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GIS BASED AUTOMATED DESIGN OF DISTRICT HEATING NETWORKS

25 October 2019

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AUTOMATE DISTRICT HEATING NETWORK DESIGN – STAY IN CONTROL

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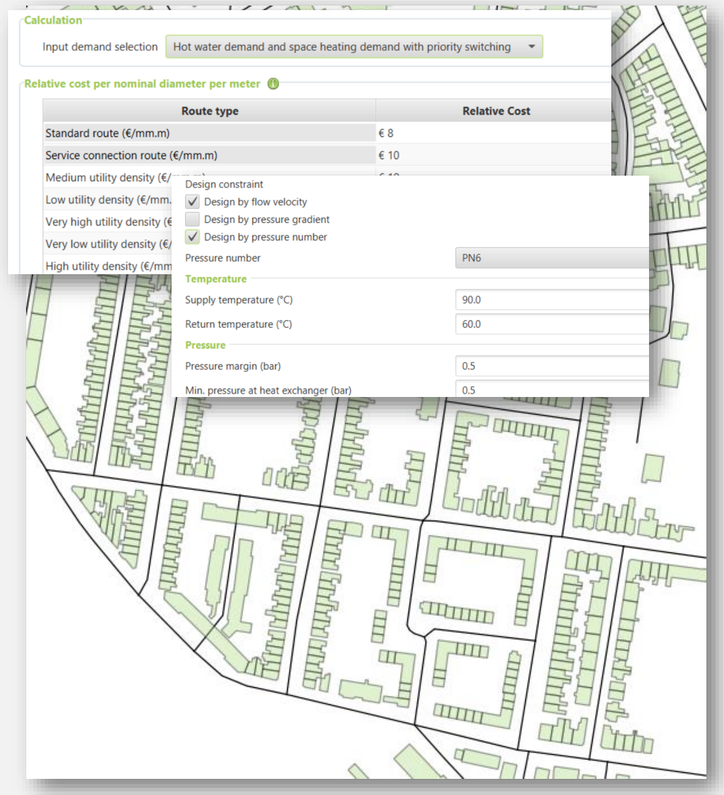
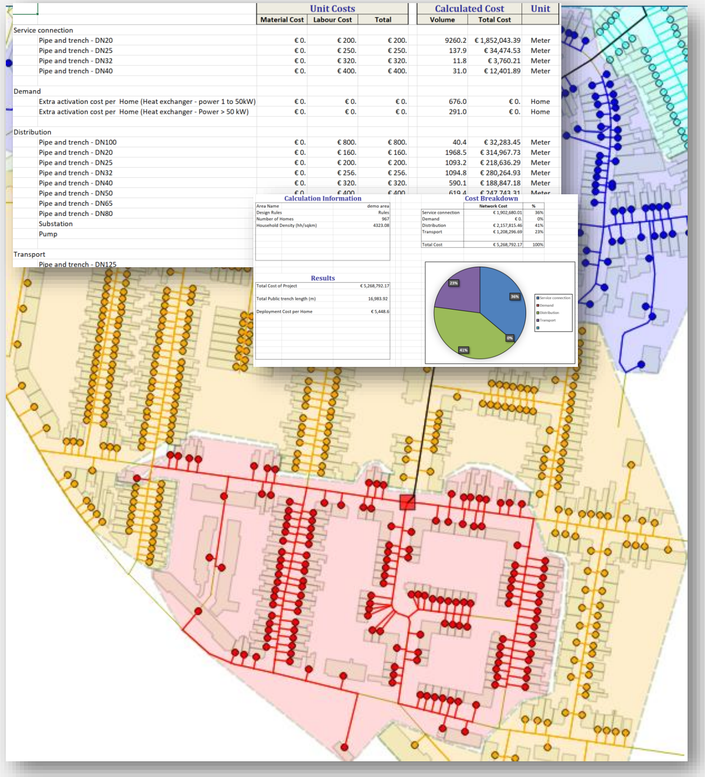


INPUT: GIS, HEAT DEMAND, DESIGN & COST PARAMETERS



OUTPUT: NETWORK, BOM and COSTS

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CASE NIJMEGEN

Netherlands

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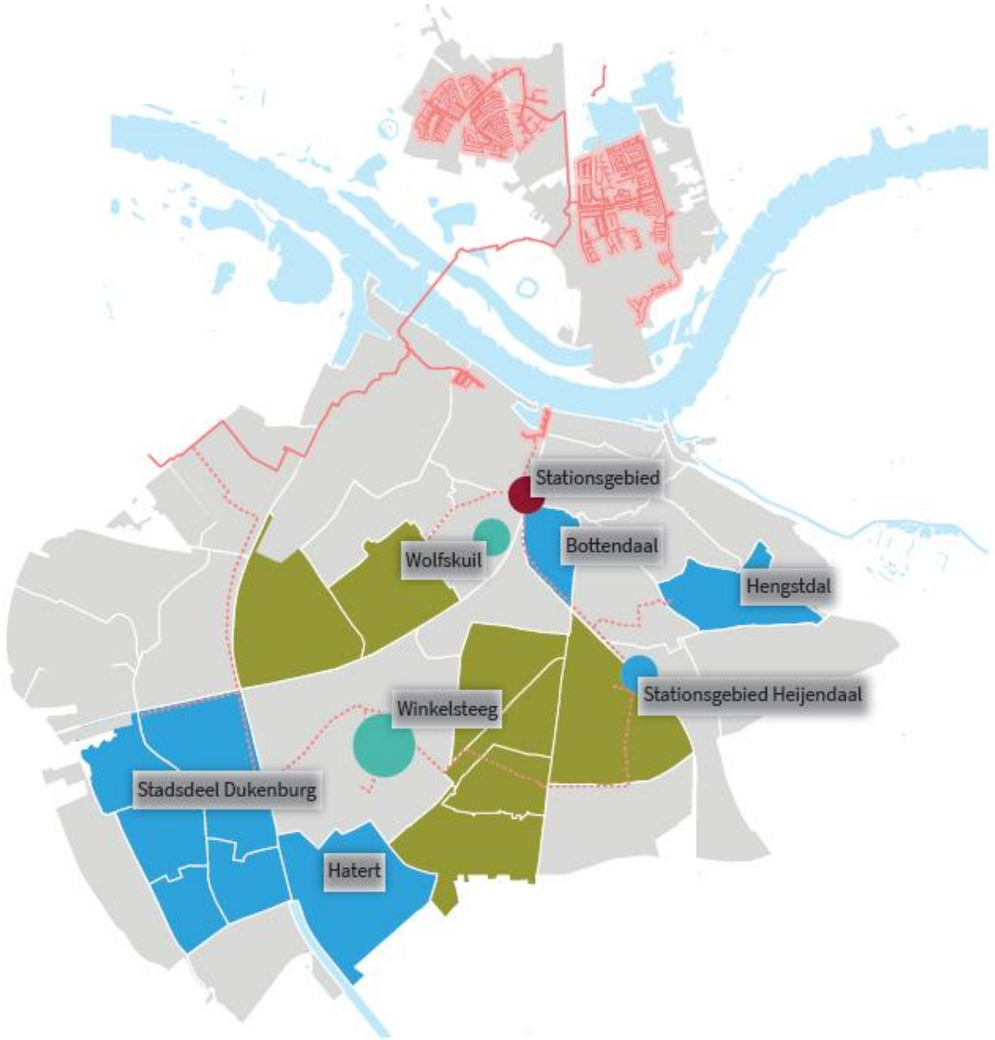
NIJMEGEN – ENERGY NEUTRAL BY 2045

EXTENSION OF EXISTING DISTRICT HEATING NETWORK

Nijmegen

- Existing district heating network in the north
- Extension of transport network to the southern part
- Four (4) districts under consideration for a new network to start in 2020
  - Dukenburg
  - Bottendaal
  - Hatert
  - → **Hengstdal**



Start before 2020 with approx. 15000 buildings

Start after 2020

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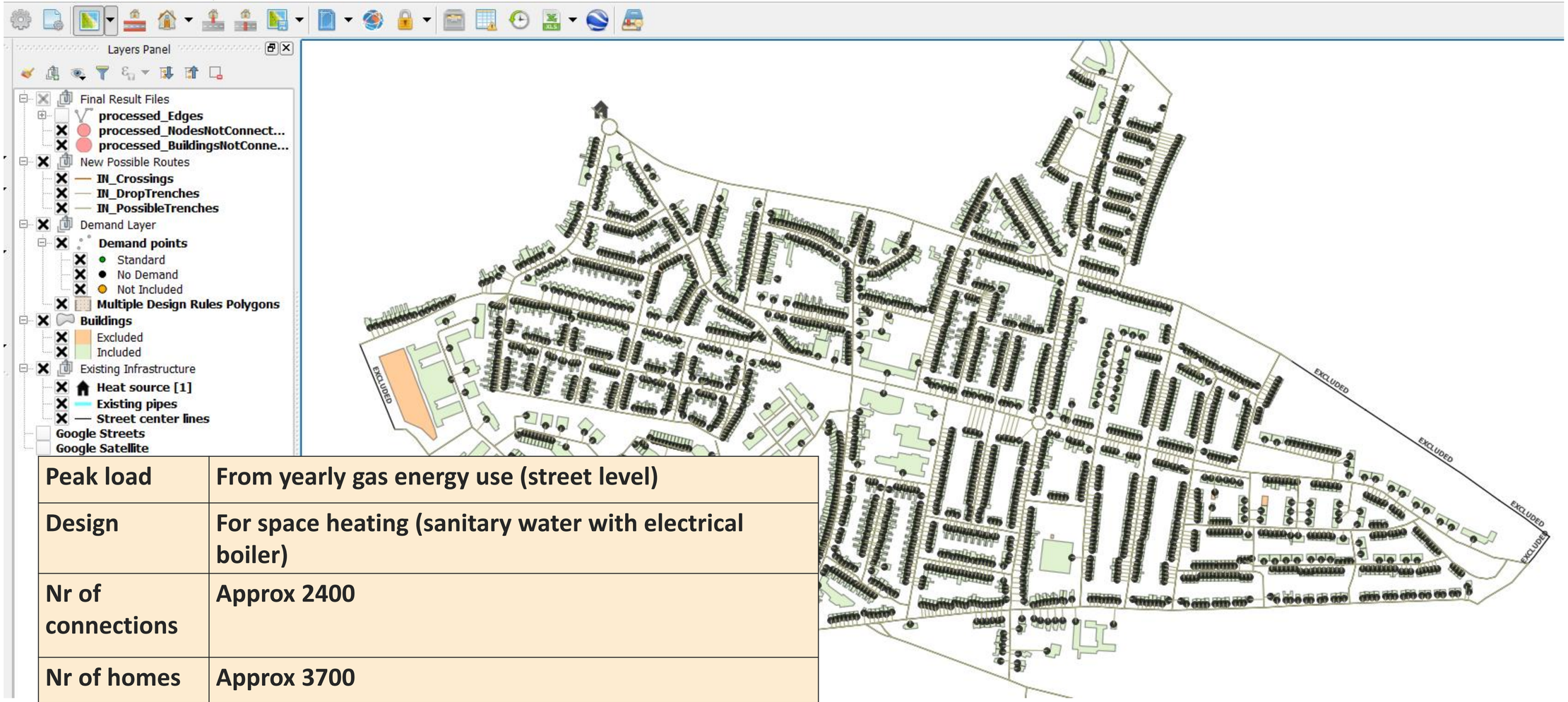
HENGSTDAL DISTRICT – APPROX. 2400 CONNECTIONS



Peak load	**From yearly gas energy use (street level)**
Design	**For space heating (sanitary water with electrical boiler)**
Nr of connections	**Approx 2400**
Nr of homes	**Approx 3700**
Source	**Connection to a major transport pipe (NW)**

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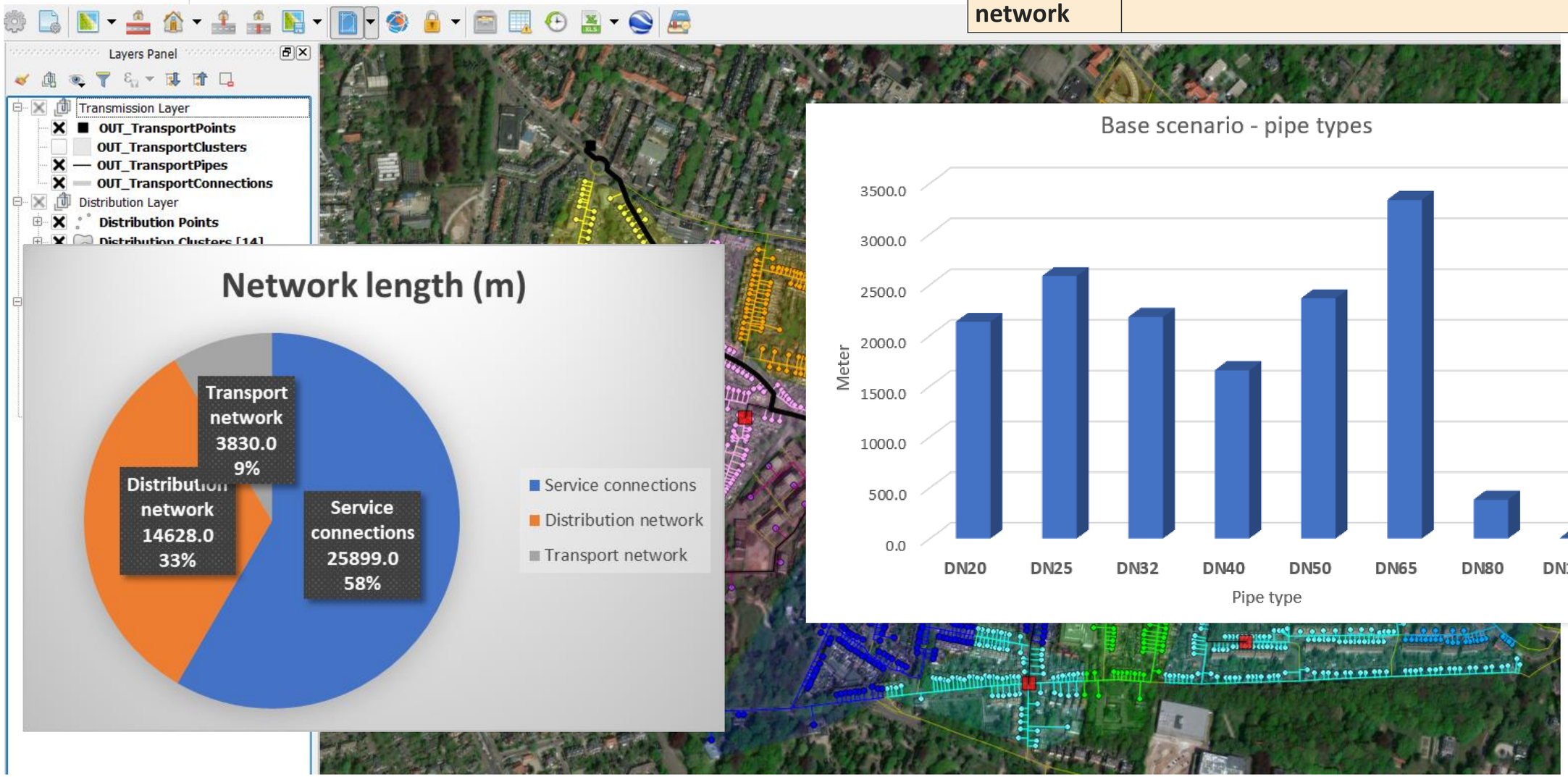
RESULTING NETWORK DESIGN

Clusters	**14 energy centres of max 1MW**
Transport network	**Interconnecting the energy centres**



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VISUALISATION & GIS INTEGRATION

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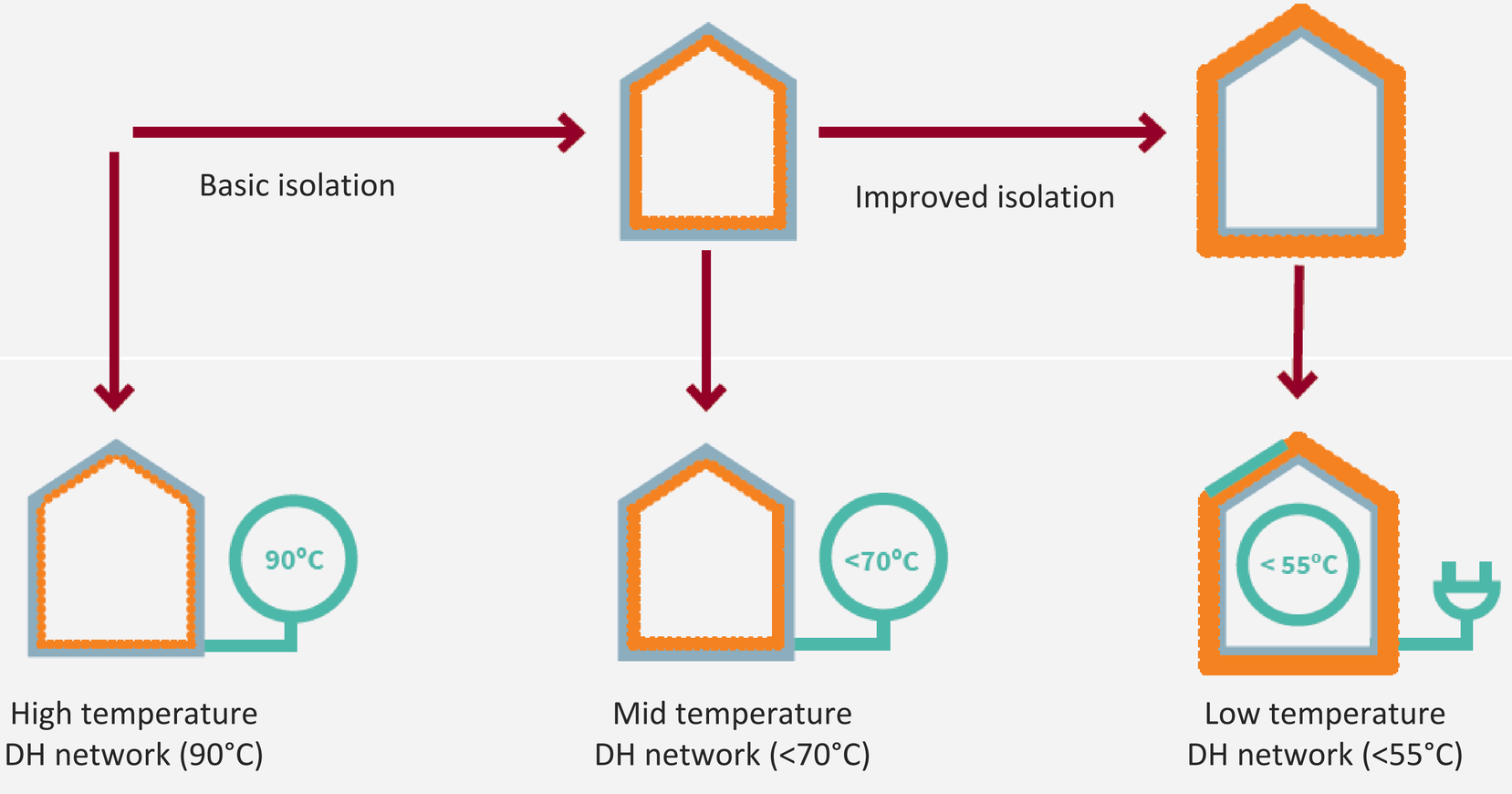
INCREASED LEVEL OF ISOLATION TO REDUCE CONSUMPTION

1. Reduce consumption

Building isolation is key to reduce natural gas use

2. Migrate to alternatives



Source: https://www.nijmegen.nl/fileadmin/bestanden/bestuur/bestuursdossiers/Nijmegen-aardgasvrij/Warmtevisie-Nijmegen-2018-180626.pdf

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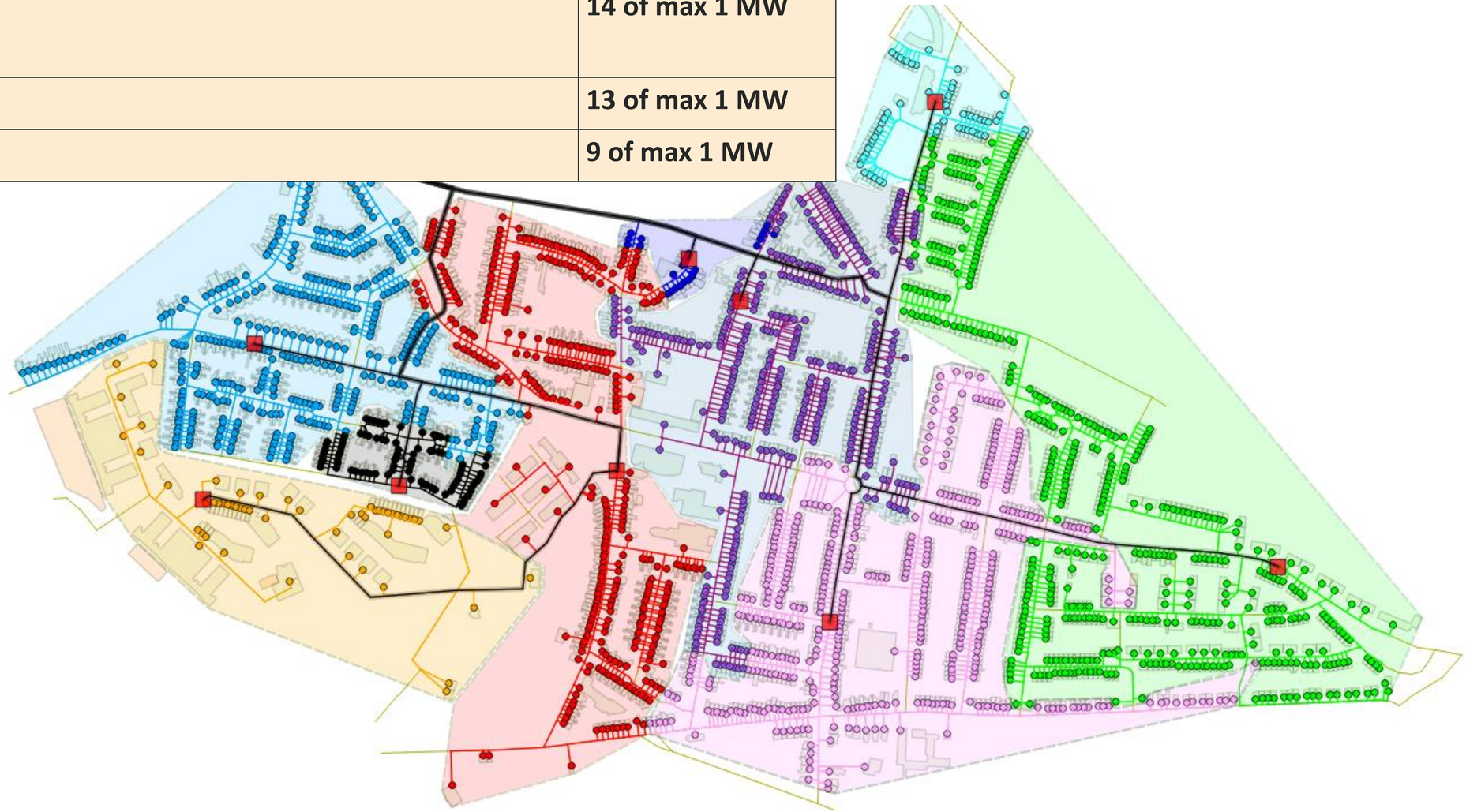
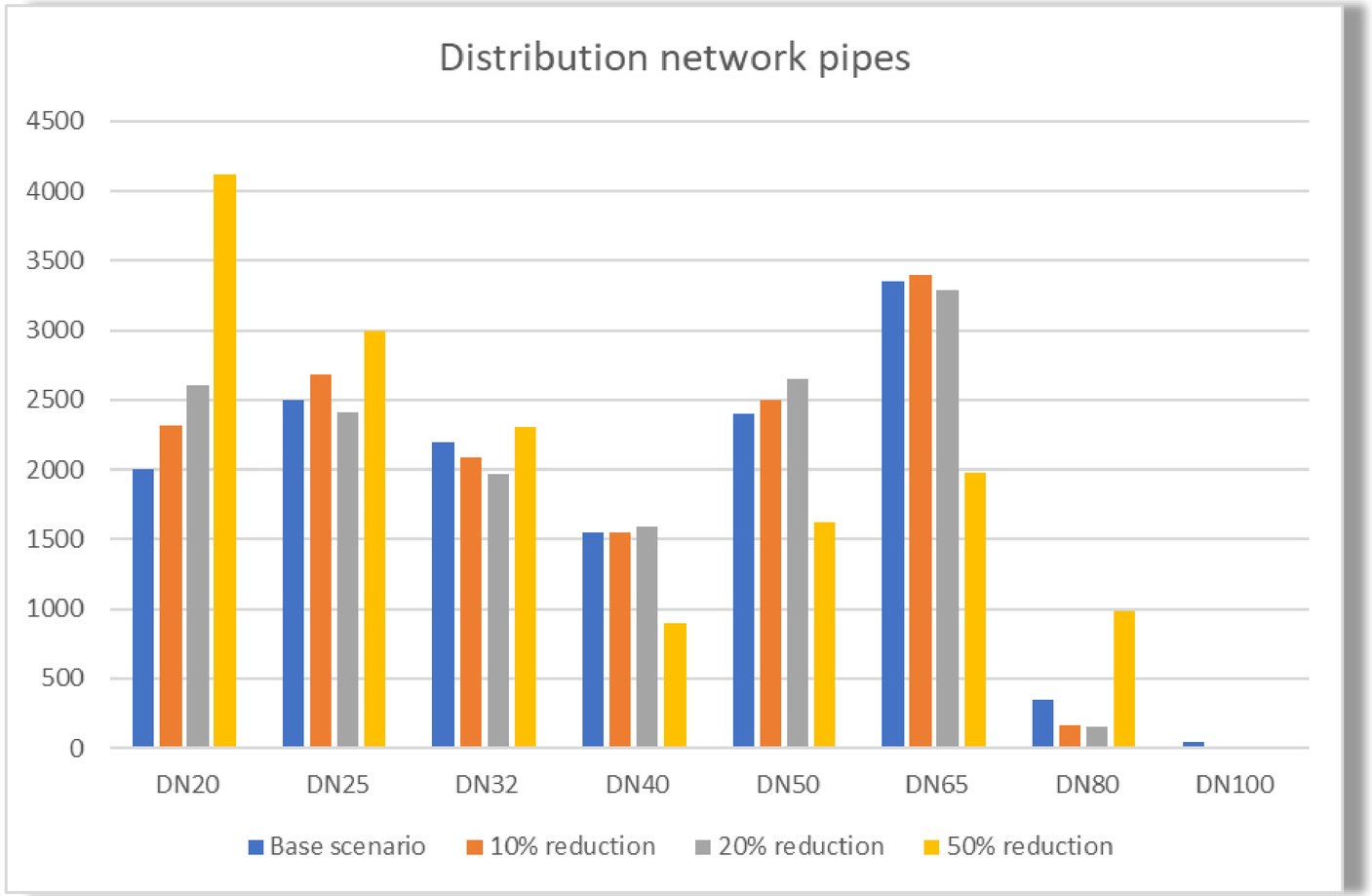
IMPACT OF SPACE HEATING DEMAND REDUCTION

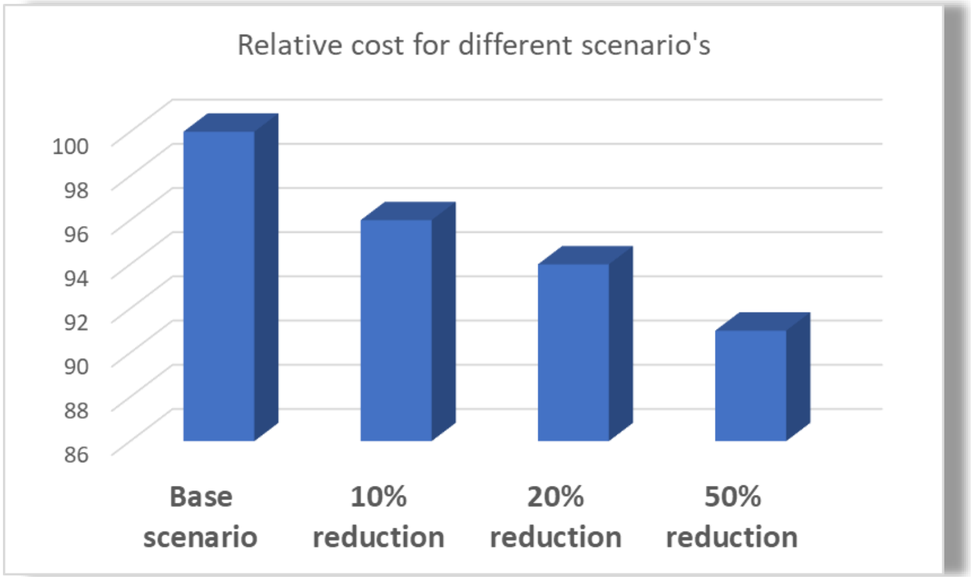
Scenario	Peak load for space heating (domestic hot water with electrical boiler)	Clusters
Base scenario	Original values	14 of max 1 MW
Scenario 2	10% reduction	14 of max 1 MW
Scenario 3	20% reduction	13 of max 1 MW
Scenario 4	50% reduction	9 of max 1 MW



IMPACT ON PIPE TYPES AND RELATIVE COST



- Trend towards lower pipe diameter for building connections (increase in DN20 and DN25) and corresponding reduction of DN40, DN50, DN65



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CONCLUSIONS NIJMEGEN CASE

- The reduction in space heating demand leads to **max 9% lower deployment cost** of the pipe distribution network for this specific district
- **Trenching cost** the is **main cost driver** for the distribution network deployment

PROJECT SETUP TIME

Half day to prepare GIS data and setup project workspace

SIMULATION TIME

Simulation time approx. 20 minutes per scenario.

City of Nijmegen:
“With this tool we can calculate the deployment costs of different scenarios of a district heating network in a simple and fast manner.”

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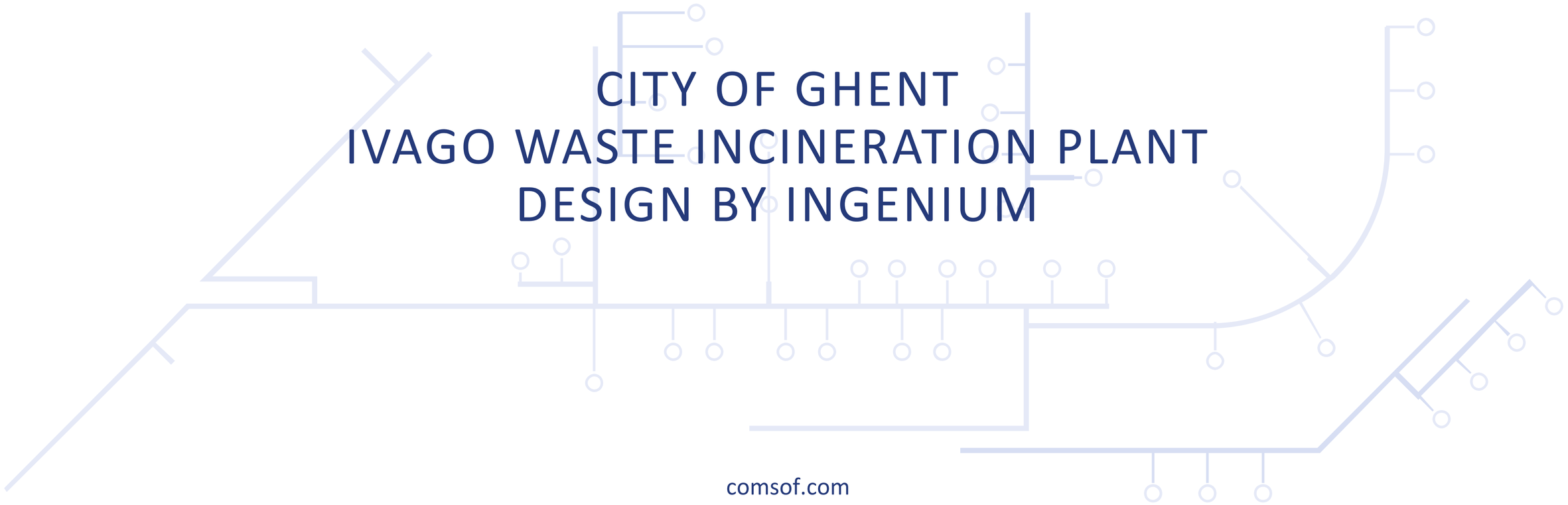
CITY OF GHENT
IVAGO WASTE INCINERATION PLANT
DESIGN BY INGENIUM



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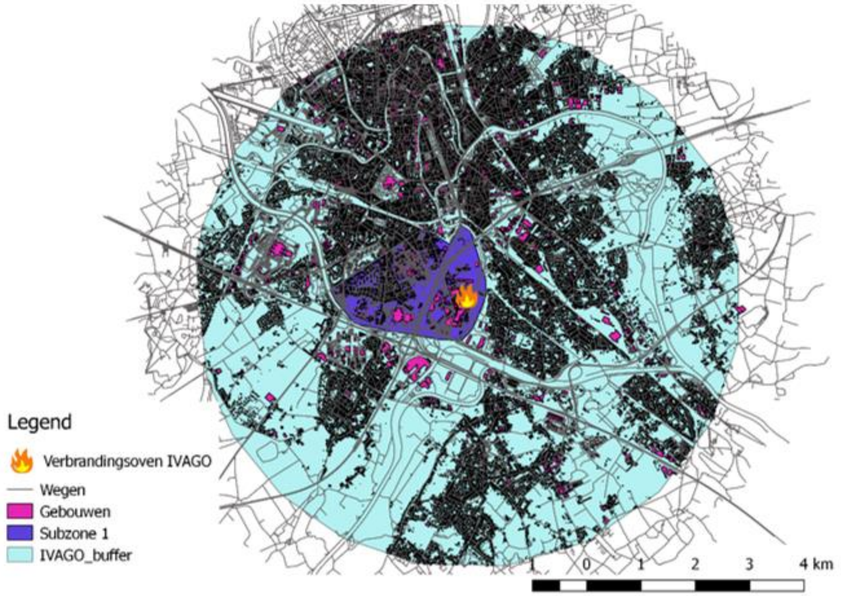
DISTRICT HEATING FEASIBILITY STUDY IN CITY OF GHENT

- IVAGO Waste incineration plant
- Peak power of the source: 15 MW

- Commissioned by City of Ghent

- Objectives
  - Identification of heat demand (customers)
  - Development of a method to estimate peak heat demand based on publicly available information
  - Feasibility study for a district heating network in a zone of 5km around the plant



- Perfomed by consulting company Ingenium

- Making use of Comsof Heat

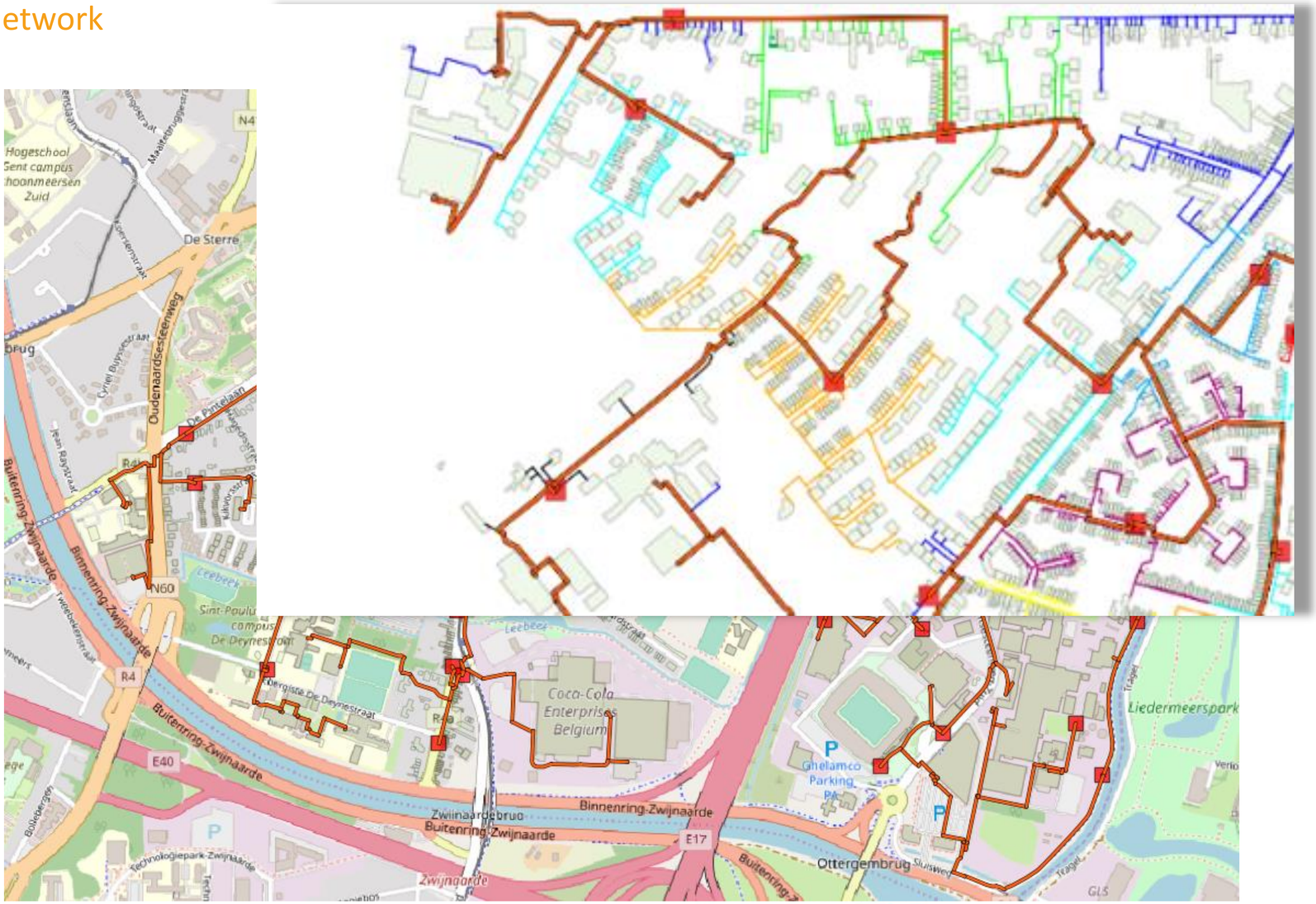
FEASIBILITY STUDY FOR DISTRICT HEATING NETWORK

Base scenario – reference network

- Reference network
- Transport network routing
  - Automate with constraints
    - Exclude routes
    - Avoid routes
    - Force routes
    - Varying costs
  - Local energy center 0.5MW
  - 16 bar network

- Distribution network
  - 6 bar network

- Reference network
  - Total trench length: 70km



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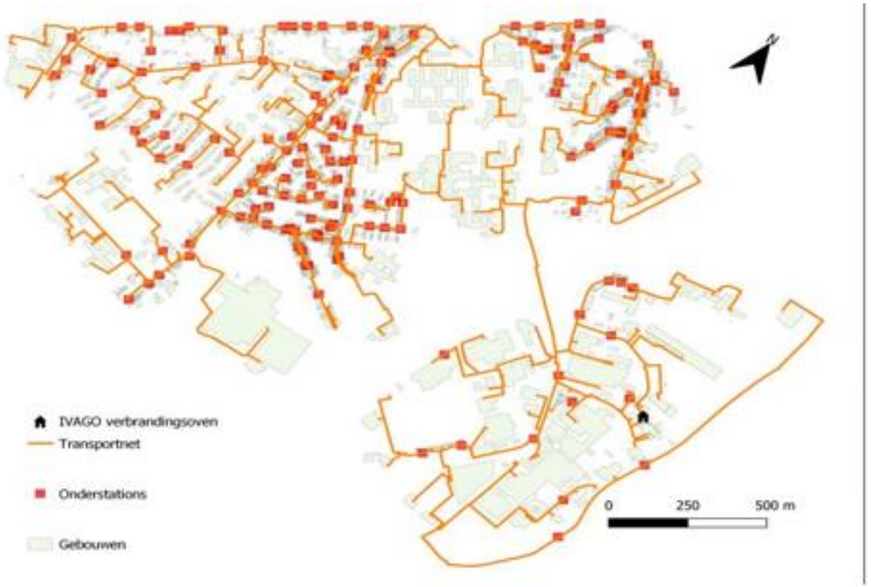
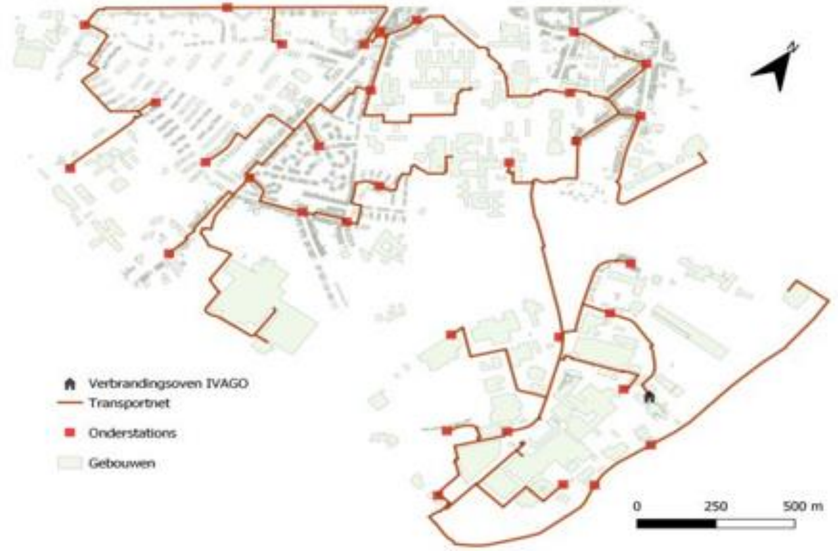
SCENARIOS WITH DIFFERENT SIZE OF LOCAL ENERGY CENTERS

Scenario comparison – different substation sizes

- Comparison of 9 scenarios
  - Energy centers (substations) of 100kW, 500kW, 1 MW, 2 MW, ….10MW
  - Results in different length of transport pipe network and distribution pipe network and deployment cost



Energy centres of 100kW



Energy centres of 10MW

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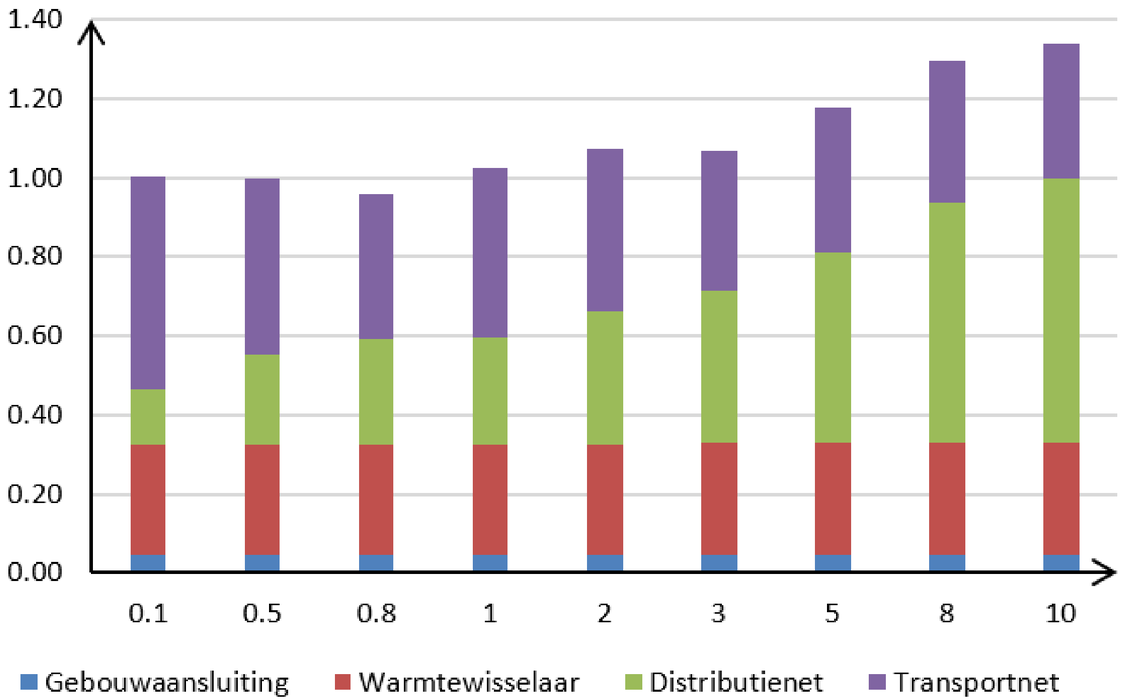
LOWEST COST SCENARIO

Scenario comparison – different substation sizes

- Comparison of network deployment cost (relative to cost of reference scenario with 0.5 MW substations)



Conclusion

- Varying size of substation size results in different cluster sizes and different share of costs for transport pipe and distribution pipe costs
- For this particular case a minimal cost was found for a cluster size based on energy centres of 800kW
- Fast and detailed analysis with Comsof Heat providing valuable inputs for the feasibility study and the decision takers in this project

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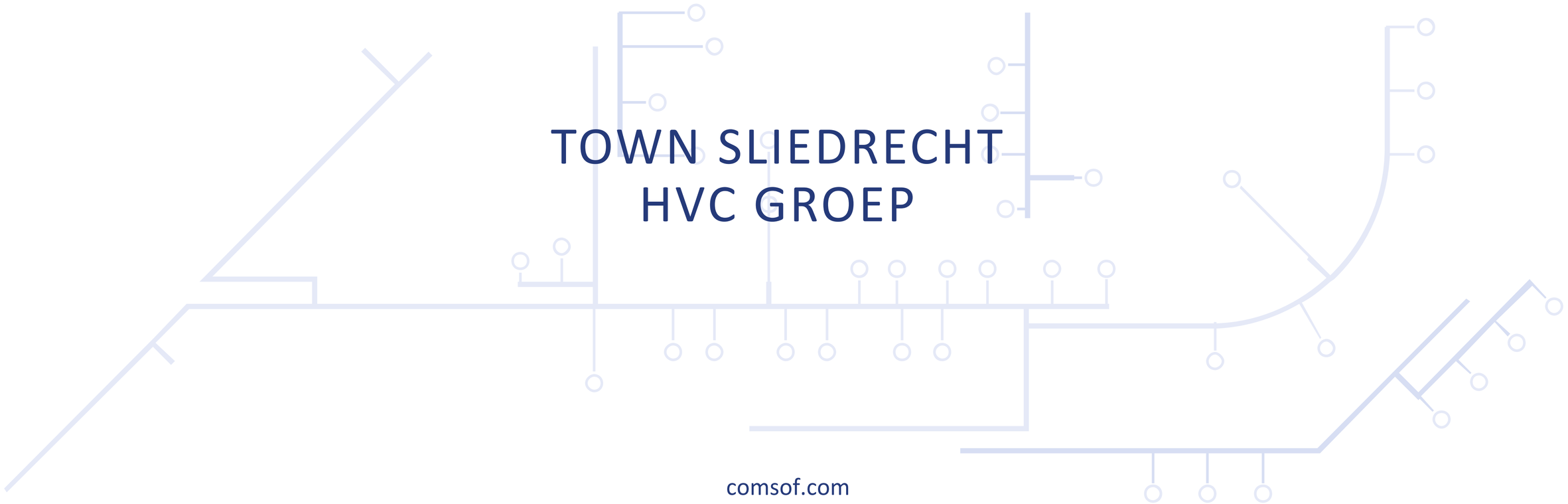
TOWN SLIEDRECHT
HVC GROEP



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FEASIBILITY STUDY IN SLIEDRECHT

Netherlands

- Waste and energy company, active in more than 40 cities in the Netherlands
- Operating multiple district heating networks and exploring options for further expansion

MULTISOURCE NETWORK AND PHASED ROLL-OUT

Town of Sliedrecht

- Multi-source network with sources at the East and the West side of the district
- Approx 2800 homes with phased roll-out over multiple years
- The route of the transport network and the location of the 19 energy centres was fixed based on a pre-study

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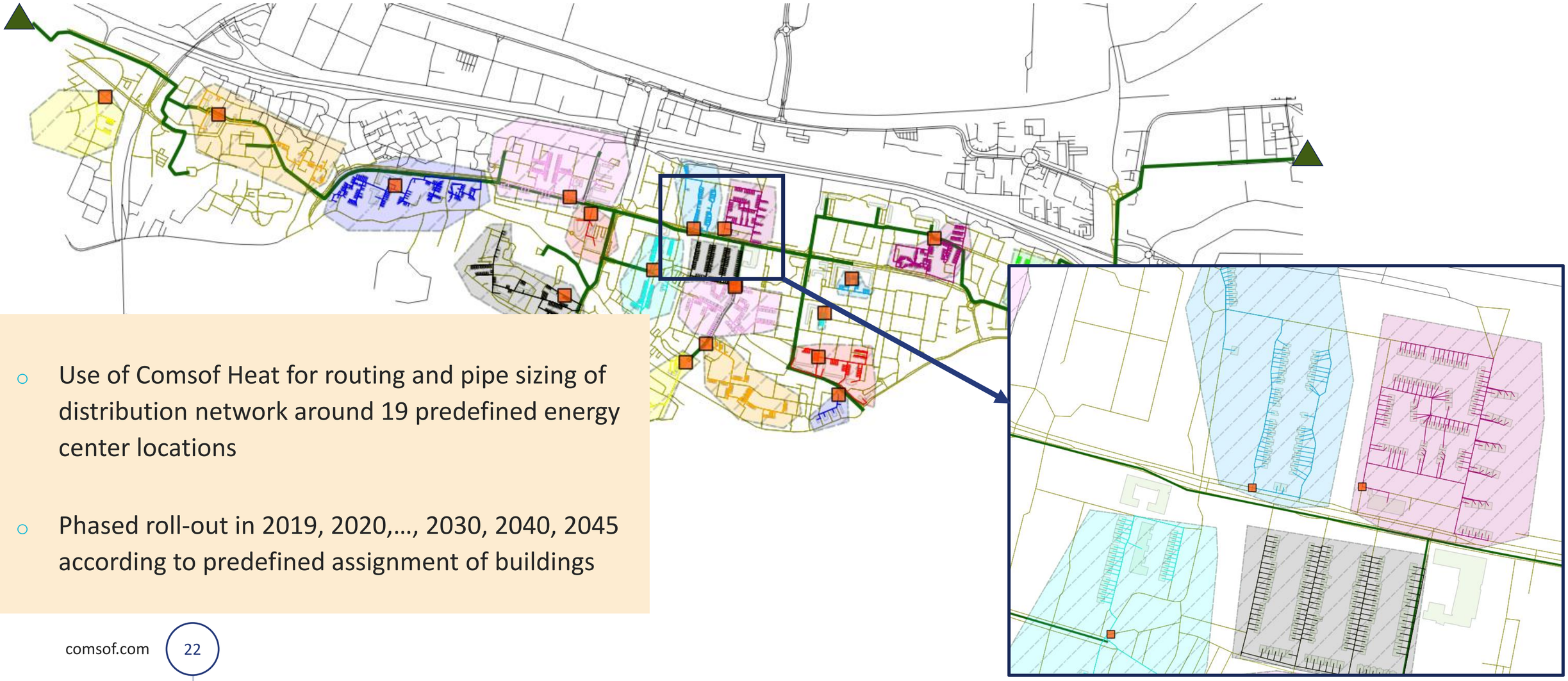
DISTRIBUTION CLUSTER ROUTING & DIMENSIONING



- Use of Comsof Heat for routing and pipe sizing of distribution network around 19 predefined energy center locations
- Phased roll-out in 2019, 2020,…, 2030, 2040, 2045 according to predefined assignment of buildings

PHASED ROLL OUT

- Determine for each phase in the roll-out
  - network deployment cost estimate
  - network trench length

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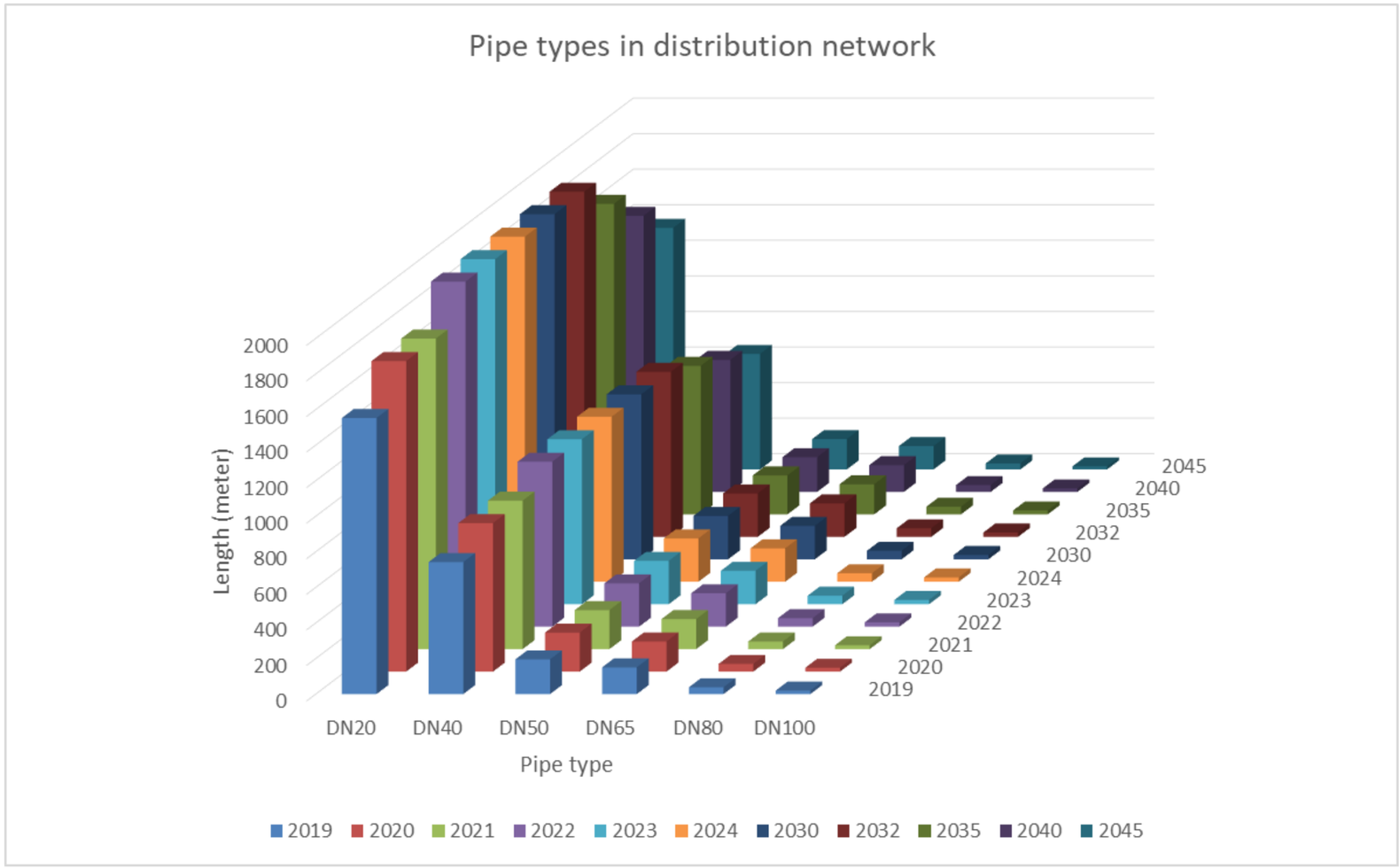
PHASED ROLL OUT

Trench length per pipe type for each roll out year



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Improving the District Heating Network Business Case

- Automate district heating network design while staying in control
- Save time and optimize your network
- Compare investment scenarios and reduce risks
- Improve your business case and make better decisions

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REFERENCES

ingenium

Nijmegen

GRUNNEGER POWER

fluvius.

Gemeente Rotterdam

KU LEUVEN FACULTY OF ARCHITECTURE

Royal HaskoningDHV
Enhancing Society Together

hvc.

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rotterdam engineering

WITH THE AUTOMATED GIS-ANALYSIS OF COMSOF HEAT, YOU GET **QUICK AND AFFORDABLE INSIGHTS** IN NETWORK DESIGN, CAPITAL COST AND MATERIAL NEED. THIS SOFTWARE PROVIDES CONSIDERABLE **MORE RELIABLE CAPITAL COST CALCULATIONS** THAN MANUAL DESIGNS, FOR ONLY A FRACTION OF THE INVESTED LABOR HOURS

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