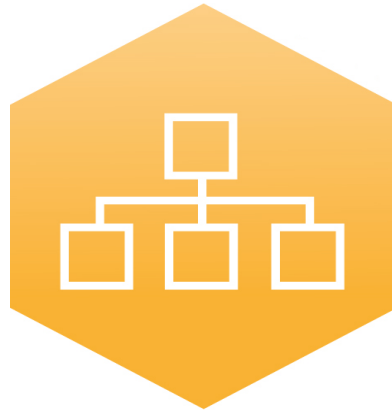


Technological Solutions to Reduce District Heating Network Temperatures - the TEMPO Project

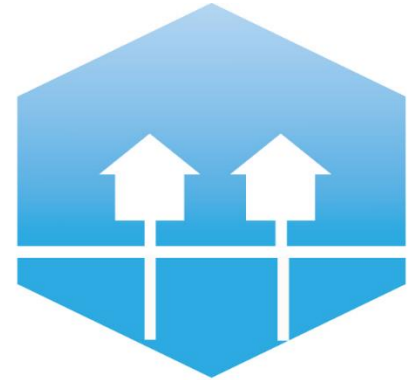


AALBORG UNIVERSITY
DENMARK

Dirk Vanhoudt - EnergyVille/VITO



4th International Conference on Smart Energy Systems and
4th Generation District Heating 2018 #SES4DH2018



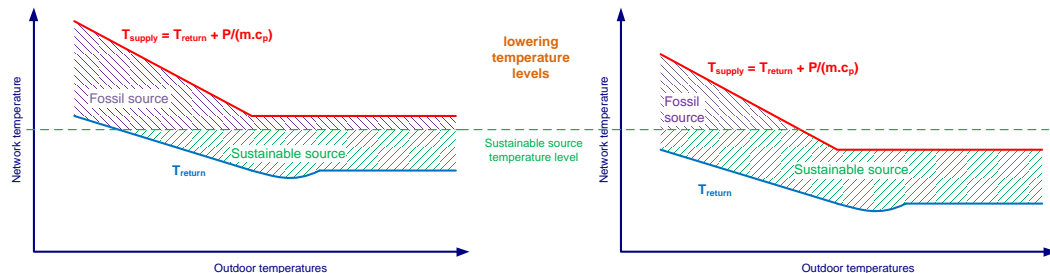
4DH

**4th Generation District Heating
Technologies and Systems**

Lower network temperatures

Benefits:

- Less heat losses
- Increased share of LT sustainable energy sources
- Increased efficiency of heat production technologies (heat pumps, CHPs, boilers etc.)



Lower network temperatures

By technological innovations:

- Digitalisation
- Network and building infrastructure optimization

By business models rewarding low return temperatures

By consumer commitment

- Awareness creation
- Involvement



H2020 TEMPO in short

- **Innovation Call:** EE-04-2016-2017, on ‘New heating and cooling solutions using low grade sources of thermal energy’.
- (**TEMP**erature **O**ptimisation for Low Temperature District Heating across Europe).
- TEMPO will demonstrate the applicability of low temperature district heating through a **COMPREHENSIVE SOLUTION PACKAGE** Including technological innovations on the network and building side, consumer empowerment enabled by digital solutions and innovative business model for EU replication.
- EnergyVille/VITO: project coordination, duration 48 months, 11 partners, Project cost: 5 MEUR, EU funding: 4 MEUR.

TEMPO objectives

- Final development of **technological innovations** for low-temperature (LT) district heating (DH) networks.
- Quantify the **benefits of the TEMPO solution packages** for LT DH networks through demonstration in 3 representative demonstration sites.
- Empowerment of **end users** in LT DH network.
- Develop innovative **business models** and demonstrate their replication potential for the roll-out of sustainable and economically viable DH networks across the EU.
- Guarantee EU-wide **market uptake** of TEMPO solutions packages by developing an exploitation and replication plan.



Project Partners

Participant No	Participant organisation name	Participant short name	Country
1 (coordinator)	Vlaamse instelling voor technologisch onderzoek	VITO	Belgium
2	NODAIS AB	NODA	Sweden
3	AIT Austrian Institute of technology GmbH	AIT	Austria
4	Thermaflex International Holding bv	THF	The Netherlands
5	Steinbeis innovation GGMBH	Solites	Germany
6	Smet GWT nv	Smet	Belgium
7	Vattenfall Europe Wärme AG	Vattenfall	Germany
8	ENERPIPE GmbH	Enerpipe	Germany
9	A2A Calore & Servizi SLR	A2A	Italy
10	Hogskolan Halmstad	HU	Sweden
11	Euroheat & Power	EHP	Belgium



Technological innovations

1. A supervision ICT platform for detection and diagnosis of faults in DH substations

A huge amount of building substations return a too high temperature back to the DH network, because of “faults”:

- malfunctioning components (sensors, valves, heat exchangers etc.)
- incorrectly designed components
- inappropriate settings in substation controller
- improper dimensioning of substation
- faults in heating supply systems
- In TEMPO:
 - **build** and **demonstrate** and on-line supervision **ICT platform**, able to **detect** and **diagnose** system faults ranging from slight operational deviations to actual malfunctioning system behaviour at the substation level.



Technological innovations

2. Visualisation tools for expert and non-expert users

Many utilities and energy companies generate a significant amount of measured data. However, to date, tools are lacking to transfer the amount of data into knowledge. In TEMPO, we will develop and demonstrate visualisation tools for expert and non-expert users:

Expert users

- energy supervisors
- maintenance staff
- hardware installers
- ...

Support tools to monitor and analyse network behaviour

Support tools to detect and correct faults in the networks

Non-expert users

- residents
- building owners

Tools to maximise their financial, environmental and operational gains:

- they give insight in energy use of the consumers building owners
- suggest energy saving possibilities

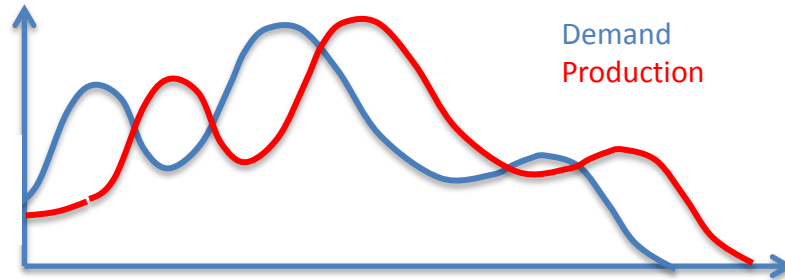
“natural language generation” for large-scale automatic report generation



Technological innovations

3. Smart DH network controller to balance supply and demand and minimise return temperature (i.e. STORM controller)

STORM controller idea: utilise the intrinsic flexibility in the DH network and the buildings to model the heat production to a desired shape.



In **TEMPO**:

development of additional features to minimize the return temperature, rather than balancing power supply and demand



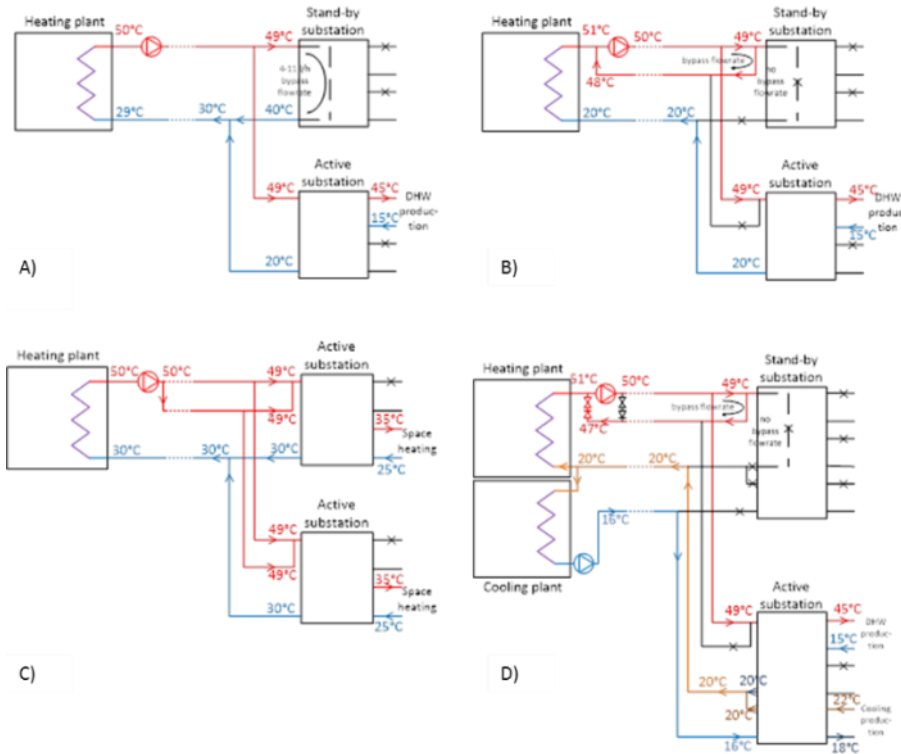
Technological innovations

4. Innovative piping system

- The issue: bypasses in substations for comfort reasons (DHW tap time) cause high return temperatures, mainly in summer

In TEMPO:

- Elimination of bypass by 3-pipe concept
- Smaller pipe dimensioning by using the recirculation line as booster pipe in winter
- Under investigation: heating and cooling still in 4-pipe system, just like in regular DHC network



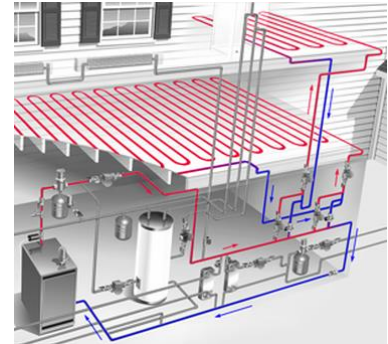
Technological innovations

5. Optimisation of the building installation

- The return temperature to the network is determined by the return temperature of the building installation
- Often, in building installations are suboptimally designed or operated

TEMPO:

- Static optimization of the building installation
 - Investigation of typically errors in building installations (e.g. improper hydraulic balancing, malfunctioning TRVs)
 - Practical guideline describing technical audit procedure
- Dynamic optimization of the building installation
 - Self-learning techniques to substation controllers to increase efficiency



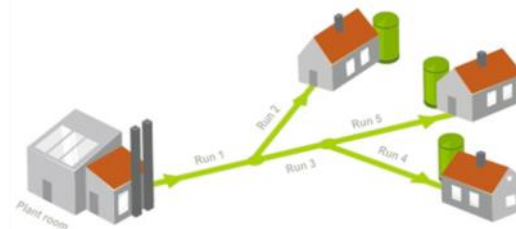
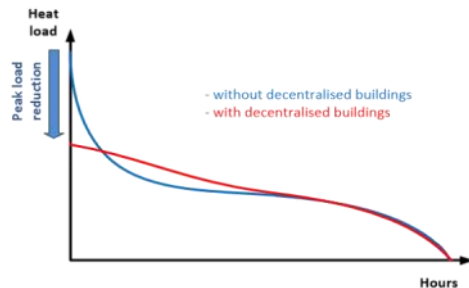
Technological innovations

6. Decentralised buffers at the consumer side

- Especially in rural areas:
 - DH networks are financially burdened by the network investment costs. Therefore, piping dimensions should be minimized to come to a positive business case.
 - Heat losses are relatively high compared to delivered energy.
- Decentralised buffers, together with an intelligent control concept, can overcome this issue: smaller pipes, no recirculation for comfort reasons.

TEMPO:

Development of new decentralised buffer concept, suited for LT DH (flow: 55-65C, return: 25-30C), including smart charging capabilities



Solution Packages

- Wraps the innovations into solution packages, dedicated to different kind of networks:

APPLICATION AREA PER PACKAGE SOLUTION	INCLUDED TECHNOLOGICAL INNOVATIONS
<u>SOLUTION PACKAGE 1</u> NEW LT NETWORKS IN URBAN AREAS	<ul style="list-style-type: none"> - Supervision ICT platform - Visualisation tools - Smart DHC controller - Innovative pipe system - Optimisation of building installation
<u>SOLUTION PACKAGE 2</u> NEW LT NETWORKS IN RURAL AREAS	<ul style="list-style-type: none"> - Supervision ICT platform - Visualisation tools - Smart DHC controller - Decentralised buffers - Optimisation of building installation
<u>SOLUTION PACKAGE 3</u> EXISTING (HT) NETWORKS	<ul style="list-style-type: none"> - Supervision ICT platform - Visualisation tools - Smart DHC controller - Optimisation of building installation

Each solution package will be demonstrated in a demonstration site

Demonstrator 1: new built LT network in urban area

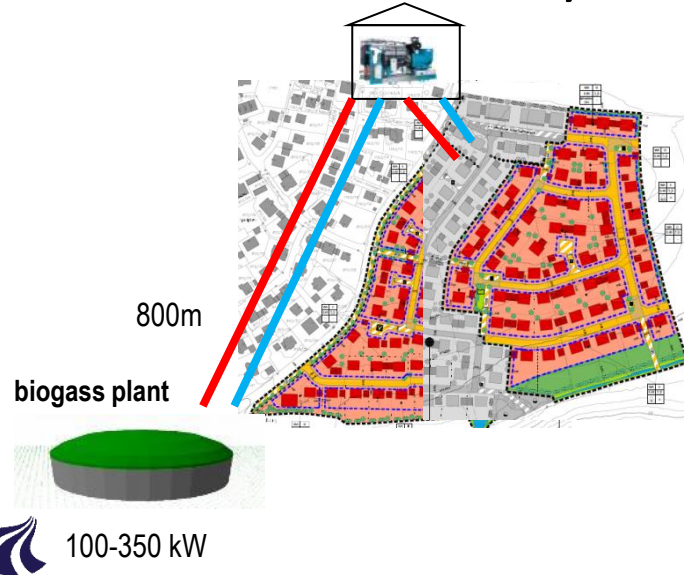
- Operated by Vattenfall
- Lübeck, Germany



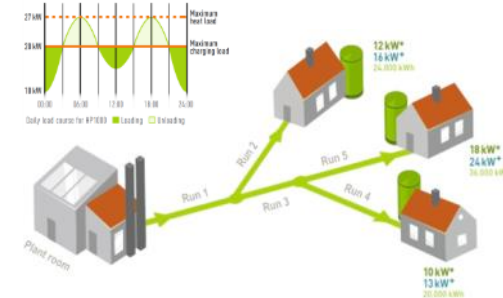
- DHC network, temperature level 50°C-22°C (heating) and 14°C-22°C (cooling), innovative pipe system
- Individual apartment substations
- Heat pump coupled to an aquifer thermal energy system (ATES), covering 50% of the peak load, >90% of the heat demand
- Small gas fired CHP to provide the electricity for the heat pump
- Peak load provided by natural gas boiler
- Cooling by ATES system
- TEMPO innovations:
 - Supervision ICT platform
 - Visualisation tools
 - Smart DHC controller
 - Innovative pipe system
 - Optimisation of building installation

Demonstrator 2: new built LT network in rural area

- Operated by Enerpipe
- Windsbach, Germany

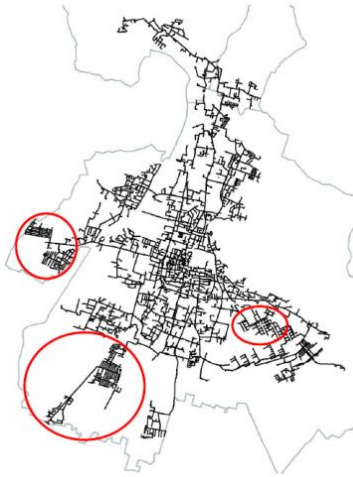


- New developing area for 100 homes, energy supply by DH network
- In phase 1, 50 houses will be connected, afterwards the remaining 50 houses
- TEMPO innovations:
 - Supervision ICT platform
 - Visualisation tools
 - Smart DHC controller
 - Decentralised buffers
 - Optimisation of building installation



Demonstrator 3: existing HT network

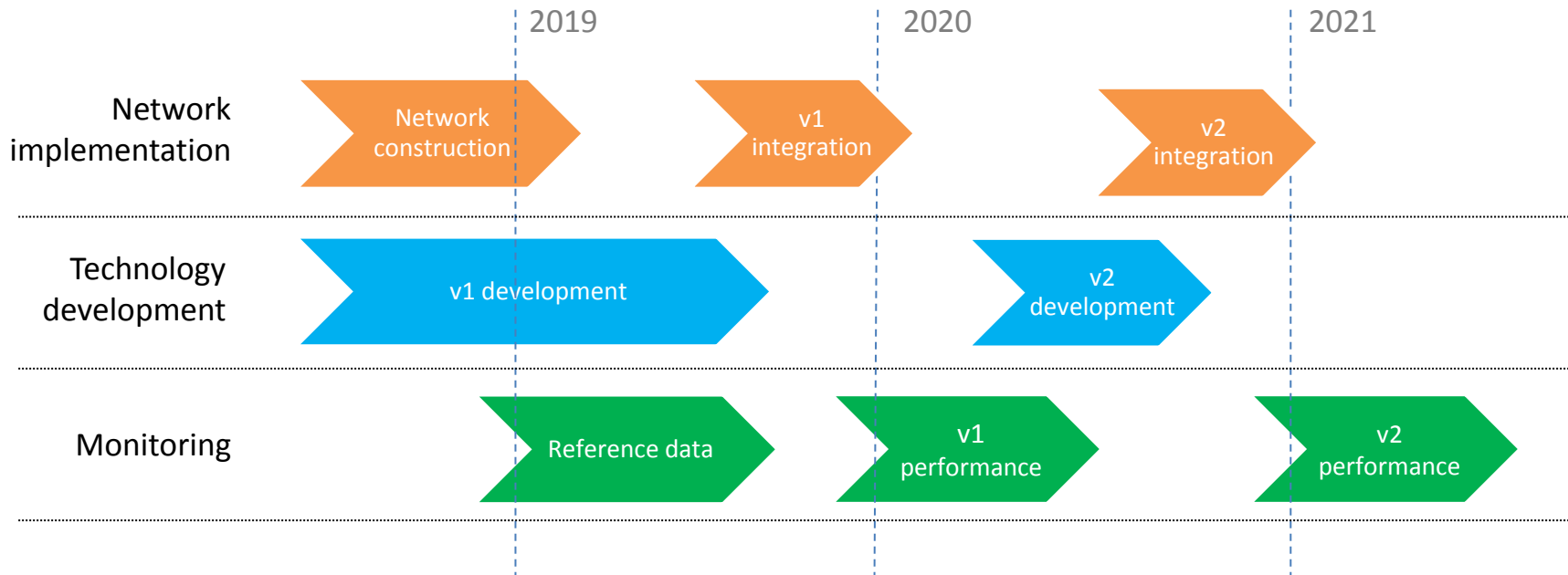
- Operated by A2A
- Brescia, Italy



- Is it possible to decrease network temperatures in low heat density area's, through the TEMPO innovations?
- Main constraints: existing buildings, existing radiators/substations, small diameter house connection
- TEMPO innovations:
 - Supervision ICT platform
 - Visualisation tools
 - Smart DHC controller
 - Optimisation of building installation



Project timeline



Project status

- Technological developments
 - Implementation ongoing
 - Tomorrow: Section 23 Smart Energy Systems (11:00 – 12:30): preliminary results of Optimization of Building Installation
 - v1 ready by August 2019
 - v2 (update) ready by August 2020

Project status

- Demonstrators
 - Lübeck
 - Network installation delayed
 - Windsbach
 - Network installed, houses constructed, 1 house occupied so far
 - Reference monitoring will start in 7 buildings, and will gradually increase to 30 (dependent of the sales of the houses)
 - Brescia
 - Target branch identified
 - Waiting for building permit to start construction of mixing station





This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 768936.

Questions?

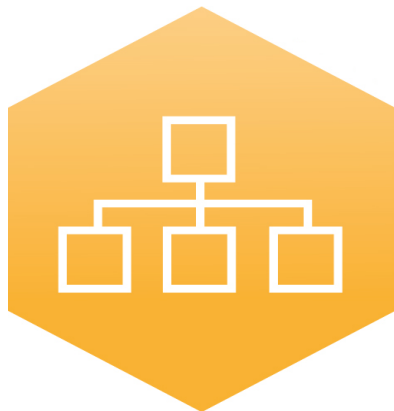
Dirk Vanhoudt, EnergyVille/VITO

dirk.vanhoudt@vito.be

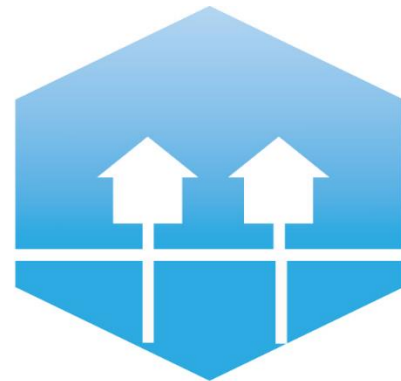
www.tempo-dhc.eu



AALBORG UNIVERSITY
DENMARK



4th International Conference on Smart Energy Systems and
4th Generation District Heating 2018 #SES4DH2018



4DH

**4th Generation District Heating
Technologies and Systems**