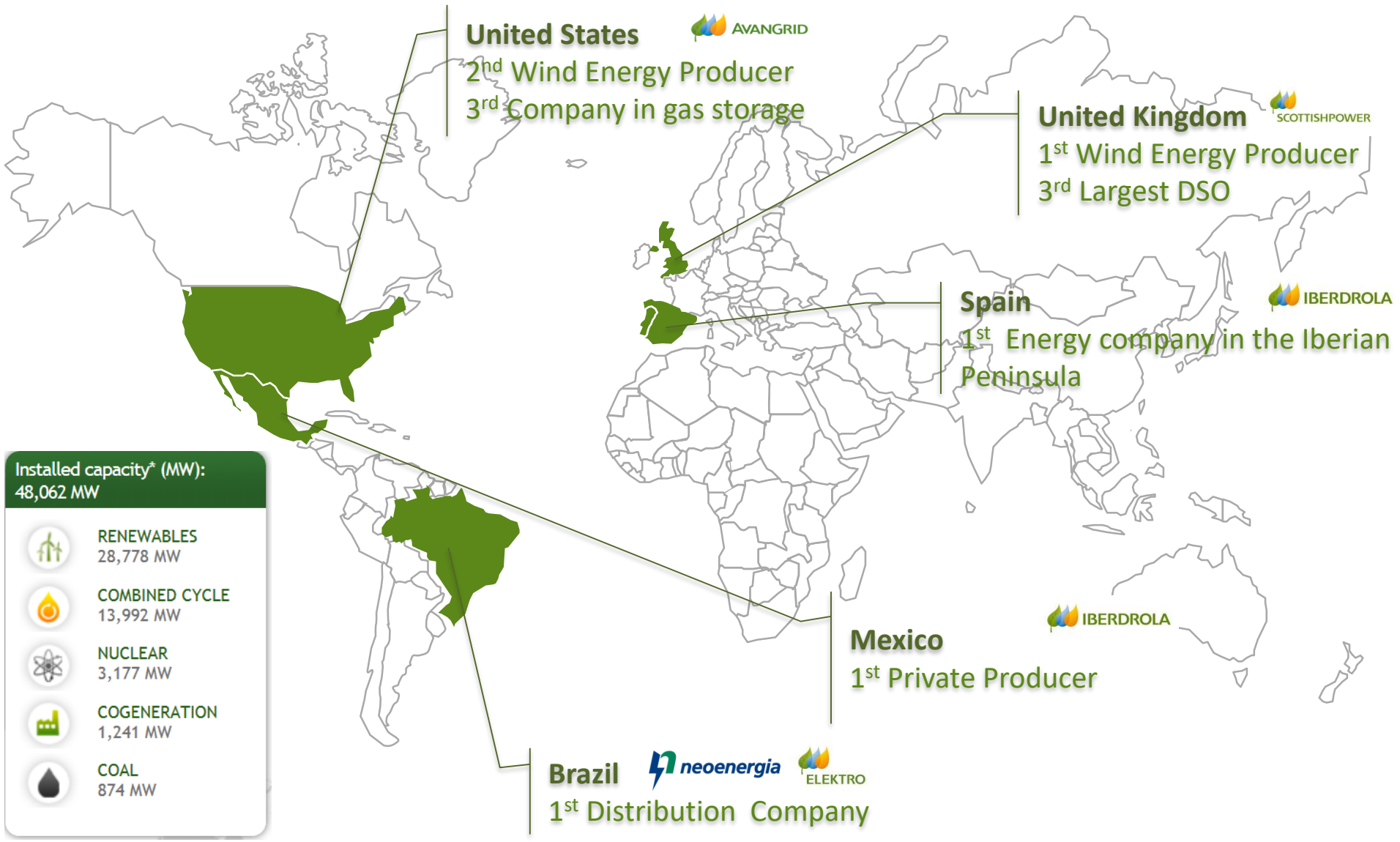
IBERDROLA QSTP

Research challenges in the Digitalization of the electrical grid

ELDER 3rd R&D Energy Workshop
December 19th 2017

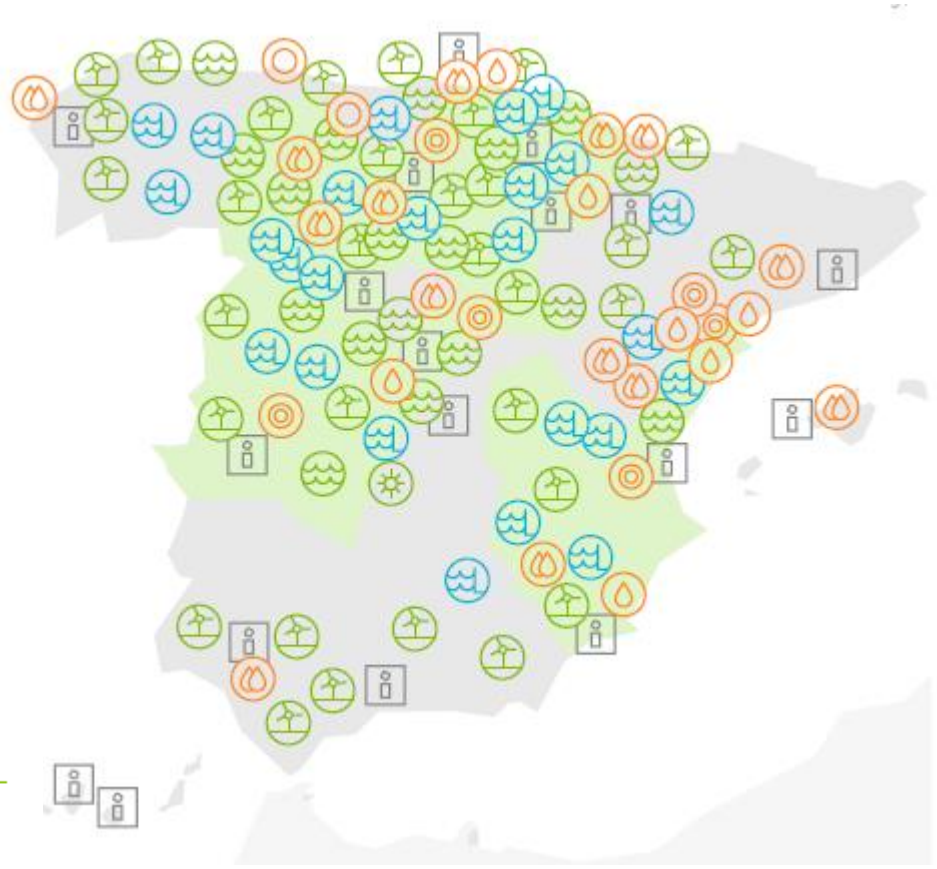
IBERDROLA - Global Utility Leader in Renewable Energy



IBERDROLA Spain

KEY FIGURES

- 11,8 Million Users
- Installed Capacity:
  - 26.162 MW
  - (15.819 Renewable)
- 267.576 Km of Lines



195 Windfarms 5,751 MW

89 Minihydro power plants 303 MW

1 Solar thermal plant 50 MW

8 Combined cycle gas plants 5,695 MW

20 Cogeneration plants 364 MW

6 Nuclear plants 3,410 MW

2 Thermal plants 874 MW

79 Hydro power plants 9,715 MW

Offices

Area of influence

Electricity distribution

IBERDROLA

IBERDROLA UK

KEY FIGURES

- 5,6 Million Users
- Installed Capacity:
  - 4,537 MW
  - (2,819 Renewable)
- 108.818 Km of Lines

32 Windfarms
1,811 MW

1 Offshore windfarm
194 MW

1 Cogeneration plant
1 MW

4 Combined cycle gas plants
1,967 MW

3 Hydro power plants
563 MW

1 Underwater power line
425 Km

SCOTTISHPOWER

IBERDROLA USA

KEY FIGURES

- 3,5 Million Users
- Installed Capacity:
  - 6,875 MW
  - (6,033 Renewable)
- 130.791 Km of Lines

55 Windfarms
5,855 MW

2 Photovoltaic energy
50 MW

1 Cogeneration plant
636 MW

4 Gas storage facilities

4 Combined cycle gas plants
209 MW

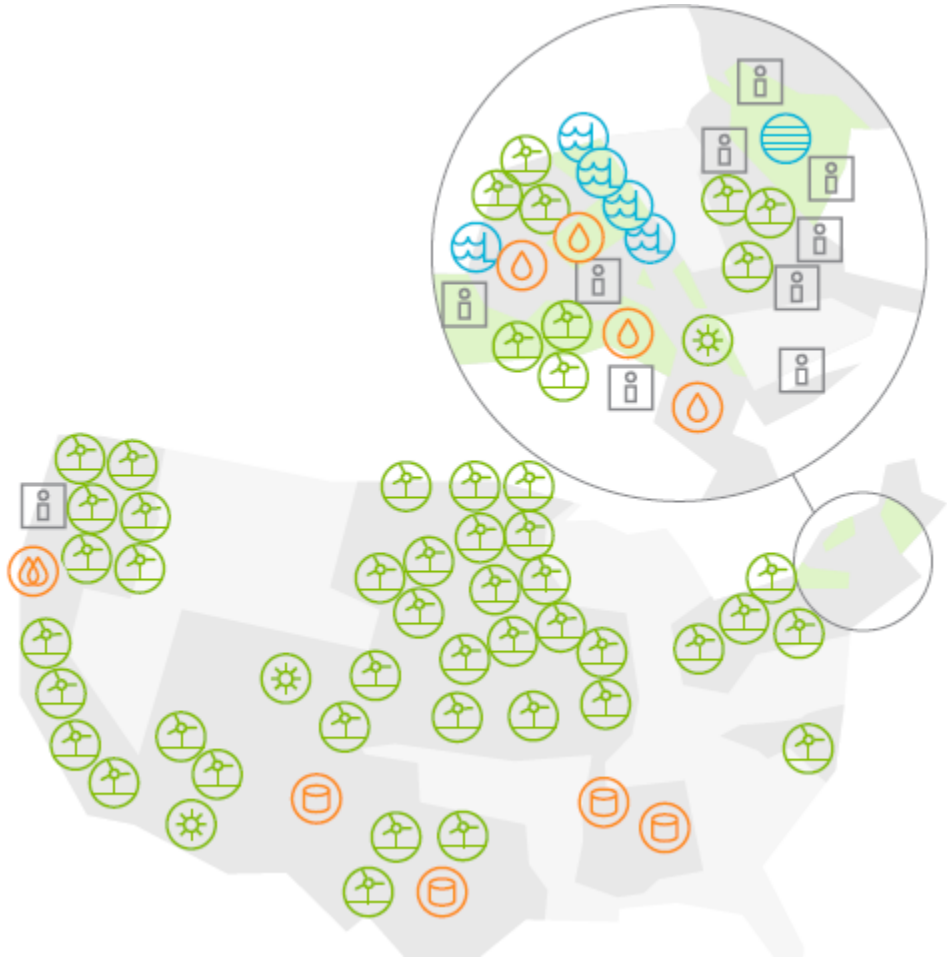
9 Hydro power plants
118 MW

1 Power transmission line
United States-Canada / 708 Km

Offices

Area of influence

Electricity distribution

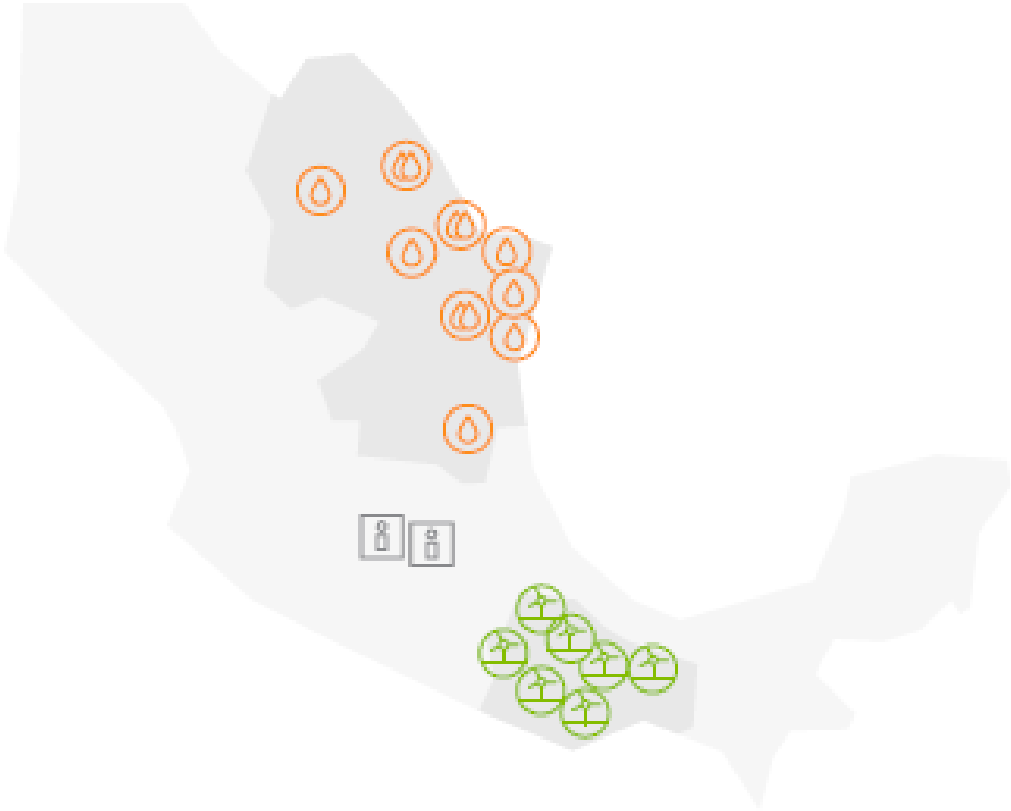


AVANGRID

IBERDROLA Mexico

KEY FIGURES

- **Installed Capacity:**
  - **5,804 MW**
  - **(367 Renewable)**



7 Windfarms
367 MW

3 Cogeneration plants
237 MW

6 Combined cycle gas plants
5,200 MW

Offices

Area of influence

IBERDROLA

IBERDROLA Brazil

KEY FIGURES

- 13,4 Million Users
- Installed Capacity:
  - 2,926 MW
  - (2,315 Renewable)
- 592.717 Km of Lines

11 Windfarms 337 MW

4 Cogeneration plants 78 MW

1 Combined cycle gas plant 533 MW

14 Hydro power plants 1,978 MW

Offices

Area of influence

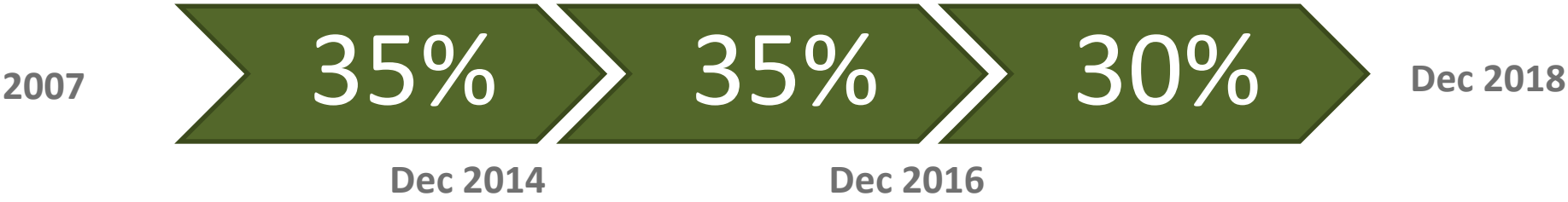
Electricity distribution

neoenergia

ELEKTRO

IBERDROLA Digitalization – Obligation to Opportunity

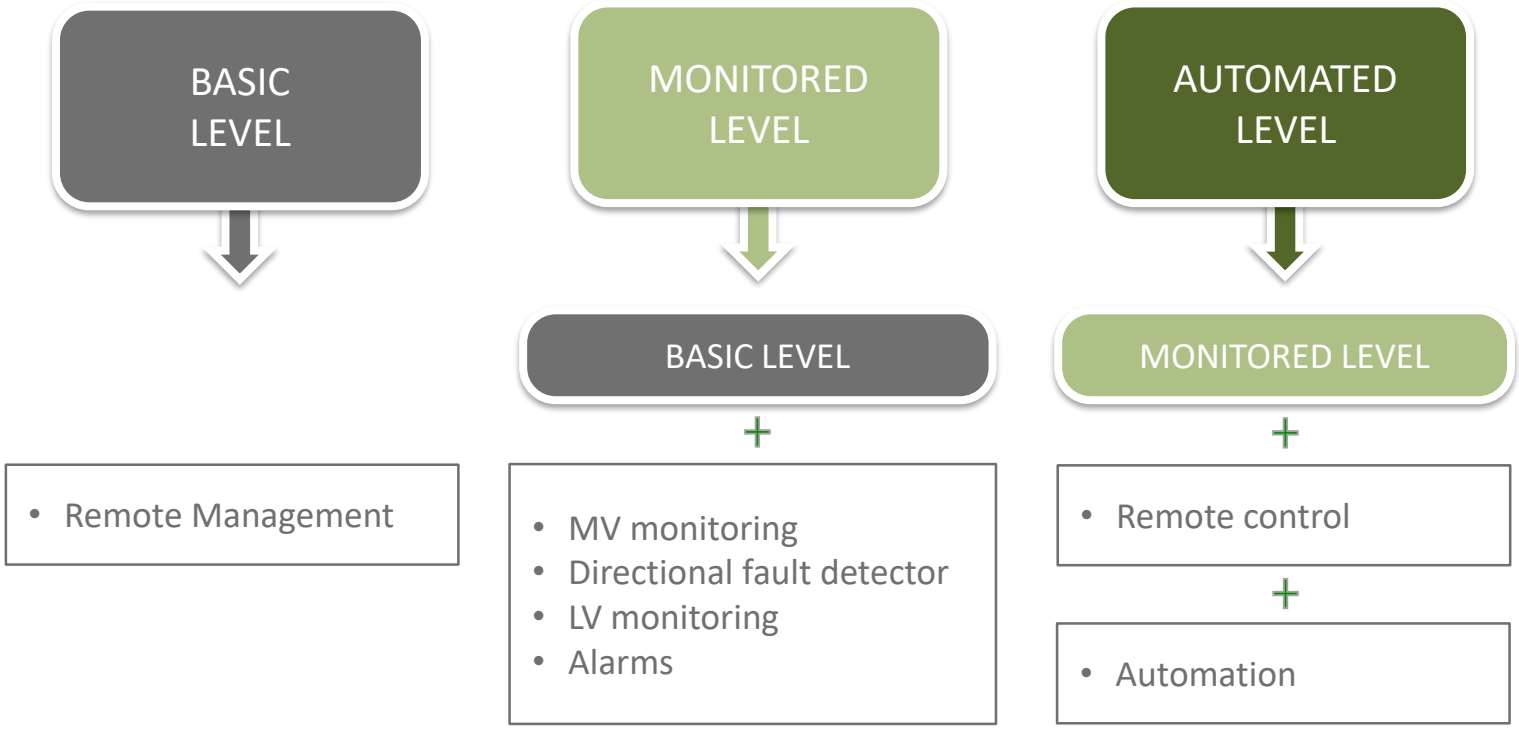
Regulatory Mandate (Jun 2016) to Deploy Remote Metering



Leverage obligation to build a Smart Grid	High Added Value Contributions
Pragmatic approach focused on: • Quality of supply • Losses reduction • Operational efficiencies	• Efficient smart metering. • New, intelligence based, MV management model. • Data based enabling technologies, including LV management.

Technological evolution as a foundation for a new way of managing distribution business

Three Levels



Justification:	Legal Obligation	Opportunity	Modulated by regulation and operational efficiencies

IBERDROLA Digitalization – STAR PROJECT

IBERDROLA Digitalization – STAR PROJECT KPI

Improvement of technical KPI & Operational performance

99%	• Success in Monthly Reading
60%	• Improvement in SAIDI* • From 60’ to 24’
40%	• Improvement in interruptions (Quantity) • From #120 to #70
16%	• Improvement in interruption (Duration) • From 24’ to 20’

Escalation Factors: Rollout is x100 times the Pilot Project

x 70	• Smart Grid Areas to be deployed • From 1 Area the Pilot Project to 71 in the Roll - Out
x 100	• Smart Meters to be installed • From 101K in the Pilot Project to 10,6 Million in the Roll – Out
x 120	• Secondary Substation to be Updated to Smart Grid • From 586 in the Pilot Project to 75K in the Roll – Out
x 20	• Smart Meters Installation Pace • From 2K/Week in the Pilot Project to 20K/Week in the Roll – Out
x 100	• Secondary Substation Installation Pace • From 12/Week in the Pilot Project to 146/Week in the Roll – Out

HORIZON 2020 - UPGRID

Real proven solutions to enable active demand and distributed generation flexible integration, through a fully controllable **LOW Voltage** and medium voltage distribution grid

IBERDROLA · edp distribuição · VATTENFALL · Energa operator

tecnalia · Imperial College London · COMILLAS · INESCTEC · ZIV

withUS · NOS · powel · Schneider Electric · GE

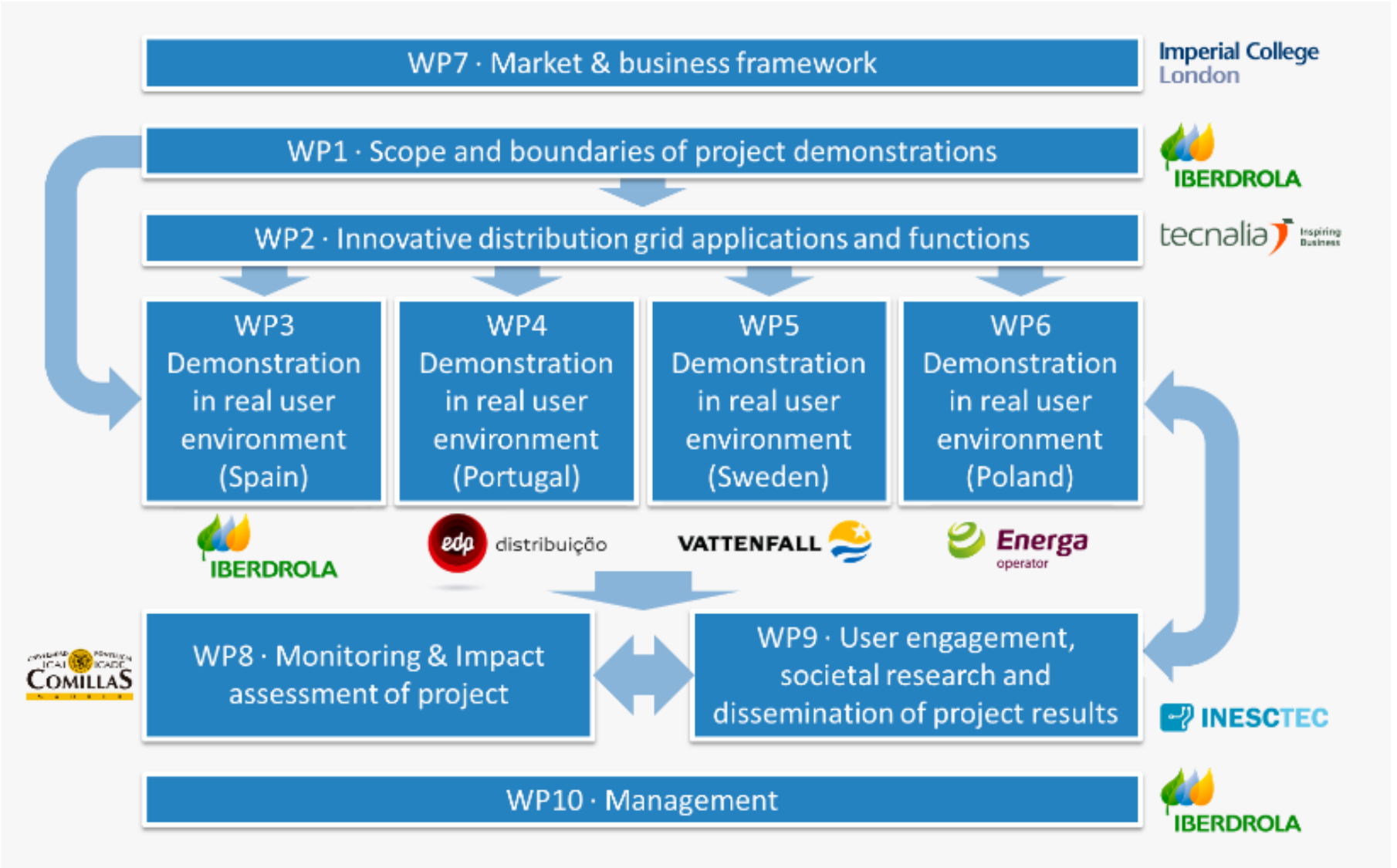
ATENDE · POLITECHNIKA GDAŃSKA · JEN INSTYTUT ENERGETYKI · ITE · ENERGIAREN

Project Information

Topic	LCE-07-2014: Distribution grid and retail market
Call	H2020-LCE-2014-3
Funding scheme	IA – Innovation Action
Duration	01/01/2015 – 31/12/2017 (36 months)
Budget	15,7 M€ (11,9 M€ EU grant)
Project Coordinator	Iberdrola Distribución Eléctrica
Partners	19 from 7 European countries (ES, PT, SE, PL, UK, FR, NO)
Demonstration sites	4 Demonstration sites (ES, PT, SE, PL)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 646.531

HORIZON 2020 - UPGRID



Spanish Demo

IBERDROLA · tecnalia Inspiring Business · EVE

Deployment of **tools to operate the LV network: LV Dispatching**

Monitoring and control of LV Network:

- Deploy **Multiservice** (metering and telecontrol) and **Manageable PRIME** subnetworks
- Smart meter **events** analysis for grid operation

Empowering Consumers by providing information, perception and control

Demo developed leveraging on bidelek sareak **project**

Located in the city of **Bilbao, North of Spain**

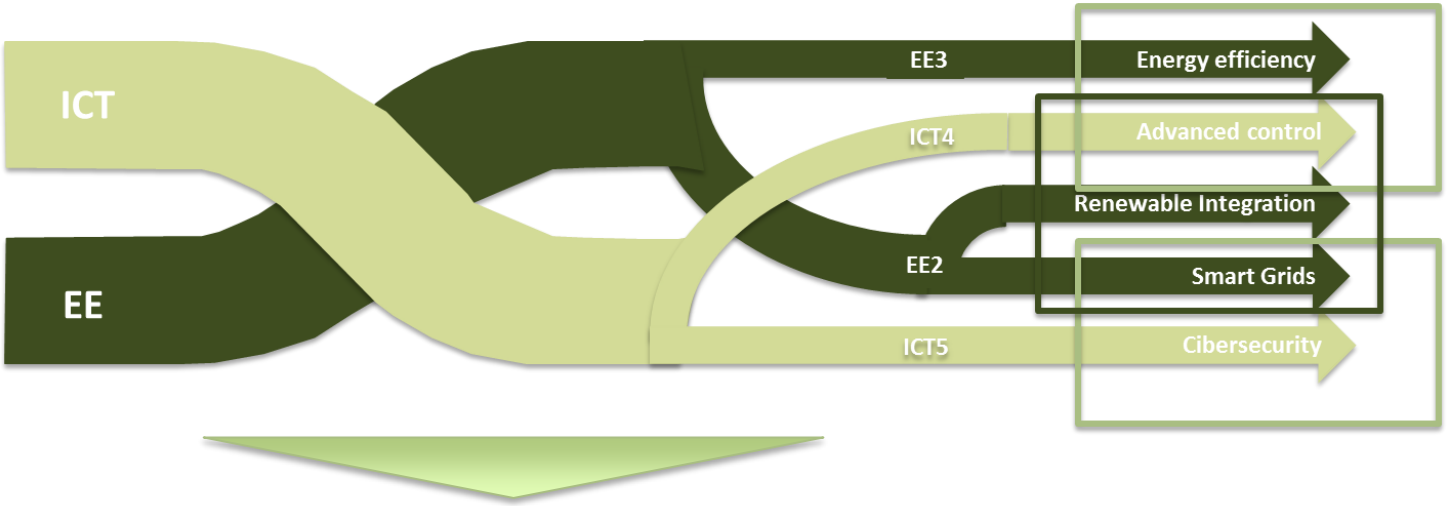
Network Characteristics

- 1.075 Secondary Substations (SSs)
- More than 3.500 LV lines supervised
- More than 190.000 consumers
- Urban area

IBERDROLA QSTP is an innovation company incorporated in Qatar

Qatar Science & Technology Park mission is "to provide a sturdy and productive **platform for technology-focused research, commercialization and enterprise growth** in Qatar", hosting 40 companies

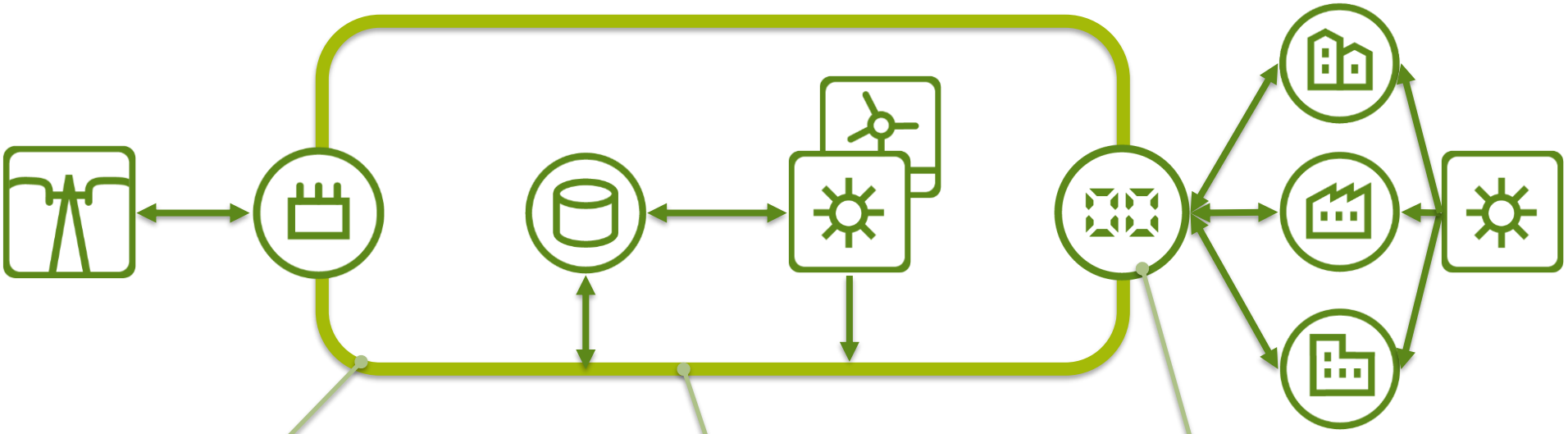
Iberdrola QSTP focus: the intersection of ICT and Energy



The technology program of Iberdrola QSTP and its laboratory focuses on the practical technology challenges related to the progressive automation and control of the electrical grid – the "**digitalization of the distribution grid**" - in a context of increasing (1) smart metering, (2) penetration of smart domestic devices and (3) renewable and distributed energy generation

Our work focuses on three key digital grid applications…

Key applications in the “digitalization” of the distribution grid



1 Smart Networks

- Smart Metering
- MV / LV Monitoring
- MV / LV Automation

2 Smart PV

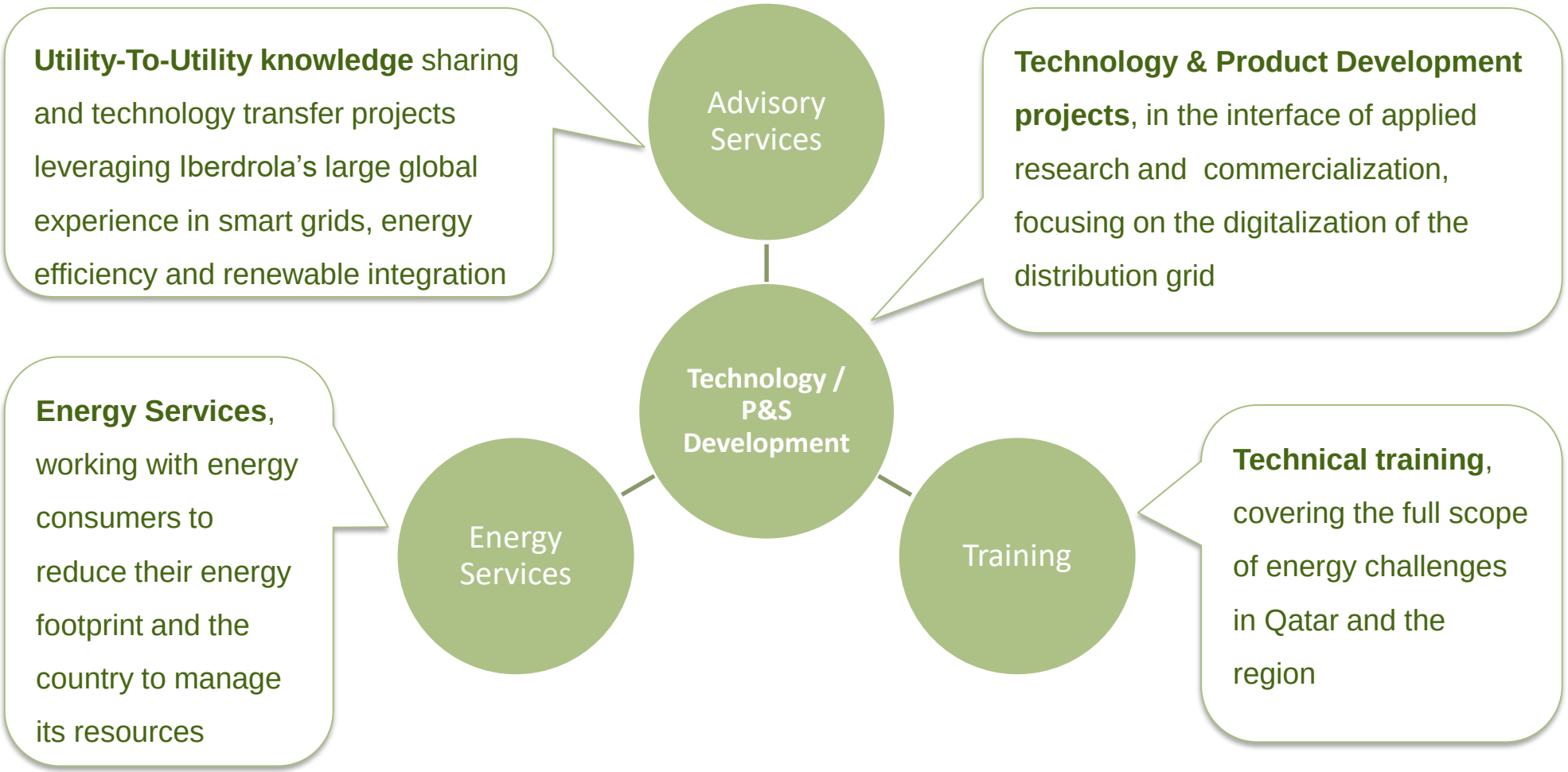
- PV /Storage integration
- Planning and operation of a DER-enabled grid

3 Smart Costumer

- Smart metering, customer engagement and Energy IoT

… within four main lines of activity centered around Innovation

Interaction of lines of activity centred on Innovation



We have been working with Kahramaa in Smart Grids since 2012

- Qatar National Utility **Kahramaa,** and **Iberdrola** signed in 2012 a **M.O.U.** to create a **Smart Grids Expert Group** located both at **Qatar and Spain** to gather the **know-how** from the different smart grid projects that Iberdrola is carrying out in Spain, UK and USA and **share experience** with **Kahramaa**

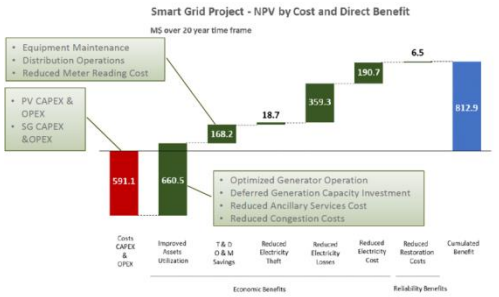
Close Technological Cooperation with Qatar National utility

IBERDROLA → KAHRAMAA

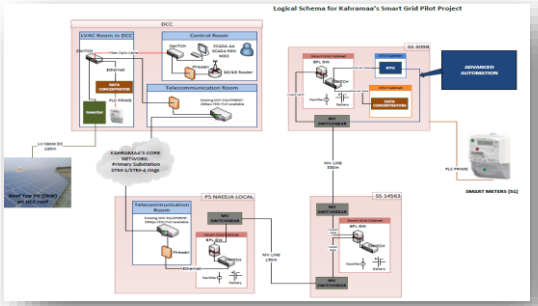
- **Studies on the applicability** of Iberdrola experience in Qatar National Grid
- **Pilot Projects** to quantify and showcase
- Support Kahramaa in **Smart Grid deployments**

Improvement Possibility	How can Smart Grid Improve it?
Operation & Maintenance for MV at Secondary Substations	***Advance Automation*** through RTU, DMS & Access Network (PS – SS link)
Backup link for Main protection	***Alternative media*** availability and redundant paths (BPL, OF)
Primary Substations ***Out of Firm*** Power (N-1) on ***peak times***	***Power Flow Control*** Service Implementation
Lack of ***Telecommunications*** in Secondary Substations	***Telecommunication Access Network*** (PS – SS link) Development
Renewable Distributed Energy Resources **Integration**	Advance Automation and ***Local PV Control from DCC***
Water & Electricity Metering	Services integration through ***Smart Metering solutions***
Kahramaa's ambition for being a top 10 Utility worldwide	**Smart Grid Show Case Development**

Feasibility study



Cost Benefit Study



Proof-of-concept design

IBERDROLA Middle East Innovation R&D lines

Starting point: Current deployments

1. Operational feedback from deployed smart Grid
2. Challenges identified from technical assistance provided to fellow utilities around the world undertaking SG deployment

Criteria for selecting innovation projects

1. Worldwide potential within Iberdrola networks
2. Aligned with Regional needs
3. Top-end R&D consortiums with right capabilities
4. Relevant research & large commercialization

Lebanon: Definition of specifications, certification process and smart metering roadmap and program definition

Qatar: Feasibility and cost benefit study for the deployment of the smart grid

Saudi Arabia: Definition of technical requirements for AMI tender and bidders evaluation

Iberdrola Innovation R&D lines

1. **Cybersecurity for Smart Grids**
2. **Big Data Analytics Platform**
3. **Smart Grid Communications (PLC/Wireless)**
4. **Integration of PV / Storage systems**
5. **In-home smart metering and energy IoT (Energy Efficiency)**

IBERDROLA Middle East Innovation R&D lines: Big Data

Big Data Analytics for a Smart Energy Management System

Objectives

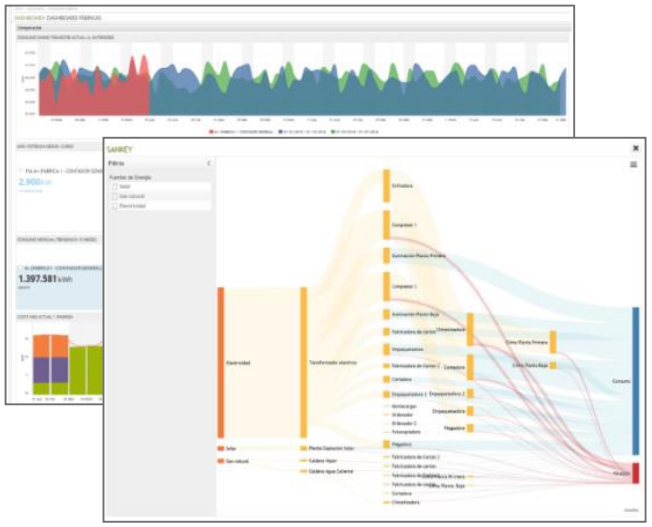
Design a Big Data analytics platform to support collection and analysis from a variety of data sources (smart meters, low and medium voltage monitoring, distributed generation production, …) to achieve:

(1) A better management of the grid assets and

(2) A better partition of the final client in the optimal management of the energy system

Benefits

- Explore new ways of putting in value data generated by the deployment of Intelligent Electronics Devices in the network
- Generate new insights of customer behavior linked to the AMI deployments



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TEXAS A&M UNIVERSITY

Qatar National Research Fund
Member of Qatar Foundation

IBERDROLA Middle East Innovation R&D lines: Integration of PV/Storage

Effective integration of PV/Storage and DR systems into the MV grid

Objectives

Evaluate the impact of the integration of PV in the MV network

Develop:

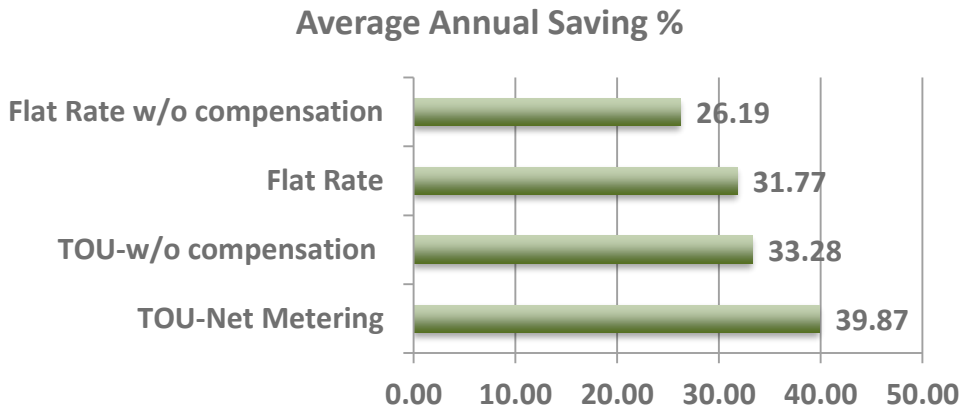
(1) An allocation planning tool to optimize the size and location of PV and storage system into the MV grid

(2) A real-time operational tool and local control strategies to optimize the management of the PV, storage and DR

+ Distributed PV Adoption Model

Benefits

- Develop a better understanding of the limits and challenges of the integration of PV, Storage and DR platforms in the network
- Real networks and Hardware-in-the loop environment demonstrators



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IBERDROLA Middle East Innovation R&D lines: Energy Efficiency

In-home metering for energy optimization

Objectives

Develop and test an Energy Management System able to interact with internal loads and optimize energy use

Design and develop a bridge between AMI system and Demand Response platforms – Smart Meter as an energy hub

Benefits

- Develop PRIME in-home functionalities
- Broadcast result to technical public
- Enhance Iberdrola's energy services value proposition

IBERDROLA Middle East Innovation R&D lines: Smart Grid Communications

LV Grid characterization

Objectives

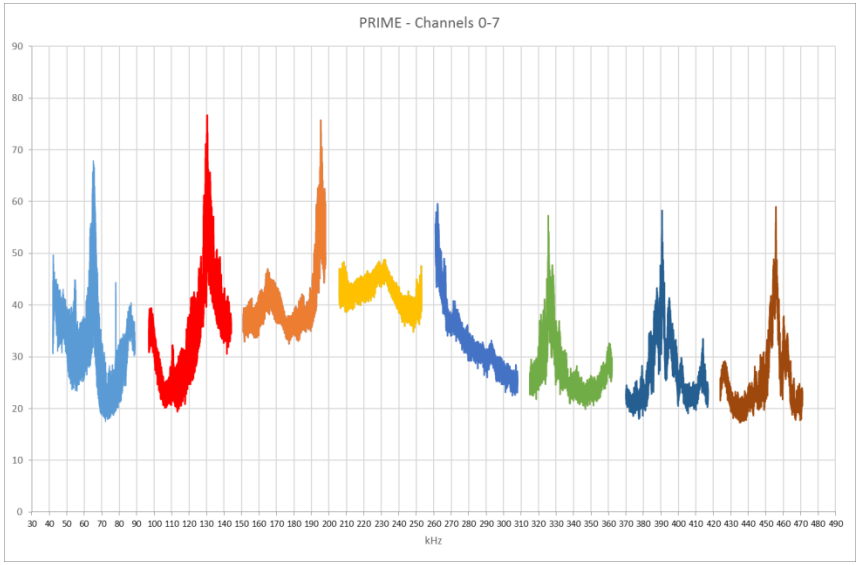
Define a Measurement Methodology covering Reliability, Coverage and Data rates KPIs and covering Cenelec- A, ARIB and FCC bands

(up to 500kHz)

Perform a Comprehensive measurement campaign

Benefits

- Take advantage of the extended bands to improve reliability of communications and increase bandwidth



+ RF Expansion

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KAHRAMAA

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Thank You