ENERGY & UTILITIES

VISION & R&D PROJECTS

WORKSHOP ON SMART GRIDS & STORAGE

Barcelona, November 2016

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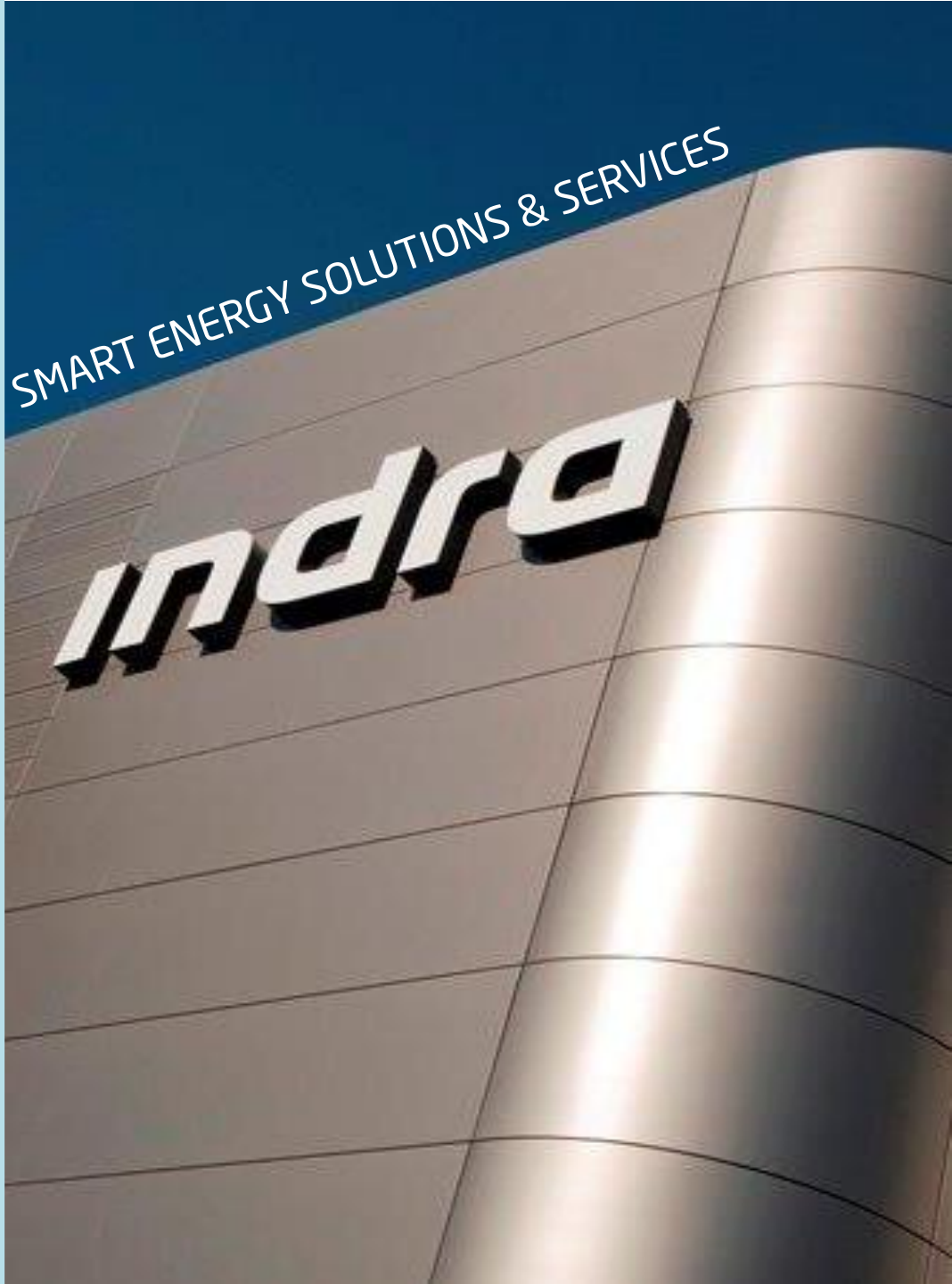

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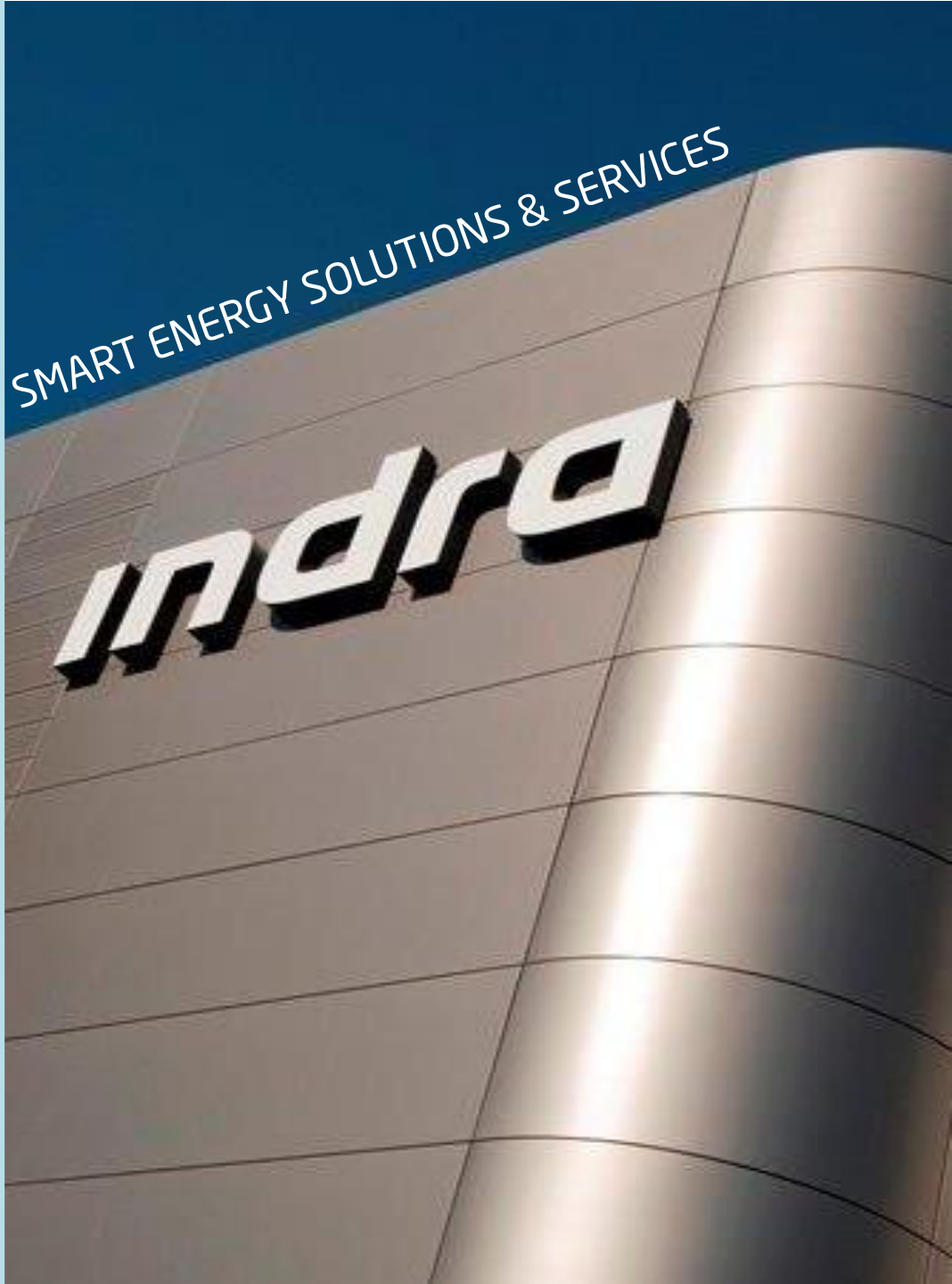
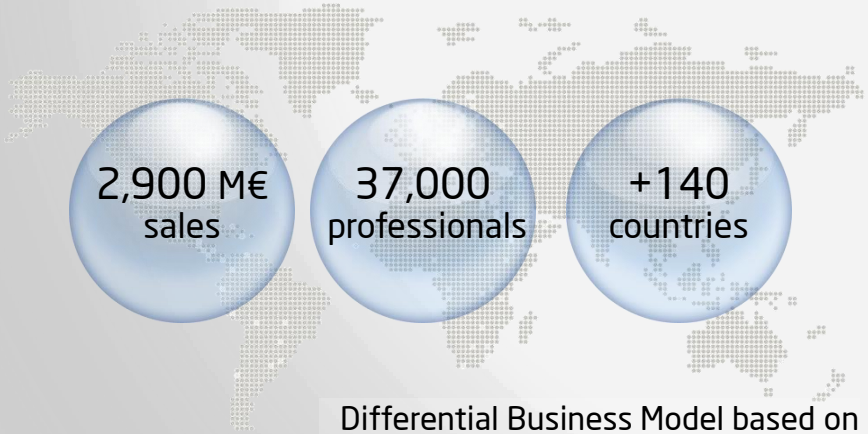
01 Indra Overview



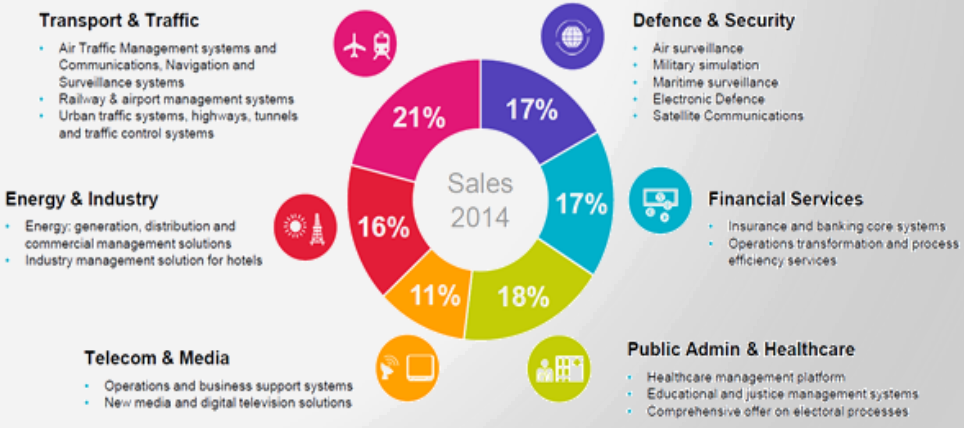
No. 1 IT company in Spain and one of the leading companies in Europe and Latin-America, with a high growth in Asia Pacific & Africa.

Own Technology R&D 6-8% of sales



Differential Business Model based on **Innovation**

Presence in all vertical sectors Diversification



→ INDRA'S ENERGY BUSINESS UNIT

Key Figures

- 350 M€ revenues
- 5,400 professionals
- Current Operations in 45 countries
- Over 500 on-going projects

Value proposition

Knowledge

Over 25 years experience in projects and services in the sector of energy companies.

Partnership

Indra is the preference partner of key software vendors within the energy sector. Some of them are:

SAP · GE · Allegro · OSIsoft. · esri · SAS · salesforce

End-to-end services: Consultancy - IT Solutions & services - IT Outsourcing - BPO

Own products:
Indra`s Solutions for Utilities

- InGEN (Plant Management): Plant & Energy Management
- Energy Management
- InGRID (Distribution Management): Transmission & Distribution
- InCMS (Customer Management): Retail /Customer Management
- InDROP (Water Solutions): Water-specific Solutions

Sample current operations: Geographies and main Customers

AMERICA: Exelon (USA), Sempra (USA), NRECA (USA), AES (Global), CFE (MX), Mitsui (MX), Electrocosta/Caribe (CO), EPSA (CO), Isagen (CO), Eletrobras (BR), Petrobras (BR), Elektro (BR), CEB (BR), ONS (BR), AyA (CR), Light (BR), Sedapal (PE), Electro Dunas (PE), Edelap (AR), Enersa (AR), UTE (UY), ANDE (PY), CGE (CL), Corpoelec (VE), ENEE (HN), CDEEE (DM), Edenorte-Sur (NI).

EUROPE: Enel (Global), GNF (Global), CEZ (Global), Repsol (Global), Viesgo (ES), Iberdrola (Global), Acea (IT), Terna (IT), EDP (PT), REE (ES), RWE (CZ), OTE (CZ), GE (Global), Electrica (Ro).

AFRICA: KPLC(KE), Eskom (SA), ECG (GH), EDM (MZ), ZETD, ZESCO, UMEME, ENEO

ASIA-PACIFIC: Meralco (PH), Maynilad (PH), Manila Water Company (PH), PLN (IN), Origin (AU), HydroTasmania (AU), CALTEX (AU)

→ ENERGY GLOBAL OFFERING

Areas

UTILITIES

Oil

Gas

Power

Water

Solutions and services

Consulting

- Strategic and business consulting
- Organization and systems consulting
- Improvement of Operations
  - Digitalization
  - Mobility
  - Asset Management
  - IoT Gateways
  - Smart Homes
  - Etc

Digital Solutions

- Internet of Things Solutions
- Analytics and BigData
- Mobility Solutions
- Cybersecurity
- Cloud (XaaS) Services
- Social Media Solutions

Systems Integration

- Plant Management & Optimization
- Energy Markets and ETRM
- Network Management / Smart Grids
- MDM (Meter Data Management) & MDC (Meter Data Capture)
- Energy & Water Efficiency
- Commercial Management System
- ERP & SMAC Solutions

Energy Technologies

- Assets Monitoring and Performance Technologies
- Physical and Logical Security
- Substation Control Equipment
- Metering Systems / Smart Metering (AMI/AMR)
- SCADA Control Systems
- Electric Vehicle Recharging Infrastructure
- Energy Efficiency Solution

Managed Services

- Application Management (AM)
- IT Outsourcing
- Business Processes Outsourcing (BPO)
- Indra Cloud Services

Own Solutions | **Third Party Solutions** | **Services**

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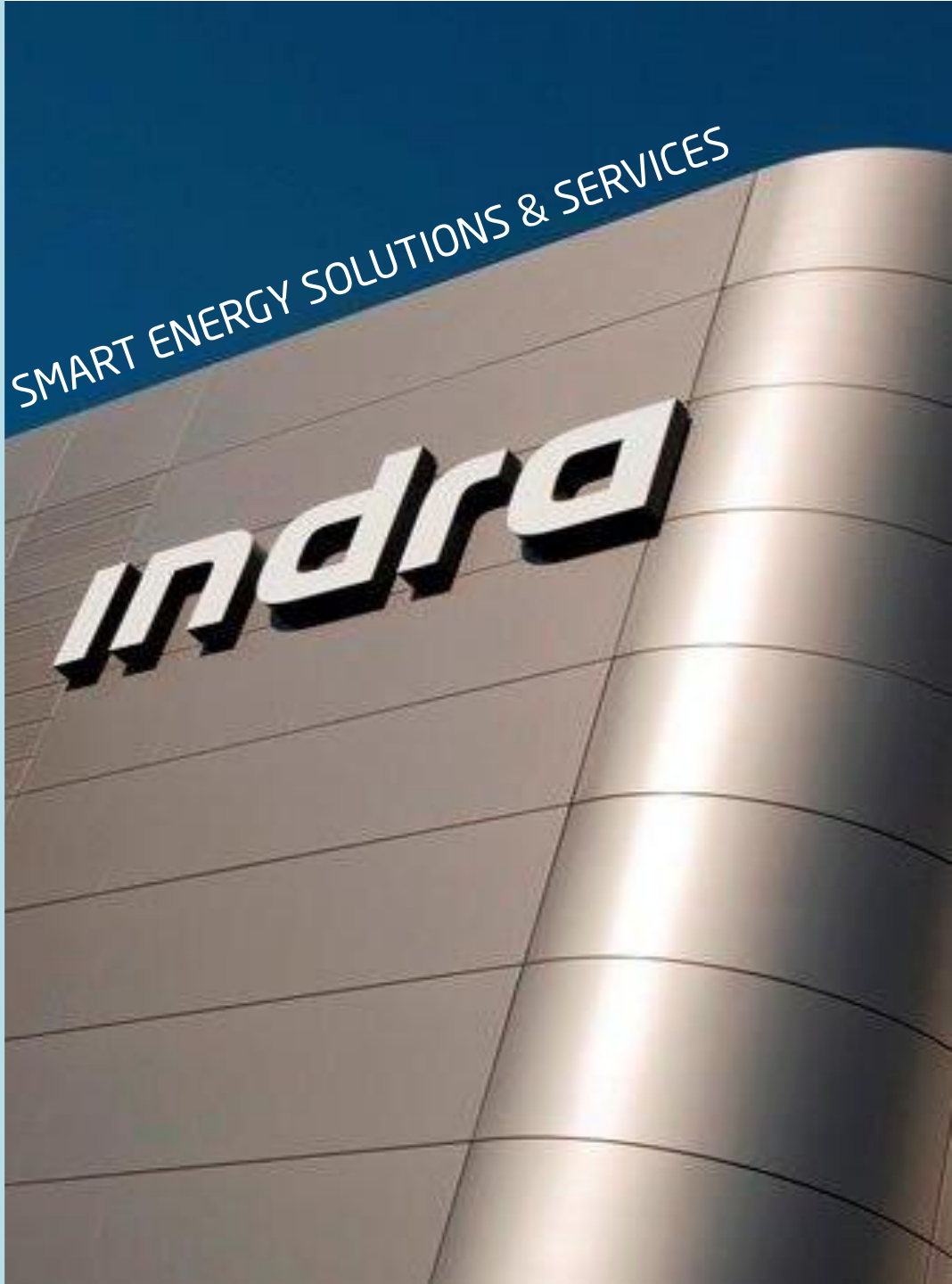
02 Strategic Vision

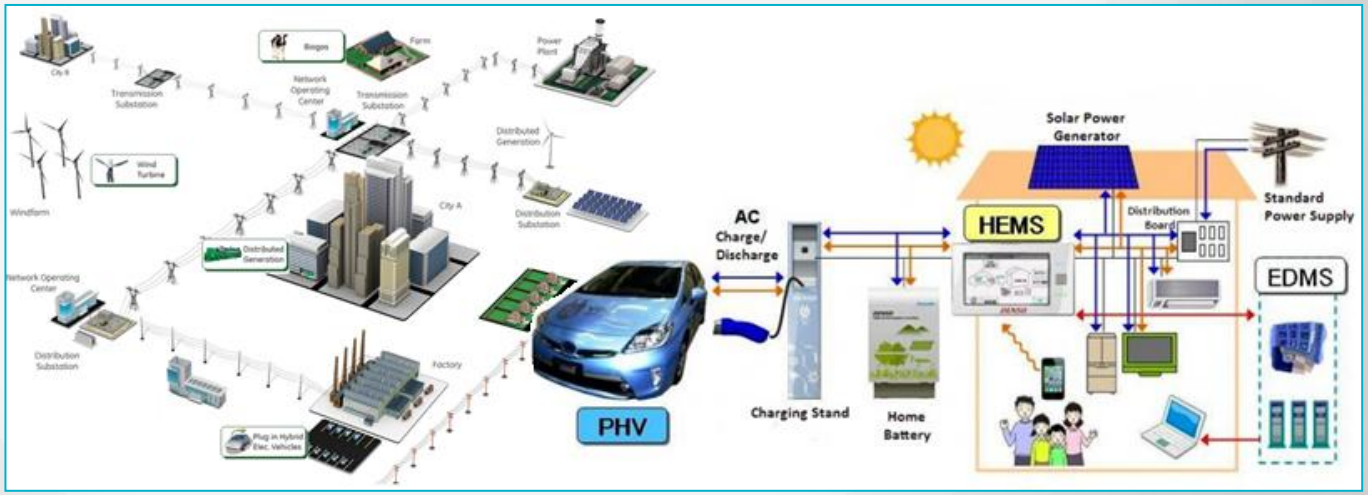


→ HOW THE FUTURE LOOKS LIKE FOR THE UTILITIES SECTOR

The Grid is becoming more complex and growing faster than our control methods and tools can handle. Global energy goals cannot be met without changes in how we control complex systems.

Physical infrastructure being added to the grid (solar panels, wind turbines, customer-owned micro-grid systems and energy storage, demand response-enabled thermostats and smart appliances) is nearly impossible for existing utility control systems to manage.

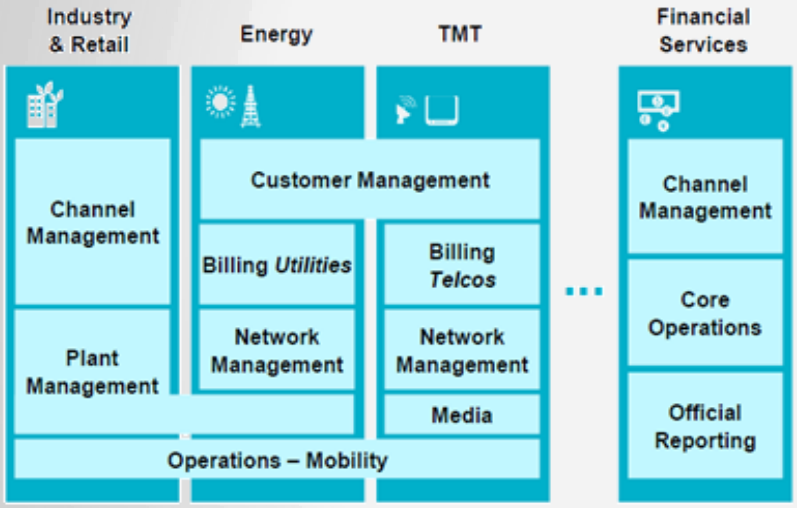
Much of it is in the hands of customers, not utilities.
Many of these systems act too quickly and in too great a volume to actually monitor and manage in real time.



→ DIGITAL TRANSFORMATION MEANS CHANGING THE WAY THE BUSINESS IS DONE...

INTERNET OF THINGS

Core business operations



Digital

Key drivers

- Efficiency
- Reliability
- Industrialized delivery

Key drivers

- Proof of value
- Innovation – trial & error
- Agility

→ PLACING ENERGY PROSUMERS IN THE CENTRE

Utility role as an energy supplier is necessary but not sufficient. Tomorrow's energy must be intelligent, and a change in value chain position is required.

Consumers are increasingly well informed, connected and committed to sustainability, and they demand new value-added services.

Enable new Smart Energy models

- Pro-sumption / Distributed generation
- Development of electric vehicles and battery storage
- Demand management
- Operation of Smart Grids

GRIDWISE™ **Transitive Energy**

Create new value added services

- New revenue sources to overcome shrinking margins and liberalization of markets
- Opportunity to build new business lines on top of the natural services of the Utility
- Opportunity to generate an attacker offer in non-primary markets

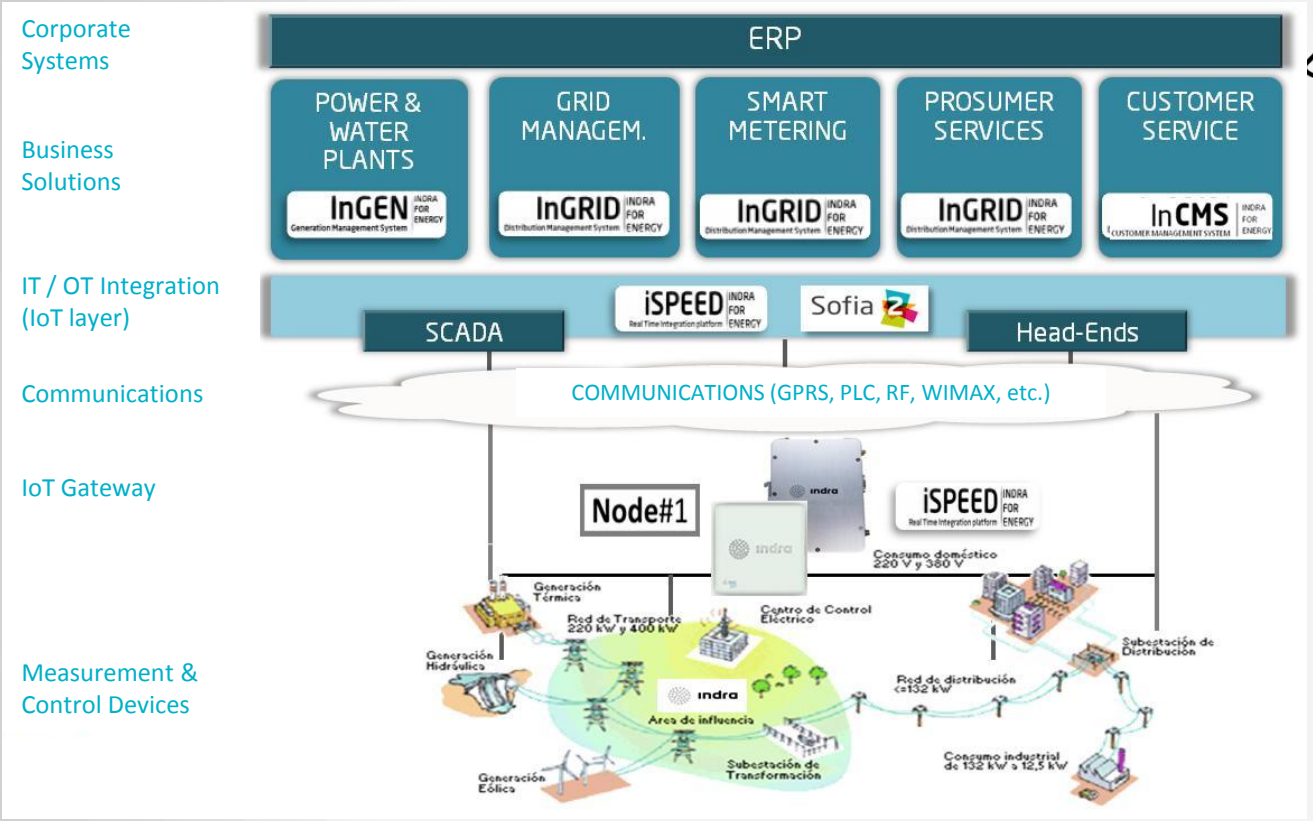
From 400€ / customer (first 3 years)

Defend yourself against competitors

- Intrusion of other companies in the energy business (eg.: Telecoms)
- New digital players taking positions at homes

Google as a new competitor

Indra has a strong Smart Grids practice supported through the participation in a number of R&D Projects together with key partners and energy & utilities companies. Indra is also active in smart grids technological platforms, both at national and European level.



Our key areas are Renewable Integration, Grid Automation, Smart Metering and Energy Services for the end customer, supported by industrial internet technology, the integration of information and operation technology and distributed intelligence.

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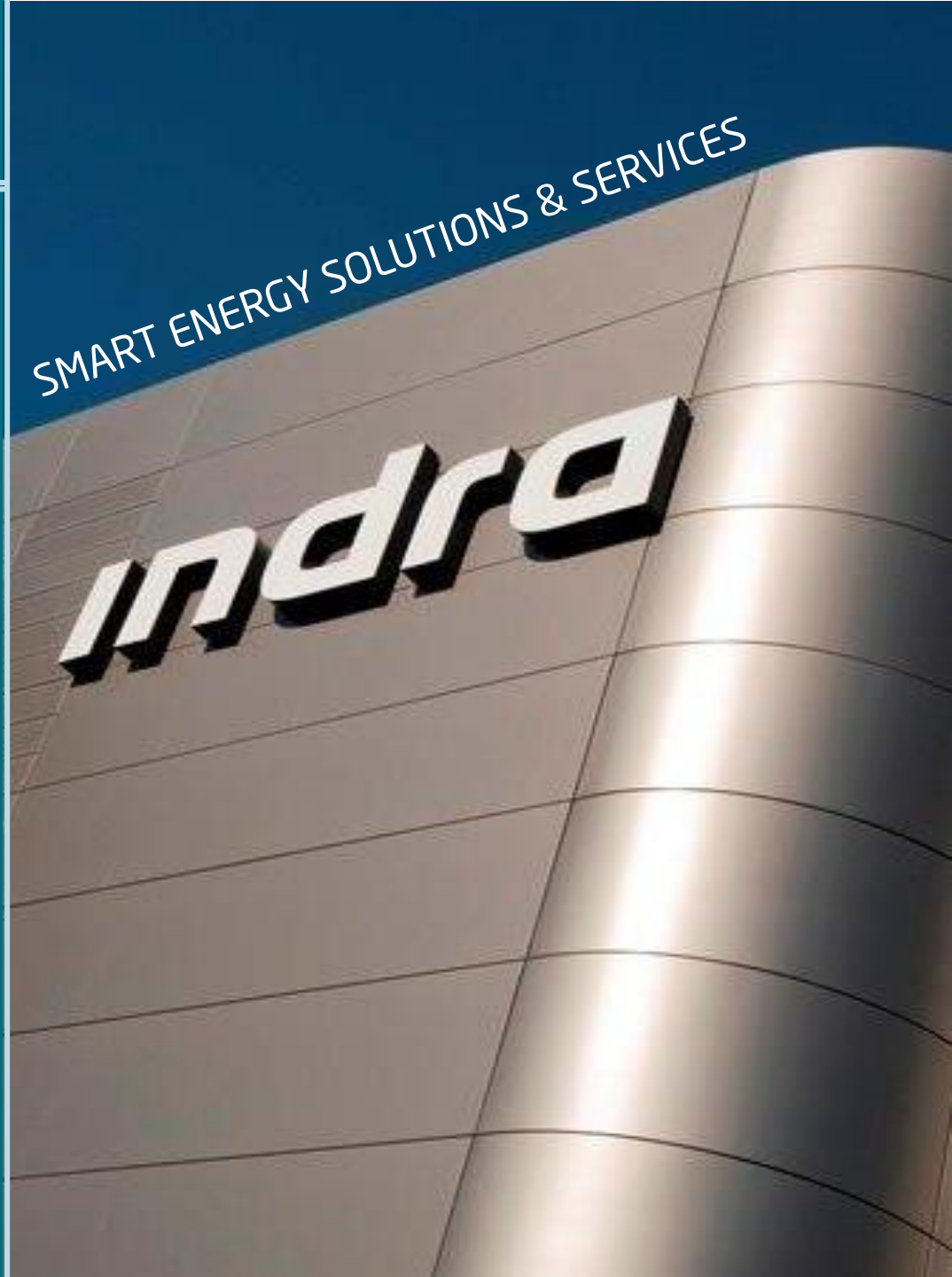
03 R&D Projects
→ SAPPIEMS (AEESD Spanish National Project)



SAPPIEMS Project

Smart Acquisition and Processing Platform for Intelligent Energy Monitoring and Supervision

- Real Time Integration Platform for:
  - Data acquisition and data exchange for a Meter Data Management System (MDM) for residential customers
  - Data acquisition and data exchange for an Active Grid Monitoring System of the MV/LV network

- MDM use cases for residential customers:
  - Real-Time Energy Data Validations: gaps, quality of measurements, negative values,..
  - Big Data Processes: aggregations, historic estimations, comparisons,..
  - Advanced Analytics: sample characterization, data enrichment, clustering,...
  - MDM Web Portal for residential customers, DSO and ESCOS

- MV/LV Active Grid Monitoring System
  - Energy Data and Events Acquisition for Secondary Substations and Smart Meters
  - Real-Time Threshold Warnings (CEP Engines)
  - Real-Time Energy Balance at the Secondary Substation for possible Fraud detection
  - Active Grid Monitoring Web Portal
  - Distribution Management System (DMS) integration

MV/LV Active Grid Monitoring Data Acquisition

Real-Time Energy Data

Magnitude	Secondary Substation	Smart Meters
Oil Temperature (ºC)	✓	
Imported Active Energy (kWh)	✓	✓
Exported Active Energy (kWh)	✓	✓
Reactive Energy Q1 (kVAr)	✓	✓
Reactive Energy Q2 (kVAr)	✓	✓
Reactive Energy Q3 (kVAr)	✓	✓
Reactive Energy Q4 (kVAr)	✓	✓
3-Phased Voltage (kV)	✓	
3-Phased Current (A)	✓	
3-Phased Active Power (kW)	✓	
3-Phased Reactive Power (kVAR)	✓	
3-Phased Apparent Power (kVA)	✓	
3-Phased Power Factor	✓	

Real-Time Secondary Substation Events

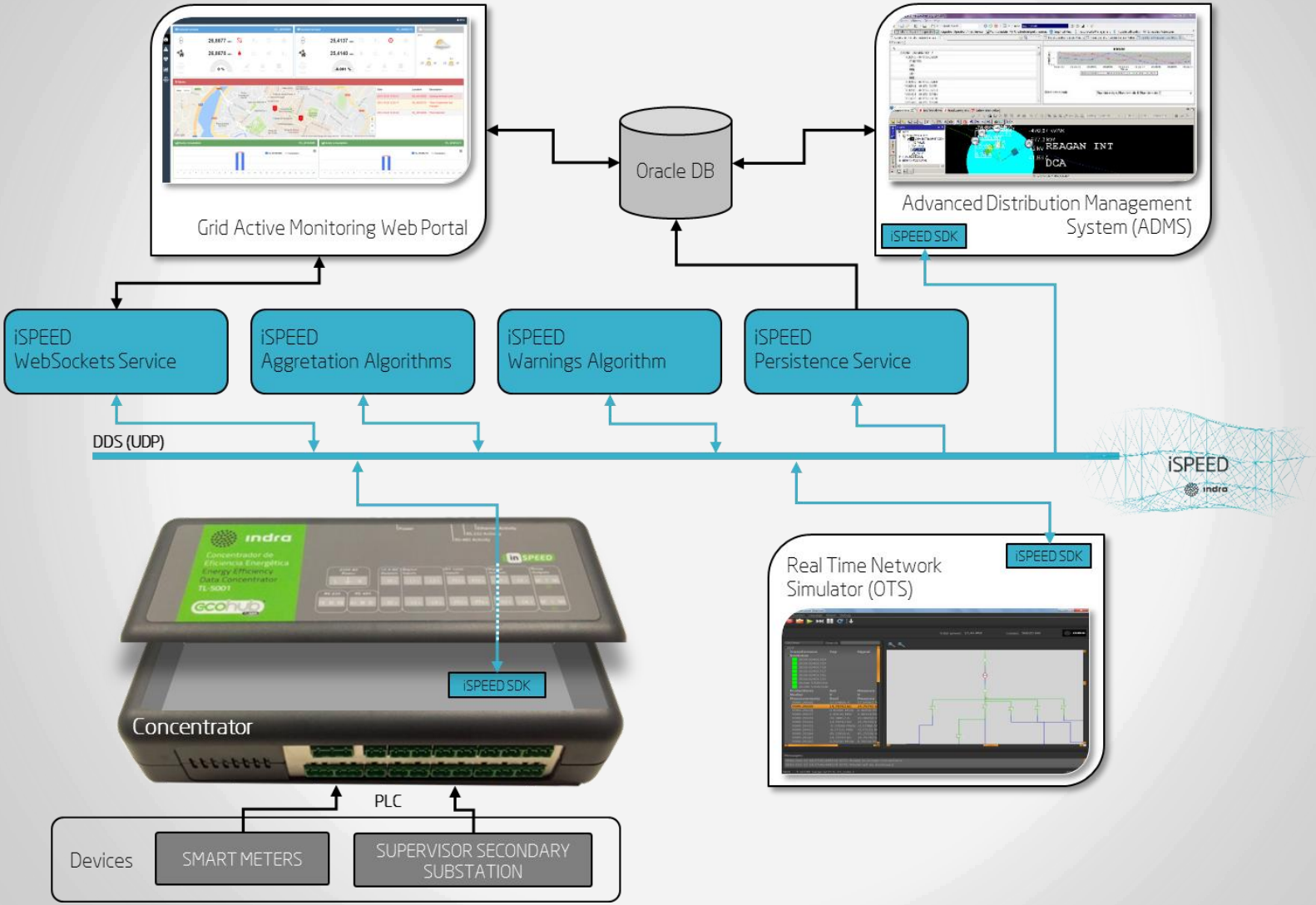
Event
HighTemperature
Open Terminal Cover
SS Intrusion
Over Current

Event
Voltage Drop
Time Changed
Fire
Flood

Event
Transformer Bay: Opened
Transformer Bay: Closed
Transformer Bay: Grounded

SAPPIEMS Project

MV/LV Active Grid Monitoring Architecture

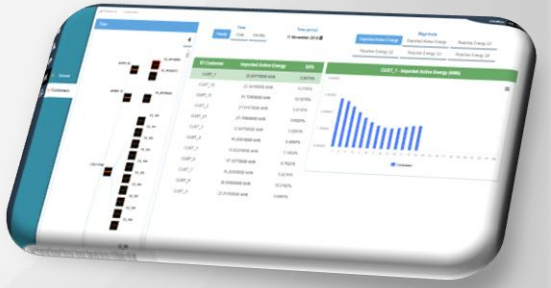


SAPPIEMS Project

MV/LV Active Grid Monitoring Web Portal

- Dashboard
  - Summary of the power consumption of the current day at the Secondary Substation and associated customers
  - Activated alarms in the Secondary Substation
- Alarms
  - Events monitoring: published by the Data Concentrator
  - Threshold warning configuration
  - Warnings monitoring: threshold exceeded or possible fraud
  - Statistics per date and type
- Real Time
  - Last value monitoring of data published in iSPEED
  - Last 60 instant values displayed in a graph
  - Real-Time values displayed in the one-line diagram

- Historic Values
  - Hourly/Daily/Monthly energy at the Secondary Substation and at the customers
  - Cost/CO2 Energy consumption equivalence
  - Smart meter consumption detail
- Losses
  - Hourly losses in kWh and percentage to detect possible fraud



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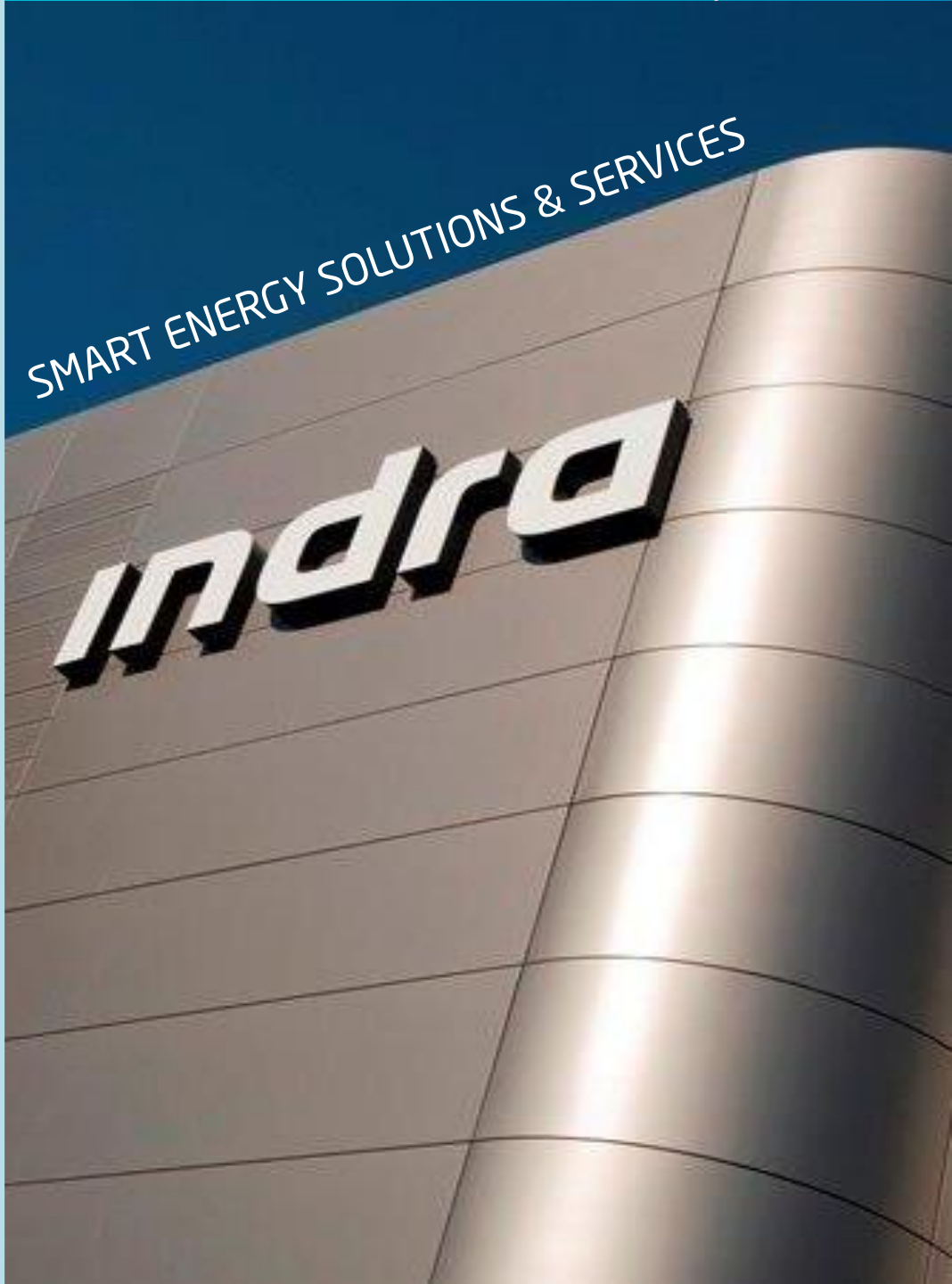
03 R&D Projects

→ SENSIBLE (H2020 Project)

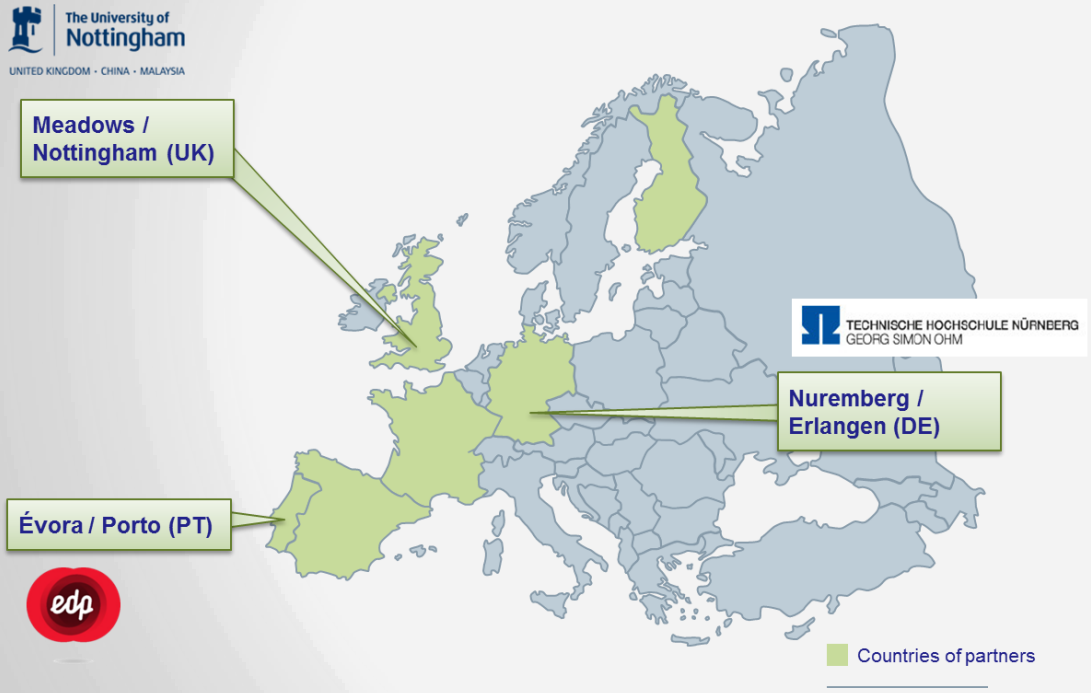


Funded by the European Commission
Grant No 645963

Storage Enabled Sustainable Energy for Buildings and Communities

- SENSIBLE will demonstrate the benefits of small scale storage integration in EU - including the building & city perspective

The three demonstration sites of project SENSIBLE



City district Meadows / Nottingham (UK)

Energy management and energy market integration of residential buildings with PV and storage

Rural Microgrid in Évora (PT)

Microgrid with PV, flywheel & battery storage systems – integrating home energy management systems

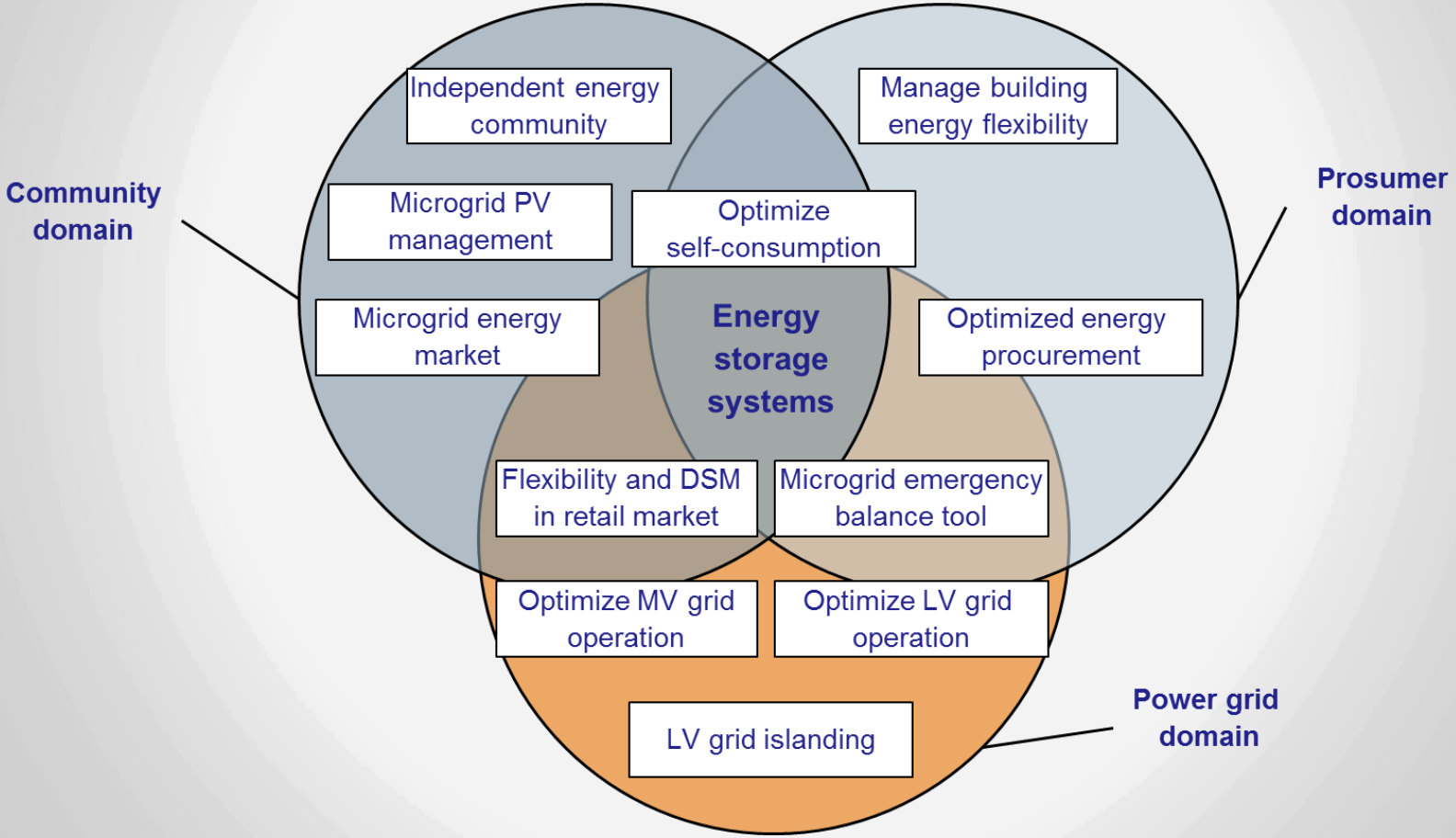
Commercial Building in Nuremberg (DE)

Multi-modal energy storage in a large building: thermal storage, combined heat & power, and different energy vectors (electricity, gas).

Funded by the European Commission Grant No 645963

Storage Enabled Sustainable Energy for Buildings and Communities

- We identified 11 relevant use cases for the operation of storage in communities, power grids and at prosumer sites



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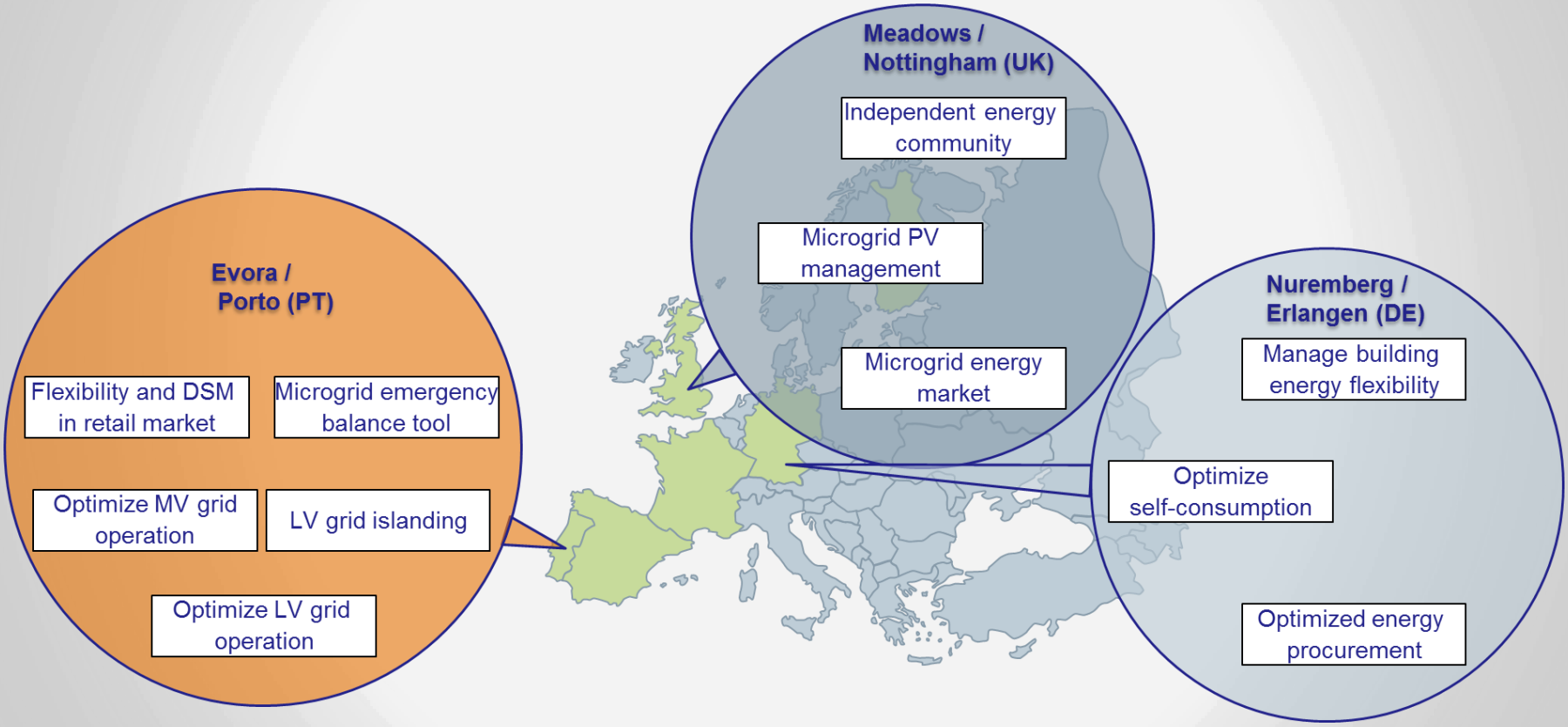
Storage Enabled Sustainable Energy for Buildings and Communities

- Each demonstrator site has been defined such, that all use cases and application domains can be analyzed



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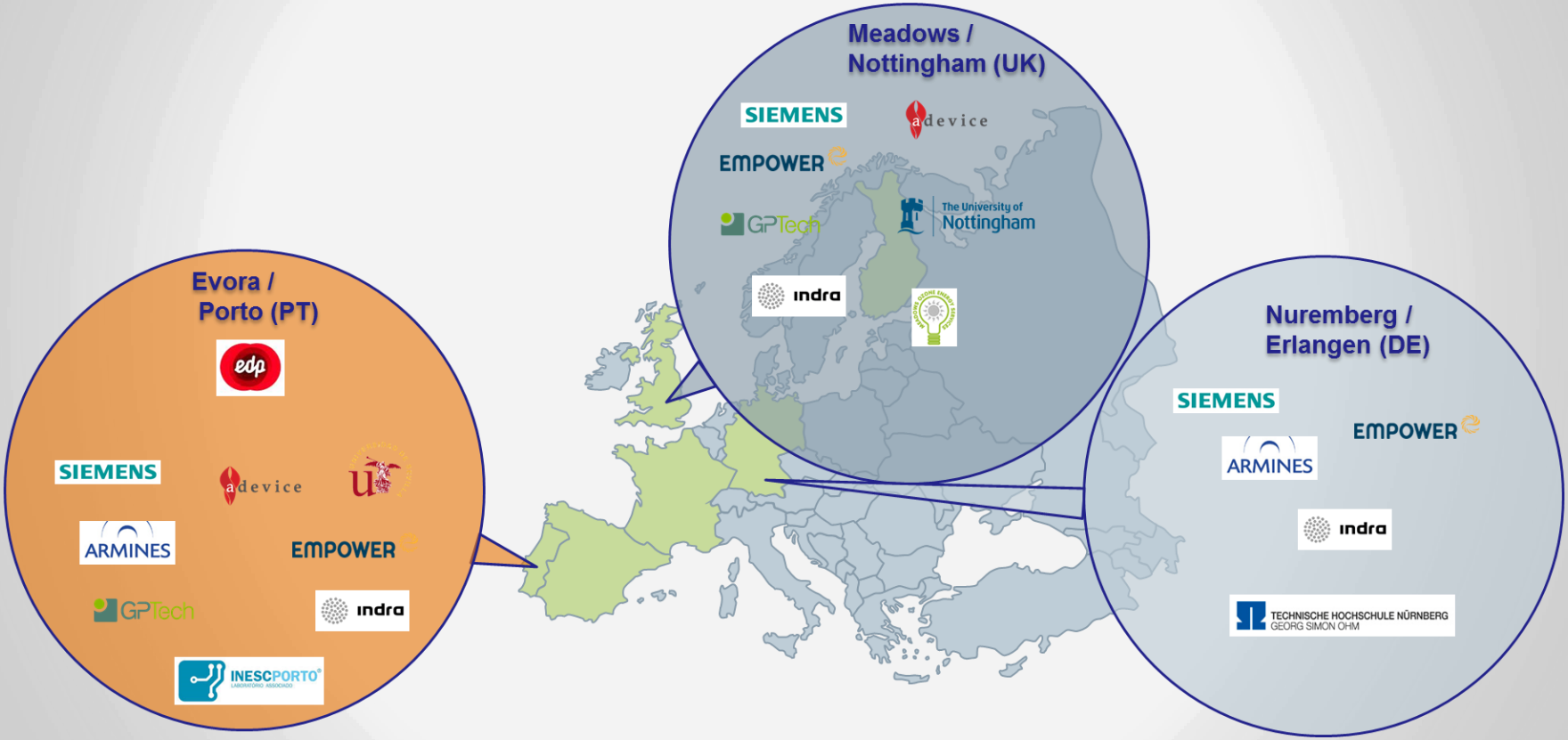
Storage Enabled Sustainable Energy for Buildings and Communities

- Partners involved in each demonstrator



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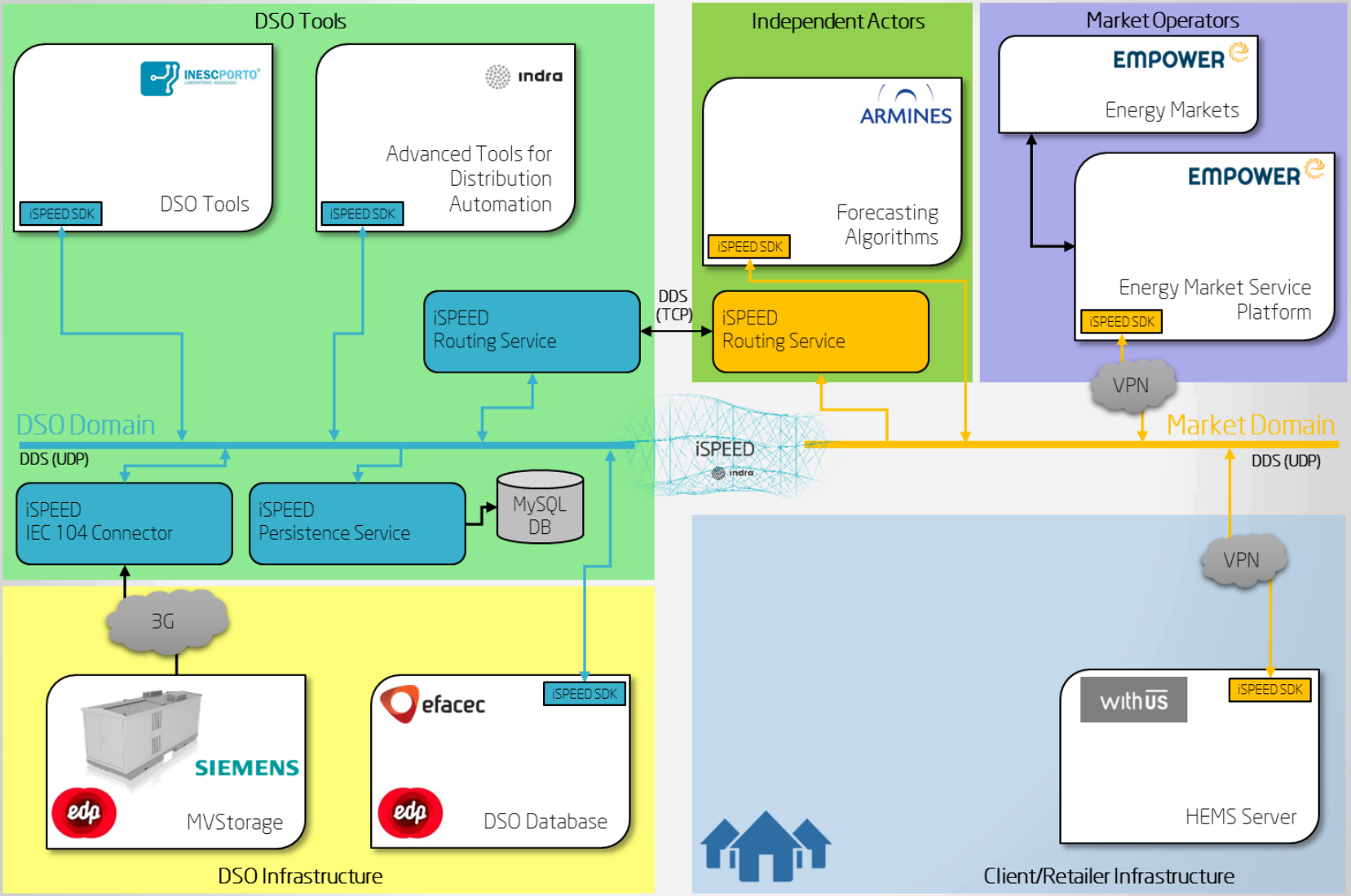
Évora Demonstrator Architecture



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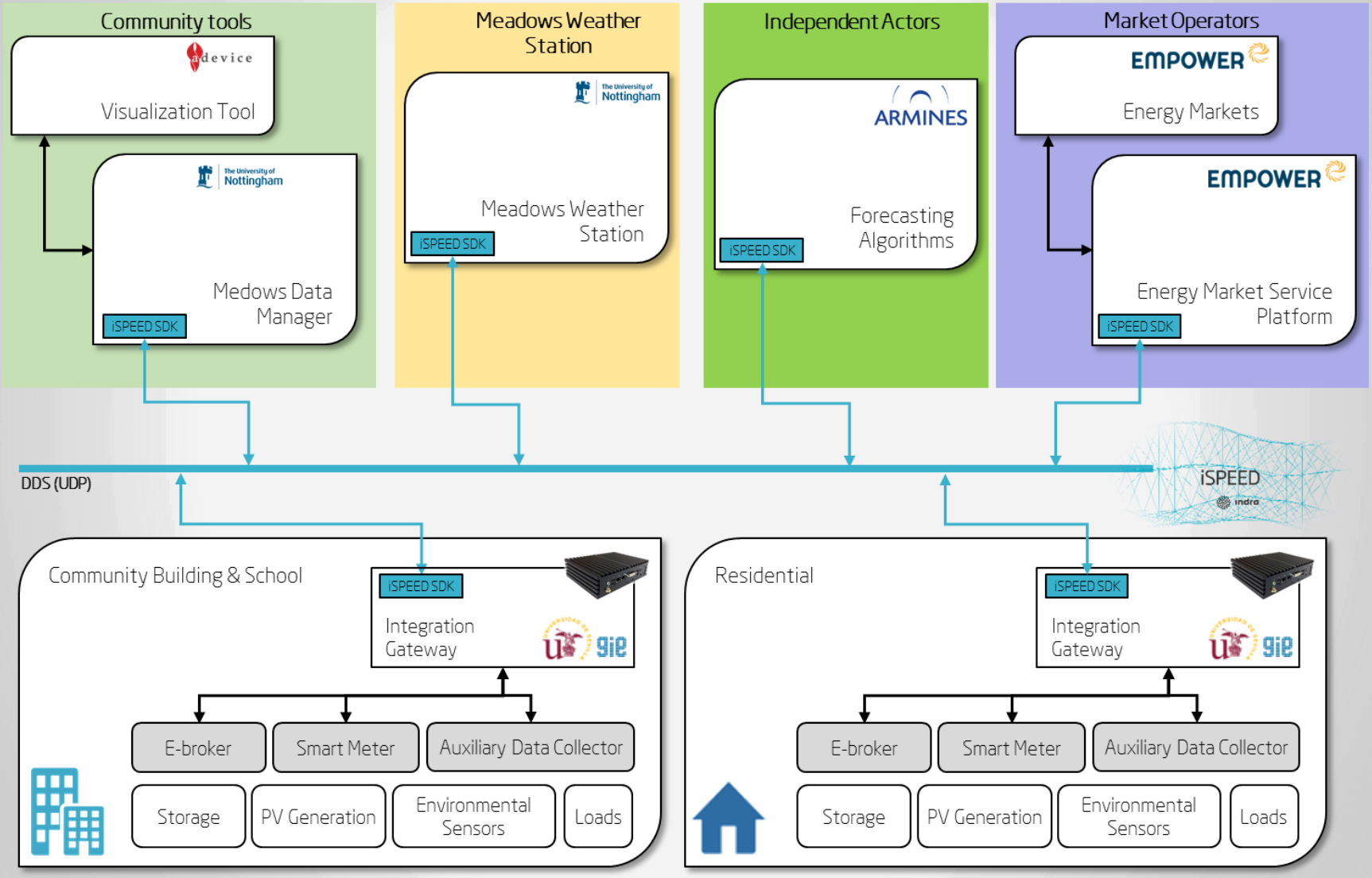
Nottingham Demonstrator Architecture



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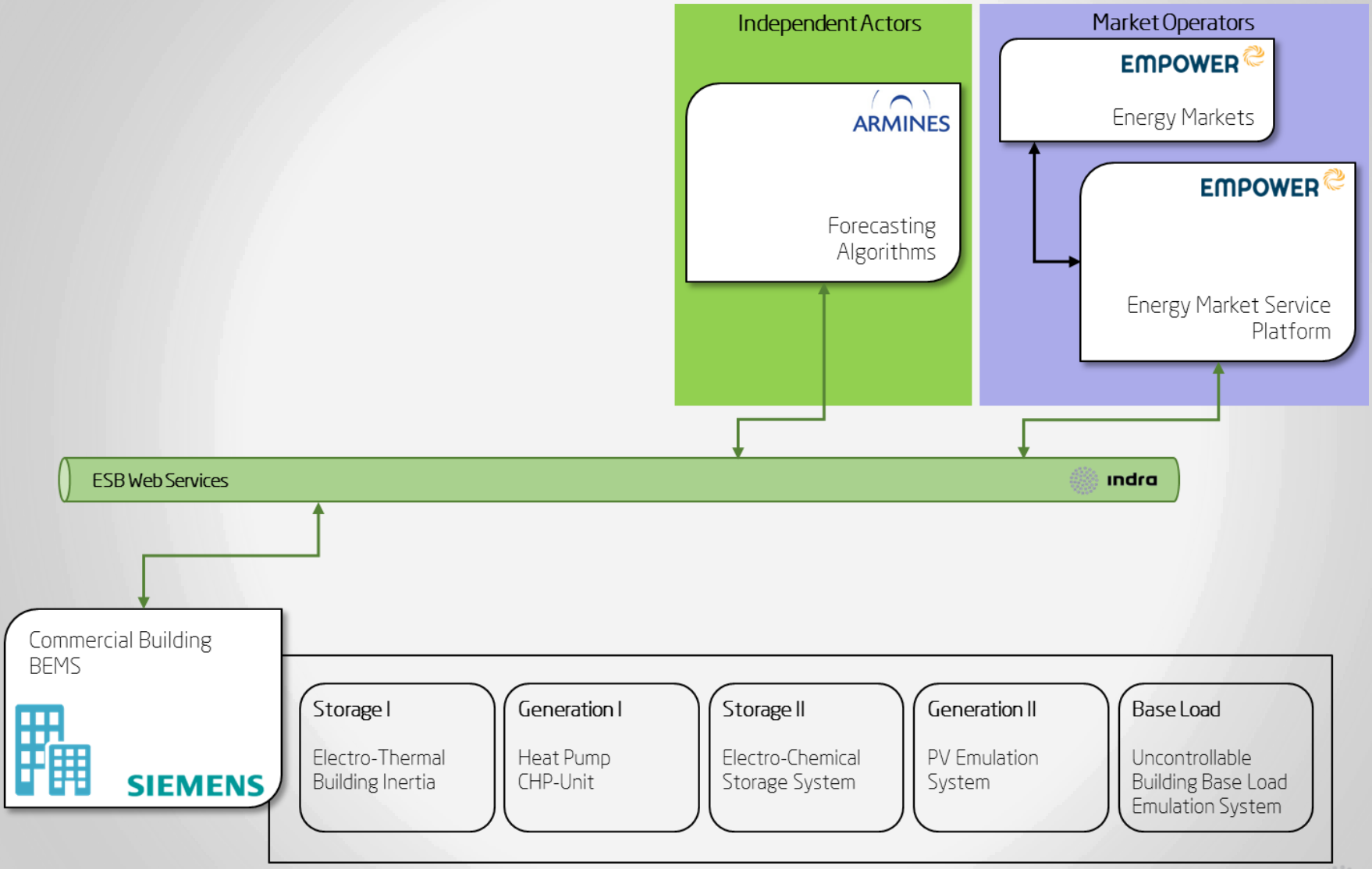
Nuremberg Demonstrator Architecture



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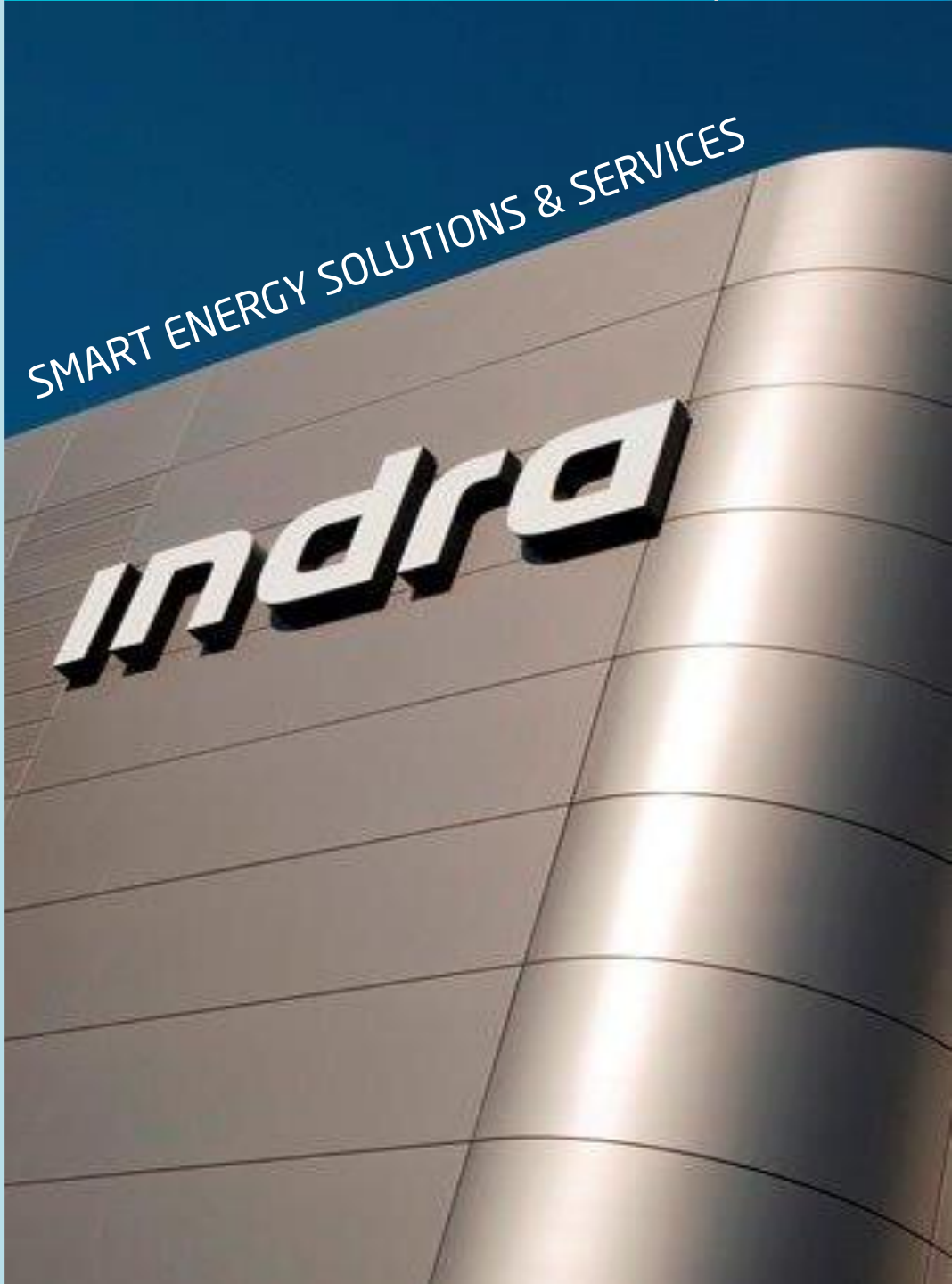
03 R&D Projects

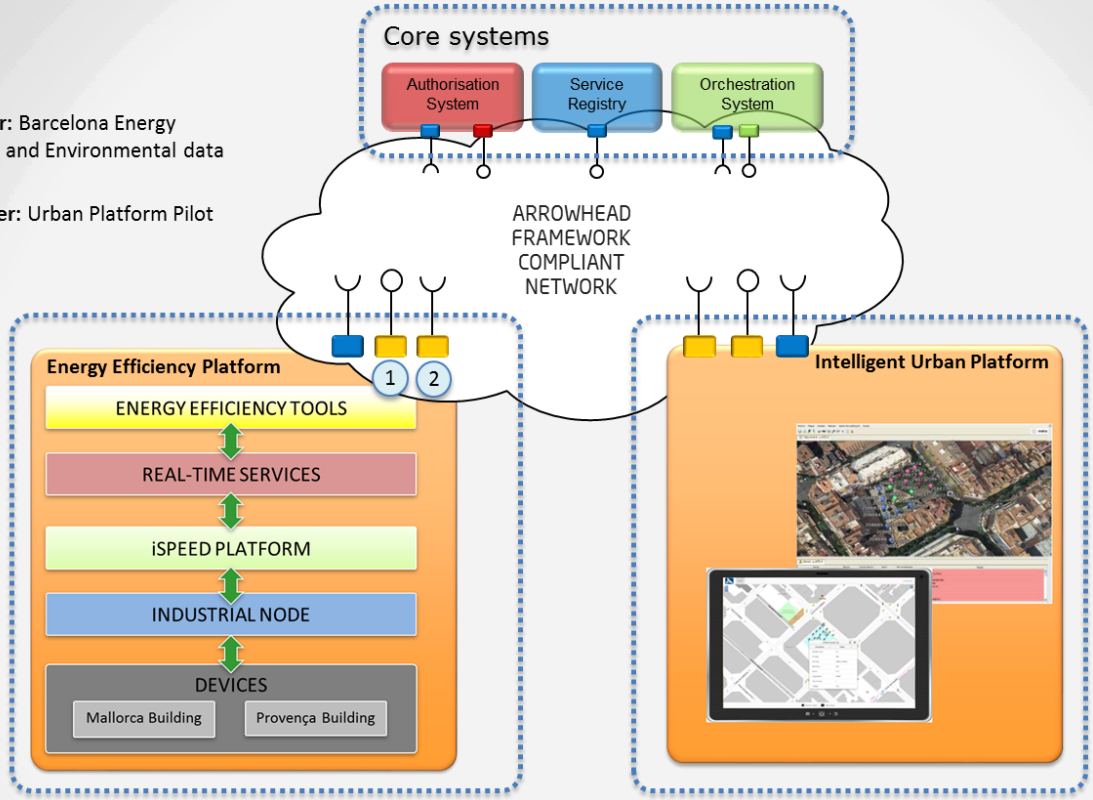
→ ARROWHEAD (Artemis Project)



ARROWHEAD Project

Energy Efficiency Platform

1. **AHF Producer:** Barcelona Energy Consumption and Environmental data
2. **AHF Consumer:** Urban Platform Pilot Energy Data



Demonstrator Site

- Mallorca Building
  - 6 Analyzers
  - 9 THL sensors (indoor)
  - 1 THL sensor (outdoor)
- Provença Building
  - 2 Analyzers
  - 2 THL sensors (indoor)

Energy Efficiency Data Acquisition and Processing

Energy Data (Analyzer)

- Total Active Energy
- Imported/Exported Active Energy
- Reactive Energy per Quadrant
- Total Active Power
- 3-Phased Active Power
- Total Reactive Power
- 3-Phased Reactive Power
- Total Apparent Power
- 3-Phased Apparent Power
- Total Power Factor
- 3-Phased Power Factor
- 3-Phased Voltage
- 3-Phased Voltage THD
- 3-Phased Current
- 3-Phased Current THD

Environmental Data (THL Sensor)

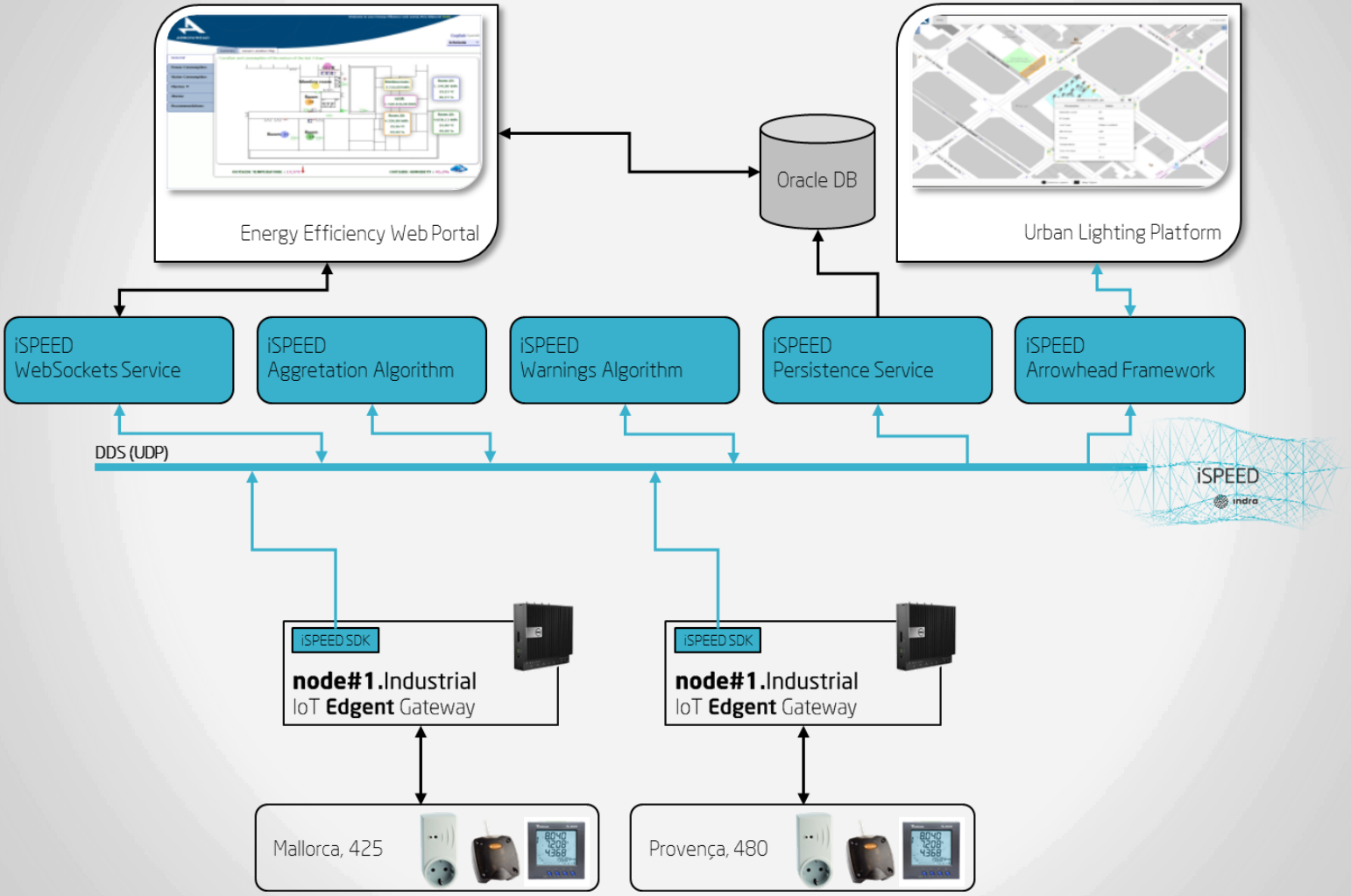
- Luminosity
- Temperature (Indoor, Outdoor)
- Humidity

Warning (CEP Engine)

- Magnitude exceeds threshold
- Magnitude is close to threshold

ARROWHEAD Project

Architecture Overview



ARROWHEAD Project

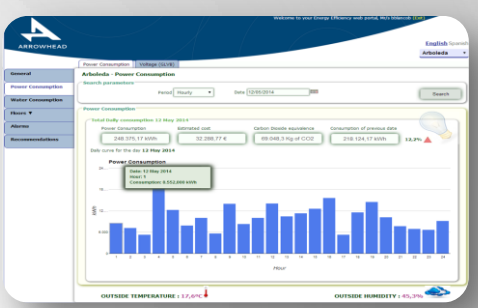
Energy Efficiency Web Portal

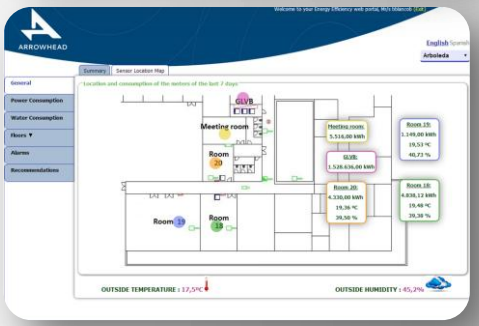
- Energy data
  - Real Time data monitoring
  - Hourly, Daily and Monthly data aggregation by floor and building
  - Energy data comparison with previous periods
  - Cost/CO2 Energy consumption equivalence

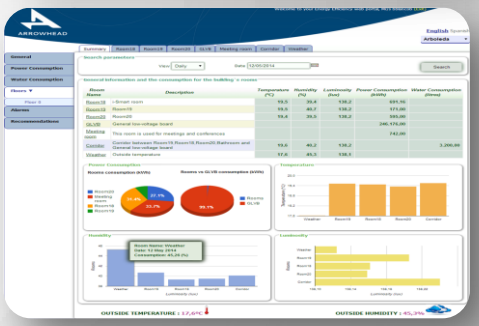
- Environmental conditions
  - Real Time data monitoring
  - Temperature, luminosity and humidity data average by floor and building

- Warnings
  - Warning threshold configuration
  - Warning details (magnitude exceeds/close to a threshold)

- Energy Savings recommendations







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Avda. de Bruselas 35
28108 Alcobendas,
Madrid España
T +34 91 480 50 00
F +34 91 480 50 80
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