ConnectHeat
Community engagement for clean heat

D4.2 – IMPLEMENTATION OF PILOT CASES – BELGIUM

INTERCOMMUNALE LEIEDAL

The LIFE21-CET-ENERCOM-CONNECTHEAT project has received funding from the European Union's LIFE Programme under grant agreement N°101076258

D4.2 – IMPLEMENTATION OF PILOT CASES – BELGIUM

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Table of Contents

The LIFE21-CET-ENERCOM-CONNECTHEAT project has received funding from the European Union's LIFE Programme under grant agreement N°101076258

The LIFE21-CET-ENERCOM-CONNECTHEAT project has received funding from the European Union's LIFE Programme under grant agreement N°101076258

List of figures

List of tables

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Summary

The *Warmtenet De Voerman* (Anzegem, Belgium) pilot project is setting a new standard for community-driven, climate-resilient energy systems in the redevelopment of a former industrial site. Located in the heart of Anzegem, this ambitious initiative is transforming the 5-hectare brownfield site into a sustainable, mixed-use neighborhood with 33 residential units and 10 SME plots. It targets both the residential and small business sectors, blending environmental ambition with social innovation.

At the core of the project is a bold vision: to create a fossil-free, affordable, and community-owned thermal energy system. De Voerman introduces a 5th generation district heating and cooling network based on aquathermy, harvesting low-temperature thermal energy from a nearby main drinking water pipeline. The extracted energy is distributed via a two-loop system (primary and secondary circuits), with each building equipped with its own heat pump for tailored heating, cooling, and domestic hot water needs.

The community approach lies in the establishment of a Thermal Energy Community, governed through VMEGLOBAL, a co-ownership association composed of all connected residents and businesses. This structure ensures transparent decision-making, proportional cost-sharing, and democratic control of the infrastructure. End users are automatically enrolled upon purchasing a plot and gain access to a digital platform to monitor usage, manage billing, and receive performance insights.

The project is spearheaded by Intercommunale Leiedal, the regional development agency, in close partnership with De Watergroep, engineering consultants, and supported financially by ERDF through the LECSEA and EFRO Vlaanderen programs. Leiedal is responsible for the phased development and coordination, while De Watergroep operates the thermal source infrastructure. Private owners invest in individual systems, promoting a cost-effective and decentralized rollout.

Key technologies include:

- Use of a high-capacity drinking water pipeline (avg. 3,000 m³/day) for thermal exchange.
- A central heat exchanger (230 kW capacity) with passive energy transfer and minimal environmental impact.
- Neutral-temperature, non-insulated piping for affordable installation.
- Decentralized in-house heat pumps for customized comfort.

Investments and impact:

- Total CAPEX: ~€1.2 million (partly subsidized).
- OPEX: ~€75,000/year, shared through a contracted capacity-based model.
- Annual energy output: ~224 MWh of thermal energy.
- Estimated electricity consumption: ~85 MWh/year.
- Emissions reduction: aligned with Flanders' 40% CO_2 cut target by 2030.

Financial resources come from a blend of public funding and private contributions:

- Leiedal invests in the primary and secondary loops, recovering costs through land sales.
- Subsidies: €123,573 (LECSEA) + €180,900 (EFRO).
- Private owners fund individual heat pumps, tailored to their property needs.

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Now entering its operational phase, the project's roadmap includes onboarding of users from 2025 onward, full operation by 2026, and transfer of ownership to the community by 2029. With its blend of technological innovation, public-private partnership, and grassroots governance, Warmtenet De Voerman serves as a pioneering model for low-carbon, community-powered energy transitions in Europe.

De Voerman is a pioneering redevelopment project in Anzegem, Belgium, transforming the former Douterloigne industrial site into a sustainable mixed-use area that harmoniously integrates residential, commercial, and recreational spaces. The initiative is led by Intercommunale Leiedal, in collaboration with the municipality of Anzegem.

Figure 1: aerial view of the site

The redevelopment of De Voerman emphases sustainability, community integration, and innovative energy solutions. The key Features of De Voerman are:

- Mixed-Use Development. The project encompasses approximately 5 hectares, featuring around 33 residential units and a dedicated zone for 10 small and medium-sized enterprises (SMEs). A significant portion of the site is allocated to green spaces, including water features and play areas, fostering a vibrant community environment.
- Innovative Heating and Cooling System. A standout aspect of De Voerman is its sustainable energy approach. The development utilizes aquathermy by extracting thermal energy from a nearby main drinking water pipeline managed by De Watergroep. This system provides both heating in the winter and cooling in the summer for the buildings within the development.

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- Environmental Commitment. Aligned with regional goals to reduce CO_2 emissions by 40% between 2005 and 2030, De Voerman serves as a model for energy-neutral urban development.

The development of both the residential units and SME units within the De Voerman project is being undertaken through private initiatives. This means that the land plots designated for these developments are sold directly to private owners, who are responsible for overseeing the construction of their individual buildings. Key aspects of this approach include:

- The project is designed to accommodate small-scale construction, ensuring that individual plots of land are developed incrementally. This allows for a diverse and organic growth of the area, rather than a uniform, large-scale construction by a single entity.
- The build-out of the residential and SME units is expected to occur gradually over a period of 5 to 10 years. This phased approach allows for flexibility in design and ensures that the development aligns with market demand and the needs of the community.
- Since different private owners are involved, a variety of architects and contractors will contribute to the project. This will likely result in a diverse architectural landscape, adding character and individuality to the neighborhood while still adhering to overall project guidelines.
- By selling plots to private owners, the project offers individuals the opportunity to customize their buildings according to personal or business needs, while still contributing to the collective vision of the development.

Figure 2: 3D figure of the future development of the site

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The overarching ambition of the De Voerman project is to create a forward-thinking, sustainable community that provides future residents with fossil-free housing and affordable energy solutions. This vision aims to enhance resilience to energy crises while promoting environmental sustainability. The key features and goals are:

- **Fossil-Free Housing.** All residential and SME units are designed to operate without reliance on fossil fuels, leveraging renewable energy sources and innovative systems to reduce carbon footprints.
- **Affordable, Sustainable Energy.** The project emphasizes energy affordability for residents, ensuring that sustainable energy solutions are not only environmentally friendly but also economically viable.
- **Thermal Energy Community**. A standout feature is the establishment of a thermal energy community, a shared system where end users collectively own and manage the energy infrastructure. This includes critical components like heat exchangers and pumps, which are central to the community's heating and cooling systems.
- **Cost-Plus Model**. A unique cost-plus model is being proposed to manage the energy system. Under this model (1) end users share operational costs, distributing expenses fairly across the community, and (2) ownership of the energy system fosters a sense of responsibility and control among residents.

Although this approach is unconventional, it aligns with the project's ethos of pioneering sustainable energy solutions. By integrating cutting-edge systems and community-based ownership models, De Voerman aspires to set a benchmark for sustainable and resilient urban developments.

The successful realization of the De Voerman pilot project is driven by two principal stakeholders, Intercommunale Leiedal and De Watergroep, alongside support from innovative engineering firms and funding from ERDF (European Regional Development Fund) projects. Each stakeholder brings a unique set of expertise, responsibilities, and commitments, contributing to the project.

Intercommunale Leiedal is a regional development agency operating across 13 municipalities in the southern part of West Flanders, Belgium. As a public intermunicipal organization, Leiedal plays a crucial role in fostering sustainable regional development, balancing economic, social, and environmental interests. The organization's mission encompasses urban planning, infrastructure development, and the promotion of innovative technologies to enhance the quality of life for its communities.

In the context of the De Voerman project, Leiedal is the primary overseer of project development, responsible for coordinating all aspects of planning, design, and execution. The organization sets ambitious goals aligned with the region's energy transition objectives, aiming to demonstrate that low-temperature, fossil-free heating and cooling systems can be viable, scalable, and cost-effective. Leiedal's role also includes stakeholder engagement, ensuring that municipalities, businesses, and residents are integrated into the process and understand the benefits of sustainable energy solutions. By positioning De Voerman as a pilot project, Leiedal showcases its commitment to spearheading innovation and setting an example for other municipalities to follow.

De Watergroep is Belgium's largest drinking water utility, providing clean drinking water to over 3 million customers across Flanders. The organization manages an extensive pipeline network and is known for its forward-thinking approach to water management and infrastructure optimization. Beyond its core mission of delivering high-quality drinking water, De Watergroep actively explores ways to leverage its infrastructure for broader societal benefits, including energy innovation.

In the De Voerman project, De Watergroep plays a pivotal role as the operator of the main drinking water pipeline that serves as the thermal energy source for the district heating and cooling system. The pipeline, which maintains a stable temperature of approximately 10°C year-round, forms the foundation for the

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project's innovative heating and cooling concept. De Watergroep's expertise ensures that the integration of the thermal energy system does not interfere with the pipeline's primary function of water supply. Their involvement reflects a commitment to advancing the energy transition by exploring unconventional applications of existing infrastructure.

The pilot project benefits significantly from collaboration with innovative engineering companies, which provide the technical expertise necessary to refine and optimize the energetic concept. These companies are instrumental in designing and implementing the dual-loop system, ensuring efficiency, sustainability, and cost-effectiveness. Studies were carried out to check the different options, the feasibility, and the detailed technical studies. Their work includes developing the central heat exchanger, configuring the low-temperature district heating and cooling network, and integrating individual heat pumps for each connected building.

Funding from ERDF (European Regional Development Fund) underscores the strategic importance of the project in demonstrating the potential of innovative, sustainable energy solutions. This support facilitates research, development, and implementation, ensuring that the project achieves its ambitious objectives and serves as a model for replication across Europe. The project received funding or the primary loop of the district heating via the LECSEA-project (investment in heat exchanger, technical cabin and bypass of drinking water pipeline) and the project "De Voerman" in the EFRO Vlaanderen program (investment in secondary loop).

Figure 3: impression of the residential area of the site

The Leiedal pilot project signifies a groundbreaking step in the advancement of 5th generation district heating and cooling systems, applied on a smaller yet impactful scale in the innovative mixed-use neighborhood of "De Voerman". This visionary redevelopment integrated into a forward-thinking design that seeks to challenge and redefine traditional thermal energy systems.

A standout feature of this project is its choice of thermal energy source. Rather than relying on conventional energy inputs, the project leverages the unique potential of a main drinking water pipeline that runs through the site. This pipeline carries significant volumes of water at a consistent temperature of approximately 10°C

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throughout the year. Using this consistent thermal baseline, a central heat exchanger is installed to extract or supply heat with a maximum temperature differential (delta T) of 4°C, achieving an impressive capacity of up to 230 kW. This innovative system not only utilizes a resource already present on-site but does so with minimal impact on the existing drinking water infrastructure.

The system's design incorporates two interconnected loops. The primary loop involves the bypass from the drinking water pipe through the heat exchanger. Here, heat or cold is exchanged without compromising the primary function of the drinking water pipeline. This loop is paired with a secondary loop, which constitutes the district heating and cooling network. In this secondary loop, non-insulated water pipes connect the heat exchanger to individual residential and commercial units throughout the neighborhood. While these pipes require a larger diameter due to the low temperature differential, their lack of insulation significantly reduces installation and material costs, making the network both cost-effective and efficient.

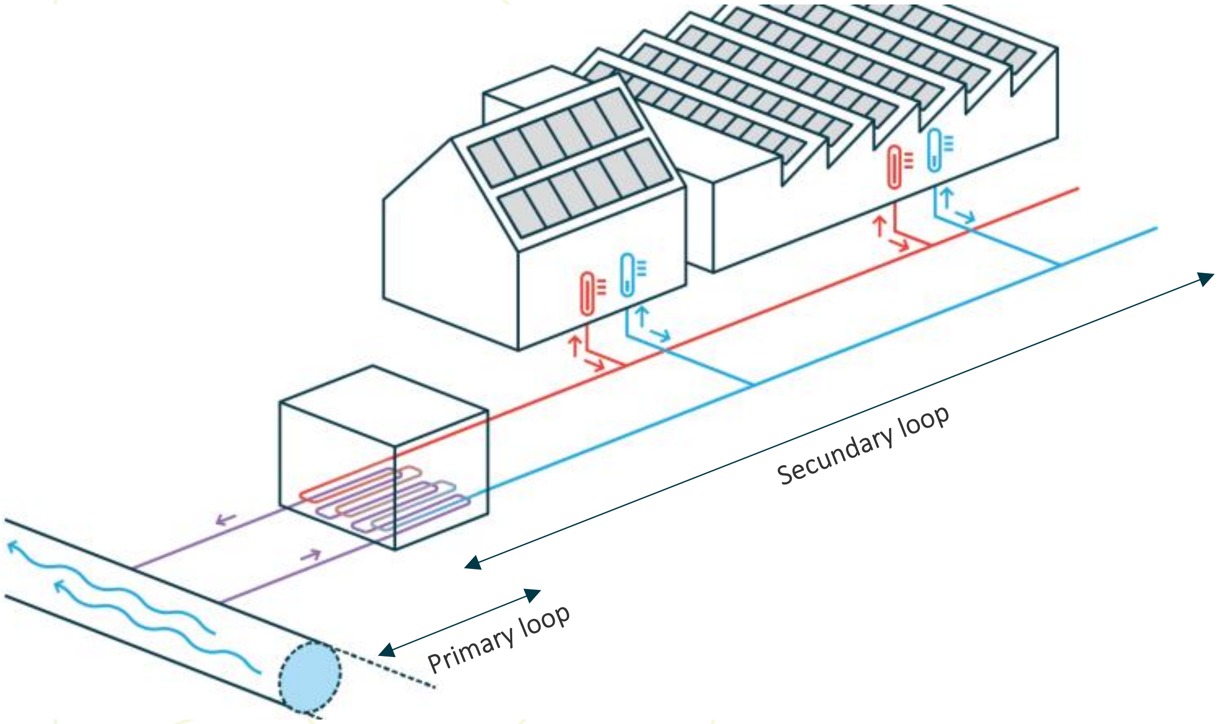

Figure 4: scheme on the primary loop, secondary loop and the heat exchanger

Each connected dwelling or building features its own individual heat pump, designed to convert the 10°C water temperature into the precise levels needed for heating, cooling, or sanitary warm water production. This decentralized approach ensures that every user has a tailored solution to meet their specific energy needs, while the shared infrastructure minimizes waste and optimizes resource use.

This pilot project represents an extraordinary case of innovation, tackling the inherent challenges of breaking new ground in the energy sector. Among the most significant hurdles is the development of a robust and scalable business model that can accommodate the unique demands and costs associated with this novel approach. These challenges are twofold. On one side, the project embraces a low-tech, cost-effective design that prioritizes simplicity and practicality. On the other side, the bespoke nature of the system, coupled with the lack of widespread adoption and standardization, drives up costs due to limited economies of scale and the need for tailored solutions.

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1. Technical feasibility

1.1. Demand side analysis

The district heating system is build for the following end users :

- 33 homes
- 10 micro and small enterprises

For the 32 homes, following energy demand estimates are used (see table below)

Heat - Demand side	**number**	**unit**
Number of homes	33	
Thermal Capacity neededed		
Heat loss per home (based on degree days)	5	kW
Connection capacity per home (Q_{tot}, home level)	6	kW
Connection capacity for the district (Q_{tot}, district level)	192	kW
SPF* = (Q_{heat} + Q_{elec}) / Q_{elec}	4	
% Q_{elec}	25%	
% Q_{heat}	75%	
Required electrical capacity for the district (Q_{elec}, district level)	48	kW
Required capacity from the district heating network (Q_{heat}, district level)	144	kW
Heat Consumption		
Heat consumption per home for heating	5	MWh/yr
Heat consumption per home for domestic hot water (DHW)	2	MWh/yr
Total heat consumption per home	7	MWh/yr
Total heat consumption for the district	224	MWh/yr
Electricity Consumption (Study VME)		
Consumption of individual water-to-water heat pumps (192 kW (32 x 6 kW)) in the district	85,19	MWh
Consumption of individual water-to-water heat pumps per home (6 kW)	2,66	MWh
Estimated Consumption for DHW Booster	0,76	MWh
Consumption of individual water-to-water heat pumps per home	1,75	kWh

** The SPF (Seasonal Performance Factor) is the average efficiency of the heat pump (COP = (Q_{heat} + Q_{elec}) / Q_{elec}), calculated over the entire heating season for a specific building. It includes the energy consumption of auxiliary equipment, such as pumps in a capture network, and reflects the ratio of heat delivered to energy consumed.*

Table 1: demand side analysis

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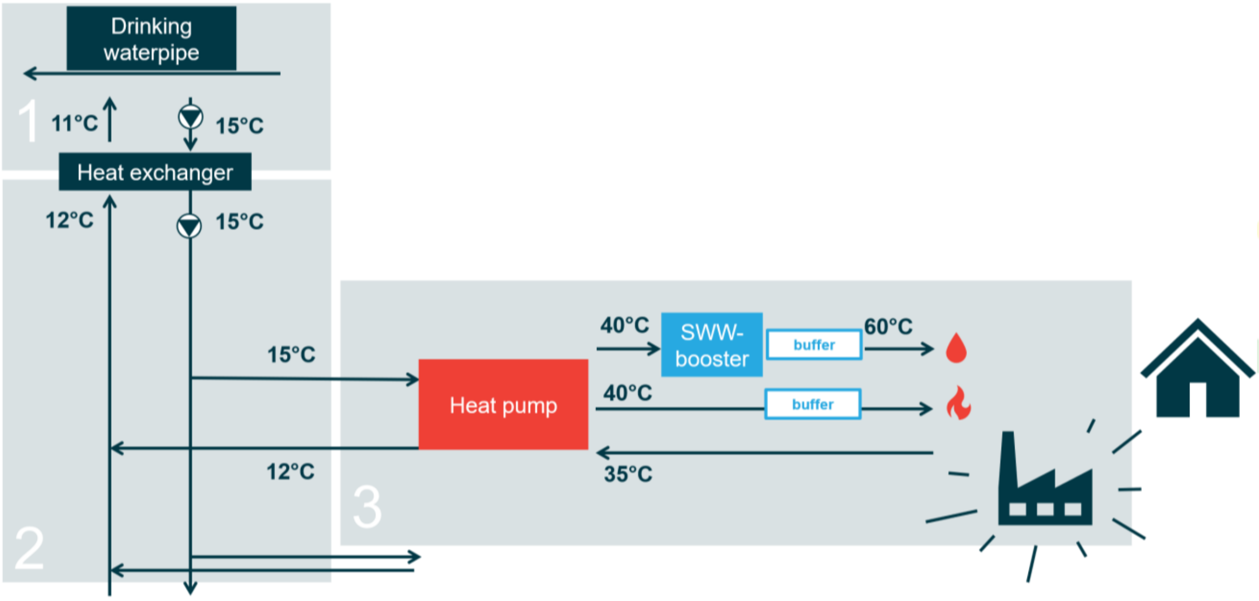

Figure 5: scheme on the thermal system on 3 levels: (1) primary circuit, (2) secundary circuit and (3) in-house circuit

1.2. Supply side analysis

The project is located between Tiegem and Waregem, with the drinking water pipeline running through a natural zone as well as passing near an existing Fluvius utility cabin along the Vichtsesteenweg. This strategic location is essential for integrating the thermal energy extraction system into the district heating and cooling network without disrupting the primary function of the drinking water pipeline.

Pipeline and Thermal Energy Integration:

- Trajectory: Before reaching the first branch-off point for heat extraction, the water in the pipeline travels a few hundred meters, allowing it to regain its original temperature. This natural re-equilibration ensures that the pipeline's temperature remains stable, even with a thermal delta (ΔT) of 1–2°C caused by the heat exchange process.
- Impact on End Users: Thanks to this design, the effects on end users of the drinking water supply are negligible to non-existent. The thermal extraction process is carefully calibrated to avoid noticeable fluctuations in water temperature, ensuring a seamless supply of drinking water.

Maintaining consistent temperatures in the drinking water pipeline is crucial. Excessive temperature fluctuations could affect water quality or system functionality. Therefore, the system is designed with safeguards to ensure that the heat exchange process operates within strict parameters, protecting the integrity of the water supply while delivering sustainable heating and cooling to the district.

This approach balances the innovative use of existing infrastructure with the need to preserve the reliability and quality of the drinking water network.

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Thermal energy capacity of the main drinking water pipeline

The average daily volume of drinking water flowing through the main distribution pipe at the site is approximately 3,000 m³ per day (i.e., an average flow rate of 125 m³/h). During peak periods, the flow can rise to 300 m³/h, while at night (around 12 a.m. to 6 a.m.), it may drop to 20 m³/h (to be confirmed through measurements by De Watergroep).

To avoid significantly affecting the temperature of the drinking water in the main pipe, no more than half of the main pipe's flow is diverted through a bypass. During nighttime, the flow through the bypass may be limited to about 10 m³/h. This limit is the most restrictive factor for the secondary installation on site. Additionally, the temperature difference between the supply and return flow in the bypass is limited to a maximum of 4°C. Since the main pipe flow is always at least twice the bypass flow, the temperature change in the main pipe is limited to a maximum of 2°C.

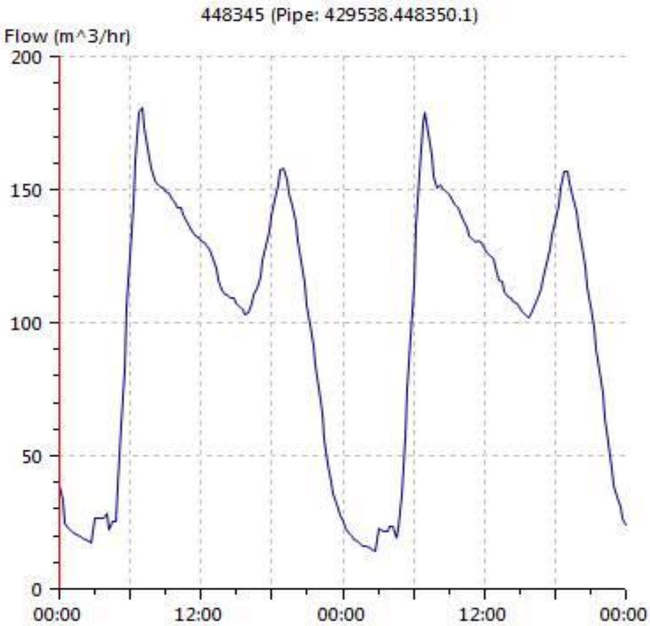

Figure 6: graph of the water flows in the main drinking water pipeline over 48 hours

Temperature limits:

- The maximum return temperature on the primary side is limited to 25°C to ensure water quality, which limits cooling capacity in summer.
- The minimum return temperature on the primary side is limited to 4°C to prevent freezing, which limits heating capacity in winter.

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Supply side: main drinking water pipeline		
Diameter of the drinking water pipeline	300	mm
The flow rates through this pipeline vary greatly throughout the year and during the day.		
Flow rate (average lower limit at night)	20	m3/h
Flow rate (average upper limit in the morning)	180	m3/h
Flow rate (peak in the morning)	300	m3/h
Average flow rate	150	m3/h
Average daily volume	3000	m3/d
Pressure variation in the pipeline (relatively constant, lower limit)	42	m
Pressure variation in the pipeline (relatively constant, upper limit)	48	m
Thermal cooling capacity (passive cooling)		
150 m3/h; delta T = 2K	350	kW
150 m3/h; delta T = 1K	170	kW
Thermal heating capacity (via heat pumps)		
150 m3/h; delta T = 2K	440	kW
150 m3/h; delta T = 1K	210	kW

Table 2 : facts and figures

4 technical scenarios

The following scenarios outline different approaches to thermal energy system design for sustainable heating and cooling. Each scenario represents a unique method of energy sourcing, distribution, and upgrading, ranging from decentralized systems to centralized solutions. These scenarios serve as a benchmark and comparative framework to evaluate performance, efficiency, and feasibility.

Scenario 1: No district heating network = BENCHMARK

- Individual geothermal boreholes
- Decentralized upgrading

This scenario relies on individual energy systems for each unit, where geothermal boreholes provide the heat source, and upgrading is done locally at each building. It serves as the baseline for comparison.

Scenario 2: Neutral Network (15-10°C)

- Drinking water pipeline
- Decentralized upgrading

In this setup, the drinking water pipeline acts as the thermal energy source. Heat or cold is extracted and distributed via a neutral-temperature network, with upgrading performed locally at individual units.

Scenario 3: Neutral Network (15-10°C)

- Borehole Energy Storage (BES) field
- Decentralized upgrading

This variation of Scenario 2 uses a Borehole Energy Storage (BES) field instead of the drinking water pipeline as the heat source. The network operates at neutral temperatures, with decentralized upgrading at each building.

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Scenario 4: Low-Temperature Network (40-35°C)

- Drinking water pipeline
- Centralized upgrading

In this scenario, a low-temperature heating network is implemented, with the drinking water pipeline as the primary heat source. Upgrading is performed centrally, allowing the network to distribute energy at higher temperatures to all connected buildings.

Comparison

The 4 scenarios were compared based on multiple criteria, to facilitate the decision-making process. The scores were developed during a workshop with the key stakeholders at the time of the development stage. The table below shows clear there is no clear favorable scenario.

	1 Individual geothermia and individual heat pump	2 Collective main drinking water pipe and individual heat pump	3 Collective geothermia and individual heat pump	4 Collective main drinking water pipe and collective heat pump
Comfort for end user	+	+	+	++
Risks related to timing	0	0	-	0
Ease for phased development (5-10y)	+	0	0	-
Extendability of energy system	0	+	0	+
Operational complexity	0	-	-	--
Future-proofness	-	+	+	++
CO2-emissions	0	0	0	-

Table 3: comparison of technical scenarios

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2. Costs and Benefits

The business model for operation is a crucial aspect, with a concerted effort to streamline operations and minimize Operational Expenditure (OPEX). The absence of a fitting legal framework for such pioneering energy concepts is a significant hurdle. The prevailing market model for district heating, rooted in the electricity market, does not seamlessly align with the energy community concept, especially in the context of 5th generation district heating.

2.1. CAPEX

A total investment cost of €1.203.890 is foreseen. The investment contains 3 major parts:

- Investment in the primary loop, works performed and supervised by De Watergroep. These works are financed by Leiedal.
- Investments in the secondary loop, bringing the heat from the heat exchanger in the district, to the homes and the companies. These works are financed and carried out by Leiedal.
- Investments in the homes and the companies to install the heat pump. These works are financed and carried out by the individual homeowners or company owners.

Primary loop	**€157.955**
Tapping into the drinking water pipeline (including excavation, piping, foundation restoration, and site installation)	€78.624
Heat exchanger + circulation pump + measuring equipment + control system	€79.331
Secondary loop	**€500.250**
Technical building for heat exchanger	€48.000
Installation accessories	€920
District energy network (uninsulated DN110, neutral, including installation)	€451.330
Residential circuit	**€545.685**
Individual water-to-water heat pumps (1.5–6kW, 180L buffer tank, option for passive cooling)	€523.740
Installation accessories	€12.663
Balancing valves	€9.282

Table 4: CAPEX

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2.2. OPEX

The operational expenditures (OPEX) of the Warmtenet De Voerman are based on a realistic estimation of recurring costs associated with maintaining and running the collective heating system. The calculation includes both fixed and variable components, reflecting the needs for infrastructure upkeep, energy usage, and administrative management. The largest portion of the annual OPEX is driven by electricity consumption for the water-to-water heat pumps, followed by equipment maintenance, failure risks, and system management. The table below presents a breakdown of the annual OPEX based on current assumptions:

Maintenance & operation (annually)	**€45.366**
4.5% * Capex installations (excluding heating network), lifespan of collective installation 30 years • Fixed costs for the boiler room • Maintenance costs • Equipment failure	€34.866
Management costs for the primary circuit	€7.500
Management costs (billing, individual connections, EMS system, etc.)	€3.000
Electricity Consumption (annually)	**€29.816**
Low-voltage tariff	€0,35
Water-to-water heat pump (kWh)	€85.188

Table 5: OPEX

TCO in 4 scenarios

To support strategic decision-making and long-term planning, a Total Cost of Ownership (TCO) analysis was conducted for four different infrastructure and operational scenarios. The TCO includes both capital expenditures (CAPEX)—adjusted to reflect applicable subsidies—and annual operational expenditures (OPEX). This comparison allows for a comprehensive evaluation of the financial impact of each scenario over the lifecycle of the system, considering not only upfront investments but also the recurring costs of operation and maintenance. The table below summarizes the CAPEX and OPEX for each scenario, including a benchmark for reference:

	benchmark	**scenario 2**	**scenario 3**	**scenario 4**
CAPEX*	€ 1.209.077	€ 899.417	€ 1.472.982	€ 925.049
OPEX	€ 64.725,81	€ 75.182,00	€ 67.682,00	€ 76.083,05

* Taking subsidies into account

Table 6: CAPEX and OPEX of 4 different scenarios

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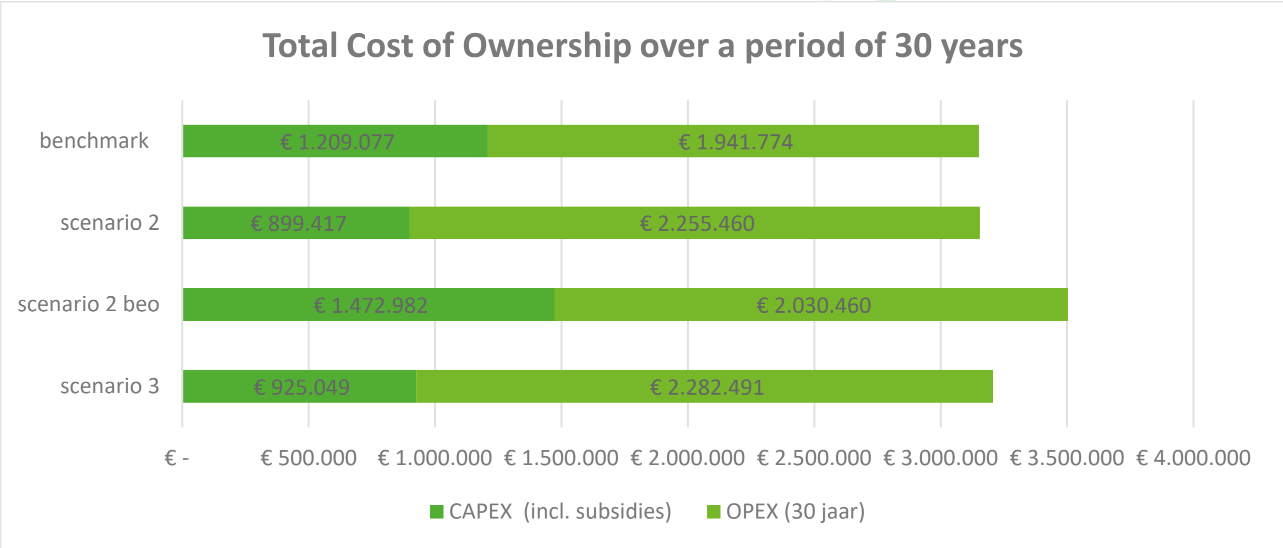

Figure 7: comparison of TCO of the 4 scenarios

2.3. Operating Expense Coverage Through a Shared Cost Principle

To cover the operational expenses (OPEX) of the collective heating and cooling system, a shared cost principle is applied. Under this approach, all actual operating costs are distributed among the end users, ensuring transparency and fairness. The division of costs is based on a proportional allocation according to the contracted heating or cooling capacity of each user. This method ensures that larger energy consumers pay a proportionate share of the expenses while smaller users contribute less.

Cost Allocation Example

In this illustrative example (subject to final confirmation of figures), the contracted capacities and number of connections for different user types are outlined as follows:

Residential Users:

- Contracted capacity per connection: 6 kW
- Number of connections: 33
- Total capacity: 198 kW

Small Companies:

- Contracted capacity per connection: 10 kW
- Number of connections: 10
- Total capacity: 100 kW

Business Units:

- Contracted capacity per connection: 5 kW
- Number of connections: 5
- Total capacity: 25 kW

Total Contracted Capacity: 323 kW

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Cost Sharing Calculation:

Assuming a total shared cost of €10,000 for operational expenses, the cost for each user is calculated as follows:

- Residential Unit Cost:

Cost per house = 6 kW / 323 kW x € 10 000 = €186

This proportional method ensures that residential users, small companies, and business units each contribute a share of the costs corresponding to their contracted energy usage.

Benefits of the Shared Cost Approach:

- Equitable Distribution: costs are fairly divided based on energy demand, ensuring no user is overburdened or subsidizing another disproportionately.
- Scalability: this model accommodates future expansion or modifications, allowing new connections to be seamlessly integrated into the cost-sharing framework.
- Transparency: users have a clear understanding of how their contributions are calculated, fostering trust in the system.
- Predictability: contracted capacities offer a straightforward basis for cost calculations, simplifying billing and financial planning for all parties involved.
- This shared cost principle underlines the collaborative nature of the project, where operational efficiency and fairness are prioritized, contributing to the long-term sustainability of the collective energy system.

2.4. Funding sources

The CAPEX for the project is divided into three main categories, each targeting a specific part of the energy system. This structure ensures that investment responsibilities are shared across stakeholders in alignment with their roles and benefits within the project.

Primary Loop

The primary loop encompasses the infrastructure required to tap into and utilize the drinking water pipeline as the thermal energy source. Key features include the installation of the heat exchanger, circulation pumps, and associated controls.

- Funding: The primary loop is funded by Leiedal, the regional development agency overseeing the project.
- Subsidies: This investment is partially offset by subsidies from the LECSEA project, amounting to €123,573.

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Figure 8: the heat exchanger

Secondary Loop

The secondary loop is the district heating and cooling network that distributes energy from the primary loop to individual connections, such as homes and businesses. This network is designed for efficiency and scalability, allowing future expansion.

- Funding: Like the primary loop, the secondary loop is also financed by Leiedal.
- Subsidies: Additional support is provided through the EFRO project (European Regional Development Fund), which contributes €180,900 toward the cost of this infrastructure.

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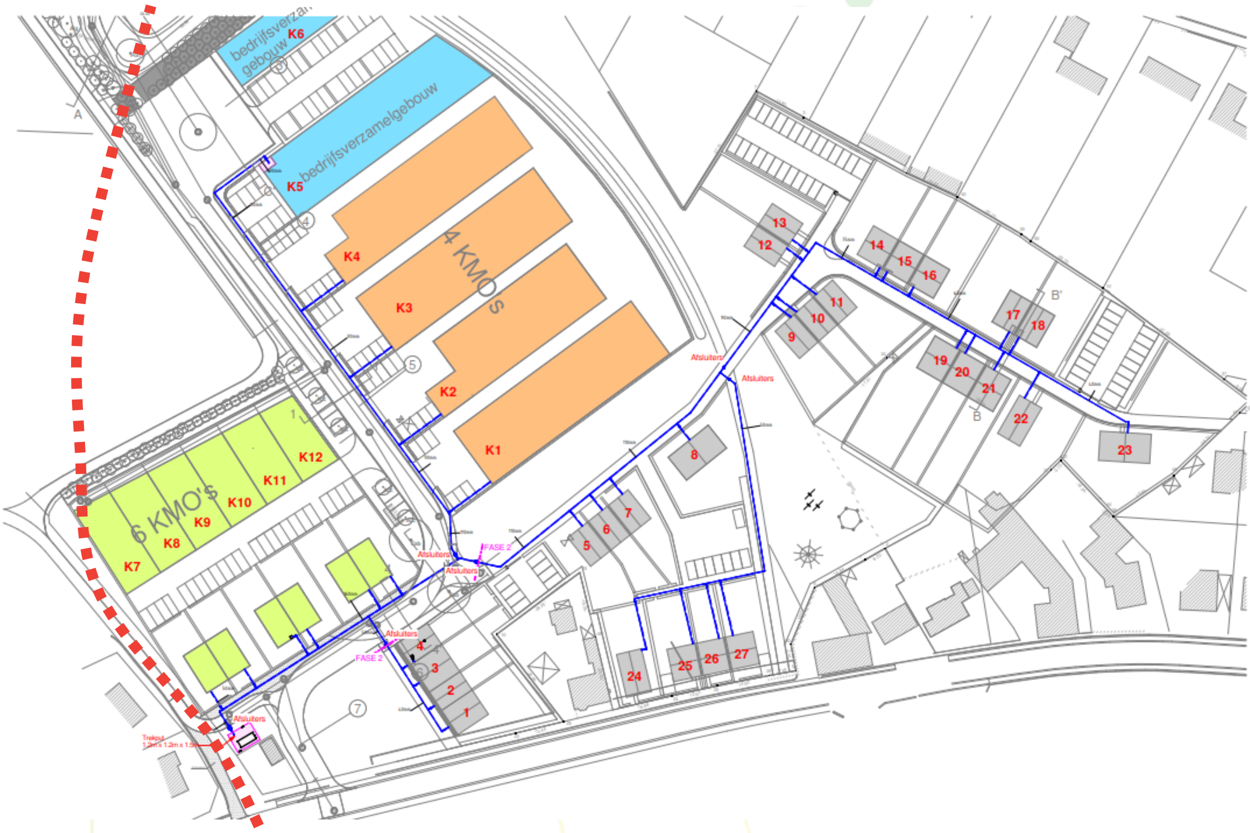

Figure 9: the lay-out of the secundary circuit (in blue)

Residential Loop

The residential loop includes the installation of water-to-water heat pumps, connection points, and in-house systems for heating, cooling, and domestic hot water.

Funding: This portion is financed directly by the owners of the dwellings and business units as part of their construction costs. Each owner invests in their share of the system to ensure compatibility with the overall energy network.

Recovery of Leiedal's Investment

Leiedal recovers its initial investments in the primary and secondary loops by incorporating these costs into the sales price of the land. This cost-recovery mechanism ensures that the upfront public investment is balanced by private contributions as the project matures.

The sales include:

- 33 residential dwellings
- 10 SME units
- 1 business unit building

This approach aligns financial responsibilities with benefits, ensuring that those who directly benefit from the energy system contribute proportionally to its costs.

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2.5. SWOT analysis

Strengths

Availability of Drinking Water Pipeline as a Heat Source

The presence of the water pipeline provides a unique, consistent, and renewable heat source, enabling the development of a neutral-temperature heating network.

Independence from Future Legislation

The project is designed to be compliant with current and anticipated regulations, minimizing risks of disruption from future legal or environmental requirements.

Financial Support for Initial Investment

Significant financial aid is available for the upfront costs of tapping into the water pipeline, enhancing the feasibility of the collective heating network. This funding reduces the financial barrier for stakeholders (see referenced table for details).

Low Maintenance and Management Requirements

The collective system is designed for simplicity, resulting in minimal ongoing maintenance and operational demands compared to more complex systems.

Weaknesses

Uncertainty About User Profiles and Technical Designs

The lack of detailed data regarding the usage profiles and technical specifications of new buildings creates challenges for system optimization. This has been partially addressed by a study conducted by Van Marcke.

Project Deadlines Linked to LECSEA Project

The first connection must be operational by March 2023 to align with the timeline of the LECSEA project, placing significant pressure on planning and implementation.

Limited Scalability for ESCO Investment

Due to its small scale, the project may not attract interest from energy service companies (ESCOs). As a result, Leiedal may need to act as the interim ESCO during the initial phases of development.

Restrictions on End-User Heating Capacity

The system imposes limitations on heating capacities for end users, which may require adjustments in system design or user expectations.

Opportunities

Reduced Disruption and Financial Advantages

Coordinating the installation of utility infrastructure alongside the heating network minimizes disruption and reduces costs for stakeholders, providing a smoother implementation process.

Funding Availability Through LECSEA

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The LECSEA project offers additional resources that can be utilized to further support the development and implementation of the heating network.

Advantages Over Individual Borehole Energy Storage (BEO) Systems

- The collective system offers several benefits compared to individual BEO systems for each home:
- No risk of depleting ground heat resources.
- Flexibility to expand infrastructure as needed.
- Reliable cooling throughout the summer.
- Lower operational expenses (OPEX), as network installation costs are shared by the community and distributed over time.

Support from De Watergroep

De Watergroep, committed to sustainability, is keen to develop innovative projects and is actively collaborating on this initiative. Their involvement strengthens the project's foundation.

Challenges

Effective Management of the Collective System

Proper management of the shared system is critical to meet the operational requirements of De Watergroep, particularly maintaining the required delta T (temperature differential). However, this issue may be less critical than initially assumed.

End-User System Compatibility

The heating and cooling systems of end users must align with the neutral heating network's specifications. This involves adapting both heating system designs and heat distribution systems within the buildings. This is becoming a standard requirement in large-scale developments and has been practically addressed in the study by Van Marcke.

Organizational Model for Network Management

A robust organizational model is required for managing the heating network, including contractual agreements with current and future stakeholders.

Stakeholder Agreements

Securing agreements with all involved parties, including De Watergroep, end users, and network managers, is essential to ensure smooth operation and long-term viability.

Leiedal's Transition Role

Leiedal, currently acting as the heating network developer, must eventually transfer its responsibilities to a long-term operator, such as a Local Energy Community (LEC), to ensure continuity.

Engaging End Users

It will be essential to convince end users of the benefits of participating in this innovative system, ensuring buy-in and cooperation for the project's success.

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3. Community Model

3.1. organizational and management structure

The Warmtenet De Voerman is a collective thermal energy system designed to provide sustainable heating and cooling to a mixed-use development of approximately 33 residential homes and 10 small businesses in Anzegem. The project is being implemented as a public-private partnership, led by Leiedal in collaboration with key technical and operational partners. The community model is built on the principle of shared ownership, minimal overhead, and real-cost-based governance.

Legal Form and Governance Model

The long-term vision for district heating De Voerman is to operate as a Thermal Energy Community embedded within a VMEGLOBAL (a general co-ownership association). This legal structure ensures inclusive participation, shared responsibility, and democratic governance of the heating infrastructure.

Ownership of the infrastructure is designed to evolve in two phases:

- **Phase 1 (2024–2029)**: Leiedal retains ownership of the district heating network to comply with subsidy conditions and to facilitate coordinated roll-out.
- **Phase 2 (Post-2029)**: Ownership of the technical cabin, pipeline network, and associated infrastructure is transferred free of charge to VMEGLOBAL, consisting of all connected property owners.

This structure mirrors the governance model already planned for shared parking havens, ensuring consistency and leveraging existing organizational setups.

Figure 10: the realisation of the bypass of the drinking water pipe

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Stakeholder Roles and Responsibilities

Leiedal

- Project developer and temporary infrastructure owner.
- Responsible for appointing the district heating operator and structuring legal and financial arrangements.
- Coordinates the design of the energy community and facilitates the creation of VMEGLOBAL.

De Watergroep

- Operator of the primary thermal circuit.
- Has an Exploitation Agreement (2022) with Leiedal for a capacity of 230 kWth, valid for 30 years.
    - Evaluated every 10 years (within the first 30 years), and every 3 years thereafter.
    - Easement for pipeline routing is granted via a notarial deed, provided by Leiedal free of charge.

VMEGLOBAL (vereniging van mede-eigenaars, consisting of all connected property owners)

- Future collective owner of the heating infrastructure.
- Acts as the governance platform, overseeing operations, cost allocation, and decision-making.
- Will manage responsibilities related to ownership, coordination, and user engagement.

End-users (Homeowners and SMEs)

- Final consumers of thermal energy.
- Will formally join the Thermal Energy Community upon purchasing a lot (starting in 2025).
- Obligated to connect to the network and co-own the infrastructure via VMEGLOBAL.
- Participate through a digital platform offering insights into usage, cost history, and system performance.

Warmtenetbeheerder (WNBH)

- Operator of the secondary network.
- Responsibilities include:
    - Executing new connections.
    - Maintaining and repairing the secondary network.
    - Performing smart load management and energy flow balancing.
    - Monitoring, reporting, and responding to alarms.
    - Ensuring compliance with relevant energy legislation.
- To be appointed via public tender initiated by Leiedal and later VMEGLOBAL.

BM Engineering Group

- Technical advisor responsible for system design, costing, and implementation specifications.

External Contractors

- Including an Aansluitbedrijf (connection firm) and Onderhoudsfirma (maintenance provider), who implement service-level agreements (SLAs) for routine and emergency work.

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Figure 11: the technical cabin

Contracts and Agreements

The management and operation of the heating network is governed through a robust set of legal agreements and embedded procedures:

- **Sales Conditions.** Every land sale contract includes technical and financial provisions regarding connection to the heating network, membership in the energy community, and contribution to collective operating costs.
- **Chapter in the Basic Deed (Basisakte) of the VMEGLOBAL.** A dedicated section outlines the governance and operational logic of the heating system, reinforcing collective responsibility and cost-sharing based on thermal demand.

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- **WNBH Operation Contract**.
  - Covers a 10-year term for operational services including meter management, smart grid control, and billing.
  - Includes an option for renewal or handover to VMEGLOBAL upon expiration.
- **Connection Agreement**:
  - Each user submits a request based on desired thermal capacity.
  - Standardized cost estimates are provided, ranging from €2,250 to €4,100 depending on property type.
- **Service Level Agreement (SLA)**:
  - Sets out detailed response times and performance standards for maintenance and emergency intervention (e.g., <30 min for critical issues).
- **Ownership Transfer Agreement**:
  - Facilitates the free transfer of the heating network and technical cabin to the community once the 5-year ownership requirement by Leiedal has passed.
  - Includes provisions for easements and underground rights to ensure legal continuity.

Engagement of Citizens and Final Users

Given the phased nature of development, early citizen engagement is limited due to the current absence of identified end-users. Nevertheless, significant emphasis is placed on future engagement and legal anchoring:

- Starting from 2025, as plots are sold, purchasers automatically become:
  - Members of the energy community.
  - Co-owners via VMEGLOBAL.
- Leiedal will guide the design of the community governance and fine-tune the model based on real needs.
- The governance model aims to be LEAN, minimizing overhead and avoiding third-party operator costs.
- All operational and financial tasks are transparent and shared based on real usage and contracted thermal capacity.

3.2. Financial Resources and Citizen Participation

The financial model for De Voerman has been designed to balance sustainability, affordability, and simplicity. It prioritizes transparency, proportional cost sharing, and minimal administrative overhead while ensuring long-term financial viability of the system. The model aims to empower citizens through participatory governance, real-time insight into energy use, and potential influence on future investments.

Financial Model Overview

The operation of the heating network is funded through a mix of up-front investment contributions and recurring operational cost recovery. The model avoids complex heat retail pricing mechanisms, thereby exempting the system from obligations such as regulated social tariffs. This simplification supports a LEAN governance structure and keeps the model accessible for both citizens and small businesses.

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The operational costs of the network are covered through:

- Annual management fees, paid by all connected entities (households and SMEs). These are calculated proportionally based on their contracted thermal capacity, ensuring a fair cost distribution.
- Cost recovery from interventions and maintenance, invoiced either to the VMEGLOBAL (association of co-owners) or directly to individual entities, based on actual incurred costs.
- Shared operational expenses, including:
  - Electricity and water consumption in the warmtecabine.
  - Subscription fees for monitoring and data management platforms.
  - Administrative and coordination overhead for smart management and reporting.

Cost Structure and Allocation

The cost structure is divided into capital expenditures (CAPEX) and operational expenditures (OPEX), and is shared according to entity typology and thermal demand.

Cost Type	Description
CAPEX (one-time)	Partially integrated into the **plot sales price**.
Connection Costs	Installation of the meterstraat, varying by entity:
	- Residential home: ~€2,250
	- Home + workshop: ~€2,400
	- SME unit: ~€2,800
	- Business facility: ~€4,100
Metering Costs	Additional metering and communication components: €780–€1,600
OPEX (annual)	Estimated site-wide costs: €20,000 per year, divided proportionally.
	Covers maintenance, smart platform subscriptions, insurance, and GBS systems.

Table 7: cost structure and allocation

The annual operational costs are shared via a real cost-based model. This includes direct cost splitting among users without a third-party intermediary. The objective is to minimize overhead while maintaining service quality and accountability.

Citizen Participation and Governance

Although citizens are not yet actively involved (as end-users will only be known post-2025), the governance model is structured to integrate community members from the moment they purchase their lot. Key features of the participatory model include:

- Automatic Membership: Each buyer of a lot becomes a member of both the thermal energy community and the VMEGLOBAL, the future legal entity responsible for ownership and governance of the infrastructure.

- Legal Embedding
  - Sales contracts include clauses obligating participation in the heating system.

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    - A dedicated chapter in the co-ownership's basic deed (basisakte) formalizes technical, financial, and governance aspects of the energy community.

- Access to Digital Tools
    - A platform gives users insight into:
        - Their own energy consumption and historical trends.
        - Billing and financial overviews.
        - Operational settings (e.g., day/night regimes).
        - Shared documents such as SEPA forms, move-in/out checklists, and technical specs.
    - This transparency fosters user empowerment and encourages efficient energy behavior.
- Smart Load Management
    - Participating users are guided to optimize energy use, particularly by avoiding high consumption during off-peak (nighttime) hours when water flow and heat capacity are lower.
    - Alerts based on abnormal consumption patterns allow for proactive corrections and behavioral adaptations.

Long-Term Vision and Flexibility

The governance and financial model is designed to be future-proof, with flexibility to evolve toward greater citizen ownership and technical sophistication:

- In the medium to long term, outsourcing the technical and billing management to an ESCO (Energy Service Company) remains a viable option.
- Alternatively, the VMEGLOBAL may continue operating the network using off-the-shelf solutions such as ZeroFriction or HMS, enabling lean and localized management without excessive overhead.

This flexibility allows the community to retain control over its energy infrastructure while adapting to future regulatory, technical, or organizational needs.

3.3. Project Roadmap

Having completed the foundational design and construction work, the project is now entering a critical transition phase from infrastructure delivery to operational management. The roadmap below outlines the key milestones and next steps necessary to activate, operate, and ultimately transfer ownership of the heating network to the community.

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Figure 12: realisation of the secondary circuit on the site

Current Status

As of early 2025, the project is in the operational preparation phase. Major infrastructural and technical elements have already been completed:

- The primary and secondary heating networks, along with the technical cabin have been fully constructed.
- All as-built documentation, technical component fiches, and detailed operation manuals have been delivered.
- A preliminary operational agreement is in place with Litran NV, which will manage the secondary network during the initial phase until the end of 2026.
- A future operator, the Warmtenetbeheerder (WNBH), will be appointed to assume full operational responsibility after this transitional period.

Next Steps

A series of well-defined steps are planned to ensure smooth commissioning and sustainable management of the thermal network:

1. Formal Handover (2026)
    - Transfer of all technical documentation and digital system access (e.g., CloudGate and Priva GBS platforms).
    - Verification of system performance and full operational readiness by the incoming WNBH.
2. Operational Rollout
    - Configuration and fine-tuning of the CloudGate interface and Priva GBS system for real-time monitoring.

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- Commissioning of the online user platform, enabling future residents and businesses to access consumption data, maintenance schedules, and billing information.

3. Connection of New Entities
   - Start processing connection applications from plot owners and SMEs.
   - Site inspections, commissioning of installations, and integration of new metering points into the digital management system.
4. Implementation of Smart Management Protocols
   - Rollout and refinement of the load management strategy (Uitschakelprotocol) to optimize energy efficiency.
   - Setup of monitoring tools for monthly and annual performance benchmarks.
5. Community Engagement
   - Launch of awareness campaigns to onboard new residents and businesses.
   - Engagement of end-users through regular stakeholder meetings and online tools to support active participation in the energy community.
6. Performance Evaluation and Optimisation
   - Continuous data analysis to ensure efficient energy use and system stability.
   - Iterative updates to operational protocols based on real-world performance and user feedback.

Implementation Timeline

The roadmap is structured across several project phases, each contributing to the successful deployment and community integration of the heat network.

Phase	Timeline	Key Activities
Design & Procurement	Until Q2 2024	Finalization of technical specifications, legal structuring, and governance model.
Network Construction	Q2 – Q4 2024	Installation of pipelines, heating infrastructure, and technical cabin setup.
Connection & Sales Prep	Q1 – Q3 2025	Development of sales documents.
Start of Sales	Q3 2025	Launch of residential and business unit sales, with integrated energy clauses.
Start of Operations	Q1 2026	Begin connection commissioning and system testing.
End of Contractor Phase	End 2026	Full handover of network management from Litran NV to WNBH.
Ownership Transfer	2029	Transfer of infrastructure ownership and responsibilities to **VMEGLOBAL**.

Table 8: implementation timeline

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Figure 13: view on the realised water basin on the site

3.4. Risks

As an innovative and multi-stakeholder initiative, the project involves a number of potential risks spanning legal, financial, operational, and user-related dimensions.

Legislative and Regulatory Risks

Risks

- Changes in Flemish energy legislation—such as amendments to the *Energiedecreet* or *Energiebesluit*—may necessitate updates to the technical operation model, pricing structure, or reporting obligations.
- Introduction of stricter rules for renewable integration, emissions, or efficiency standards could lead to retroactive infrastructure modifications.
- Risk of unintentionally qualifying as a "heat supplier", which could trigger additional regulatory obligations, including social tariffs.

Mitigation

- Adhere to a fixed-cost pricing model to avoid falling under heat supply regulation.
- Ensure all legal arrangements (e.g. easements, rights-of-use) are clearly formalized and periodically reviewed.
- Maintain close alignment with legal counsel and energy policy experts.

Financial Risks

Risks

- The model depends on timely and accurate payment of management fees and shared costs by individual entities and the VMEGLOBAL.
- Delays in user onboarding or disputes over cost allocation could jeopardize cash flow and budget stability.

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Mitigation

- Rely on real-cost sharing principles and transparent allocation rules (e.g., based on contracted thermal capacity).
- Incorporate clear payment terms in sale contracts and community agreements.
- Use conservative cost forecasts based on BM Engineering estimates, with room for adjustment through indexation.

Approval and Organizational Risks

Risks

- Delays in connecting new entities or in obtaining approval for connections may slow operational progress.
- Setting up the VMEGLOBAL and ensuring formal mandates from all end-users may take longer than anticipated.

Mitigation

- Include energy network participation obligations directly in sales conditions and basic deeds.
- Provide clear onboarding procedures and household regulations for VMEGLOBAL.
- Coordinate early with notarial and legal teams to ensure timely establishment of co-ownership structures.

Technical and Operational Risks

Risks

- Risk of insufficient water flow at night, which could affect thermal transfer efficiency.
- Dependence on specialized systems such as CloudGate, LoRaWAN modules, and the Priva GBS increases vulnerability to technical issues.
- Potential gaps in technical expertise (e.g. alarm management, data protocols) could impact service continuity.

Mitigation

- Implement a smart load management strategy, using predictive control and off-peak modulation.
- Maintain service-level agreements (SLAs) with strict response times for technical faults.
- Ensure technical teams are trained on system specifics and establish contracts with specialized support firms.

Demand and Behavioral Risks

Risks

- The financial viability of the system depends on sufficient and stable heat demand. If fewer entities connect or usage patterns vary drastically, underutilization of capacity may occur.
- High night-time usage—when water flow is lowest—can lead to inefficiencies and pressure drops.

Mitigation

- Provide consumption guidance and feedback to users through the online platform.
- Explore time-of-use incentives or penalties to encourage daytime heating and avoid nighttime peak demand.
- Use real-time data to monitor consumption patterns and adjust system settings accordingly.

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Coordination and Stakeholder Engagement Risks

Risks

- The site includes a diverse mix of property types (single-family homes, SMEs, workshops, a collective building), making governance and cost allocation more complex.
- Lack of user engagement or transparency could erode trust and reduce participation in energy-saving behaviors.

Mitigation

- Use standardized governance tools (e.g., base deeds, sales agreements) adapted to each typology.
- Ensure regular communication and reporting to VMEGLOBAL members.
- Maintain a user-friendly platform that respects GDPR and promotes active involvement.

Risk Summary Table

Category	Risk Description	Mitigation Strategy
Legal & Regulatory	Risk of "heat supplier" classification and evolving regulations	Use fixed pricing; clarify legal rights early; monitor policy changes
Financial	Cost forecasting errors; payment delays from users	Transparent financial model; embed payment obligations in contracts
Organizational	Slow setup of VMEGLOBAL; missing user mandates	Align legal structures with sales process; prepare governance in advance
Technical	Night flow insufficiency; expertise gaps in smart tech systems	Implement smart protocols; train teams; maintain robust SLAs
Demand/Behavioral	Low demand; excessive night use	Encourage daytime use; monitor and optimize behavior via platform
Coordination	Diverse stakeholder interests complicate governance	Standardize agreements; ensure inclusive and flexible VMEGLOBAL structure

Table 9: risk summary table

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