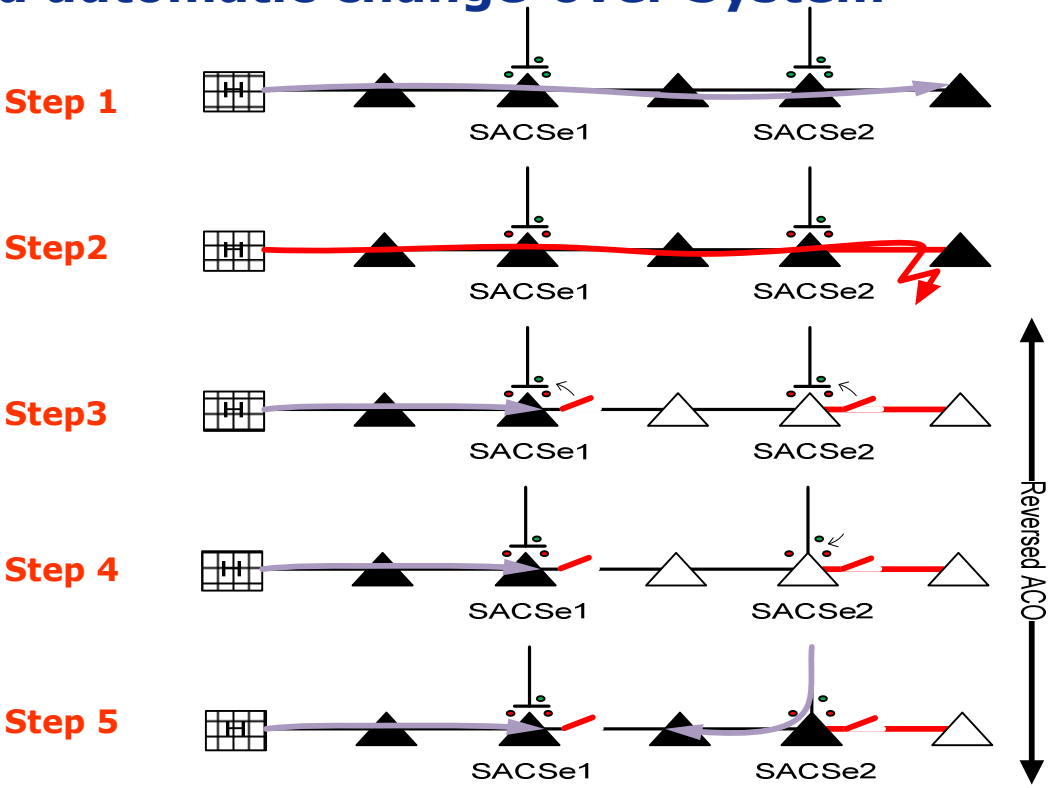
- **Target: re-supply as many customers as possible within 1 mn or less on an underground MV feeder with compensated MV neutral**

- The utility has many **wind farm plants** that are connected to the grid: their problem is to re-supply customers from all possible power sources but need a specific protection scheme to avoid every line to be out of service because of MV network faults.

- **The solution consists of upgrading all MV/ LV substations with the following options:**
  - **1 incoming Load Break Switch and 2 outgoing Circuit breakers**
  - **Simple protection relays, MV voltage detectors and directional fault indicators**
  - **1 automation system controlling all these equipment**

Case study: focus on Smart Feeder Automation

Combination of Circuit Breakers (downstream faults) and automation (upstream faults) with an enhanced sectionalizing and automatic change-over System



Case with two substations

Smart Feeder Automation: A complete solution

- A MV switchgear control cabinet embedding:
  - MV switchgear remote control
  - Reliable DC power management
  - Reliable switchgear connection system
  - Optimized communication (IEC870-5-104+GPRS)
  - Voltage presence detection from MV phases
  - 2x protection relays for downstream fault tripping
  - 1x specific automation software
  - 2x Directional Fault Passage Indicators for upstream earth fault detection
  - Enhanced MV current and LV voltage Measurement

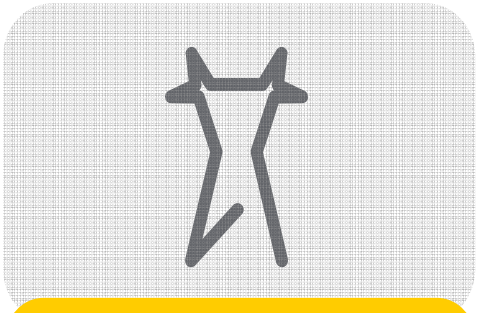
E mobility: Connection between EV infrastructure, Energy Management and Smart-Grid

- The introduction of EV will increase the demand for energy and thus solicit and stress the electric network
- EV is one of the links in the sustainable urban mobility chain
- EV can be considered simultaneously both a means of transportation and a mobile energy-storage device
- EV, in the future, can be able to inject energy into the utilities electric network
- Vehicle to grid:

  This is most likely to happen in case of critical peak reached on the network to avoid black out, or local black out provoked by storms or heavy snowing episodes.
- Energy and Communications interfaces to the grid must be standardized
- Intelligent energy management will encourage the use of electric vehicles and reduce transportation's environmental footprint.

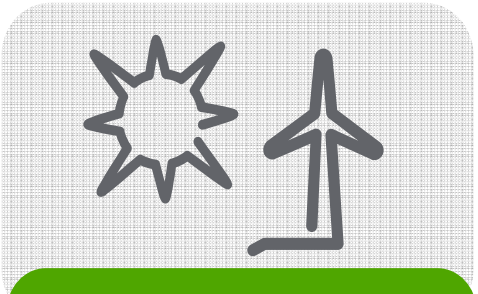
Smart grid needs large, high and dynamic level of competencies (academic and industrial)

Today,
Smart Grid means:

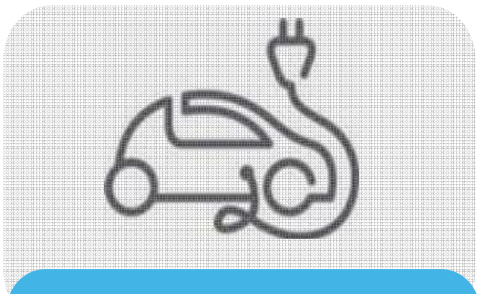


Flexible Distribution

Energy Efficiency

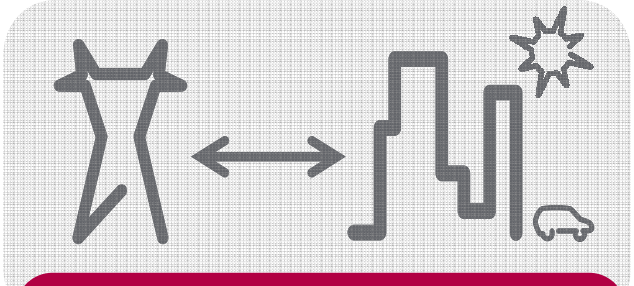


Renewable integration



Electric Vehicle charging

…and new applications are coming fast :



Demand-Response