Microgrids Opportunities within Spain’s Smart Grids initiatives

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- Renewable Energy
- Ocean Power
- Solar Power
- Smart Grids
- Electric Storage and Mobility
- New materials from Waste
- Prediction Systems
- Water Cycle
- Environment and Climate Change
- The Energy System of the Future
- Sustainability as Mega-trend

Sustainability as Mega-trend
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1. Smart Grids market in Spain

Global smart grid market opportunity

USA $7.1 billion
Ontario $1.0 billion
Spain $807 million
France $265 million
Brazil $204 million

China $7.3 billion
Japan $849 million
South Korea $824 million
Australia $380 million

Note: The above figures represent planned investment in smart grid infrastructure.
1. Smart Grids market in Spain

**TOP TEN COUNTRIES FOR FEDERAL SMART GRID INVESTMENT, 2010**

1. USA: $7.09 billion
2. Japan: $849 million
3. South Korea: $824 million
4. Spain: $807 million
5. Germany: $397 million
6. Australia: $360 million
7. UK: $290 million
8. Brazil: $204 million
9. France: $265 million
10. China: $7.32 billion

**SOURCE:** Zpryme Research & Consulting
1. Smart Grids market in Spain

**Figure 10** — Number of R&D and demonstration SG projects

**Figure 11** — Budget of R&D and demonstration SG projects start

Source: Joint Research Centre - European Commission
1. Smart Grids market in Spain

Figures 13 – Investments in R&D and demonstration SG projects across Europe

Source: Joint Research Centre - European Commission
1. Smart Grids market in Spain

SG benefits will total between €19 and 36B, generating value of 2 to 3.5 times the investment needed for their development.

For each stakeholder, investments and efforts need to be aligned with benefits.

**Investment required**

- **Grid elements**
  - Smart meters
  - Automation of Medium and High Voltage, including remote control, supervision, and metering elements
  - Advanced applications to manage grids and operate power system
  - Smart elements in High Voltage

- **Customer elements**
  - Power management systems that respond to system's price signaling, adapting customers' consumption patterns

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**Intrinsic benefits**

**Direct benefits**

- Reduction of energy intensity and flattening the demand curve
- Increase in system's energy efficiency (fewer losses)
- Increase in systems' operation and maintenance efficiency
- Optimization of assets utilization and extension of assets life cycle

**Indirect benefits**

- Increase in the country's productivity from improvements in power supply quality

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For each stakeholder, investments and efforts need to be aligned with benefits:

- Regulated businesses: reasonable compensation
- Liberalized businesses: attractive business plans

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Additionally, Smart Grids will facilitate distributed energy resources' integration (renewables, distributed generation, and e-vehicle, etc.)

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1. Average investment value. Arithmetic mean between minimum and maximum scenarios.
Note: Benefit scenarios calculated as the net present value of the total benefit in 20 years, assuming an 8% discount rate.
2. Reference of main SG initiatives
2. Reference of main SG initiatives

1. Smart grids → combination of traditional facilities with state-of-the-art ICTs technology
2. Compliance with legislation = opportunity
3. 60 M€ project investment
   • Roll out of (200,000+27,000) smart meters
   • HV/MV/LV: 1,100 secondary substations and 3 rural primary substations
   • Integration of DG and EVs
4. Improved energy and environmental efficiency
5. Driver project for Basque companies
6. Reference project worldwide
2. Reference of main SG initiatives

An open public solution: PRIME protocol
Smart secondary substations:

1,100 secondary substations will be upgraded to provide the following services:

• 235 with remote management (level 1 - basic)
• 700 with remote management and monitoring (level 2 – monitoring)
• 165 with remote management, monitoring and automation (level 3 – automation)
2. Reference of main SG initiatives

**PRICE: “Smart Grid Project in Henares Region”**

PRICE (Proyecto de Redes Inteligentes en el Corredor del Henares) is a joint Demonstration Project led by IBERDROLA and GAS NATURAL FENOSA, consisting in the deployment of a global intelligent electrical network solution for their power distribution systems in a shared geographic area, in order to get the experience and knowledge in deploying and managing intelligent power systems.

![PRICE Project](image)

*Figure 1: PRICE geographic area*
2. Reference of main SG initiatives

- Monitor, automation and remote control the MV/LV power network, improving its observability, operation and maintenance.
- Improve the integration of already existing distributed generation (73.300 kW).
- Forecasting and monitoring system for distributed generation based on state estimation.
- DSVC system for voltage stabilization in MV feeders and LV generators.
- Specification of the Distributed Generation Control Center
- Contribution to interoperability and common open standards.

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### PRICE Project

- 500,000 inhabitants involved
- 200,000 customers
- > 1,500 MV/LV secondary substations
- Urban, Semi-urban and Rural network topologies
- Budget: 34 M€ (excluding smart meters cost)
- Large collaboration: 21 partners
- Execution period: 2011-2014
3. Opportunities for microgrids projects

Plataforma Española de Redes Eléctricas

Inventario de microgrids existentes en España
3. Opportunities for microgrids projects
Power Sources:
- Diesel Generator (2x55kW)
- μTurbine (50kW)
- Pacific Power Sources - programmable network simulator- (2x62.5kVA/50kW)
- PV single phase (0.6kW and 1.6kW)
- PV (3.6kW three phase)
- Wind Turbine (single phase 6kW)
- Ballard Fuel cell (1 kVA)
- DC power source (125 kW)

Static Switch:
- Islanded – Grid connected

Main switching board:
- Three busbars (Three phase)
- Most devices can be connected to any busbar

Tests switching board:
- Concentrates all load banks at a single connection

Communication network:
- Ethernet, WiFi, RS 485 & RS 232, TCP/IP, ModBus...

Storage:
- Flywheel (250kVA)
- Ultracapacitor bank (48V 2.8MJ)
- Battery banks (48V-1925Ah and 24V-1120Ah)

Controllable load:
- Resistive load bank (150kW & 55kW)
- Reactive load banks (up to 200kVARr reactive or capacitive)

Other:
- Line simulator (R & X)
- DC Network, Rectifier and PM1000 Inverters (2x100kW)
- Hidrotec
- EV platform
- Kubik
3. Opportunities for microgrids projects

Conclusions on the inventory

• 19 installations / 5 MW
• Purpose: pilot projects / demo / experimental platform
• Most of them can work connected or isolated
• All of them are private distribution networks connected to the main grid (utility) in a single point
• There is a regulation under discussion (net balance) that can mean a great opportunity for microgrids deployment in Spain
• Several laboratories have developed experimental capacities for technology testing
• Some of them are even working under real conditions
Thank you for your attention

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