



# Development of Smart Grids in Spain

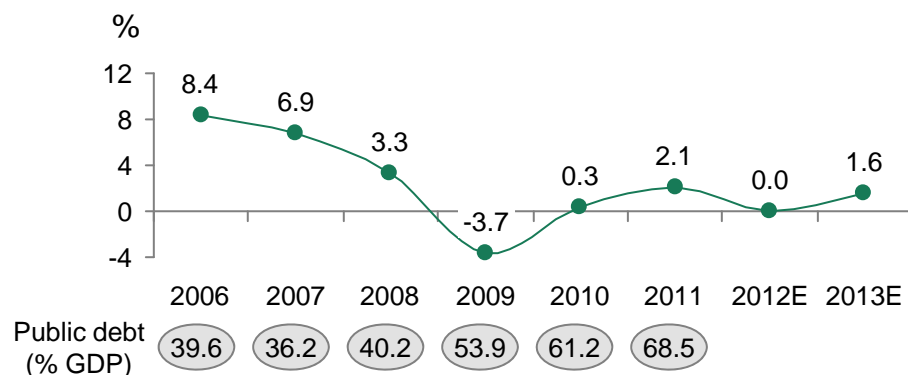
## Main conclusions

June 2012

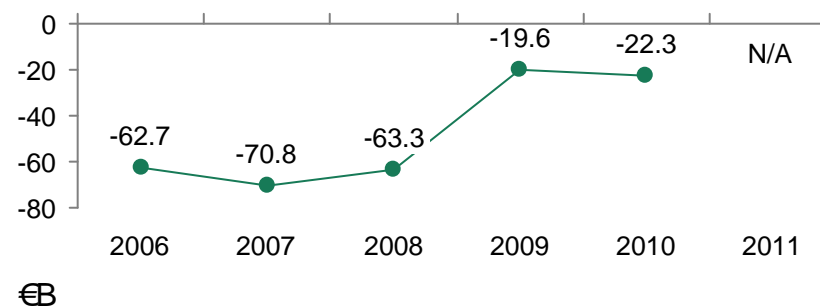
THE BOSTON CONSULTING GROUP

# The Spanish macroeconomic environment facing major challenges

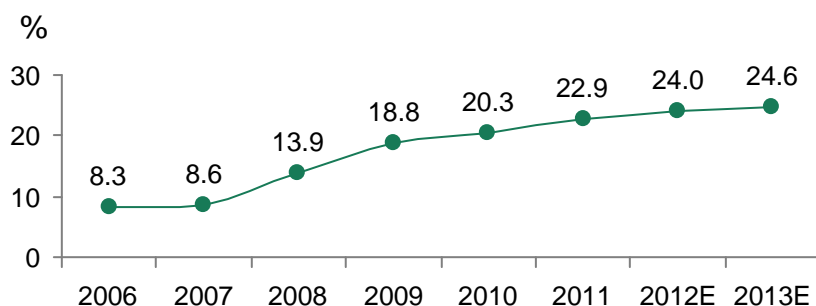
### Spain's nominal GDP growth



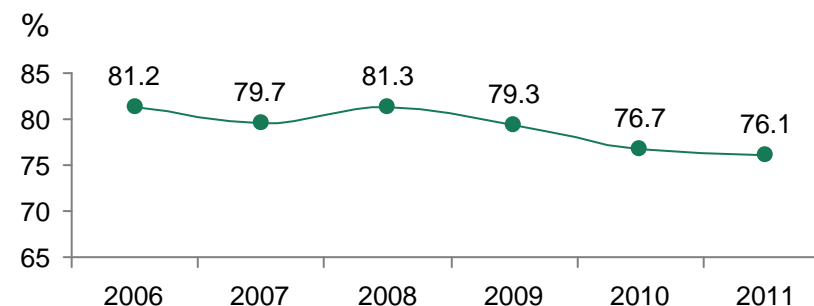
### Spain's trade balance<sup>2</sup>



### Unemployment rate in Spain<sup>1</sup>



### Spanish energy dependence<sup>3</sup>



1. Values for 4th quarter of each year. 2. Net difference between Spanish imports and exports. A negative trade balance means that imports are higher than exports. 3. Percentage of primary energy imported over country's total primary energy.

Note: Unemployment forecasts from Funcas' April report that crosses data from different information sources like BBVA, AFI, Intermoney, La Caixa and Santander, among others. GDP growth forecasts based on BBVA.

Sources: INE, Funcas, BBVA, Eurostat, BCG analysis

# Developing Smart Grids will improve country's competitiveness, generating benefits for the technological & industrial sectors

## Contributing to economy's sustainable growth

**Productivity increase and GDP growth**

↑ **0.2%-0.35% GDP**  
(€2,300-3,800M/year)

- Due to improved quality of supply and increase of power system efficiency

**Job creation**

↑ **40,000-50,000 jobs**

- In producing elements required and their deployment

**x2-x3.5**  
Benefit / investment

## Leadership of the Spanish technology and industrial sectors

Development of **Spanish technology and industrial sectors** with leadership in smart grids

**€1,200-2,000M/year** in Smart sales

- Exports of Smart goods and services to attractive markets

Strengthening of Spanish **power companies' capabilities**

**Monetizing efficiency in grid management**

- Active role of Spanish companies in the reconfiguration of the energy industry at a global level

## New applications and efficiencies for the power system

Development and **integration of new applications** and **improved power system efficiency**

**€1,100-1,800M/year** in benefits

- Benefits for the power system from the new Smart Grid applications
  - Grid automation
  - Integration of distributed energy resources
  - Increase of customer's participation in the system



**Smart Grids will generate a value of €19,000 - 36,000M**



- **Benefits will be 2 to 3.5 times the investment** required, due to an increase in the system's reliability and efficiency and the ability to manage consumption in real time
- **A €10,200M estimated investment required**, in grid elements and customer installations over the next 10 years



**Smart Grids are a precondition to generate a value of €3,100M/year and more than 200,000 jobs**, by facilitating compliance with the 2020 targets on renewable energy, energy efficiency and e-vehicle integration

# Smart Grids will favor the sustainable growth of the Spanish economy



Increased productivity and GDP growth

↑ **0.2%-0.35%**  
(€2,300-3,800M/year)

**Undertaking and leading the process to transform the power system with Smart Grids could improve Spain's Gross Domestic Product +0.2% to +0.35%**

- Development of the Spanish power and technology sectors and creation of jobs
- Adjustment of the trade balance by reducing imports of primary fossil energy
- Increase in country productivity derived from an improvement in supply quality



Job creation

↑ **40,000-50,000 jobs**

**Developing Smart Grids will generate 20,000 direct jobs in Spain and 20,000 to 30,000 indirect jobs in high added value activities**

- Manufacturing electrical and communications components
- Setting up, installing in situ and maintaining electrical and communications installations
- Developing companies on energy management businesses



Reduction of energy dependence

↓ **5.3 p.p<sup>1</sup>**  
(€4,050M/year)

**Spain's energy dependence could be cut 5.3 percentage points by 2020 (10,800 ktep less primary fossil energy)**

- Increase in the power system's energy efficiency
- Effective integration of renewable energies and e-vehicles<sup>2</sup>

**For the power sector, energy dependence could drop 12.2 p.p. by 2020**



Reduction of CO2 emissions

↓ **3.7%<sup>1</sup>**  
(€160M/year)

**Spain's CO2 emissions could drop 3.7% by 2020 (15 million tons less)**

- Less fossil fuels used to generate electricity
- Effective integration of renewable energies and e-vehicles<sup>2</sup>

**For the power sector, CO2 emissions could drop by 15% by 2020**

1. Includes integration of renewable energies, the effect of Smart Grids and the addition of 1 million e-vehicles. 2. One million e-vehicles.

# Smart Grids will develop the Spanish technology sector favoring the export of Smart goods and services

As well as maintaining and increasing current exports in electrical equipment goods

**~€700,000M expected to be invested in Smart Grids globally from 2011 to 2022, creating large potential market to export technological goods and services**

- Developed countries are making a major effort to modernize their grids (e.g. the U.S. has destined \$4,500M in public funds to Smart Grids)
- The IEA recommends developing countries to include Smart elements when developing power systems

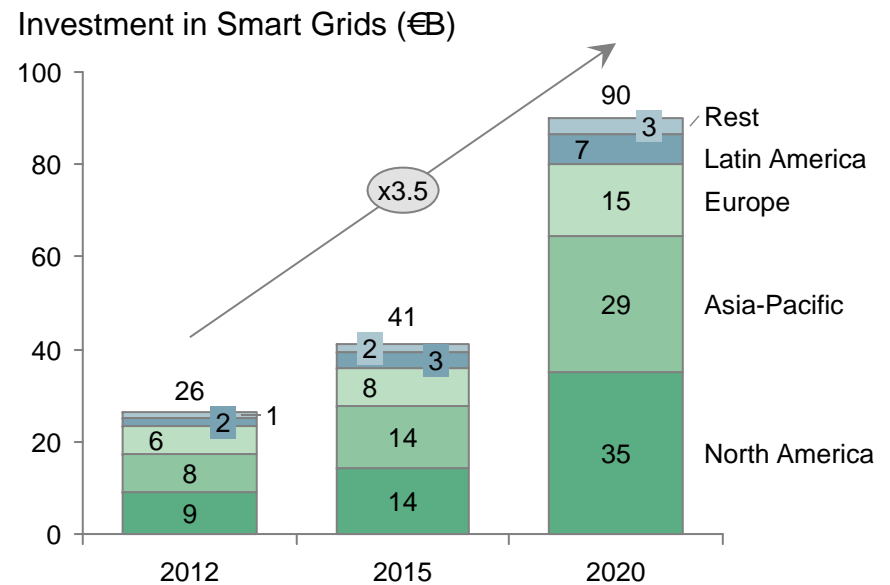
**Spanish technological companies could capture a part of this potential market (€1,200 to 2,000M/year)**

- Aspiring to capture 3-5%<sup>1</sup> share in those markets attractive for the sale of Smart goods and services (Europe, Latin America and North America)
- The presence of Spanish companies in the Smart market will also allow them to **maintain and increase their exports in traditional electrical equipment goods (€8,000M in 2011)**

**The development of the Spanish technology sector should be well supported to capture the highest potential**

- Support from Spanish institutions, incentives for pilot project development, development of financing mechanisms, etc.

**Estimate of Smart Grids investments globally**



National technology companies could aspire to export **€1,200 to 2,000 M worth of Smart goods and services a year** to those geographies most attractive for Spanish companies

1. As a reference figure, in 2011, Spanish electric goods exports made up 3.6% of the global market. Source: Visiongain, NRG Expert, INE, BCG analysis

# Additionally, Smart Grids will help maintain and increase the leadership of Spanish power industry

## The Spanish power system is key to the country's productivity and power supply constitutes an essential driver of competitiveness

- An interruption of 1 hour for the whole system has a negative impact of €1,500M for the country

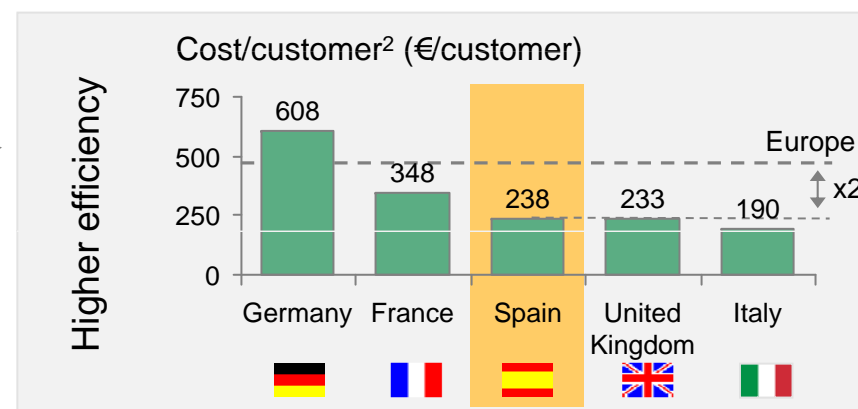
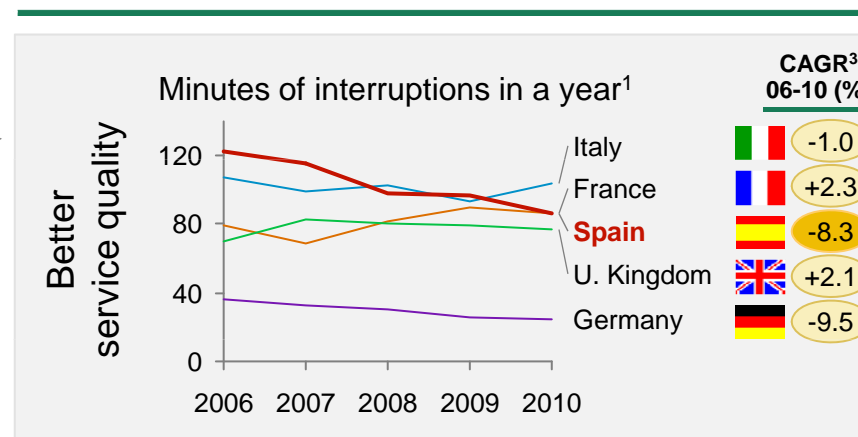
## Spanish companies have demonstrated that they are a best-practice in power grid management and system operation, both in quality and efficiency

- Service quality in Spain has improved 8% since 2006, situating at French and British levels
- Grid cost efficiency in Spain is double European average and almost triple than German
- World-leading integration of non-manageable renewable energies and distributed generation

## Smart Grids will further strengthen and increase this leadership, strengthening the capabilities of Spanish energy companies

- Developing new business opportunities for Spanish companies outside of Spain
- Playing an active role in the power industry reconfiguration process at European and world levels

## Grid system quality and efficiency in major European countries



1. Scheduled and unscheduled interruptions, excluding exceptional events. 2. The cost refers to recognized costs in distribution and transportation tolls. Data for 2011.  
 3. CAGR is the Compound Annual Growth Rate.  
 Source: National power regulators; Ministry of Industry, Energy & Tourism; BCG analysis

# Smart Grids' new applications will help to successfully face the power system's challenges

## Smart Grids' new applications

Increase of Customer's participation in the system



Raising awareness about **energy efficiency** by providing more information to customers (consumption, cost, etc.)

Enabling **real-time** consumption **management, flattening** the demand curve

Integration of distributed energy resources



**Effective integration** of new sources of energy into the system

- Actively managing **renewable energies**
- Allowing the customer with **distributed generation** to feed power to the grid
- Integrating the e-vehicle successfully

Network automation



Advanced grid management, through **increased** system **monitoring** and ability to **remotely manage** operations (more precise meter readings, real time readings, possibility of tariffs by time range, incident responses, etc.)

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

Security of supply



Economic sustainability



Environmental sustainability



These yearly **benefits for the power industry total**  
**€1,100 to 1,800M**

**Additionally, Smart Grids are a precondition for developing new business models (e.g. demand aggregators, virtual power plants, etc.)**



# 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

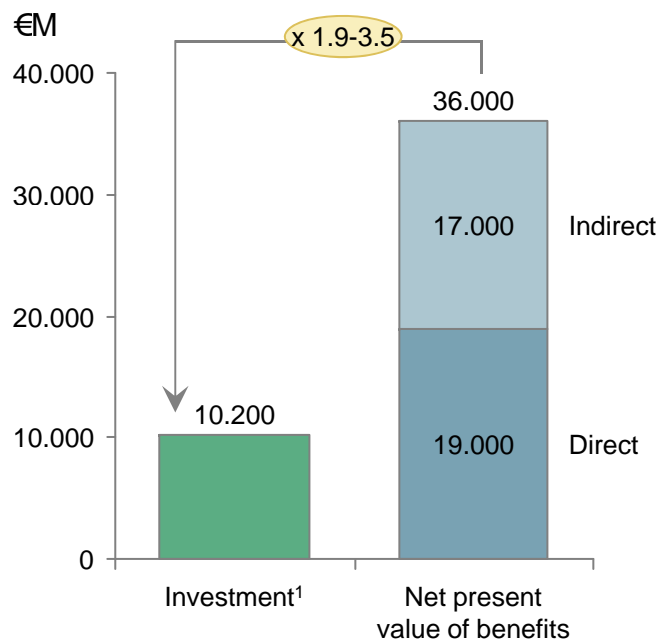
## Investment required

### 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



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

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

## 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**

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

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.



# 3 lines should be followed to drive Smart Grid development in Spain

1

## Align energy and industry policies

- Design of an adequate **compensation scheme** to align investments and efforts with benefits generated for each stakeholder in the system
- Development of an **industrial policy** to consolidate and develop **leading companies**, and favor **creation of new companies** to capture Smart market opportunities
- Assignment of clear **roles** and **responsibilities** to different system stakeholders to capture as many of the Smart Grids' potential benefits as possible
  - E.g. manageability of intermittent generation sources
- Creation of **mechanisms** that encourage **a reduction in energy intensity**
  - E.g. price signals adapted to the real electricity cost in each period

2

## Encourage development incentives

- **Finance** or provide **economic incentives** to develop **R&D** projects in real conditions
  - Prioritizing projects run by national companies
  - Favoring collaboration between companies in different sectors
- **Financing Smart applications and systems** for households
  - For those customers where breakeven appears in the long term
- **Education** on new Smart technologies in technical careers

3

## Strengthen institutional support

- **Support from Spanish institutions** in all the areas of Smart Grid development
  - Fostering international leadership of the Spanish technological and power sectors
  - Driving and supporting access to international markets
  - Collaborating in the definition and implementation of international protocols and standards
- Create **information, awareness** and **educational** programs about:
  - Smart Grids benefits for the community
  - Consumer's new role as active participant in the power system

# Smart Grids development in Spain is profitable and generates benefits for the customer and the country's economy

