Growing Smart Energy Cities

Strategies, Instruments and Financial Tools

Smart Energy Supply in Spain – Making Cities Smarter

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Smart Energy Supply – Making Cities Smarter

COP 21

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OBJECTIVE:

"Reduce global carbon emissions and aim to keep warming very below the 2ºC threshold, "pursuing efforts" to limit warming to 1.5ºC above pre-industrial levels"

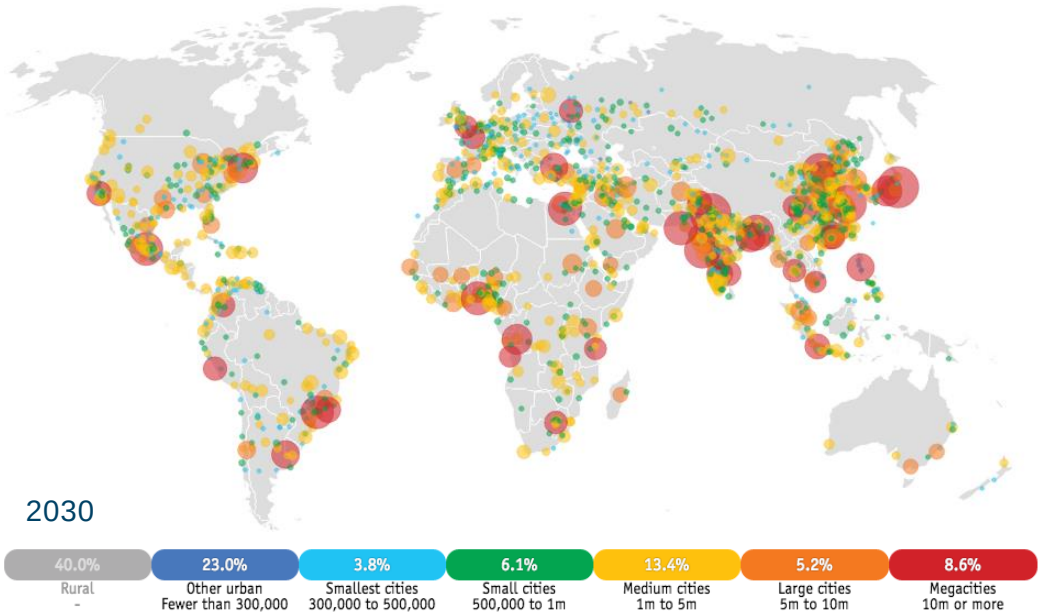
COP 22:

Collaboration between the COP21 countries was reaffirmed

Which role will cities play?

Cities need to play a **central role** to tackle the transition, not only because they are part of the problem, but also because they are potentially an important part of the **solution**.

in 2030



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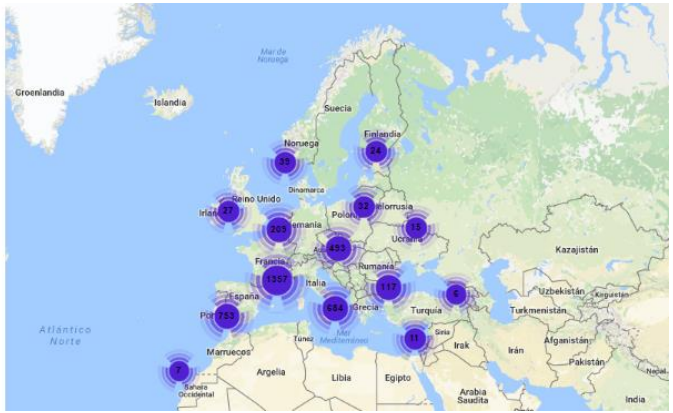
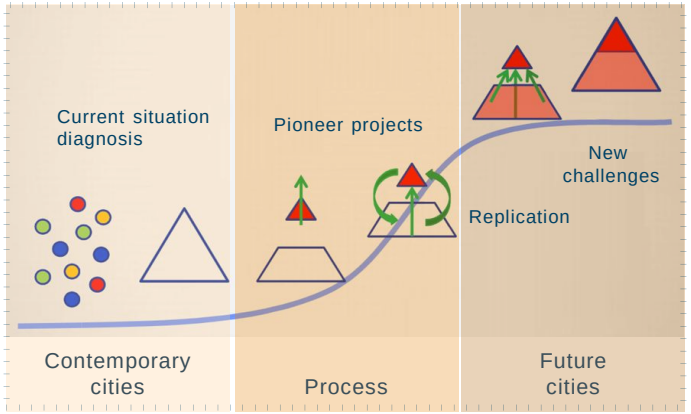
European Initiatives

- **“Covenant of Mayors” for Climate & Energy**
  - The Covenant of Mayors for Climate and Energy brings together local and regional authorities who voluntarily commit to implementing initiatives aligned with the EU’s climate and energy objectives on their territory.
- **At Spanish level** ➡ different initiatives as e.g. **GICI**: **Grupo Interplataformas de Ciudades Inteligentes**





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Priority areas

NZEB/Smart buildings:

- Energy efficiency/RES usage
- Demand response

Data management:

- IoT
- Automation
- Integrated management

Smart mobility:

- Alternative fuels (electric, NG)
- EV grid integration

Sustainable energy systems:

- Distributed Generation, storage and Smart Grids
- DH&C (waste/renewable sources)

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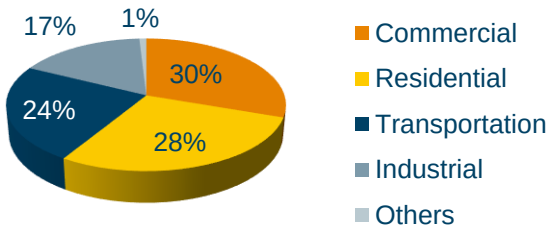
Energy consumption in Barcelona

- **Final energy consumption** in Barcelona was of 16.7 GWh. The distribution by sectors is representative of Mediterranean cities.
  - **Commercial buildings** represent the **largest proportion** of energy consumption, with above 5 GWh.
  - **Residential and commercial** buildings suppose **more than half** of final energy consumption, (mostly electricity and natural gas).

    Thermal energy from DH&C is not widespread, especially in small buildings.
  - **Transportation** is a relevant fraction of energy consumption, above 90% in the form of petroleum products (especially gasoil).
  - Barcelona comprises an **industrial area** (Zona Franca), which explains the contribution of Industry to energy consumption.

Energy consumption in Barcelona (2013)



Source: Barcelona's Municipality

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Energy consumption in Barcelona

- Renewable electricity produced in Barcelona accounted for about 1.2% of the City's electricity consumption, reaching 83 GWh.

- Including solar thermal, **total renewable production was of 155 GWh**, close to 1% of the city's final energy consumption.
  - Currently installed solar collector surface is above 90,000 m^2.

- Barcelona's municipality is promoting the **use of renewable energy in public buildings** by implementing self-consumption power plants.

Les Corts graveyard

Joan Miró library

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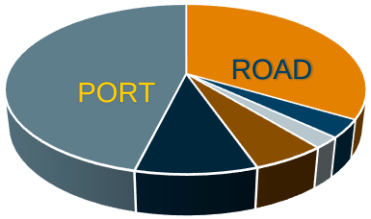
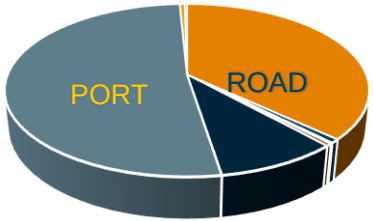
Air quality in the city

- **Transportation** is the most important source of **NOx** and **particles emissions** in **Barcelona**.

NO_x emissions



PM_{10} emissions



- It becomes necessary to reduce the use of petroleum-based products in transportation.
  - Local governments in main cities are placing restrictions to polluting vehicles, initially put in place in high pollution episodes and eventually becoming permanent (2020 horizon).
  - Foster alternative fuels: electricity, natural gas (CNG/LNG) in road transport and port docking.

PM_{10} particles median concentration

NOx median concentration
Source: Barcelona's Municipality

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GrowSmarter: Transforming cities for a smart, sustainable Europe

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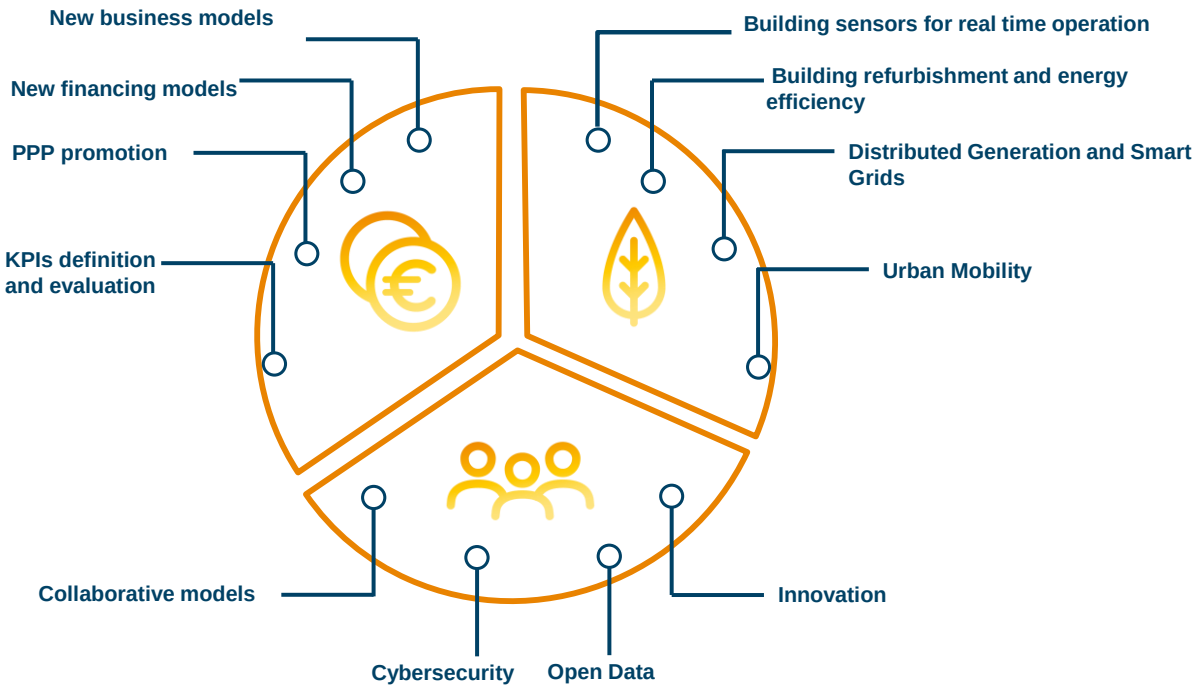
Smart City concepts: sustainability, efficiency and life quality improvement through new technologies and services.

Low Energy Districts

Infrastructure

Sustainable mobility



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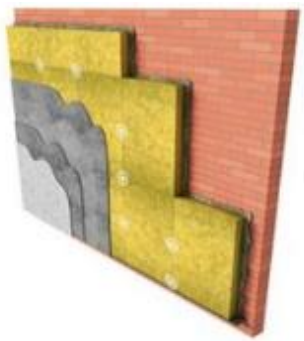
Low Energy District: residential refurbishment in Canyelles

- **Refurbishment** of a **residential building** → it is a 56-dwelling building of about 5,000 m2 in a public-private partnership with the ***Housing Agency of Catalonia (ACH)***
  - **Envelope isolation** with higher standards than the national regulation.
  - New windows and blinds
- Space heating and DHW systems improvements:
  - New high efficient boilers
- Home energy Management Systems.



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Low Energy District: Home Energy Management Systems

Providing information on real-time energy usage and waste levels to tenants is a key tool to help them see and reduce their own environmental footprint.

GNF provides smart devices that allow:

- To monitor & control electrical consumption
- To monitor gas consumption
- To monitor & control photovoltaic generation
- To control electrical consumption as well as the on/off state of a device
- To control home temperature from your Smartphone.
- Video surveillance, smoke & CO detector, doors & windows opening sensors, etc

All these, from your Smartphone and touch-screen home automation center

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Low Energy District: tertiary buildings refurbishment

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Sports Centre

Educative Centre

Hotel

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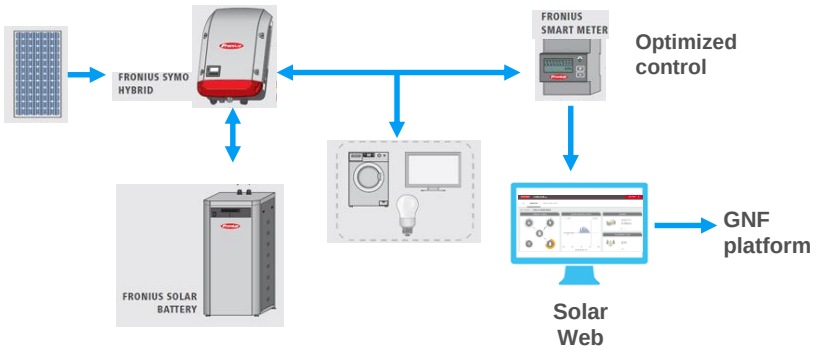
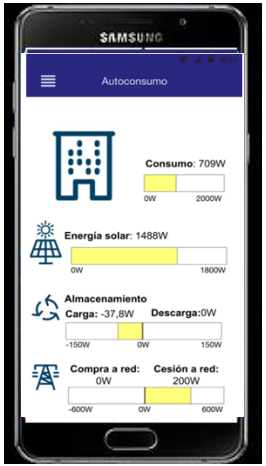
Low Energy District: Our GNF prosumers- Developing GNF Smart tools

Developing GNF EMS to optimize the control and integration of PV and energy storage in end customer and in the grid.

Following different strategies:

- Self-consumption
- Peak shaving
- Demand response/arbitrage
- DSO/TSO services
- Ancillary services





Working with different PV, energy storage and power electronics providers and integrating their systems in GNF EMS

Our prosumer have access to all their PV and energy storage information, knowing in real time which type of energy is consuming.

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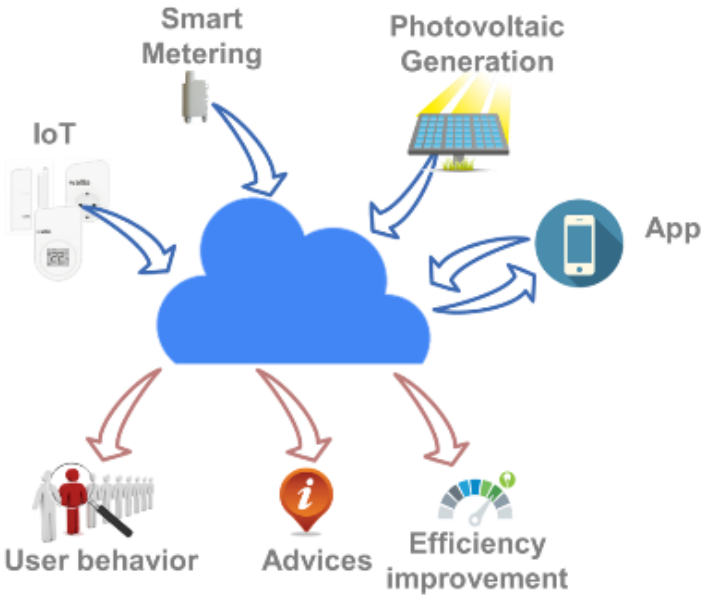
Low Energy District: GNF plattform

All sensors and the equipment will communicate through radiofrequency protocol to a corporate platform. Gathered data from equipment, along with other information like gas consumption, energy price per hour, photovoltaic generation… will produce valuable insights, for a better understanding of users behaviour.



Smart Energy Supply – Making Cities Smarter

KIC – COFAST: Combined Heat and Power for EV fast charging

Image provided by PASCH Y CIA

COFAST

Overview of COFAST – Scope and Consortium

SCOPE

Design, test and commercialize an integrated Electric Vehicle (EV) fast charging station fueled by a Combined Heat and Power (CHP) engine. It aims to provide fast charging services to EVs as well as use the residual heat to satisfy building thermal needs or to inject to district heating (DH) networks.

CONSORTIUM

Utility & ESCO	Engine Manufacturer and Integrator	Power Electronics Provider	Control system Provider	R&D partner, EMS provider

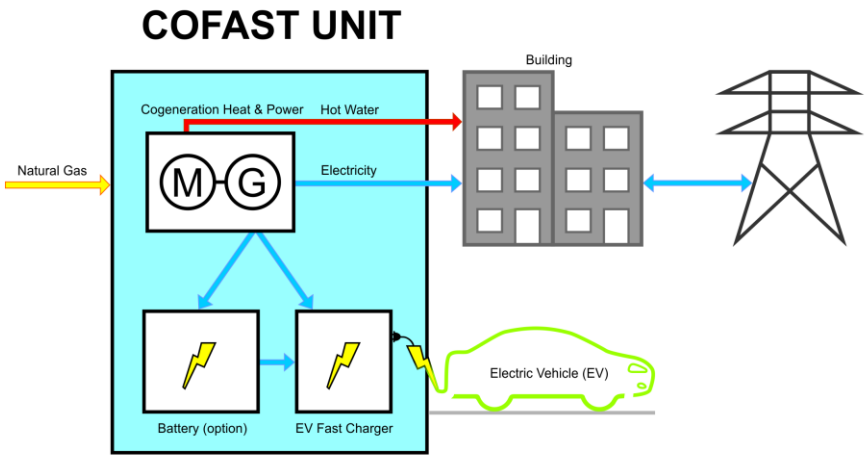
FINANCED BY:

COFAST

Solution description

Main characteristics:

- Natural gas **cogeneration** engine (142 kWe, 212 kWt)
- **High energy efficiency** (≈90%)
- EV **fast charging** (≈50 kW), compatible with CHAdeMO, CCS and AC Mode 3.
- Two possible configurations: **integrated or modular** solution.
- Two possible solutions: **with or without Lithium Ion battery.**



COFAST

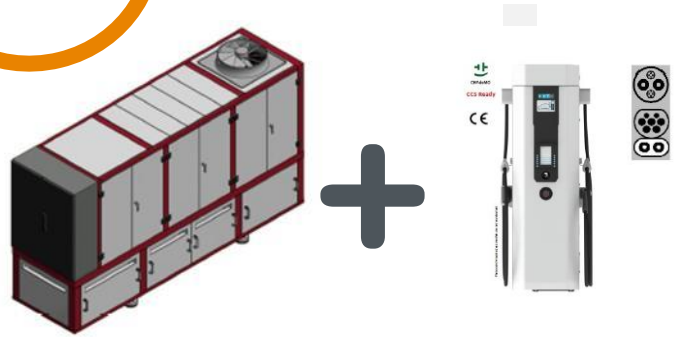
Solution description

INDUSTRIAL
SEMI-URBAN

Integrated solution
(Image provided by PASCH Y CIA)

URBAN

Modular solution



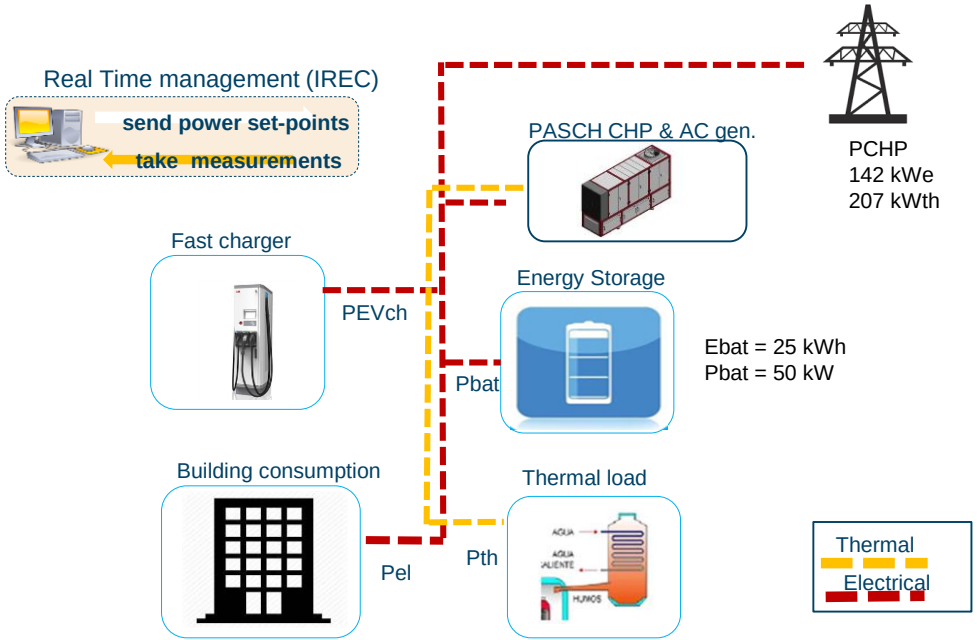
Located at the technical room

Located at the public roadside

COFAST

Solution description

- The COFAST solution is controlled by an **integrated Energy Management System** that manages the operation of the different subsystems:
- **Technical and economic optimization** considering:
  - Equipment characteristics and status
  - Real-time and expected energy demand (building, EV)
  - Energy prices
  - Building systems status (available power)
- **Outputs:**
  - CHP setpoint
  - Battery setpoint
  - Fast charger setpoint: ON, OFF, power limitation.



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Benefits to different stakeholders

Policy Makers and City Governments

- Cities air quality improvement by promoting deployment of sustainable transport
- Provide a high efficiency solution for EVs fast charging station

Energy System

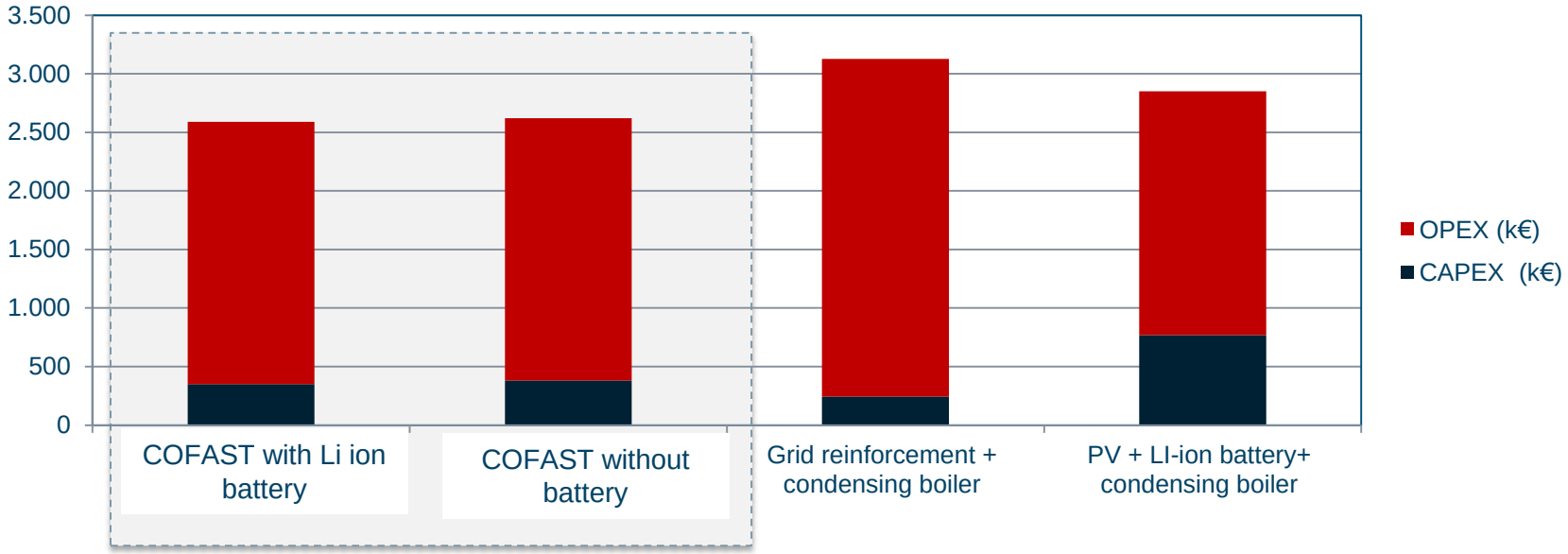
- Decrease congestion in distribution networks
- Potential of avoiding grid reinforcement
- Support Distributed Energy Resources (DERs) integration

End – User

- Increase EV charging infrastructure and decrease EV driver range anxiety
- Benefits for the thermal user due to the distributed generation (CHP)

COFAST

Business models for EV fast charging stations – Competitive analysis



- In case of grid reinforcement, it is considered that the construction of a new transformer substation as well as Medium Voltage reinforcement will be needed
- In case of photovoltaic (PV) and Lithium ion battery is considered an installation that provides the same services of COFAST and avoids grid reinforcement (291kWp and 343kWh of storage required)

COFAST

Business case players

ENERGY SERVICE COMPANY (ESCo)

Provides → **Energy Services**

Acts as → **Fast Charger Operator**

END-USERS:

Buildings and District Heating Operators

Individual EV drivers or EV corporate fleets

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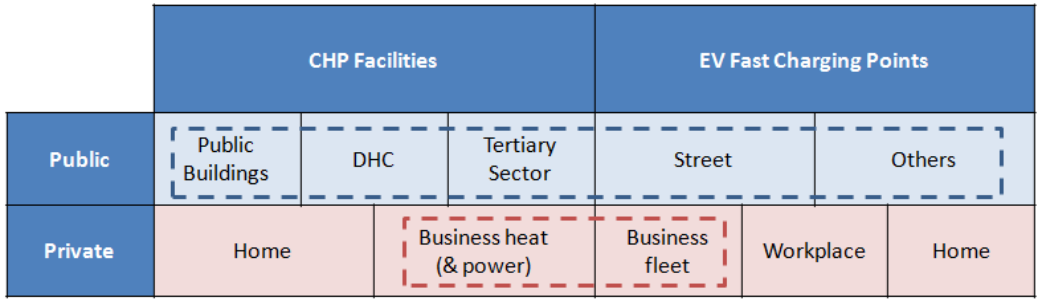
Applications

- Urban and inter-urban areas where there is a demand for EV fast charging services and there is a thermal and electric consumer.



- The market analysis carried out during the feasibility analysis determined that there are over 120,000 potential locations for installing the COFAST solution.

Type of building (CHP consumer)	Potential locations
Hotels	15,081
Shopping malls	7,389
Sports centres	97,210
Transport infrastructures (airports, train stations, etc.)	3,500
District Heating grids	>6,000
Total	**>120,000**

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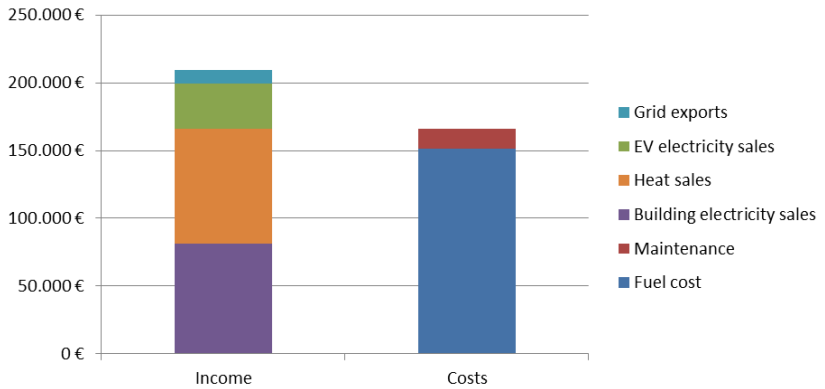
Business case Germany – Sports Centre

Pay Back:
8 years

Gas Tariff (€/kWh): 0.049

Fast Charging Electricity Tariff (€/MWh): 400

Electricity Tariff (€/MWh): Dynamic from 107 to 167 (*)



(*) Estimations based on data from Eurostat

(**) Example calculated **only considering energy savings**, i.e. a general case without considering CAPex avoided due to a new substation, grid reinforcement, new fic costs due tro capacity increase, etc,

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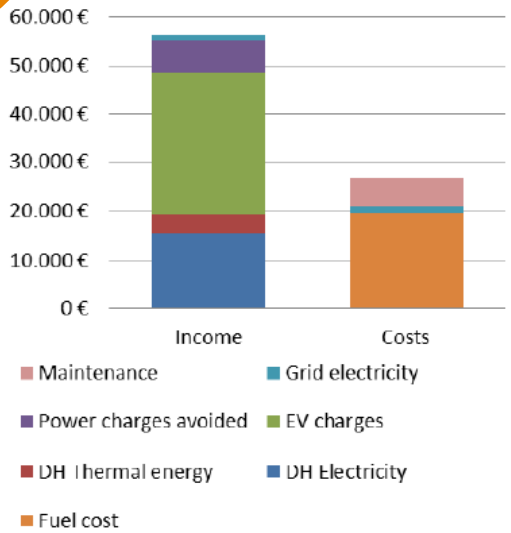
Business case Spain – District Heating & Cooling grid

Pay Back: 10 years

Gas Tariff (€/kWh): 0.020

Fast Charging Electricity Tariff (€/MWh): 400

Electricity Tariff (€/MWh): Dynamic from 54 to 107



This is the expected scenario, which considers a modification regarding self-consumption regulations, and a liberalized EV charging market that is not yet developed in Spain.

Prices based on real consumers

Example calculated **only considering energy savings**, i.e. a general case without considering CAPex avoided due to a new substation, grid reinforcement, new fic costs due tro capacity increase, etc,

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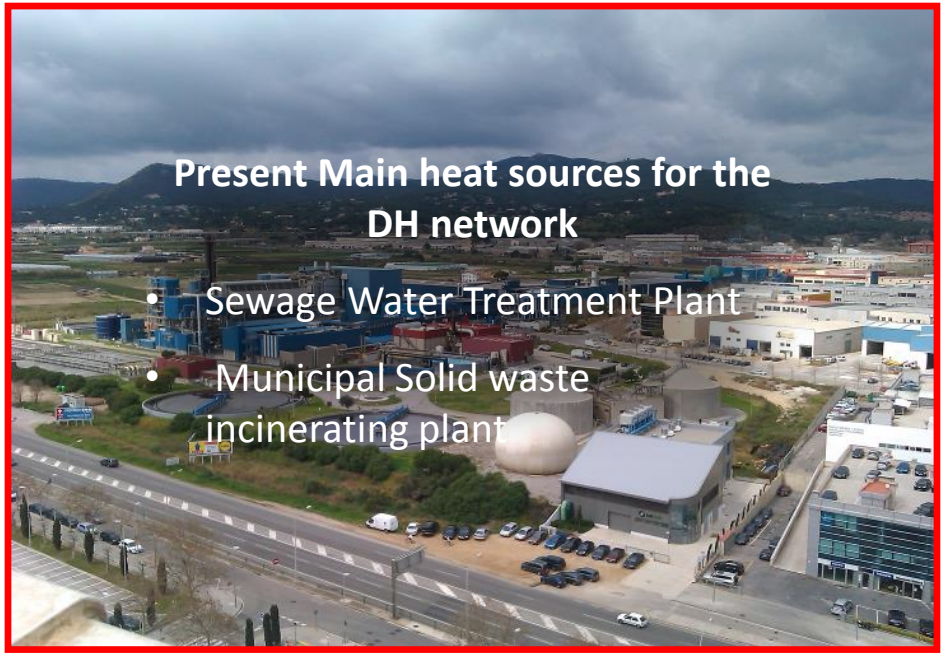
Installation of the pilot unit – Tub Verd Mataró



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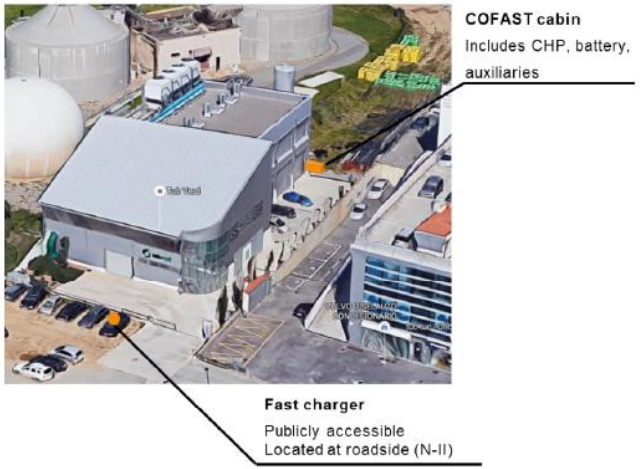
Installation of the pilot unit – Tub Verd Mataró

- The COFAST pilot unit will be installed in Tub Verd, a DH&C network in Mataró (30 km from Barcelona)
  - Tub Verd is jointly owned by Mataró's municipality (through public water supply company) and Gas Natural's ESCo.



- Heat from the CHP unit will be provided to the heating network, contributing to a diversified high-efficiency, waste, and renewable heat mix.
- Electricity will be used for EV charging and powering the pumps and chillers.
- The fast charger will be available for free-of-charge use by the public.

COFAST

Installation of the pilot unit – Tub Verd Mataró

- Contacts have been established with several Public Administrations:
  - **ICAEN (Regional Energy Administration)**: Dissemination of the solution in order to receive guidelines for searching for a pilot location. Frequently, large infrastructures such as DH&C grids are partly owned by or receive support from public administrations.
  - **Local Administrations** (Barcelona, l'Hospitalet de Llobregat, Mataró), in order to align the COFAST pilot experience with the city's **EV charging infrastructure strategy**, and search for potential locations for installing the COFAST unit.

- An agreement is being negotiated with Mataró's municipality in order to obtain:
  - **Permission to install the fast charger** in public roadside
  - **An economic collaboration for the economic model for charging services and charger management**, so that free charging services can be provided to the public (neighbouring towns and generally in the region, municipalities provide free charging services to citizens).
  - **This kind of agreements can be replicated** in markets where EV fostering strategies include offering free charging services.

Muchas gracias

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