Renovation towards a smart district heating in Valladolid

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SMART ENERGY SYSTEMS AND
4TH GENERATION DISTRICT HEATING

COPENHAGEN, 12–13 SEPTEMBER 2017

Renovation towards a smarter DH in Valladolid

- Introduction.
- Case study: FASA DH
- Transition towards a 4GDH.
- Conclusions.

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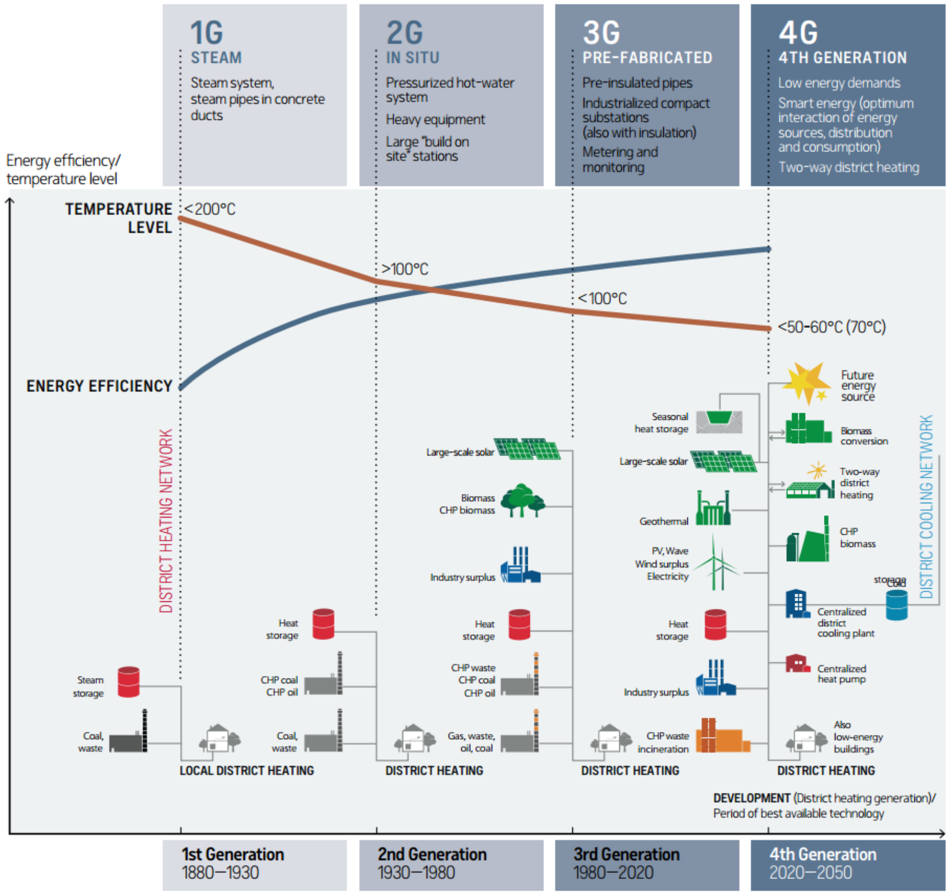
Introduction

Historical development of DH systems



Source: Aalborg University and Danfoss District Energy, 2014

Europe

12% population DH-connected
5,000 big DHC networks
25% from RES

Northern Europe

Copenhagen, Helsinki, Warsaw, Riga…

*¡¡¡ **90%** citizens connected to DH!!!*

Future of district energy

Low temperature district heating
Smart energy management
Two-way networks (prosumers)

Source: ADHAC (District Heating and Cooling Companies Association in Spain)

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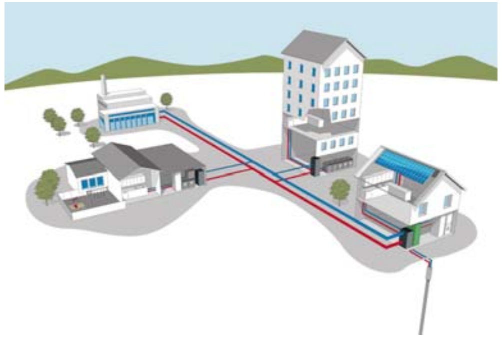
Heating and Cooling networks in Spain



306 networks
1,219 MW
550 km
4,030 buildings
< 1% people

74% RES
97% biomass
↓ 180,000 $TnCO_2$

90% heating
23% residential
48% private

Source: ADHAC (District Heating and Cooling Companies Association in Spain)

VEOLIA: Global figures in 2016

24,390 M€ turnover | **163,226** employees

WATER

100
million people supplied with drinking water

61
million people connected to wastewater systems

4.052
water production plants managed

2,928
wastewater treatment plants operated

WASTE

40
million people provided with collection services on behalf of municipalities

45
million metric tons of treated waste recovered into energy

764,477
business customers

591
waste treatment facilities operated

ENERGY

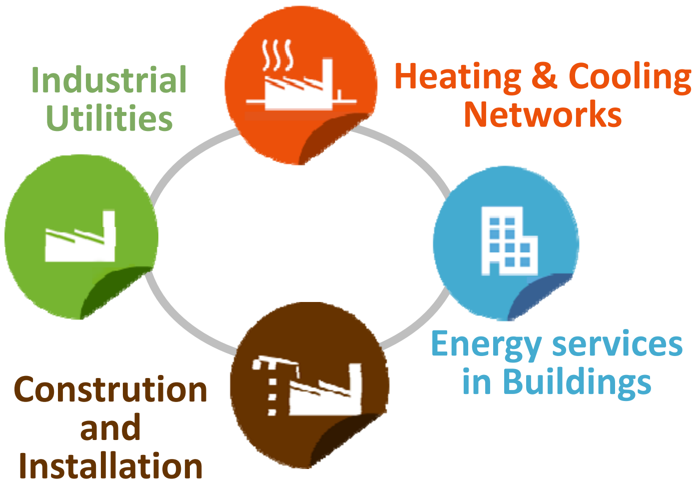
44
million MWh produced

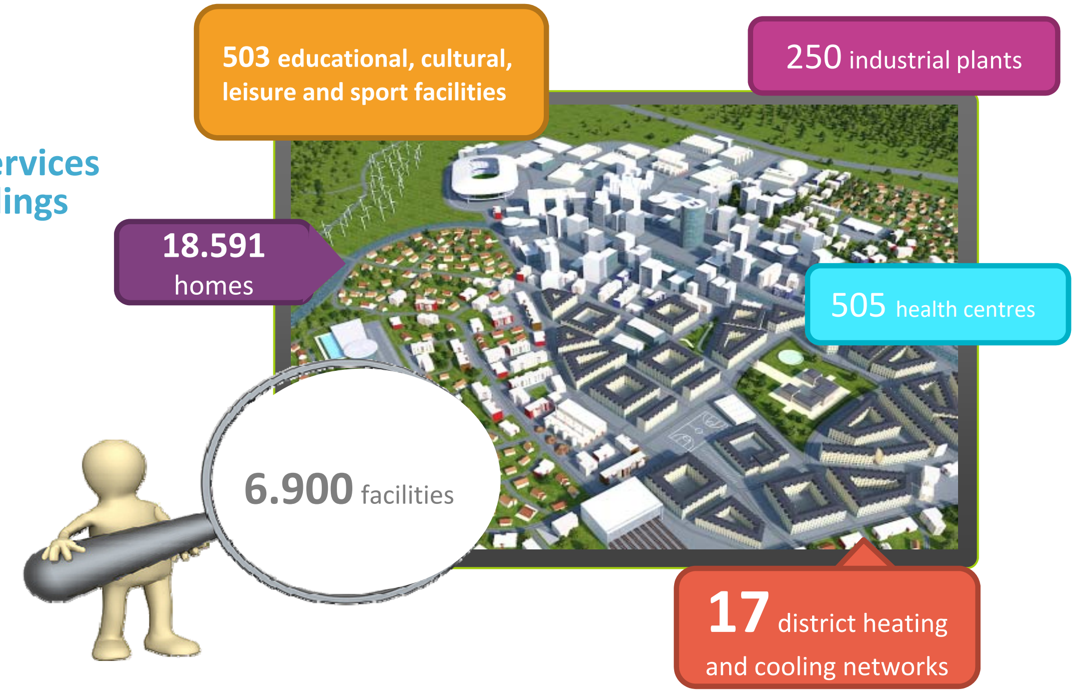
37,339
thermal installations managed

2.086
industrial sites managed

551
heating and cooling networks operated

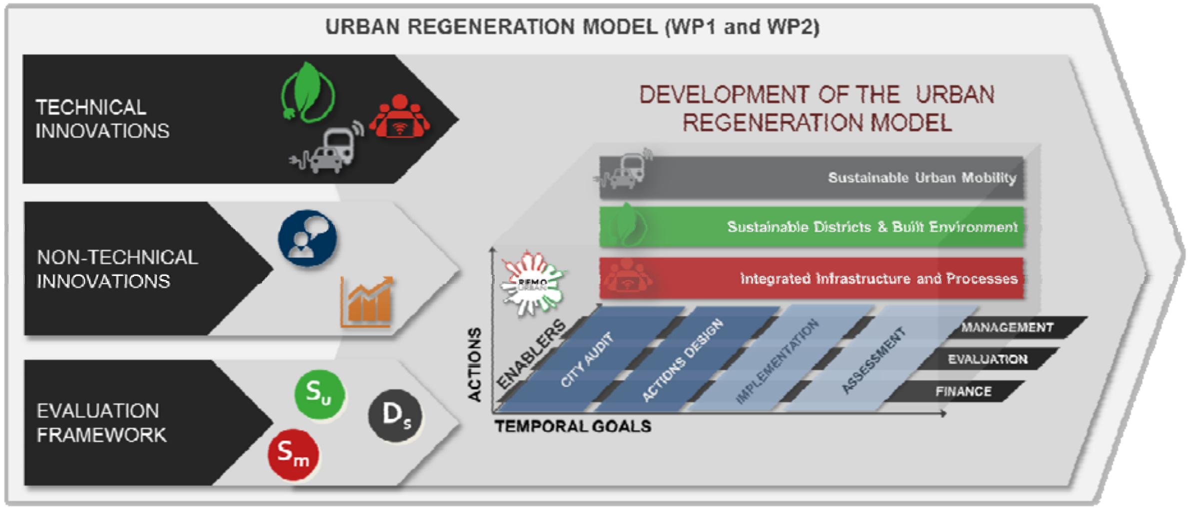
VEOLIA in Spain: Main activities





REMOURBAN project: General overview

REMOURBAN: REgeneration MOdel for accelerating the smart URBAN transformation



REMOURBAN project: Demo cases

REMOURBAN: REgeneration MOdel for accelerating the smart URBAN transformation

KEY FACTS

Start Date: 1st Jan 2015

Duration: 60 months

Total Budget: 23,790,405 €

EC Funding: 21,541,949 €

22 partners from 7 countries

3 Lighthouse and 2 Follower cities

Case study: FASA DH

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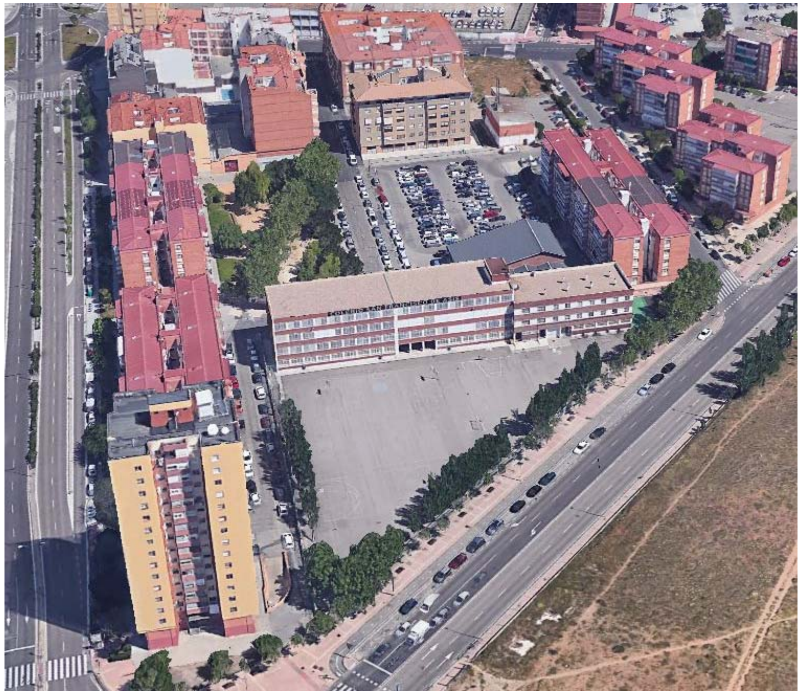
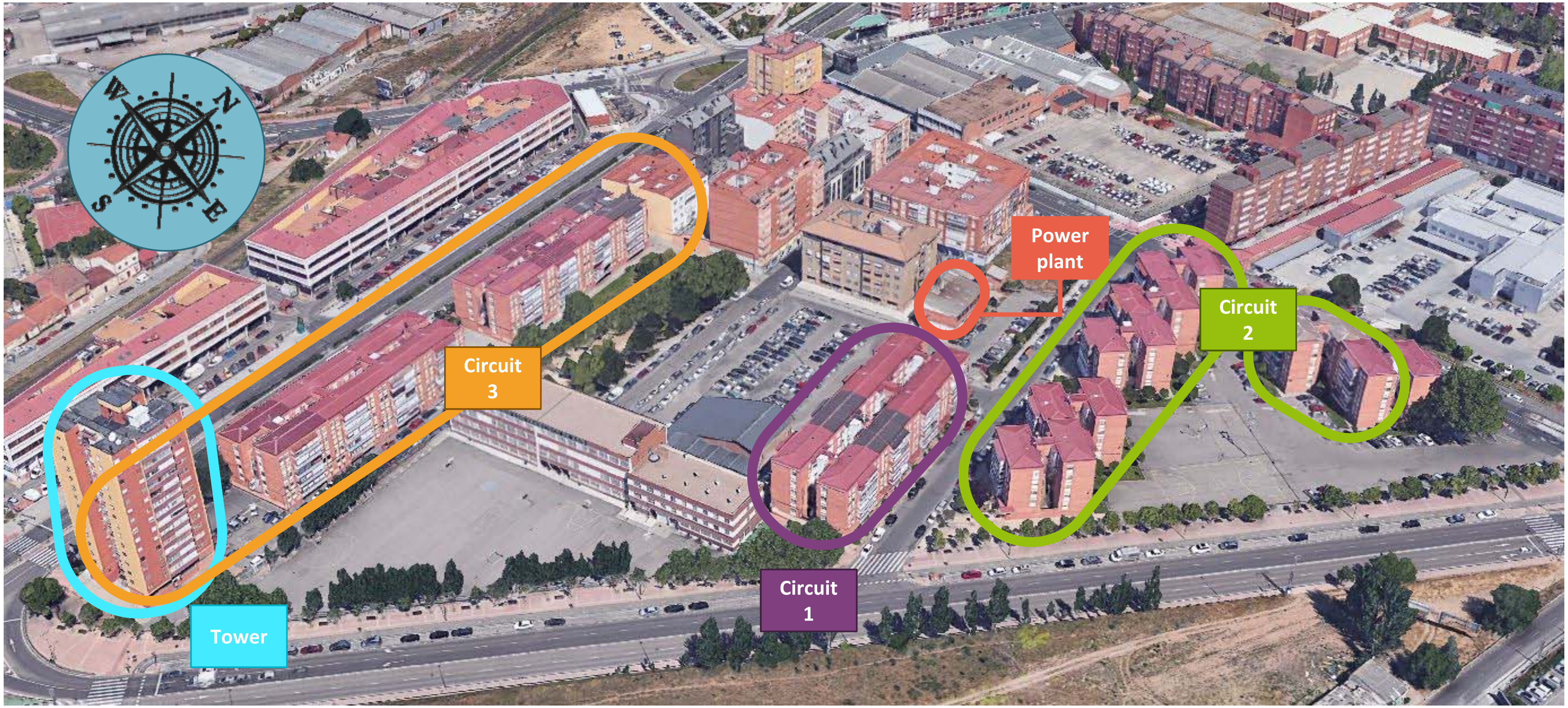
Description and original situation of FASA DH

FASA district heating:

- Built in **60s –70s**
- **Private** Community of **Owners**
- **20** residential buildings
- **398** private apartments
- **24,700** m^2 heated
- **2G**-DH system
- **Fossil** fuels (oil and gas)
- Consumption: **4.0** GWh/yr
- Power installed: **7.4** MW



Panoramic view of FASA DH



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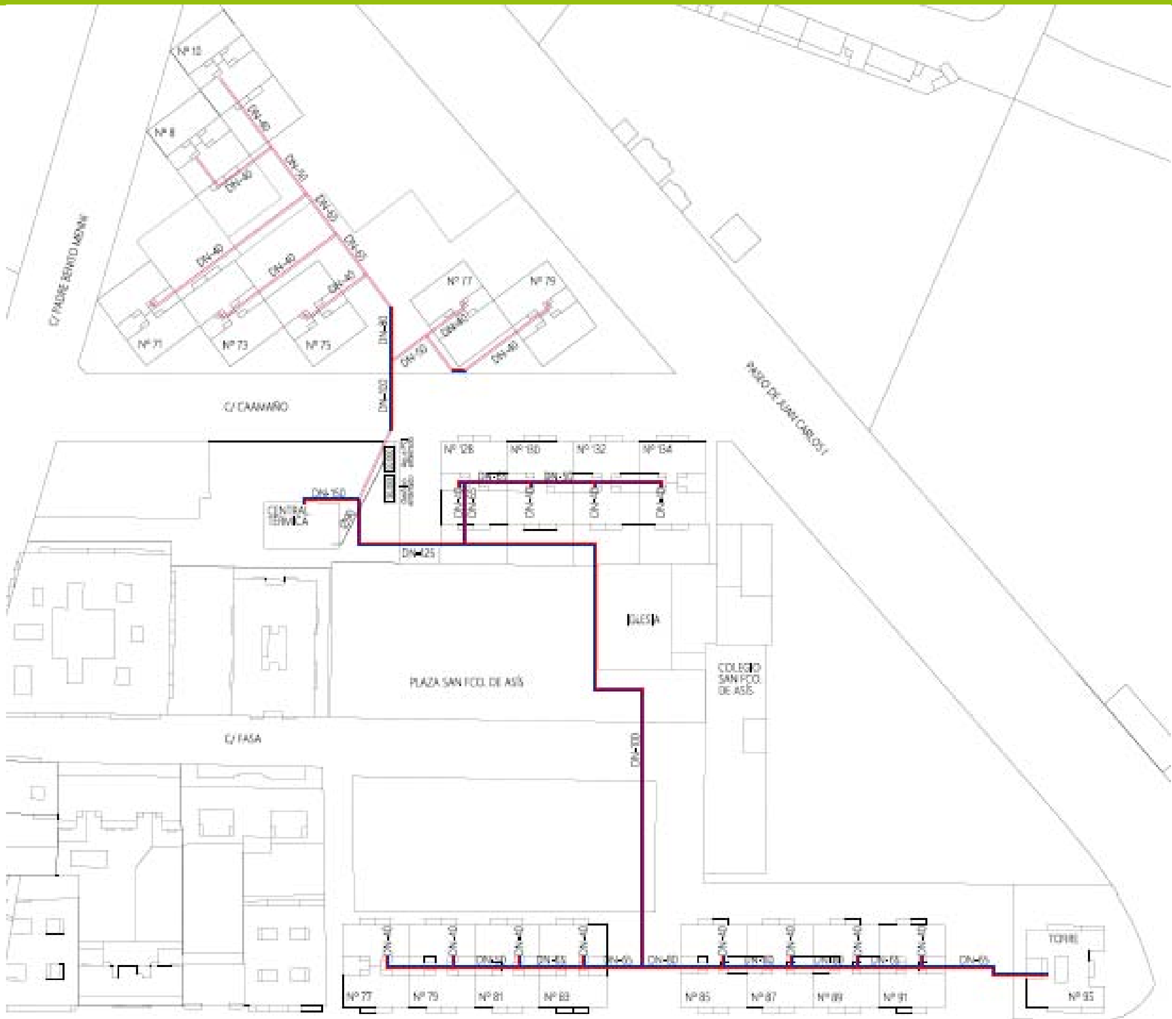
Original network layout of FASA DH



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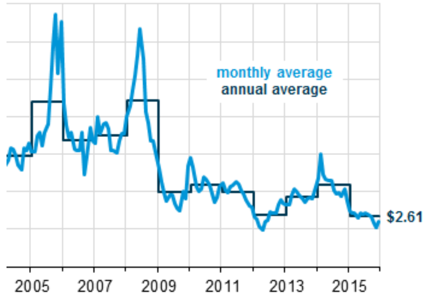
Community of Owners needs in FASA DH

- **Old equipment** and bad performance of the energy facilities.
- **Inefficient** management of the district **heating** system.
- Network with continuous **breakages** and **leaks** => **High reparation costs**.
- Expensive **energy bill** and low-comfort conditions inside the homes.
- Instability of the **energy price** due to external conditions.



Transition towards a 4GDH

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Objectives for FASA DH renovation

- Reduction of the **buildings' energy demand** by a **50%**.
- Improvement of the **comfort level** inside the dwellings.
- Decrease of the **operation & maintenance costs**.
- Enhancement of the overall **energy performance**.
- Reduction of the **CO_2 emissions**.
- Increase the share of **renewables beyond 80%**.
- **Residents decision-making** at district, building and home level.

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Energy efficiency measures in FASA DH

1. Buildings external **insulation**.
2. Overall **energy management**: supply, operation and maintenance.
3. High-efficiency **biomass boilers**: 1.0 MW.
4. High self-sufficiency biomass **buried silo**: 205 m^3.
5. **Variable flow** pumping system.
6. **BIPV** in the tower façade: 24 kWp.
7. New **pre-insulated** pipeline network + **Leak detection** system.
8. Optimized **control strategies**.
9. Smart energy **metering** and **monitoring**.
10. **HEMS**: thermostatic valve, smart thermostat and heat cost allocators.

Reduction on the buildings’ energy demand

External insulation solution in all the buildings’ façades

acciona Construcción

IPR: José Antonio González Barjas (Architect)

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Optimized energy production

- 2 new **biomass** boilers: 1.0 MW
- Back-up gas boiler: 3.7 MW
- **Heat storage**: Water buffer tanks
- **Variable flow** pumping system
- New valves, pipes, accessory...
- Remote **control system**

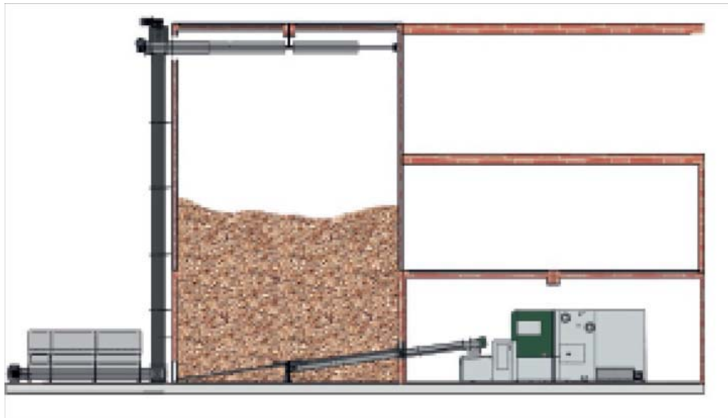
Higher energy self-sufficiency

Biomass wood chips:

- Biomass class: P16B (G30 – G50)
- Density: 325 kg/m^3
- Moisture (W): 15 – 40 %
- Calorific value: 3.5 kWh/kg

Buried silo:

- Dimensions: **10.25m x 4m x 5m**
- Useful Volume: **205 m^3**
- Biomass storage: **66 tons**
- Capacity (average): **65 days**



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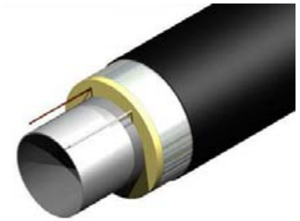
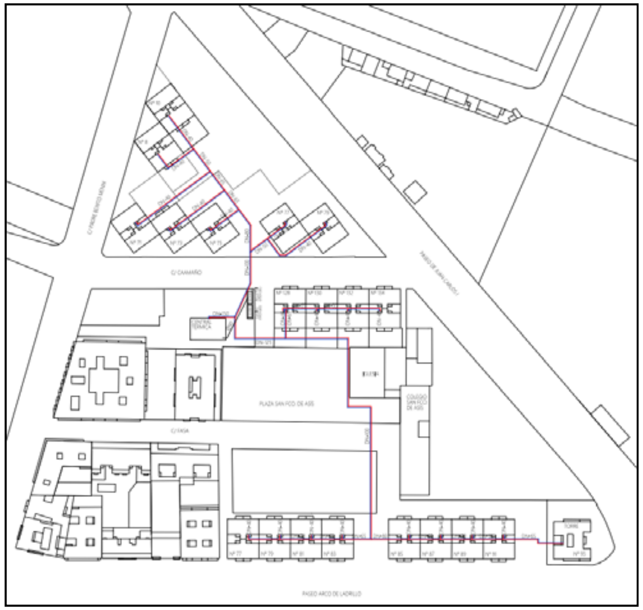
Improved energy distribution

New **distribution network**:

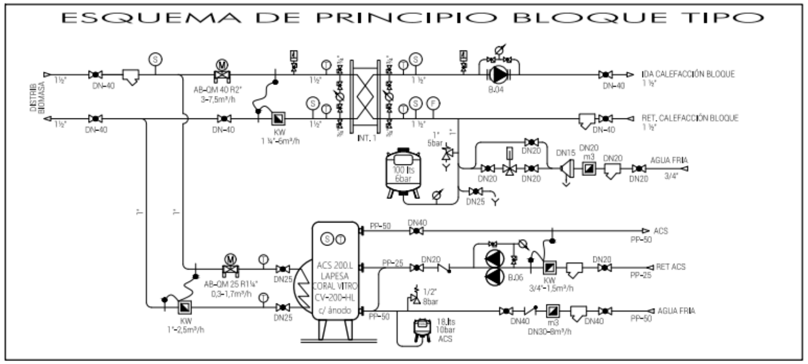
- Energy carrier: Hot water (85 / 65 °C)
- Pre-insulated pipelines
- Same layout
- Leak detection systems





New high-performance **substations:**

- Heat plate exchanger
- Pump
- DHW tank
- Smart energy meters



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Better control & Higher comfort

- **Home Energy Management System:**
  Individual thermostatic valve at dwelling level
  Smart thermostat
  Heat cost allocators

- **Comfort sensors:**
  Indoor ambient temperature
  Indoor relative humidity

Transition to a smarter district heating (1/2)

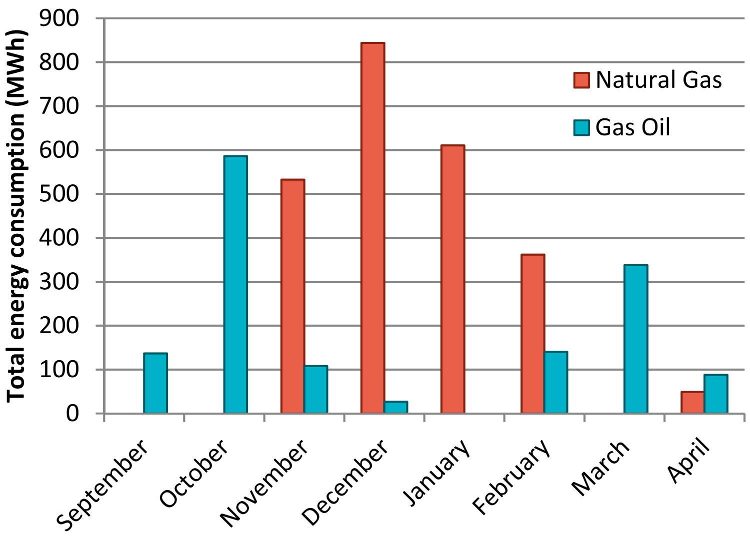
Before renovation

"2G district heating"
Old and inefficient equipment
Lack of insulation in the buildings
Based on fossil fuels (gas and oil)
Pressurized superheated water
(T = 120/100 °C)
Distribution heat losses and leaks
Manual control
Production not adapted to demand
Not metering (energy bills in paper)
Additional costs in O&M

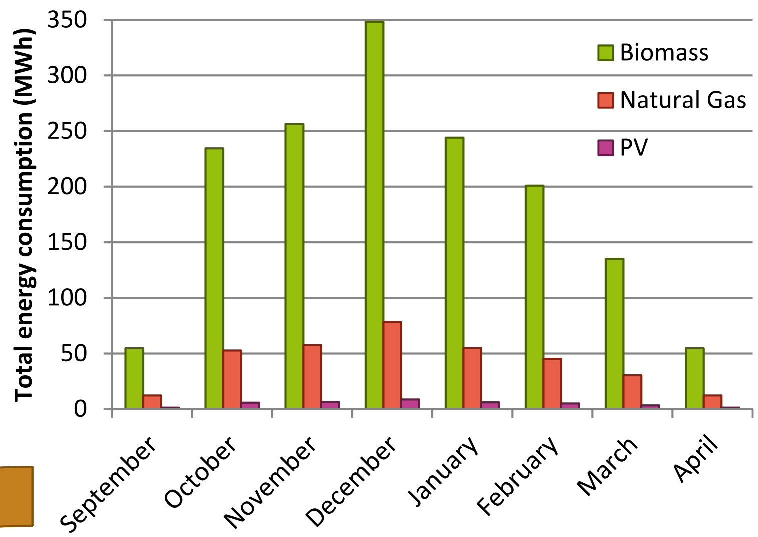
After renovation

"3G-4G district heating"
New and high-performance equipment
External insulation in the buildings
Based on renewables (biomass and PV)
Hot water
(T = 85/65ºC)
Pre-insulated pipes and leaks detection
Automatic and remote control
Production adapted to demand
Smart metering and monitoring
Overall energy management

Transition to a smarter district heating (2/2)



Before: 3.80 GWh/a



After: 1.91 GWh/a

Conclusions

Key figures in FASA district heating

- Expected **energy savings**: **50%**
- Expected **CO_2 emissions** reduction: **1,000 tCO_2/yr**
- **Thermal power** : **1.0 MW (biomass-main)** + 3.7 MW (gas-backup)
- **Electric power** : **24 kW (BIPV)**
- Total **heated area**: **24,700 m^2**
- Total **investment** for retrofitting: **4.0 M€** (**162 € / m^2**)
- **Contract**: Long-term ESCO model (**18 yr**)
- **Financing** scheme: EC + Municipality + ESCO + Building company

Barriers in FASA district heating

Political	Spanish **legislation** against electrical **self-consumption**.
Economic	High **upfront costs** for district energy retrofitting. Need of a **long-term contract** > 15 yr to be feasible (financial risk).
Social	**Private multi-property** ownership (agreements, decision-making...). Citizens' **distrust companies** (energy and building).
Technical	General **lack of knowledge** about energy & environmental projects.

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Success factors in FASA district heating

Political	The use of both regional and international fuels enables a more **stable energy price** and **security of supply** in the long term.
Economic	**European Commission and Municipality financing support** made the renovation feasible without raising the energy bills to the Communities of Owners.
Social	**Engagement campaigns** with the owners foster their confidence in this kind of projects.
Technical	**Companies' expertise** to improve the owners´ confidence. **M&V** to assure the energy savings increase transparency and trust.

Thank you very much for your attention

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