Renovation towards a smart district heating in Valladolid

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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

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

Northern Europe
- Copenhagen, Helsinki, Warsaw, Riga...

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

Source: Aalborg University and Danfoss District Energy, 2014
Source: ADHAC (District Heating and Cooling Companies Association in Spain)
Heating and Cooling networks in Spain

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

74% RES
97% biomass
↓ 180,000 TnCO₂

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

- Industrial Utilities
- Heating & Cooling Networks
- Construction and Installation
- Energy services in Buildings

- 250 industrial plants
- 503 educational, cultural, leisure and sport facilities
- 18,591 homes
- 505 health centres
- 6,900 facilities
- 17 district heating and cooling networks
REMOURBAN: REgeneration MOdel for accelerating the smart URBAN transformation
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Case study: FASA DH
FASA district heating:
- Built in 60s–70s
- Private Community of Owners
- 20 residential buildings
- 398 private apartments
- 24,700 m² heated
- 2G-DH system
- Fossil fuels (oil and gas)
- Consumption: 4.0 GWh/yr
- Power installed: 7.4 MW
Panoramic view of FASA DH
Original network layout of FASA DH
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
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 CO₂ emissions.
- Increase the share of renewables beyond 80%.
- Residents decision-making at district, building and home level.
2. Overall energy management: supply, operation and maintenance.
3. High-efficiency biomass boilers: 1.0 MW.
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

IPR: José Antonio González Barjas (Architect)
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**
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
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
• **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
  \( T = 120/100 \, ^\circ C \)
- 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
  \( T = 85/65 \, ^\circ C \)
- 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

Natural Gas
Gas Oil

Biomass
Natural Gas
PV
Conclusions
Key figures in FASA district heating

- **Expected energy savings**: 50%
- **Expected CO₂ emissions reduction**: 1,000 tCO₂/yr
- **Thermal power**: 1.0 MW (biomass-main) + 3.7 MW (gas-backup)
- **Electric power**: 24 kW (BIPV)
- **Total heated area**: 24,700 m²
- **Total investment for retrofitting**: 4.0 M€ (162 € / m²)
- **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.
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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