

020
02025
2025

Kennissessie “Innovatieve warmte netwerken”



@02025amsterdam



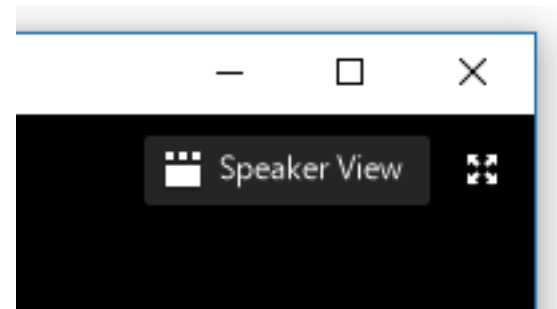
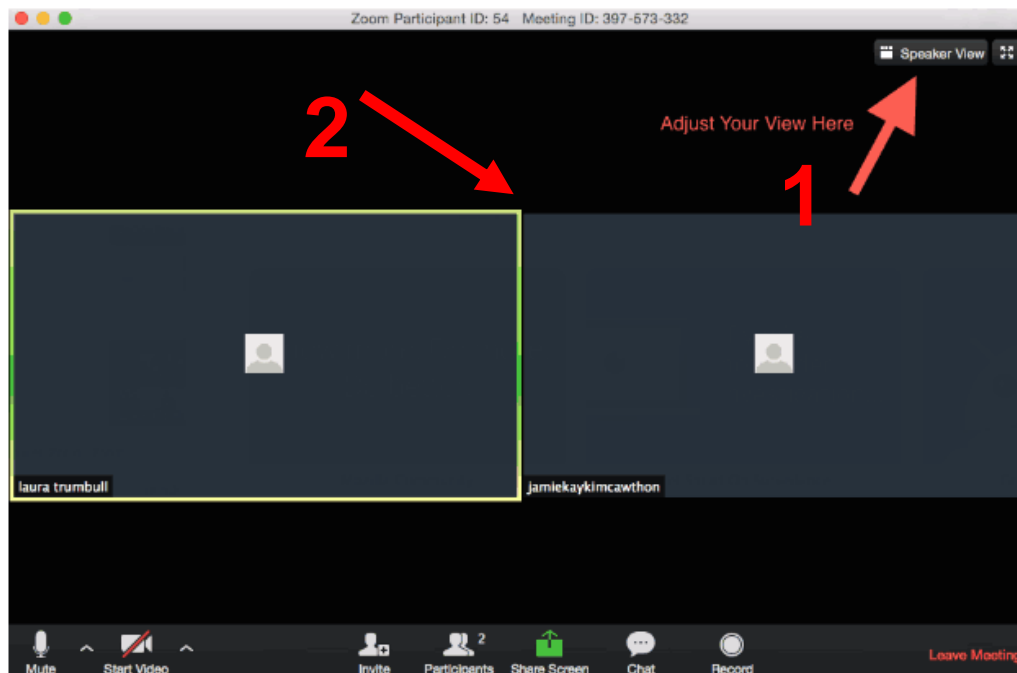
02025amsterdam

Online Meeting

CHAT functie:

Gebruik voor onderling contact en vragen.

We vragen je wel om tijdens de presentaties “etherdiscipline” te respecteren en alleen bij specifieke vragen je microfoon te gebruiken.



Beeld instelling :

1 Klik op “view” en kies “Speaker view”

2 schuif “beeld” met muis groter/kleiner



We benutten lokale intelligentie om de Energietransitie te versnellen



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Programma



13:00 Welkom & introductie door John van Gelder- 02025

13:05 **Comsof**, Kurt Marlein, Head of Innovation,
Planning & roll out van warmte projecten

13:30 **Minibems**, Simon Gunter, Executive Chairman.(Engelstalig)
Optimalisation of heat network installations by hard & software tools

13:55 **Zerofriction**, Wim Jacobs, CEO,
Data, monitoring, facturatie van gebruikers warmte netwerken

14:20 Q&A

14.30 Einde



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Kurt Marlijn – Comsof

Planning & roll out van warmte projecten

**020
02025
2025**



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COMSOF HEAT

GIS BASED AUTOMATED DESIGN OF DISTRICT HEATING NETWORKS

Kurt Marlein

28 April 2021

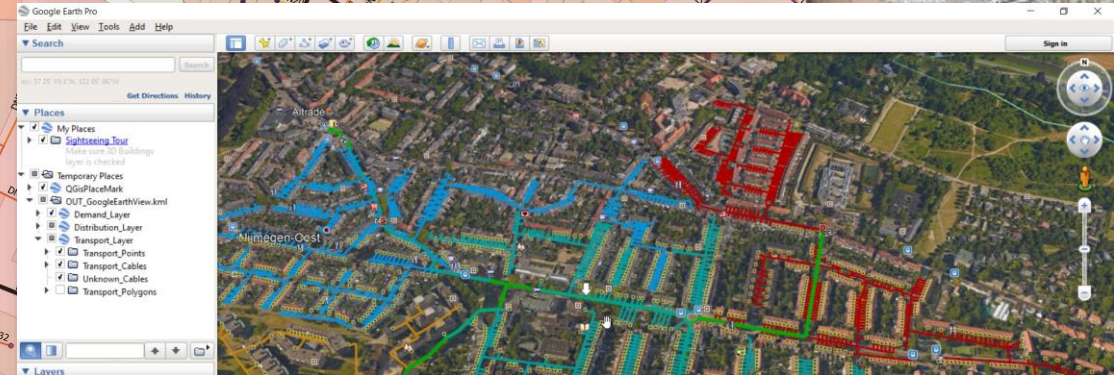
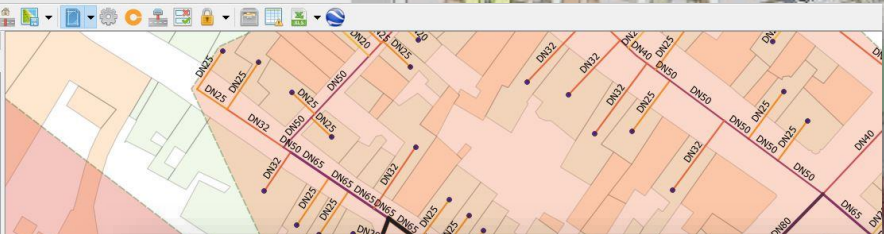
Layers Panel

- Transport Layer
 - OUT_TransportPoints
 - OUT_TransportClusters
 - OUT_TransportPipes
 - DN300



Layers

- Transport Layer
 - OUT_TransportPoints
 - OUT_TransportClusters
 - OUT_TransportPipes
 - DN300
 - DN250
 - DN200
 - DN150
 - DN125
 - DN100
 - DN80
 - DN65
 - DN40
- OUT_TransportPipes ...
- OUT_TransportPipes ...
- OUT_TransportConne...
- Distribution Layer
 - Distribution Points
 - Distribution Clusters ...
 - 1,478 - 1,600 [0]
 - 1,600 - 1,800 [0]
 - 1,800 - 2,000 [0]
 - 2,000 - 2,200 [0]
 - 2,200 - 2,400 [0]
 - 2,400 - 2,600 [8]
 - 2,600 - 2,800 [4]
 - 2,800 - 3,000 [6]
 - 3,000 - 3,200 [4]
 - 3,200 - 3,262 [0]
- Distribution Pipes [2347]
- Distribution Pipes copy
 - DN100
 - DN80



COMSOF HEAT

Available as plug-in for

QGIS 3.14 pi

ArcGIS Pro

on Information

Rules	Network Cost	%
Service connection	€ 1.005.325,54	21%
Demand	€ 0,00	0%
Distribution	€ 2.803.884,58	59%
Transport	€ 917.143,84	19%
Total	€ 4.726.353,97	100%

Results

€ 4.726.353,97	15.371,20	1,659
Wh/m		€ 2.100,60

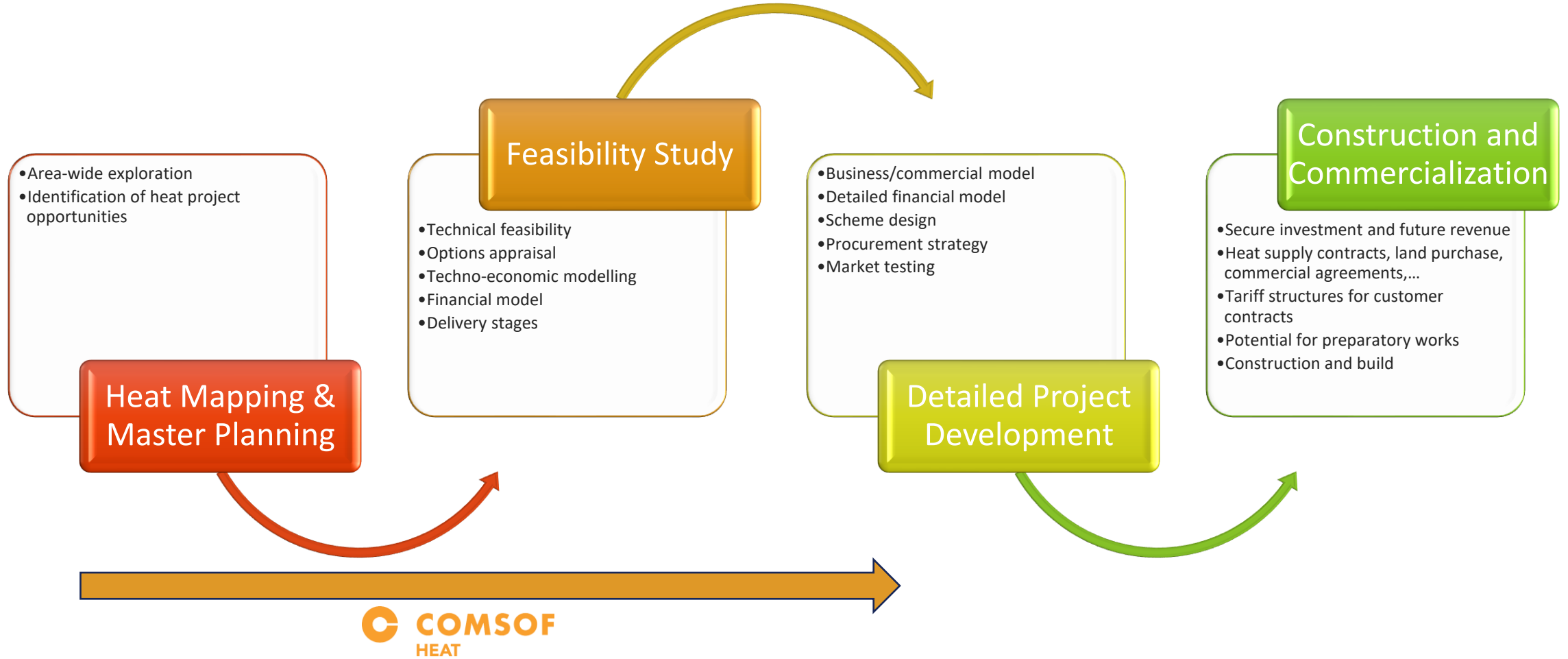
Heat 20.1.3.0

COMSOF HEAT



HEAT NETWORK PROJECT DEVELOPMENT STAGES

Comsof Heat



Source: Heat networks investment project brochure, BEIS & Triple Point



SPEED UP FEASIBILITY STUDIES WITH AN INTEGRATED SOLUTION

GIS data



Energy data



Technical parameters



Unit Costs



Heat Tarif



Route type	Relative Cost
Standard route (€/mm.m)	€ 8
Service connection route (€/mm.m)	€ 10

Design constraint: Design by flow velocity, Design by pressure gradient, Design by pressure number

Temperature: Supply temperature (°C) 90.0, Return temperature (°C) 60.0

Pressure: Pressure margin (bar) 0.5, Min. pressure at heat exchanger (bar) 0.5



Service connection	Unit Costs			Calculated Cost		Unit
	Material Cost	Labour Cost	Total	Volume	Total Cost	
Pipe and trench - DN20	€ 0.	€ 200.	€ 200.	9360.2	€ 1,872,043.39	Meter
Pipe and trench - DN25	€ 0.	€ 250.	€ 250.	137.9	€ 34,474.53	Meter
Pipe and trench - DN32	€ 0.	€ 320.	€ 320.	11.8	€ 3,760.21	Meter
Pipe and trench - DN40	€ 0.	€ 400.	€ 400.	31.0	€ 12,401.89	Meter

Cost Breakdown: Transport 20%, Service connection 21%, Demand 0%, Distribution 59%

Network topology



Network dimensions



CAPEX



Investment analysis



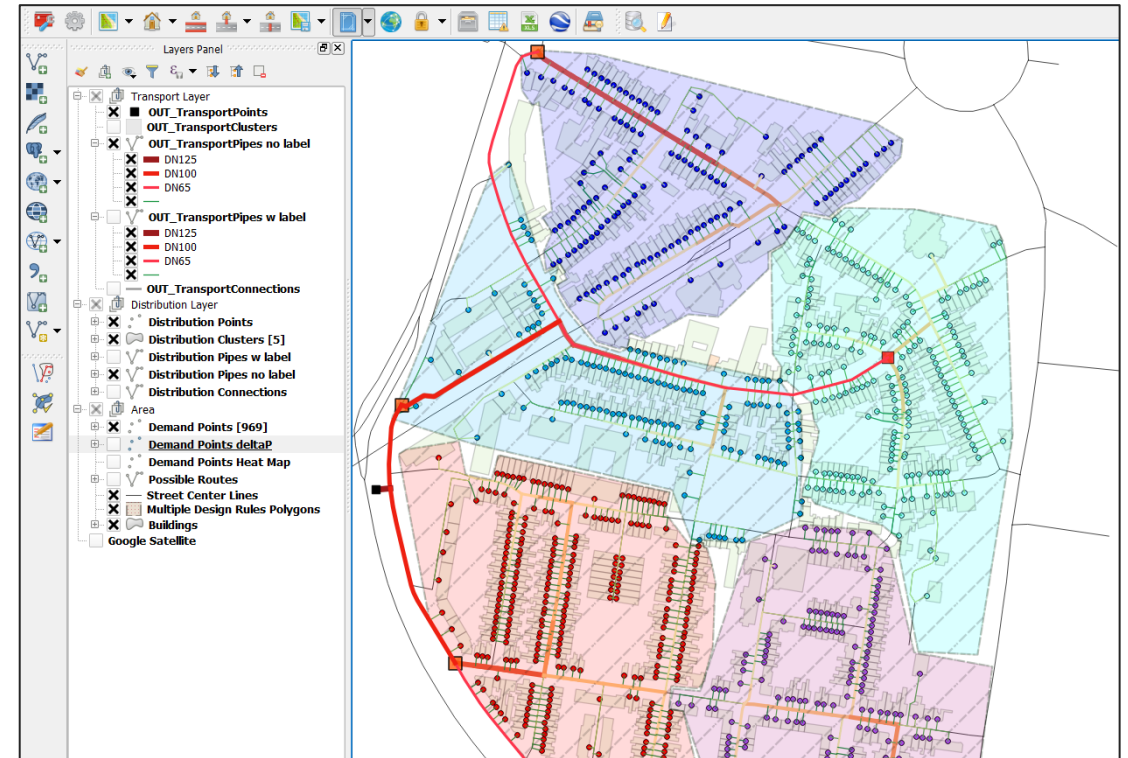
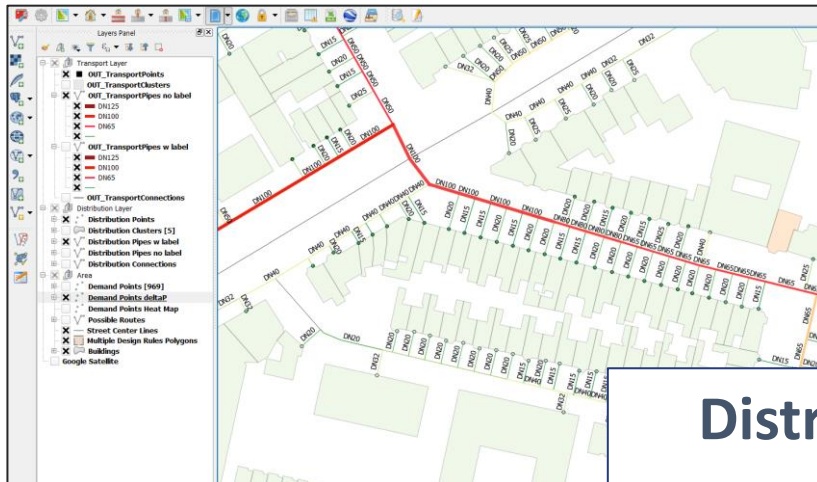
Techno-economic assessment of a district heating network



AUTOMATED PLANNING & DESIGN

Proven algorithms based on more than 10 years of development

- Automated clustering
- Automated & optimized routing
- Automated network dimensioning & pipe sizing
- Automated selection of buildings



Distributio...

Length... 2000g



Pipe diameter

Rotterdam designs district heating networks with Comsof



In brief

- ✓ Rotterdam is continuing to build its district heating network
- ✓ As it got more responsibilities, it needs more control over the planning & design stage
- ✓ It uses Comsof Heat to calculate costs and design a high-level network



Amsterdam selects Comsof Heat for its district heating network research

To expand the existing network

Amsterdam chose Comsof Heat for its district heating network research. It wants to make strategic decisions on questions such as: which neighborhoods are suited for district heating and how to connect these neighborhoods efficiently.

The Netherlands have ambitious plans to decarbonise their economy and stop their dependence on natural gas. In this turnaround, the country's municipalities are playing a vital role. The Dutch capital, Amsterdam, is investigating the feasibility of the expansion of the district heating networks within the city limits.



Municipalities strengthen their directing role with Comsof Heat



In brief

- ✓ HVC specializes in sustainable energy and waste management in the Netherlands
- ✓ The company helps the region of Drechtsteden to further expand its district heating network
- ✓ HVC uses Comsof Heat for the roll-out preparation

HVC focusses on sustainable energy and waste management for its owning 44 municipalities and six water authorities.

The authorities want to get insights into the different choices and conditions at hand. To work in an inclusive environment, focused on the local needs. ***Comsof Heat helps in this exploratory phase.***

As Comsof Heat calculates fast, **choices in planning can quickly be translated into different scenarios**

Comsof Heat allows us to **turn scenario analyses in to maps and euros.**

We take these facts and figures to our stakeholders such as authorities and residents to offer and **discuss different solution pathways.**



Royal HaskoningDHV creates district heating network designs with Comsof



In brief

- ✓ Royal HaskoningDHV is an independent international engineering firm
- ✓ The company uses Comsof Heat for high-level plans of district heating networks
- ✓ Their network design results are optimized and they save a lot of time



Comsof Heat helps Groningen to build its district heating network



Generate high-level designs and cost estimates

In brief

- ✓ A submunicipality of the city of Groningen wants to roll-out a district heating network to reduce gas dependency
- ✓ It is building a smaller network as a pilot project
- ✓ This initiative called '050 Buurtwarmte' is using Comsof Heat to assess costs and inform the community



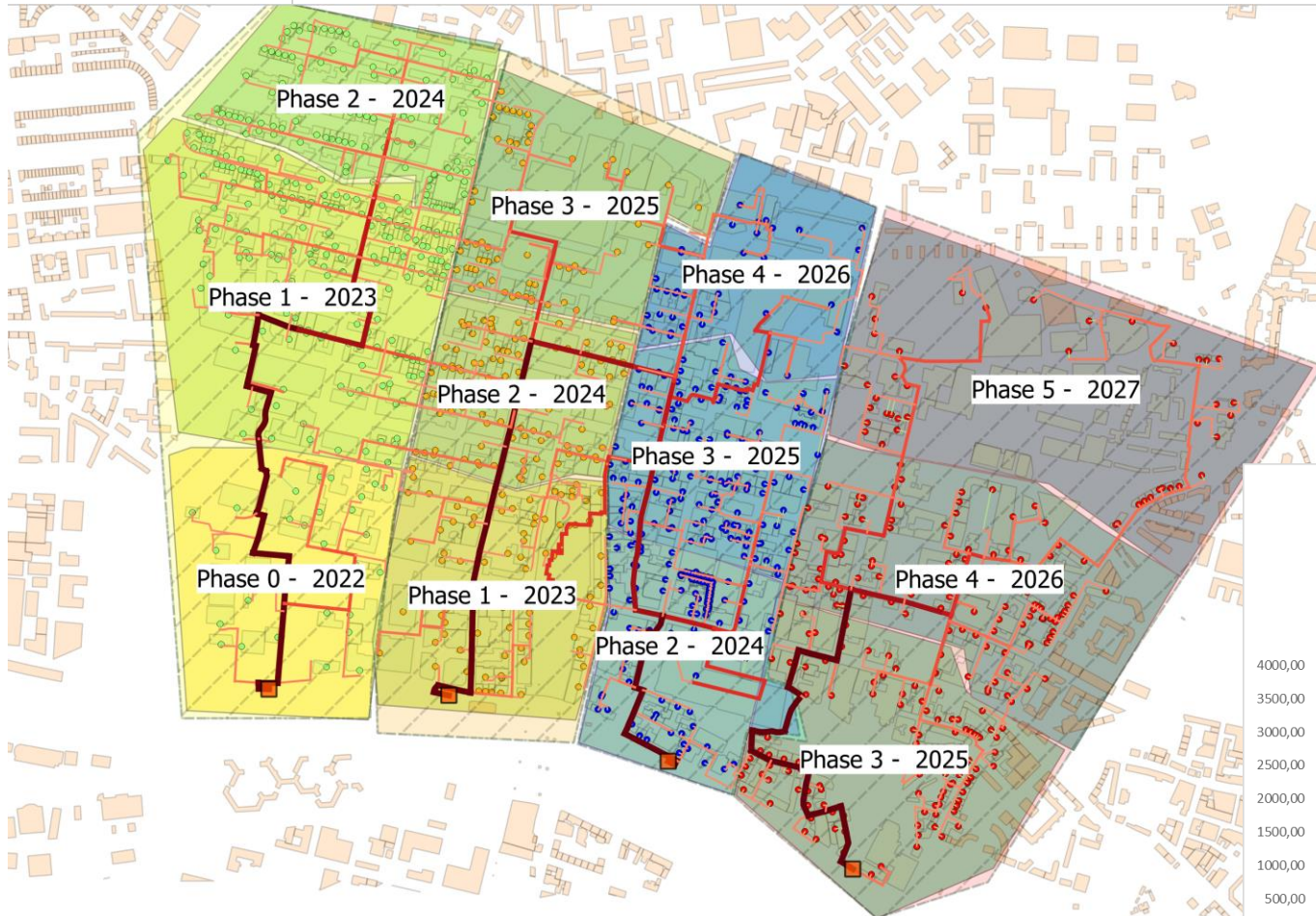
Rotterdam Engineering handles bigger projects with Comsof Heat

In brief

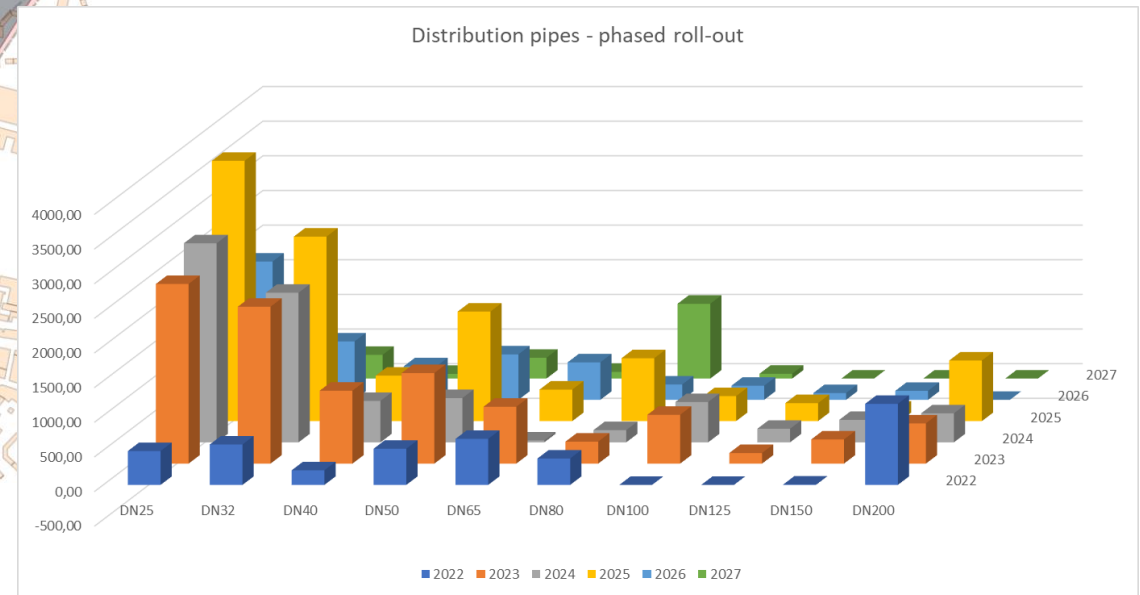
- ✓ Rotterdam Engineering is a key player in the DHC sector, and has lots of expertise in this field
- ✓ Fluvius, a utility infrastructure firm asked the company to execute a DHC feasibility study for about 14,000 potential customers, with a tight deadline
- ✓ With the help of Comsof Heat, Rotterdam Engineering was able to deliver a comprehensive study on time and in great detail



PHASED NETWORK ROLLOUT IN GLASGOW CITY CENTER



Feasibility Study



INSIGHT IN THE FINANCIALS - CAPEX

Bill of Material

Calculation Information

Area Name	Glasgow PoC
Design Rules	Rules2
Number of Homes	1341
Household Density (hh/sqkm)	0.00

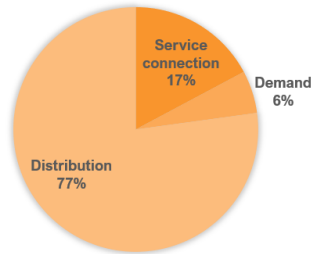
Cost Breakdown

Service connection	Network Cost	%
Demand	£43,419,181.63	17%
Distribution	£194,751,663.76	77%
Total	£252,394,095.39	100%

Results

Total Cost of Project	£252,394,095.39
Total Public trench length (m)	73,674.32
Total Network linear heat density (MWh/m)	1,904
Deployment Cost per Home	£188,213.34

Generated by Comsof Heat 20.2.1.1458



		Material Cost	Labour Cost	Total	Volume	Calculated Cost	Unit
Service connection							
4	Trench and pipe - DN100	£2,000.00	£0.00	£2,000.00	26.5	£52,972.82	Meter
5	Trench and pipe - DN25	£2,000.00	£0.00	£2,000.00	15608.8	£31,217,569.13	Meter
6	Trench and pipe - DN25 - footway	£2,000.00	£0.00	£2,000.00	43.4	£86,730.93	Meter
7	Trench and pipe - DN25 - path	£2,000.00	£0.00	£2,000.00	74.0	£147,943.42	Meter
8	Trench and pipe - DN25 - residential	£2,000.00	£0.00	£2,000.00	50.8	£101,681.83	Meter
9	Trench and pipe - DN25 - service	£2,000.00	£0.00	£2,000.00	90.4	£180,895.87	Meter
10	Trench and pipe - DN32	£2,000.00	£0.00	£2,000.00	3568.5	£7,136,953.21	Meter
11	Trench and pipe - DN32 - footway	£2,000.00	£0.00	£2,000.00	58.0	£115,942.19	Meter
12	Trench and pipe - DN32 - residential	£2,000.00	£0.00	£2,000.00	32.3	£64,604.95	Meter
13	Trench and pipe - DN32 - service	£2,000.00	£0.00	£2,000.00	102.7	£205,429.27	Meter
14	Trench and pipe - DN32 - steps	£2,000.00	£0.00	£2,000.00	9.7	£19,300.03	Meter
15	Trench and pipe - DN40	£2,000.00	£0.00	£2,000.00	1061.7	£2,123,300.51	Meter
16	Trench and pipe - DN40 - footway	£2,000.00	£0.00	£2,000.00	2.7	£5,480.10	Meter
17	Trench and pipe - DN50	£2,000.00	£0.00	£2,000.00	736.7	£1,473,481.46	Meter
18	Trench and pipe - DN65	£2,000.00	£0.00	£2,000.00	222.2	£444,321.34	Meter
19	Trench and pipe - DN65 - steps	£2,000.00	£0.00	£2,000.00	2.1	£4,209.27	Meter
20	Trench and pipe - DN80	£2,000.00	£0.00	£2,000.00	19.2	£38,365.31	Meter
Demand							
23	Extra activation cost per Home (Heat exchanger - power 400 to 1000kW)	£75,000.00	£150,000.00	£225,000.00	11.0	£2,475,000.00	Home
24	Extra activation cost per Home (Heat exchanger - power 1 to 50kW)	£2,500.00	£750.00	£3,250.00	925.0	£3,006,250.00	Home
25	Extra activation cost per Home (Heat exchanger - power 100 to 400kW)	£20,000.00	£10,000.00	£30,000.00	176.0	£5,280,000.00	Home
26	Extra activation cost per Home (Heat exchanger - Power > 1000 kW)	£100,000.00	£150,000.00	£250,000.00	3.0	£750,000.00	Home
27	Extra activation cost per Home (Heat exchanger - power 50 to 100kW)	£10,000.00	£2,000.00	£12,000.00	226.0	£2,712,000.00	Home
Distribution							
30	Trench and pipe - DN100 - cycleway	£2,000.00	£0.00	£2,000.00	32.1	£64,171.26	Meter
31	Trench and pipe - DN100 - footway	£2,000.00	£0.00	£2,000.00	1082.5	£2,164,904.14	Meter
32	Trench and pipe - DN100 - primary	£2,000.00	£0.00	£2,000.00	152.1	£304,258.88	Meter
33	Trench and pipe - DN100 - residential	£2,000.00	£0.00	£2,000.00	201.3	£402,581.47	Meter
34	Trench and pipe - DN100 - service	£2,000.00	£0.00	£2,000.00	326.8	£653,665.58	Meter
35	Trench and pipe - DN100 - tertiary	£2,000.00	£0.00	£2,000.00	136.0	£271,964.32	Meter
36	Trench and pipe - DN100 - unclassified	£2,000.00	£0.00	£2,000.00	819.8	£1,639,594.80	Meter
37	Trench and pipe - DN125 - cycleway	£2,000.00	£0.00	£2,000.00	44.4	£88,897.21	Meter
38	Trench and pipe - DN125 - footway	£2,000.00	£0.00	£2,000.00	248.4	£496,765.95	Meter
39	Trench and pipe - DN125 - residential	£2,000.00	£0.00	£2,000.00	161.7	£323,461.20	Meter
40	Trench and pipe - DN125 - tertiary	£2,000.00	£0.00	£2,000.00	117.1	£234,206.34	Meter
41	Trench and pipe - DN125 - unclassified	£2,000.00	£0.00	£2,000.00	395.4	£790,716.85	Meter
42	Trench and pipe - DN150 - footway	£2,000.00	£0.00	£2,000.00	123.2	£246,494.57	Meter



INCLUDES CATALOGS FOR MOST COMMON PIPE MANUFACTURERS

Comsof Heat



Others can easily be added by means of a table in a predefined format in .csv file

INSIGHT IN THE FINANCIALS - OPEX

Investment analysis

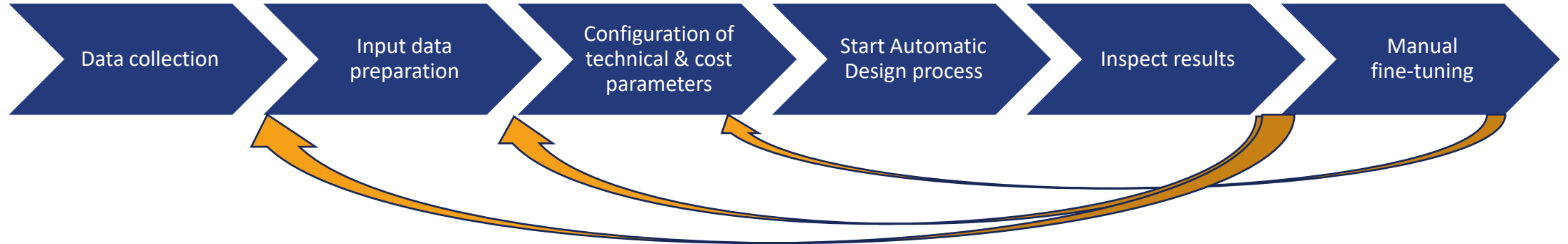
		0	1	2	3	4	5	6	7	8	9	10
1 Network & energy evolution												
2 Year		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
3 Additional energy demand (sold) in year x	MWh		4445.00	5354.00	4695.00	3495.00	2468.00	1513.00	1468.00	3565.00	2486.00	2586.00
4 Cumulative energy demand (sold)	MWh		4445.00	9799.00	14494.00	17989.00	20457.00	21970.00	23438.00	27003.00	29489.00	32075.00
5 Heat Losses (distribution losses)	MWh		335.98	689.92	994.09	1202.65	1456.66	1636.39	1829.16	2134.75	2328.67	2545.34
6 Total energy demand production (sold+distribution losses)	MWh		4780.98	10488.92	15488.09	19191.65	21913.66	23606.39	25267.16	29137.75	31817.67	34620.34
7 Total pipe network length in use	km		2.21	4.52	6.54	8.04	9.69	10.96	12.39	14.37	15.80	17.38
8 Pipe Network length deployed in year x	km		2.21	2.31	2.02	1.50	1.65	1.26	1.43	1.98	1.43	1.59
11 Investment costs												
12 Network deployment cost			1,332,114 €	1,075,885 €	886,965 €	534,644 €	759,147 €	481,435 €	470,857 €	878,424 €	490,103 €	535,454 €
14 Cost of operation												
15 Heat production cost			95,620 €	209,778 €	309,762 €	383,831 €	438,273 €	472,128 €	505,343 €	582,755 €	636,353 €	692,407 €
16 Pump energy cost			12,998 €	14,599 €	20,755 €	21,761 €	23,829 €	25,301 €	27,907 €	33,731 €	40,736 €	53,511 €
17 Fixed operation and maintenance cost			9,991 €	18,060 €	24,712 €	28,722 €	34,416 €	38,026 €	41,558 €	48,146 €	51,922 €	55,838 €
18 Variable operation and maintenance cost			2,390 €	5,244 €	7,744 €	9,596 €	10,957 €	11,803 €	12,634 €	14,569 €	15,909 €	17,310 €
20 Total cash out			1,332,114 €	1,196,884 €	1,134,647 €	897,618 €	1,203,060 €	988,910 €	1,018,116 €	1,465,866 €	1,169,304 €	1,280,274 €
23 Subsidy												
24 Government subsidy network investment			199,817 €	161,383 €	133,045 €	80,197 €	113,872 €	72,215 €	70,629 €	131,764 €	73,515 €	80,318 €
25 Government subsidy on energy production			28,686 €	62,934 €	92,929 €	115,150 €	131,482 €	141,638 €	151,603 €	174,826 €	190,906 €	207,722 €
28 Sales												
29 Total yearly sales turnover			188,913 €	416,458 €	615,995 €	764,533 €	869,423 €	933,725 €	996,115 €	1,147,628 €	1,253,283 €	1,363,188 €
30 Total cash in			199,817 €	378,981 €	612,436 €	789,120 €	993,555 €	1,073,140 €	1,167,344 €	1,379,418 €	1,444,194 €	1,650,908 €
33 Total cash flow			-1,132,297 €	-817,903 €	-522,211 €	-108,497 €	-209,505 €	84,224 €	149,228 €	918,252 €	287,890 €	370,634 €
34 Cumulative Cash flow			-1,132,297 €	-1,950,199 €	-2,472,410 €	-2,580,908 €	-2,790,413 €	-2,706,189 €	-2,556,961 €	-1,388,709 €	49,181 €	419,815 €
35 NPV			2,858,356 €									
36 IRR			9.71%									
37 Payback time			13									



33 GBP	NPV	IRR	Payback time
6p	-187,318,676	-3.96	N/A
8p	-137,283,202	-0.49	N/A
10p	-87,247,727	1.47	43
12p	-37,212,252	3	32
15 GBP	NPV	IRR	Payback time
6p	-134,327,755	-0.35	N/A
8p	-84,292,280	1.57	42
10p	-34,256,805	3.08	32
12p	15,778,670	4.4	26

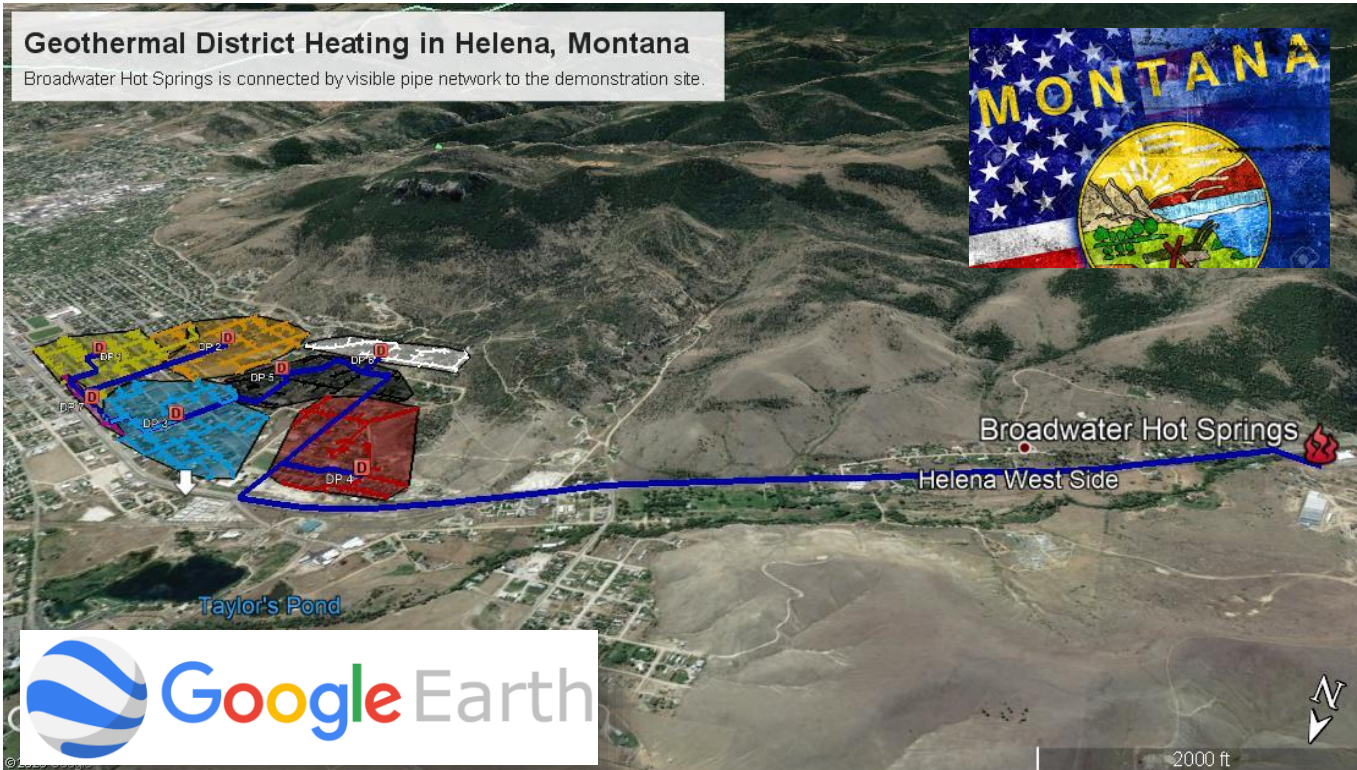


TAKE BETTER DECISIONS BASED ON SCENARIO ANALYSIS



Geothermal District Heating in Helena, Montana

Broadwater Hot Springs is connected by visible pipe network to the demonstration site.



- USA, Montana
- Geothermal Heat source
- 1400 single family homes from the sixties
- Final design selected after ***analysis of 55 different design schemes***
- ***Each network design run takes 2 to 5 minutes***

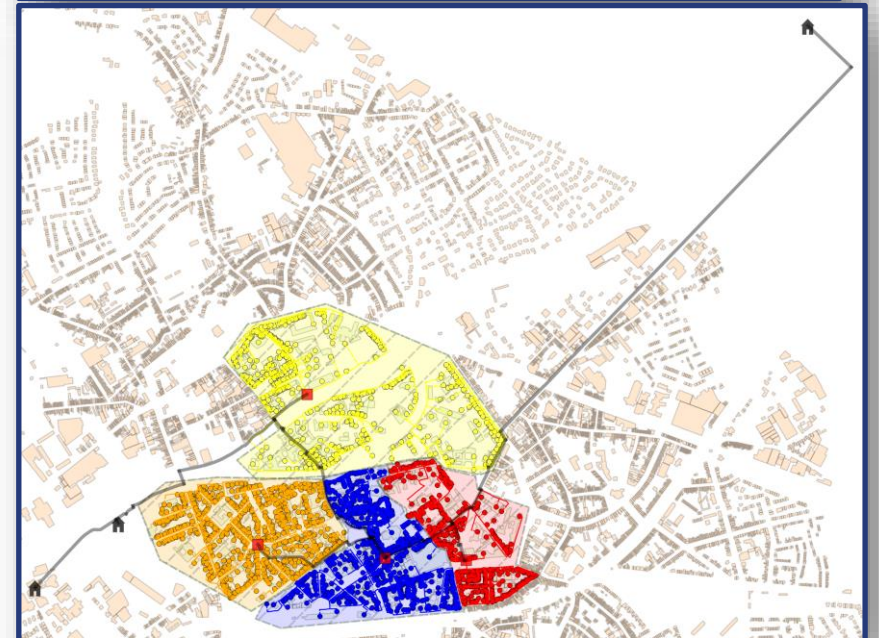
White Paper: Rapid Geothermal District Heating Assessments in the Rural United States

<https://comsof.com/heat/blog/>

SELECT THE OPTIMAL TYPE, LOCATION AND AMOUNT OF HEAT SOURCES

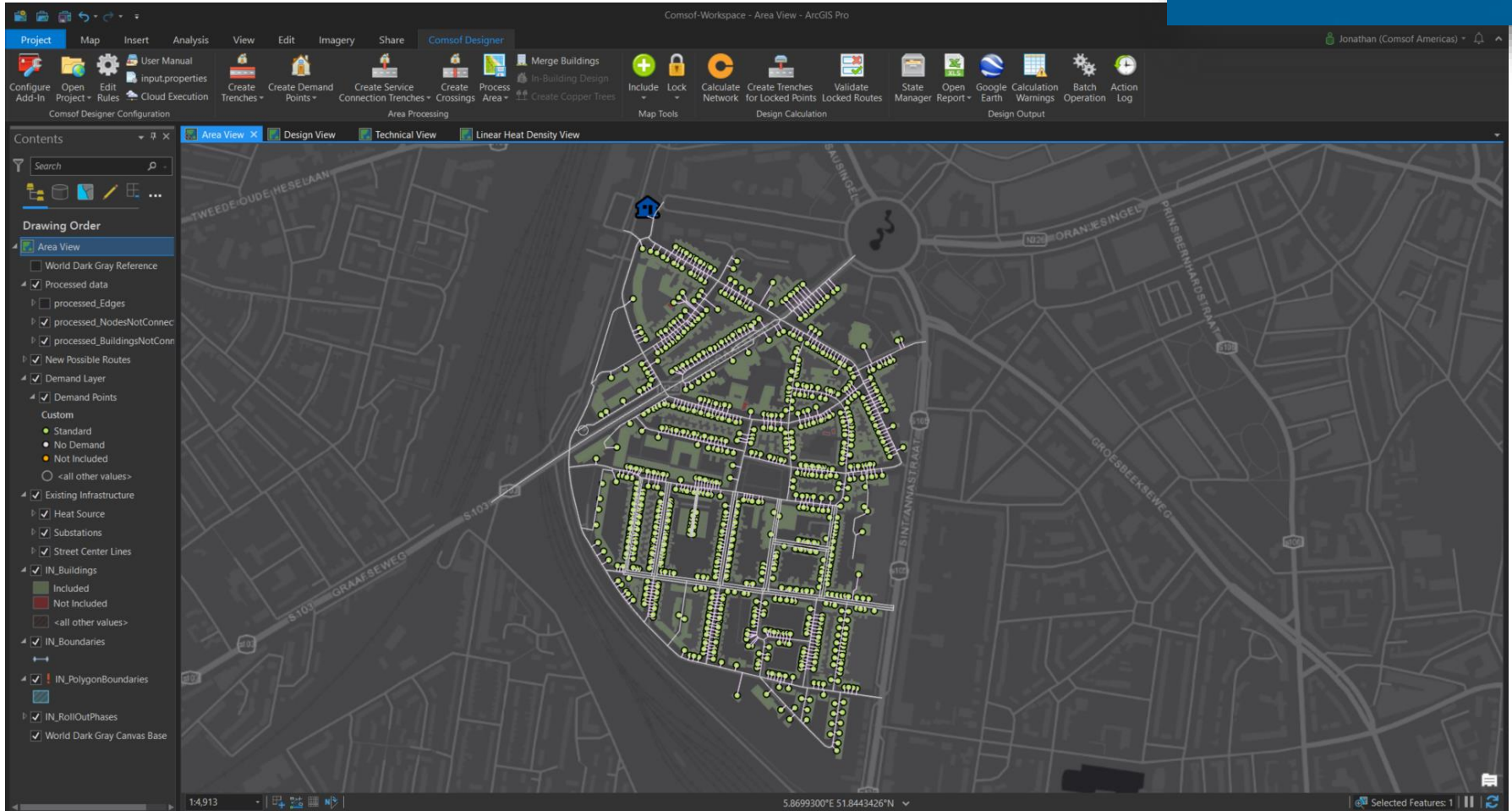
Comsof Heat

- **Multiple source** network design
- Optimize for
 - Lowest CAPEX
 - Highest carbon reduction
 - Lowest Energy production costs
 - Or a combination of the above
- while selecting the available sources in the area

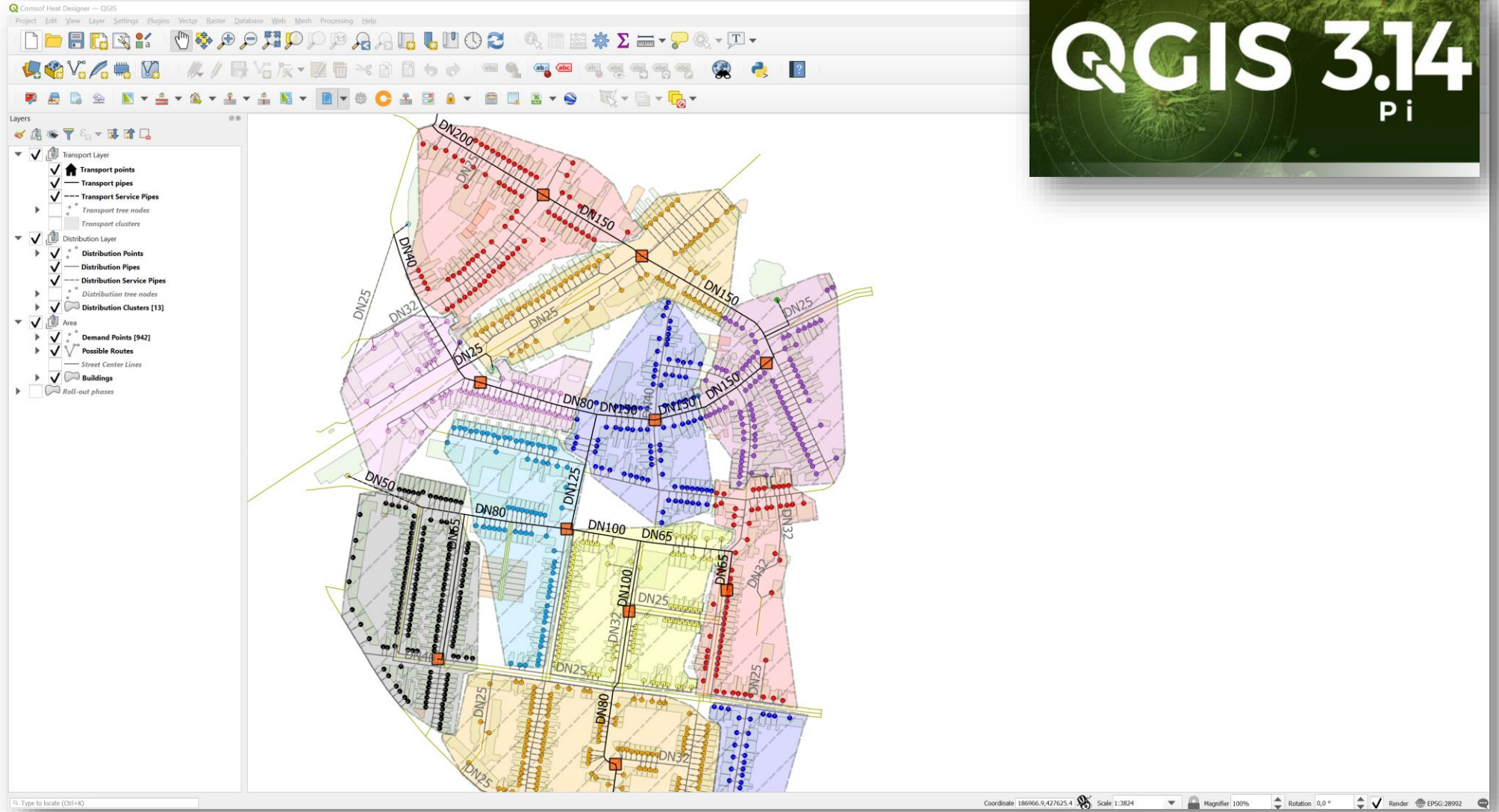


Feasibility Study

GIS INTEGRATION : PLUG-IN FOR ARCGIS PRO

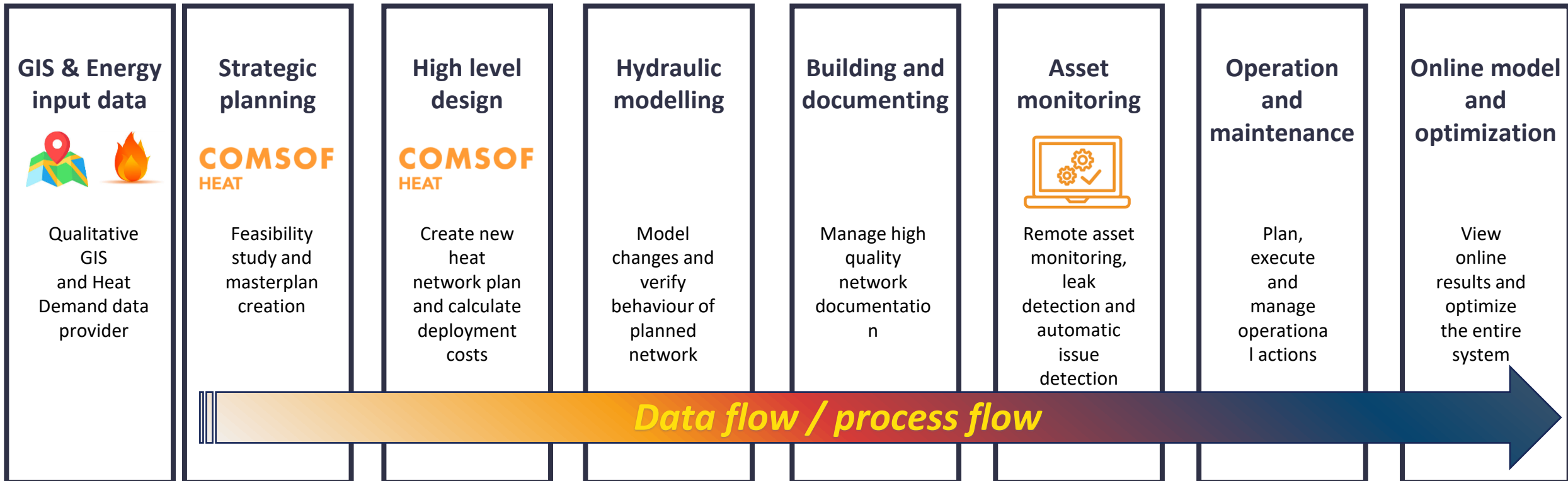


GIS INTEGRATION : PLUG-IN FOR QGIS



SOFTWARE PARTNERS – OPEN PLATFORM

Heat network lifecycle



COMSOF HEAT REFERENCES



WITH COMSOF HEAT YOU CAN HANDLE LARGER PROJECTS. FOR A PROJECT WHERE YOU WOULD NEED **THREE MONTHS DESIGN TIME** YOU CAN NOW DO THE SAME CALCULATIONS IN A **NUMBER OF DAYS**, AND WITH **MORE DETAIL**

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



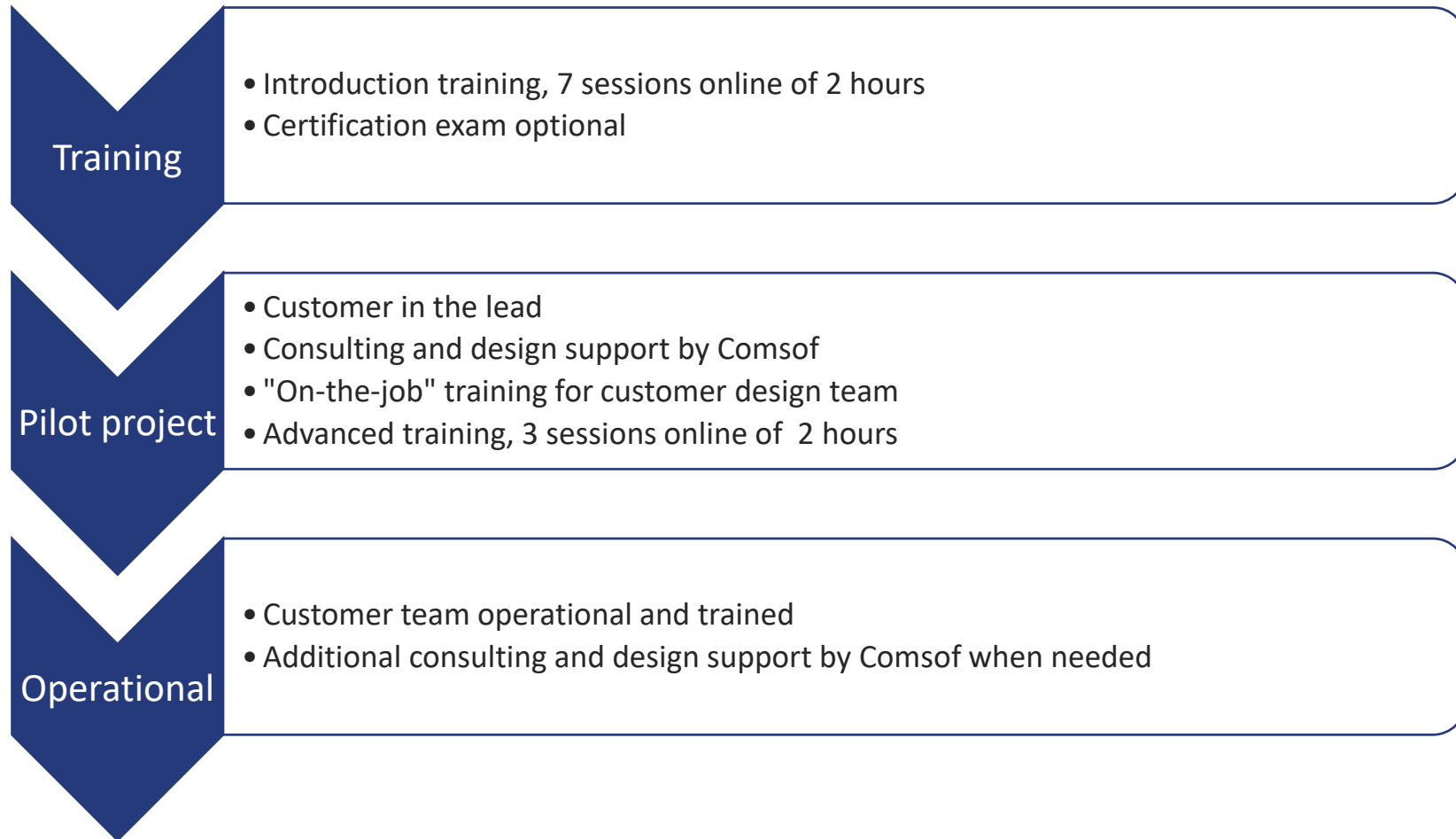


GETTING STARTED

[comsol.com](https://www.comsol.com)

GETTING STARTED

COMSOF HEAT



COMSOF TRAINING OFFERING

Comsof Heat

Classroom training

1. Basic training: 2 days
2. Advanced training: 1 day



Online training

- Basic: 7 sessions of 2 hrs
- Advanced: 3 sessions of 2 hrs



Online training –
based on video
tutorials



Includes Theory and
Practice

Exam to obtain a
Certificate



Train the trainer

- Online workshop – 4 sessions
- This workshop will introduce you to
 - The Comsof Heat planning methodology
 - Practical use of Comsof Heat with hands-on exercises
- An opportunity to see if the software is suitable for your type of projects.
- Places are limited and registration is required

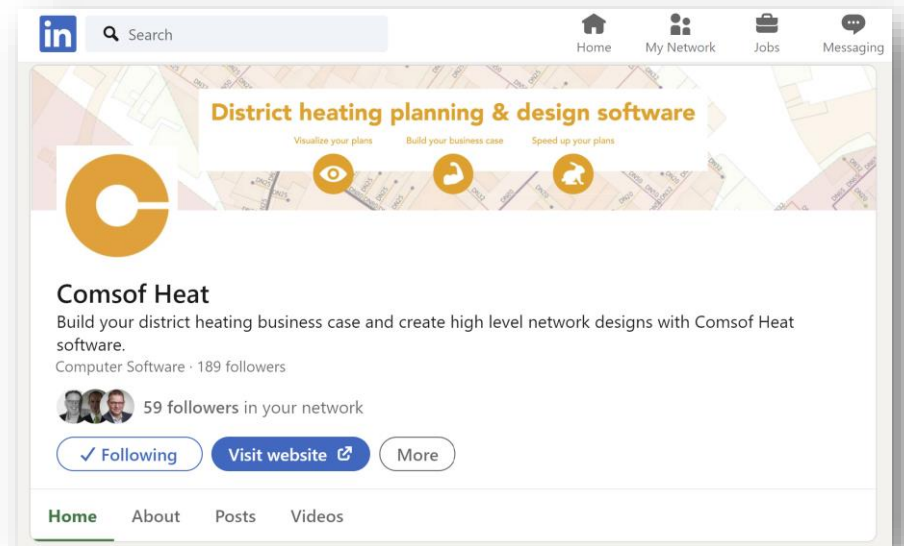
Edition April/May – ongoing – fully booked

Edition Sept/Oct 2021–

follow our linked-in page to get informed when registrations open

Linked 

@comsof heat on linked-in



ONLINE TRAINING WITH VIDEO TUTORIALS

Comsof Heat

- Software license for max 2 persons per company for a period of 2 months
- You will receive training material consisting of:
 - Training slides (140+)
 - Access to online manual
 - Project files for hands-on exercises
 - Step by step guide through the exercises via video tutorials online
 - Access to Comsof customer support portal for questions
- Fully functional software for a period of 2 months for a limited geographic area
- NDA signature required





CASE GLASGOW HEAT VISION 2030

United Kingdom



GIS-based software for granular and accurate heat network planning and design



Big river-source heat pumps for heat networks



Global leader in building performance analysis and insight



Real-time, online, and optimised heat network operation

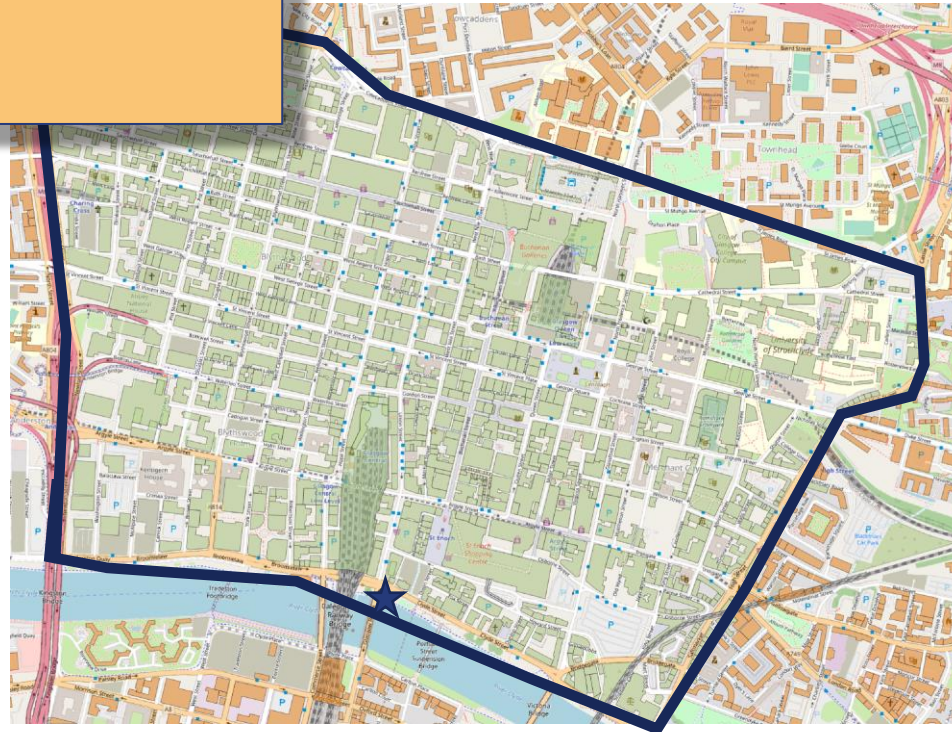


U.K'S LEADING FIRM FOR HEAT NETWORK BUILD AND OPERATION

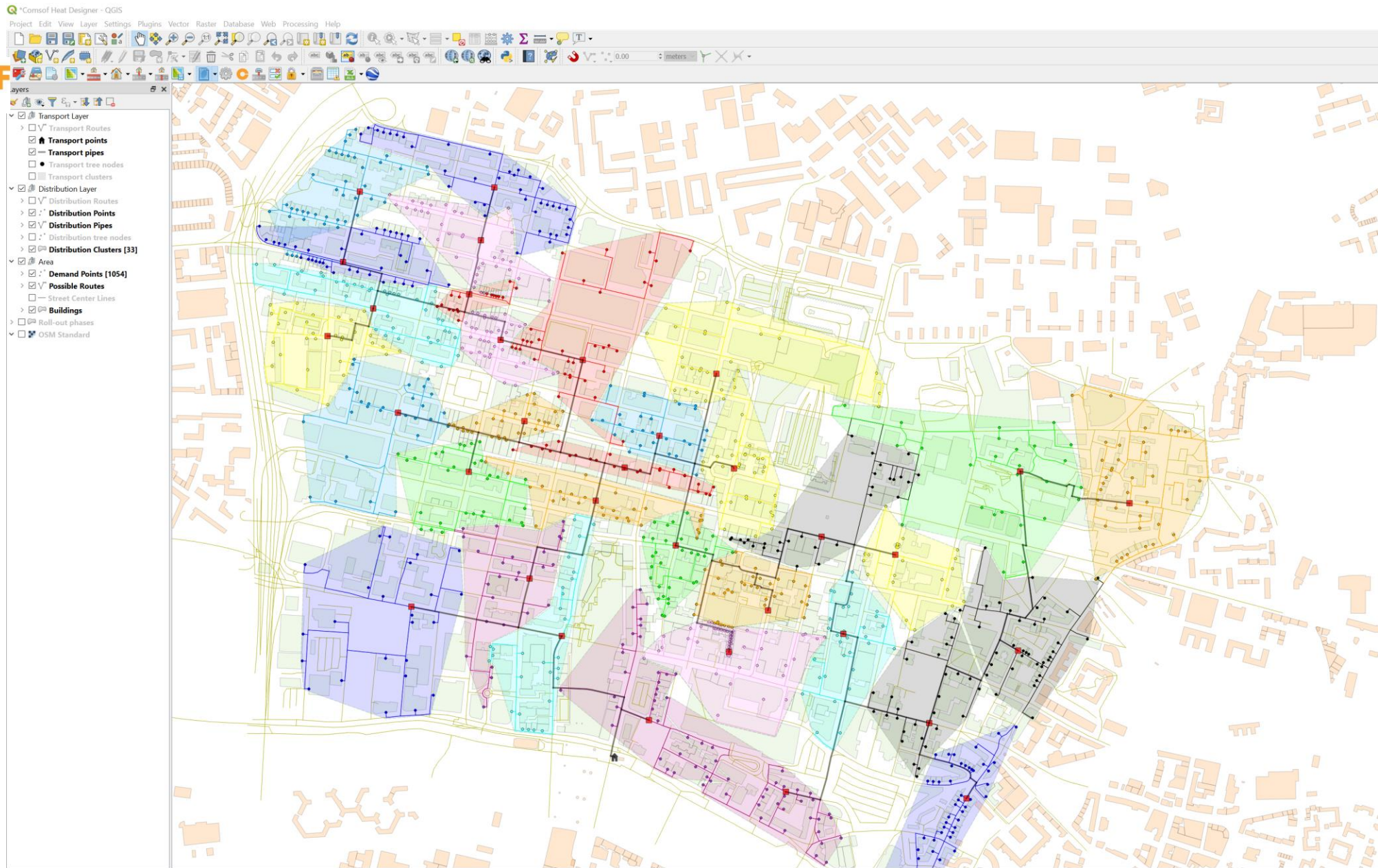
SCENARIO 1 – SINGLE SOURCE NEAR THE RIVER

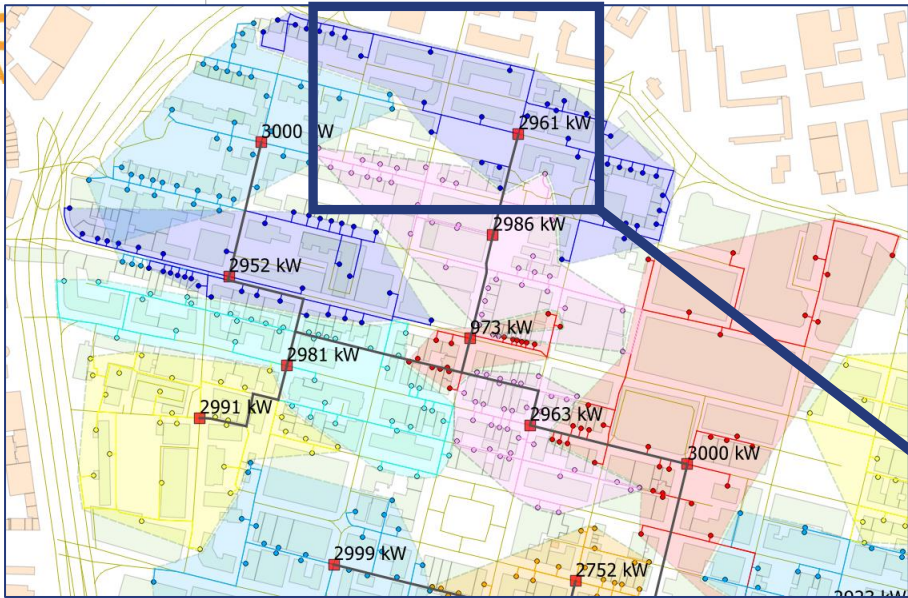
District Heating

- Design a district heating network for the city center
 - + 1000 buildings
- Network deployment cost
- Source power requirements
- Economical feasibility over 40 years



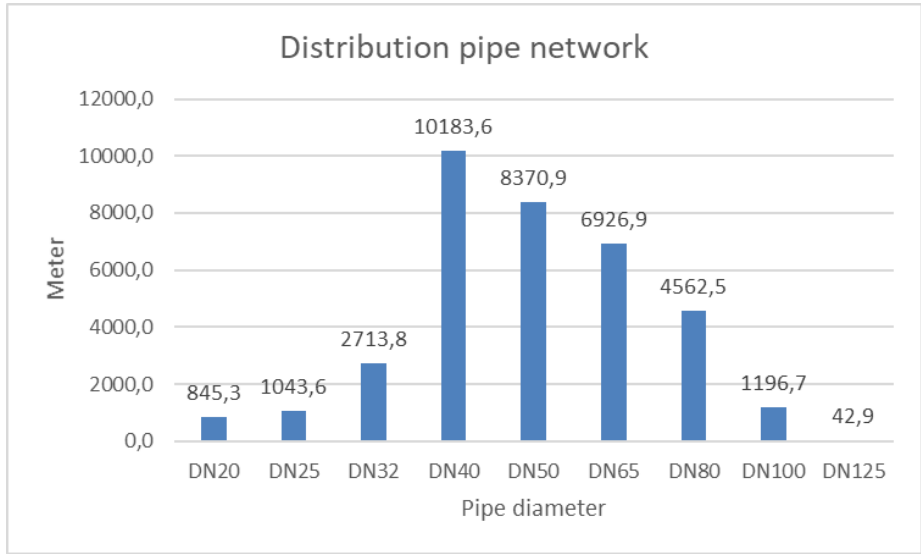
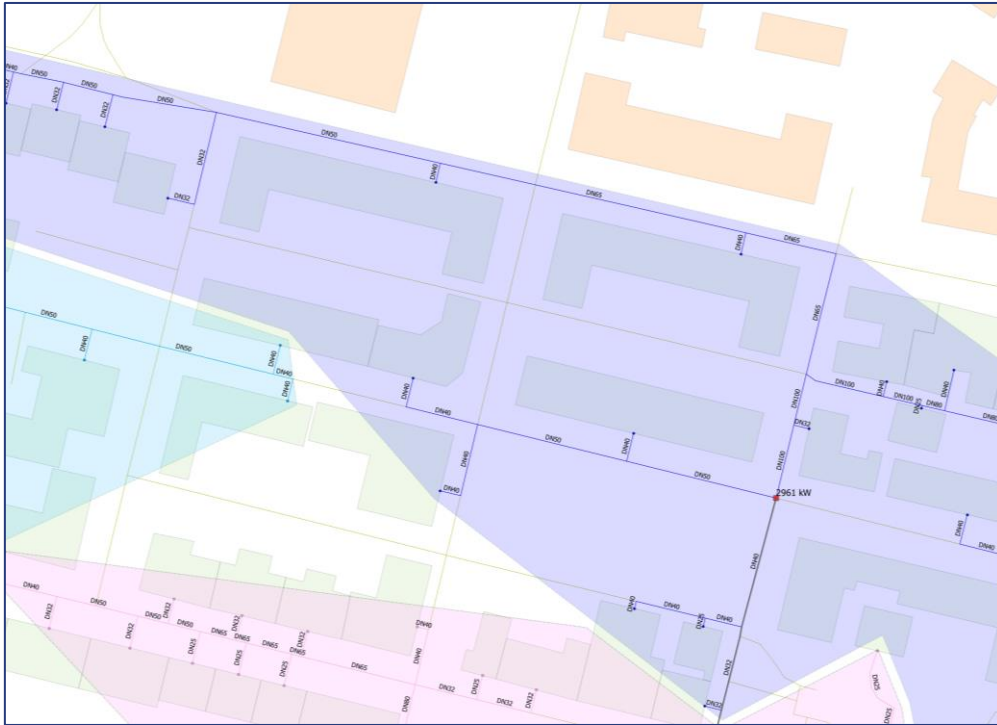
★ Source location





Distribution network:

- Steel pipes
- At 10 bar
- Length of distribution network: 35886 meter (street pipes)



Search

Search

Get Directions History

Places

- My Places
 - Sightseeing Tour
 - Make sure 3D Buildings layer is checked
- Temporary Places
 - EarthView
 - QGisPlaceMark
 - OUT_GoogleEarthView.kmz
 - Demand_Layer
 - Distribution_Layer
 - Transport_Layer
 - Transport_Points
 - Transport_Pipes
 - Unknown_Pipes
 - Transport_Polygons

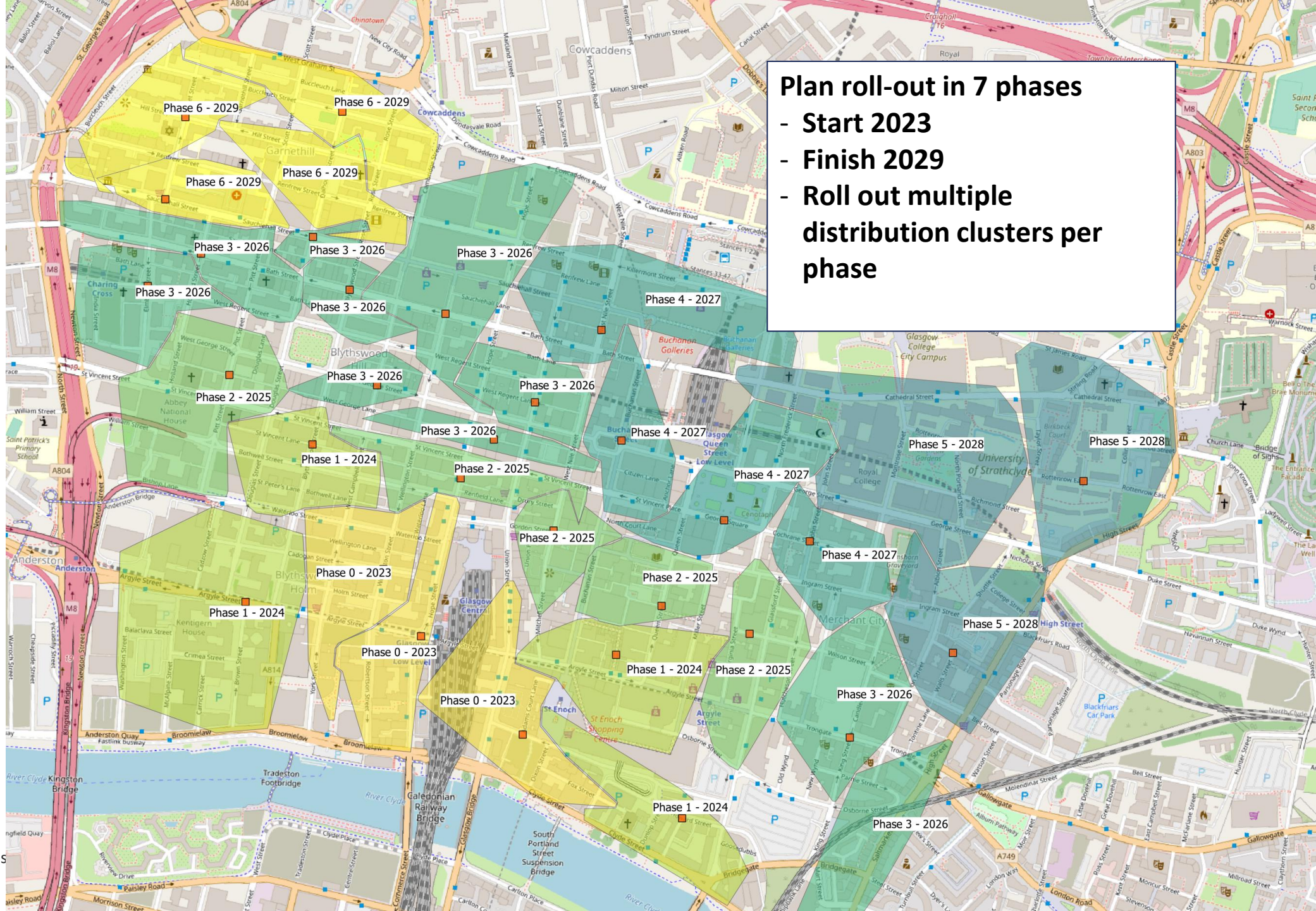
Layers

- Primary Database
 - Announcements
 - Borders and Labels
 - Places
 - Photos
 - Roads
 - 3D Buildings
 - Ocean
 - Weather
 - Gallery
 - Global Awareness
 - More
 - Terrain



Plan roll-out in 7 phases

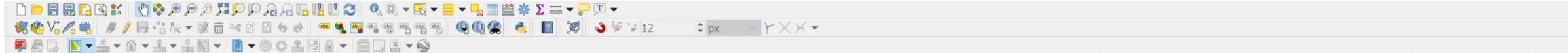
- Start 2023
- Finish 2029
- Roll out multiple distribution clusters per phase



Phase 0 - 2023

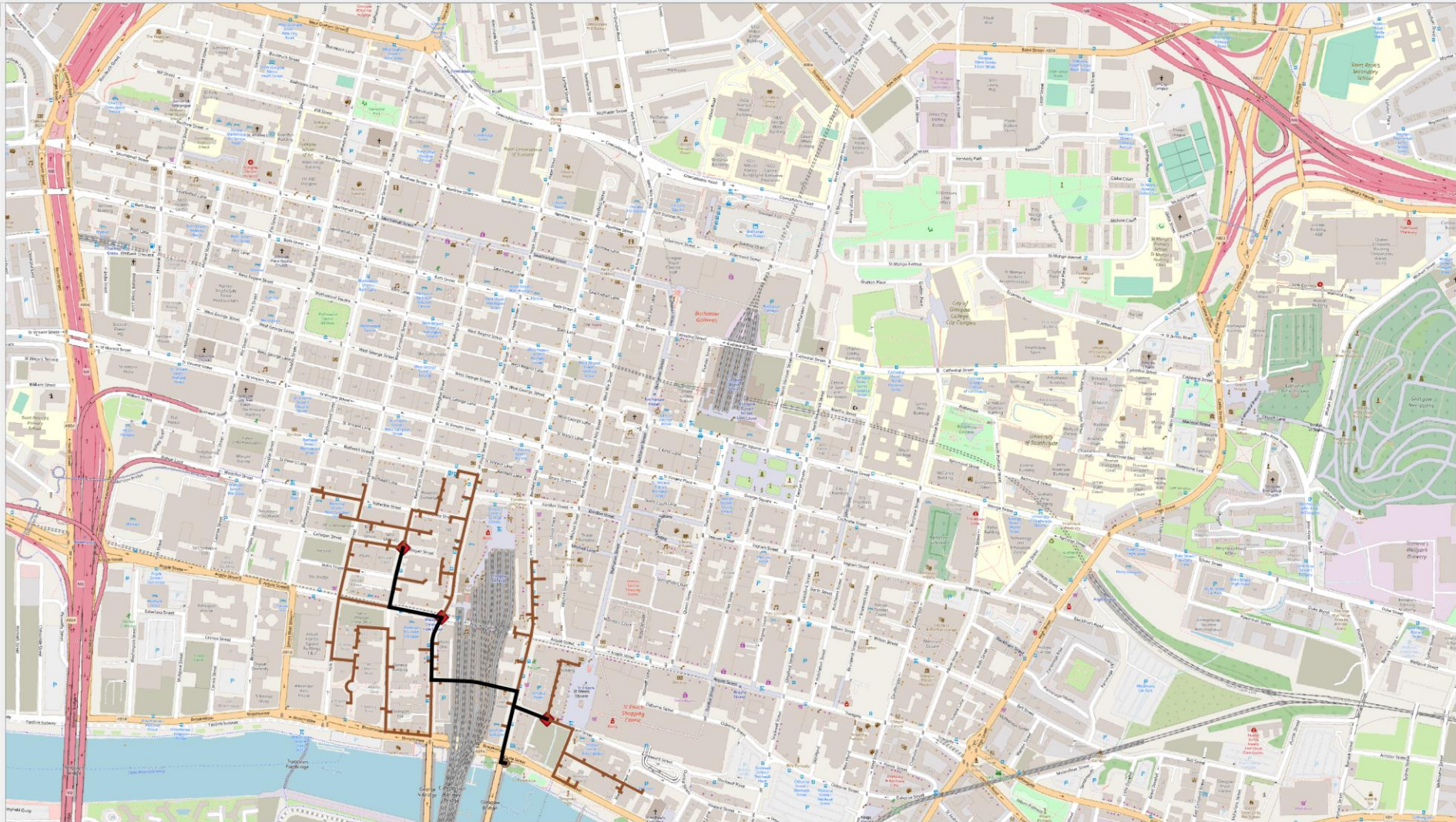
QGIS - QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help



Layers

- IN_Buildings
- Phase 0
- Phase 1
- Phase 2
- Phase 3
- Phase 4
- Phase 5
- Phase 6
- Phase 7
- OSM Standard



Q Type to locate (Ctrl+K)

Coordinate: 257880.5, 666091.6 Scale: 1:8091 Magnifier: 100% Rotation: 0.0° Render EPSG:27700

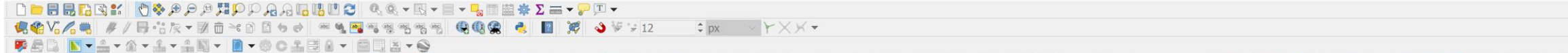


15:05 15/02/2020

Phase 1 - 2024

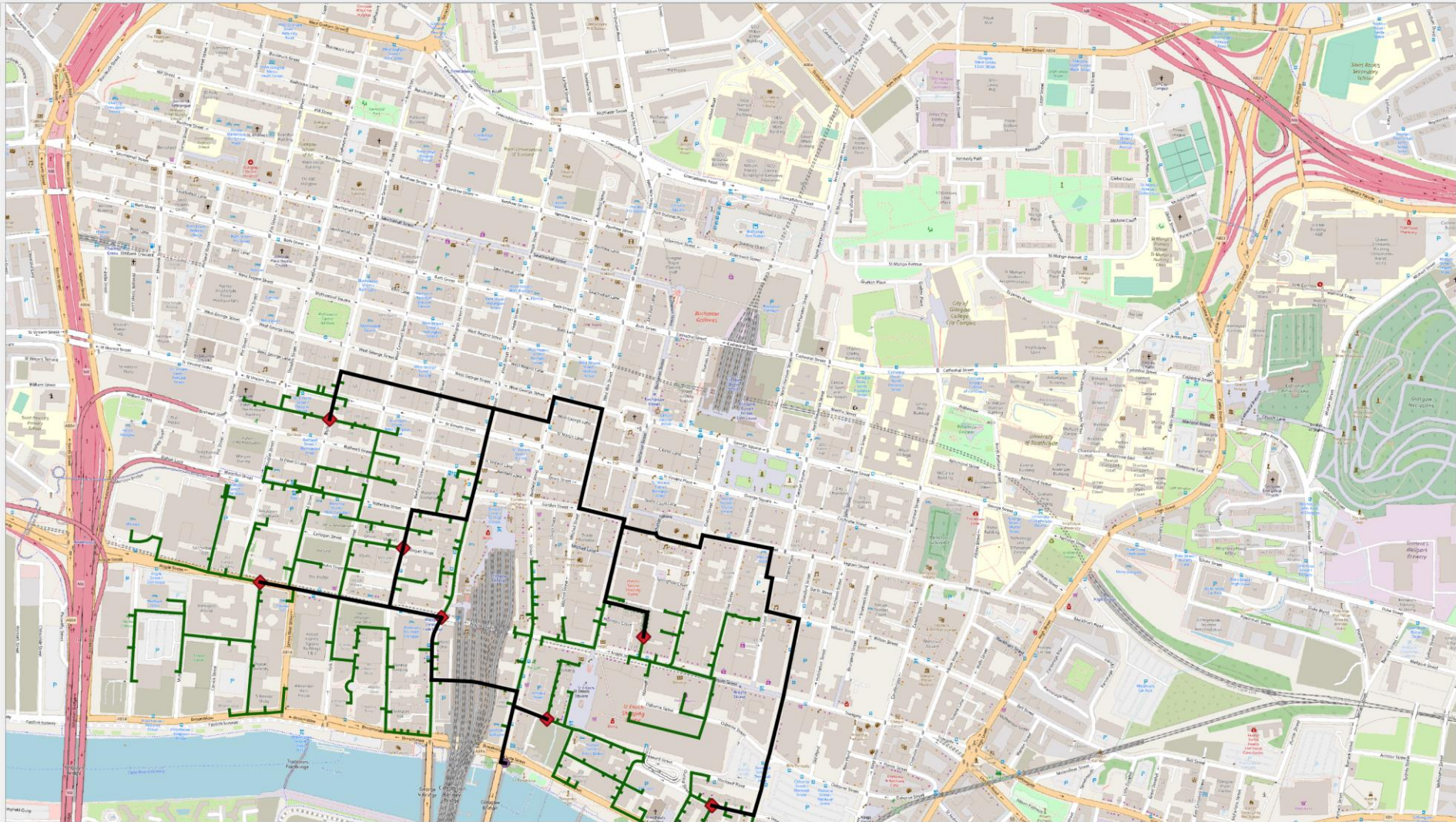
Q*rollout - QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help



Layers

- IN_Buildings
- > Phase 0
- > Phase 1
- > Phase 2
- > Phase 3
- > Phase 4
- > Phase 5
- > Phase 6
- > Phase 7
- > OSM Standard



Q Type to locate (Ctrl+K)

Coordinate: 259120.5,664753.2 Scale: 1:8091 Magnifier: 100% Rotation: 0.0° Render EPSG:27700



Phase 2 - 2025

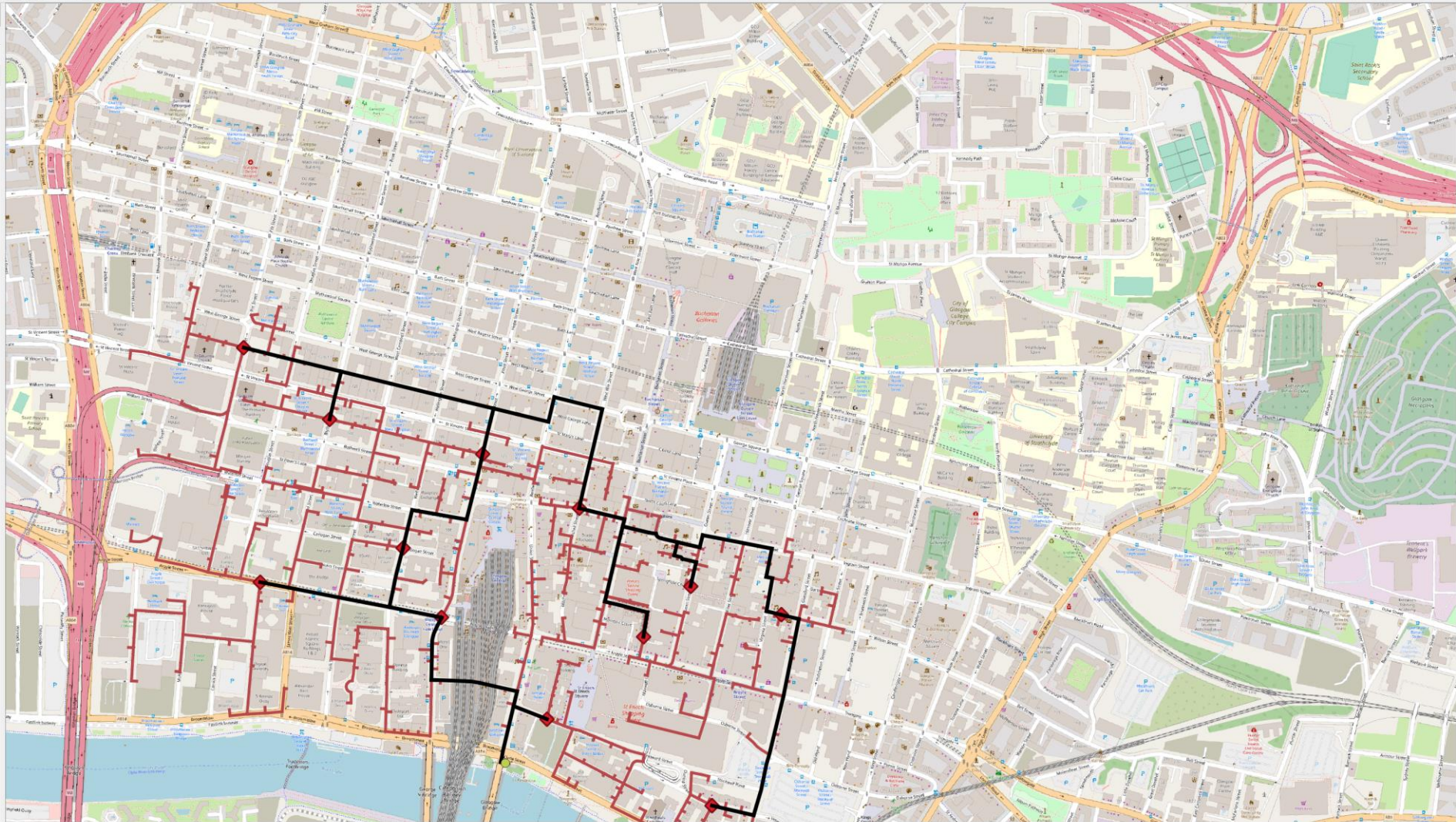
Q*rollout - QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help



Layers

- IN_Buildings
- > Phase 0
- > Phase 1
- > Phase 2
- > Phase 3
- > Phase 4
- > Phase 5
- > Phase 6
- > Phase 7
- > OSM Standard



Q Type to locate (Ctrl+K)

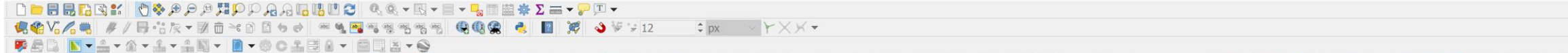
Coordinate: 259173.5,664765.2 Scale: 1:8091 Magnifier: 100% Rotation: 0.0° Render EPSG:27700



Phase 3 - 2026

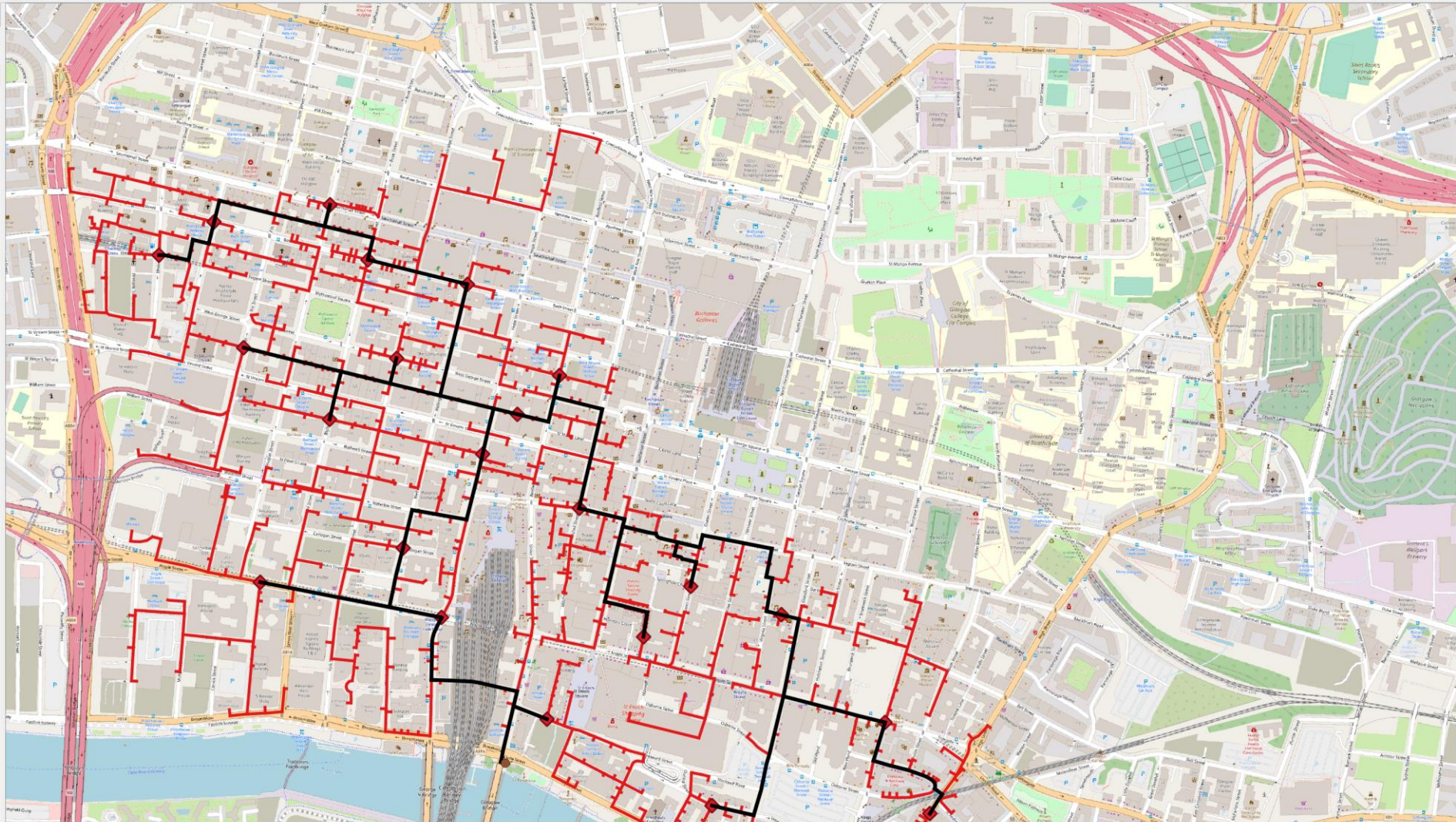
rollout - QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help



Layers

- IN_Buildings
- > Phase 0
- > Phase 1
- > Phase 2
- > Phase 3
- > Phase 4
- > Phase 5
- > Phase 6
- > Phase 7
- > OSM Standard



Q Type to locate (Ctrl+K)

Coordinate: 259100.8,664753.2 Scale: 1:8091 Magnifier: 100% Rotation: 0.0° Render EPSG:27700



Phase 4 - 2027

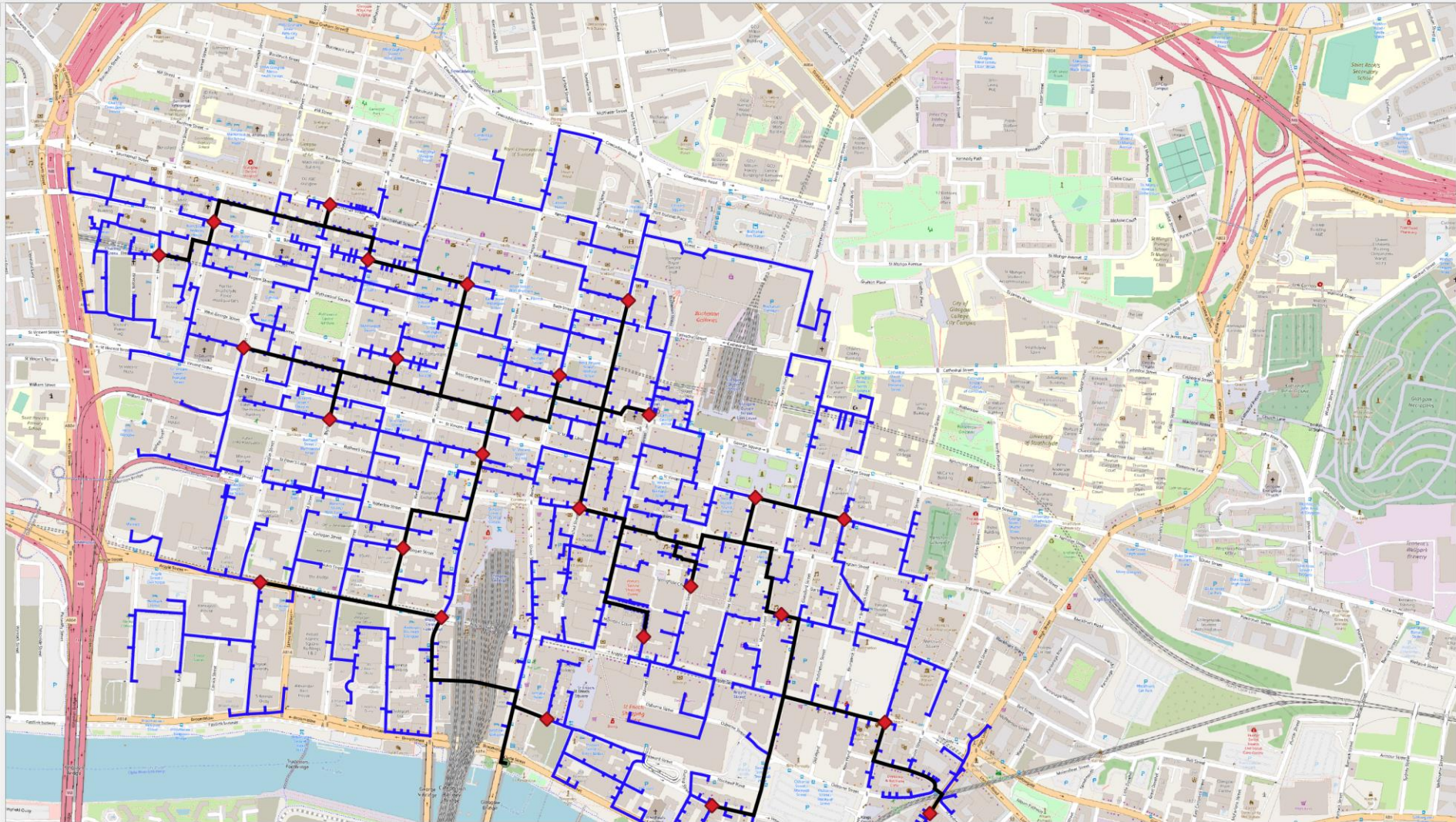
QGIS - QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help



Layers

- IN_Buildings
- > Phase 0
- > Phase 1
- > Phase 2
- > Phase 3
- > Phase 4
- > Phase 5
- > Phase 6
- > Phase 7
- > OSM Standard



Q Type to locate (Ctrl+K)

Coordinate: 259139,3,664753.2 Scale: 1:8091 Magnifier: 100% Rotation: 0.0° Render EPSG:27700



Phase 5 - 2028

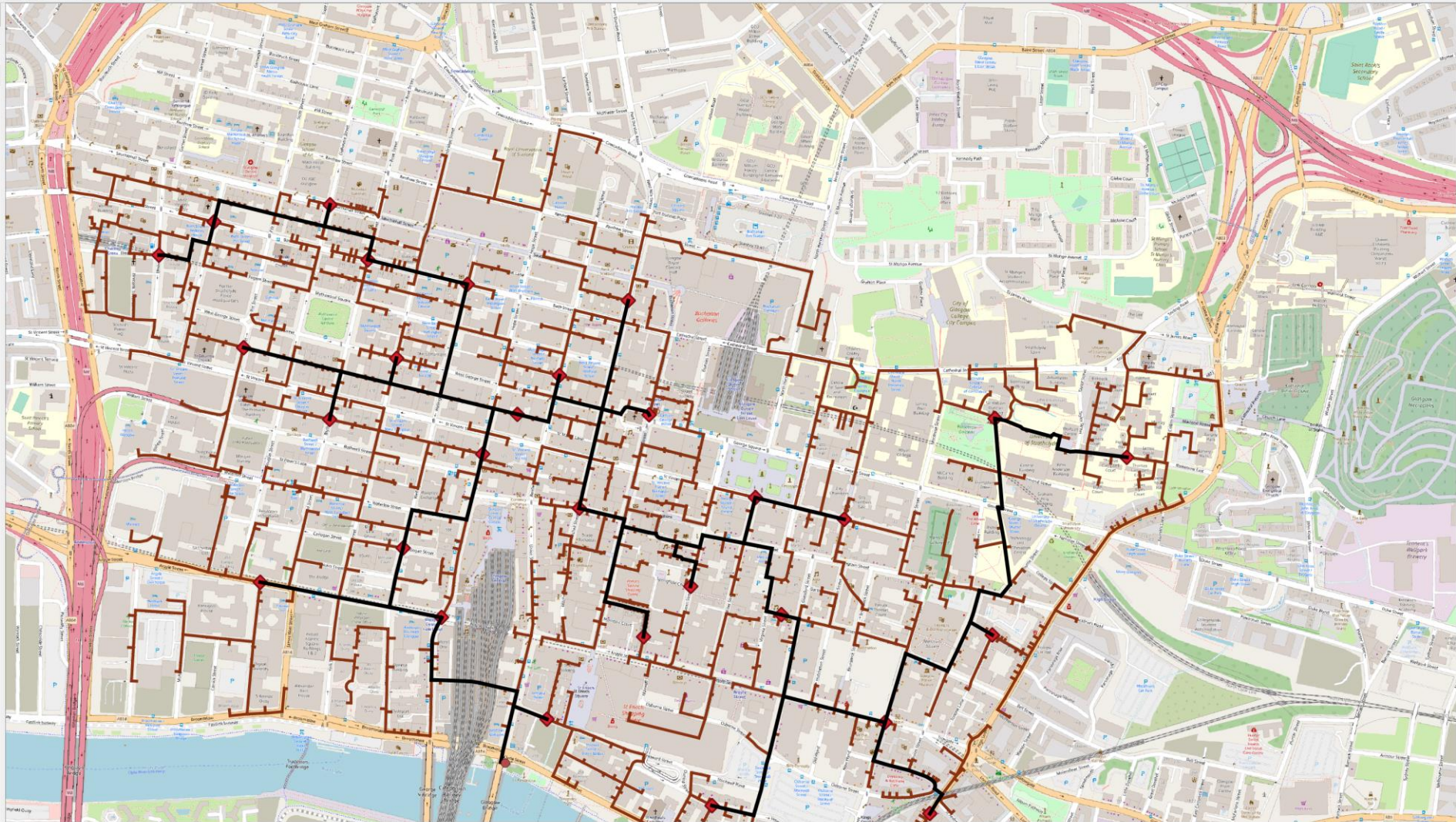
QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help



Layers

- IN_Buildings
- Phase 0
- Phase 1
- Phase 2
- Phase 3
- Phase 4
- Phase 5
- Phase 6
- Phase 7
- OSM Standard



Q Type to locate (Ctrl+K)

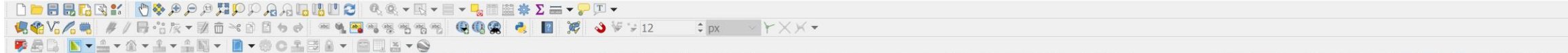
Coordinate: 259189.0,664754.9 Scale: 1:8091 Magnifier: 100% Rotation: 0.0° Render EPSG:27700



Phase 6 - 2029

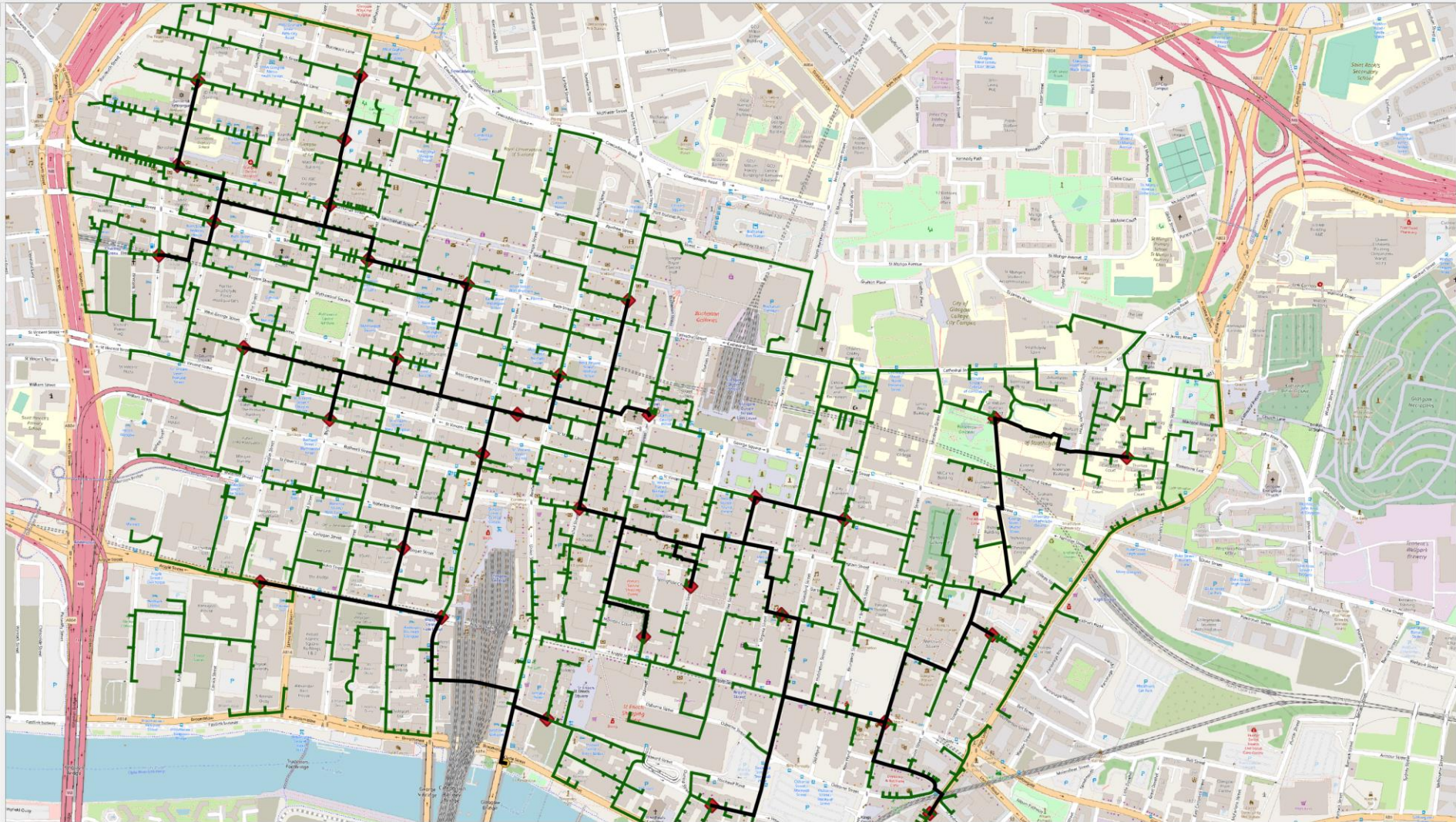
rollout - QGIS

Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Help



Layers

- IN_Buildings
- > Phase 0
- > Phase 1
- > Phase 2
- > Phase 3
- > Phase 4
- > Phase 5
- > Phase 6
- > Phase 7
- > OSM Standard



Type to locate (Ctrl+K)

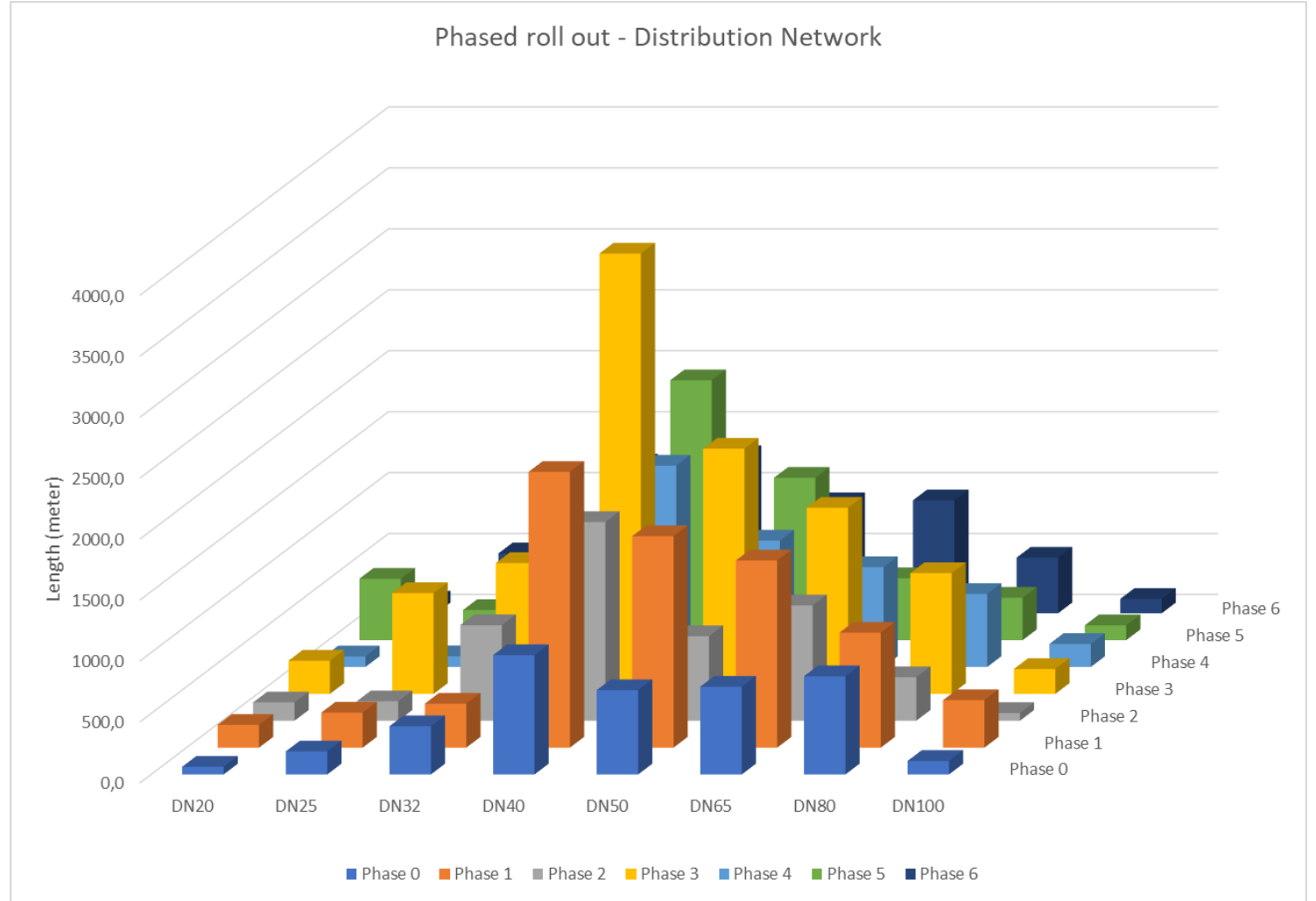
Coordinate: 259065.6,664754.9 Scale: 1:8091 Magnifier: 100% Rotation: 0.0° Render EPSG:27700



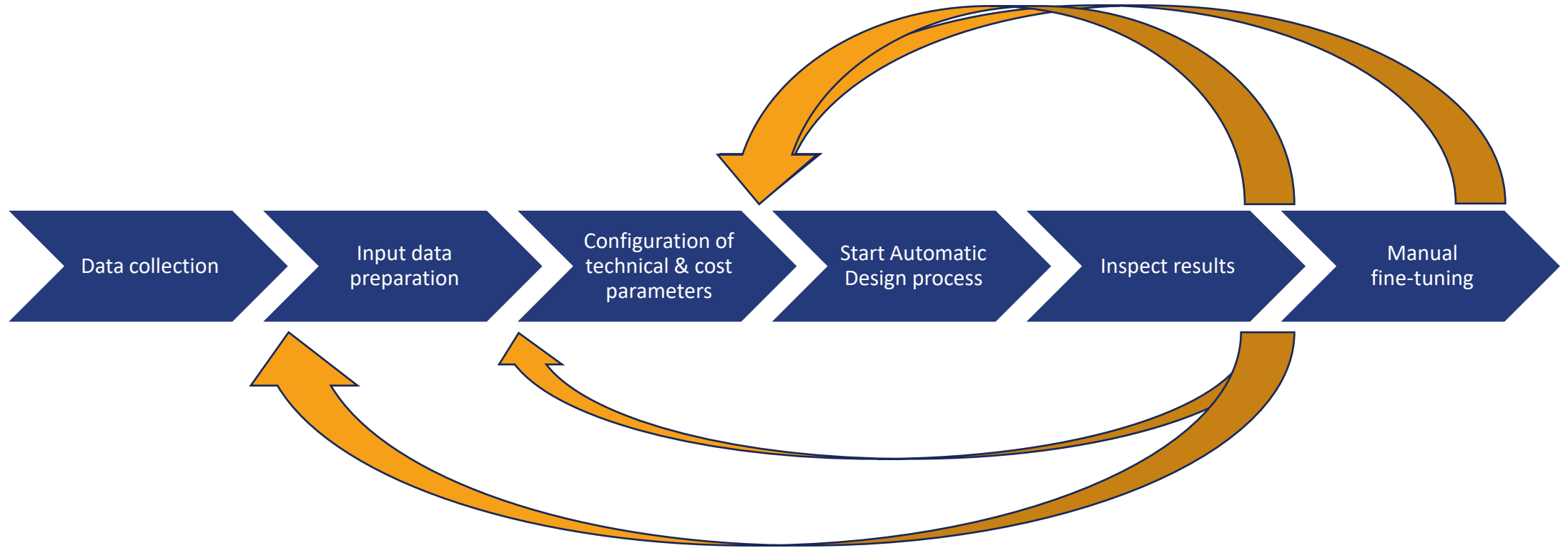
DEPLOYMENT PHASES

Pipe types

	Phase 0	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
DN20	63,2	186,7	150,1	272,1	86,6	504,3	95,9
DN25	189,3	286,7	159,2	826,7	88,5	247,3	491,9
DN32	395,5	360,8	784,0	1073,1	467,5	501,3	1221,3
DN40	978,8	2261,6	1629,9	3612,1	1652,2	2132,1	1289,9
DN50	691,3	1733,8	693,6	2010,8	1037,0	1331,7	903,4
DN65	720,2	1534,1	946,4	1526,5	819,4	508,2	927,1
DN80	805,2	942,2	357,1	990,7	599,8	347,9	456,7
DN100	110,8	389,2	63,3	204,4	189,0	122,0	118,0
Total (meter)	3954,3	7695,1	4783,6	10516,4	4939,9	5694,7	5504,1



SCENARIO ANALYSIS

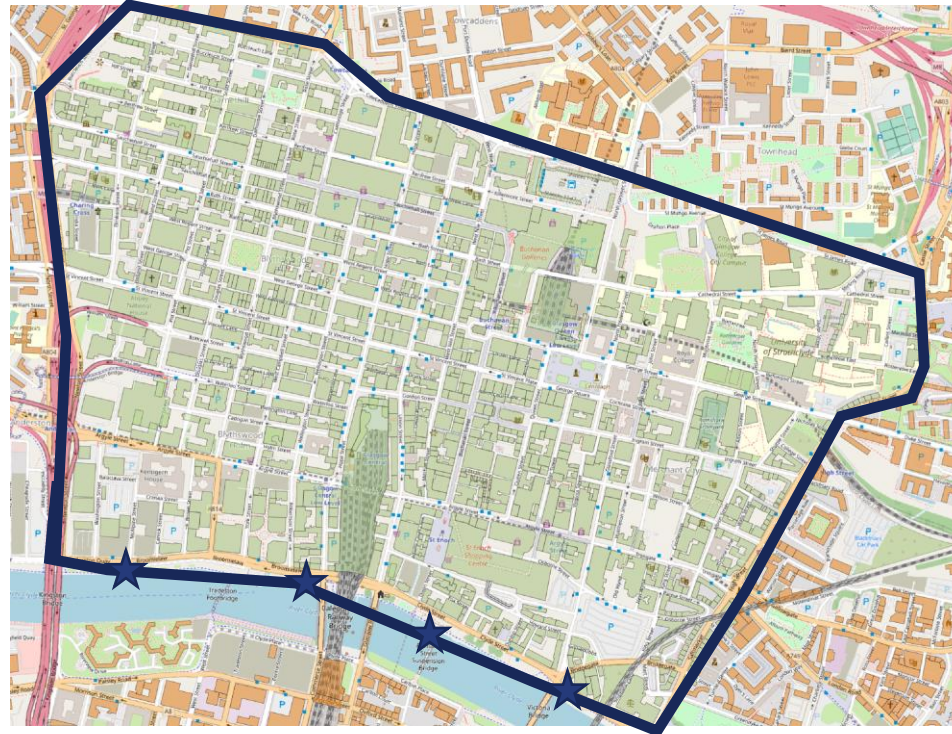


Create and compare multiple scenarios

SCENARIO 2: MULTIPLE SOURCES AT THE RIVER

District Heating

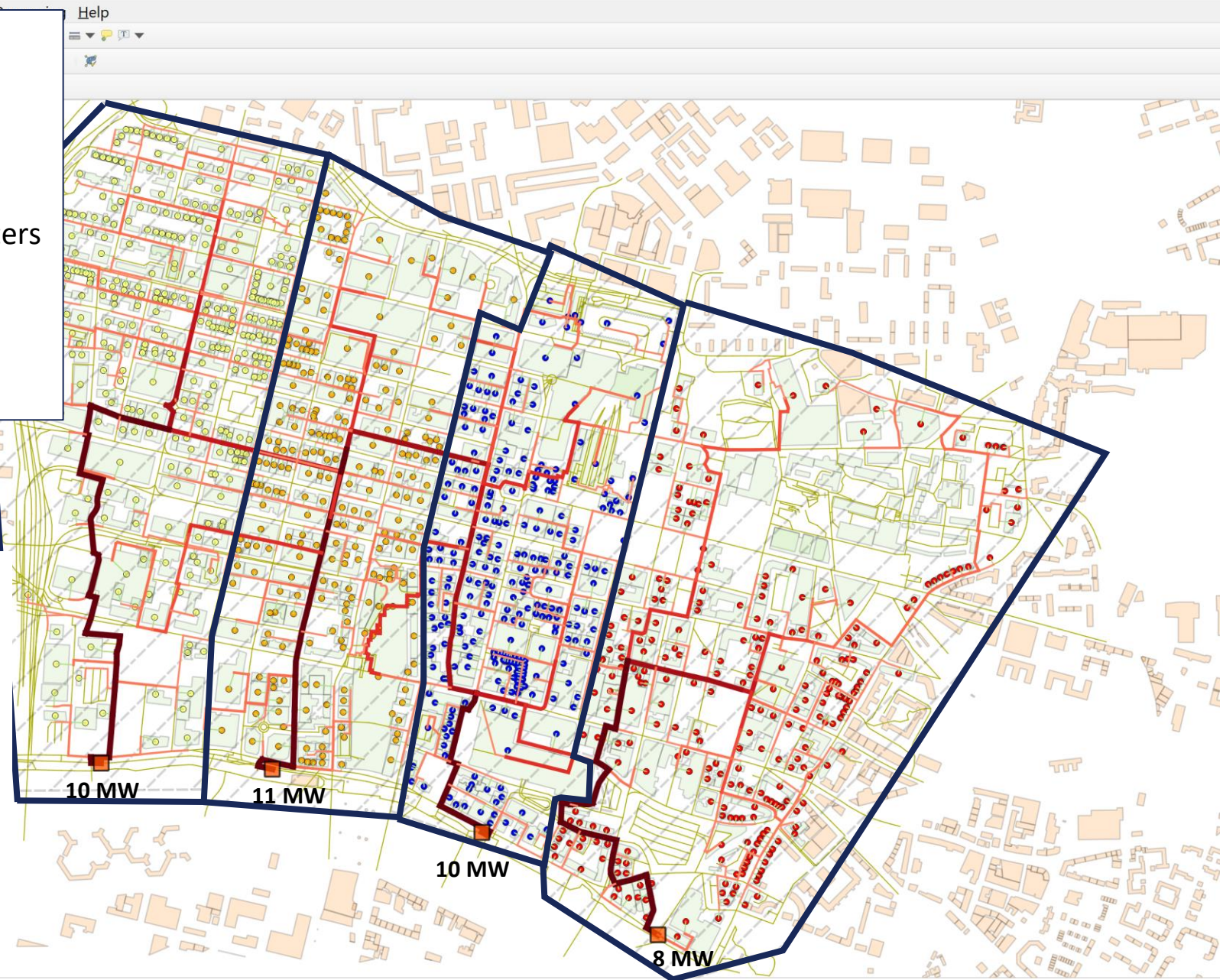
- 4 Heat sources, approx 10 Mega Watt peak per source
- Providing heat to 4 different clusters (groups of buildings)
- Supply temperature: 80°C
- Return temperature: 50°C



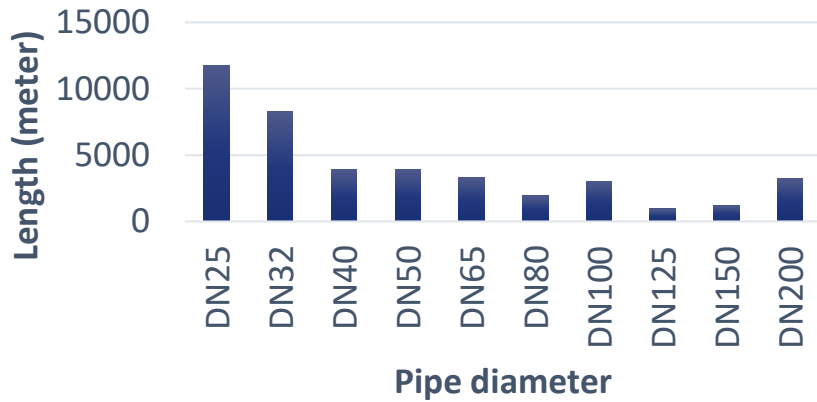
★ Source locations

Distribution network:

- Steel pipes
- Operating at 16 bar
- 80 °C Supply and 50° C Return temp
- 4 Heat pumps supply heat to 4 separate clusters
- Clusters size: 10, 11, 10 and 8 MW
- Total public trench length: 46639 meters
- Total network linear heat density: 2 MWh/m



Distribution pipe network





DEPLOYMENT COST CALCULATION (ASSUMPTIONS)

Glasgow

- Based on sample costs per meter pipe network including
 - Excavation
 - Supply & return pipe
 - Welding & installation costs
 - Refill and repair of top layer
 - Project management overhead
- Heat source cost (Heat pump)
 - 1,600,000 GBP / Megawatt
- Intermediate pump cost – 60,000 GBP / Megawatt
- Heat delivery unit cost

Heat exchangers

Activation Type	Demand Identifier	Lower Bound	Upper Bound	Cost			
				Material	Labour		
Power		1	50	£2,500.00	£750.00	+	✗
Power		50	100	£10,000.00	£2,000.00	+	✗
Power		100	400	£20,000.00	£10,000.00	+	✗
Power		400	1000	£75,000.00	£150,000.00	+	✗
Power		1000	∞	£100,000.00	£150,000.00	+	✗

Activation Type Identifier +

Tariff

Identifier	Tariff (£/kW)	Connection fee (£/Building)	Monthly fee (£/Home)
<default>	£0.12	£0.00	£15.00

Pipe definitions

Nominal diameter	Cost (£/m)
	Material cost
DN25	£1,000.00
DN32	£1,000.00
DN40	£1,000.00
DN50	£1,000.00
DN65	£1,000.00
DN80	£1,500.00
DN100	£1,500.00
DN125	£1,500.00
DN150	£1,500.00
DN200	£3,000.00
DN250	£3,000.00
DN300	£3,000.00
DN350	£3,000.00
DN400	£3,000.00
DN450	£3,000.00
DN500	£3,000.00
DN600	£3,000.00

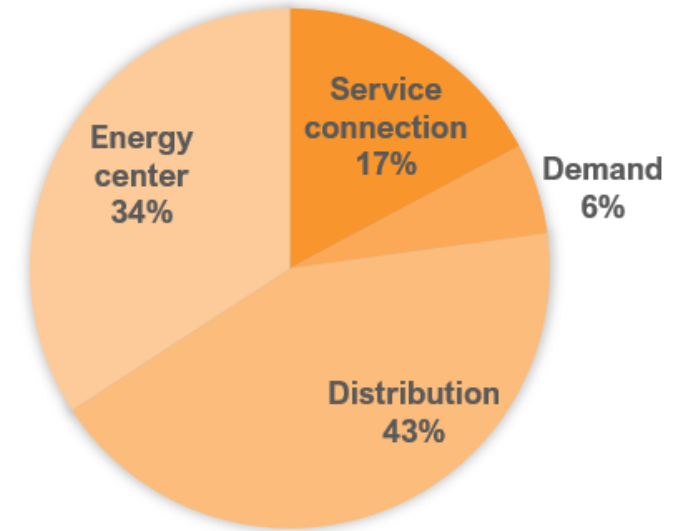
RESULTS – 100% UPTAKE

Glasgow

- Cost breakdown

Results

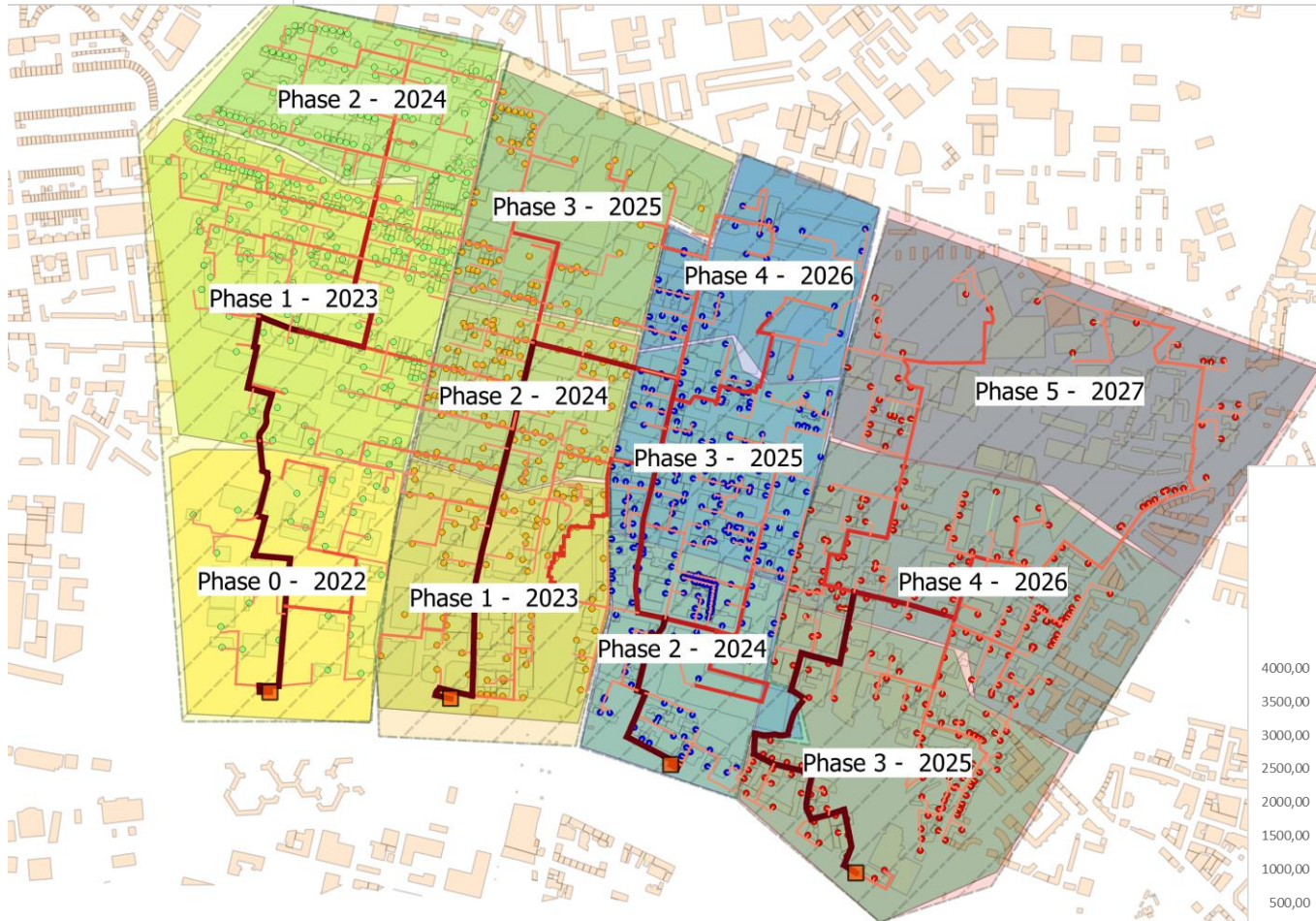
Total Cost of Project	£252,394,095.39
Total Public trench length (m)	73,674.32
Total Network linear heat density (MWh/m)	1.904
Deployment Cost per Home	£188,213.34



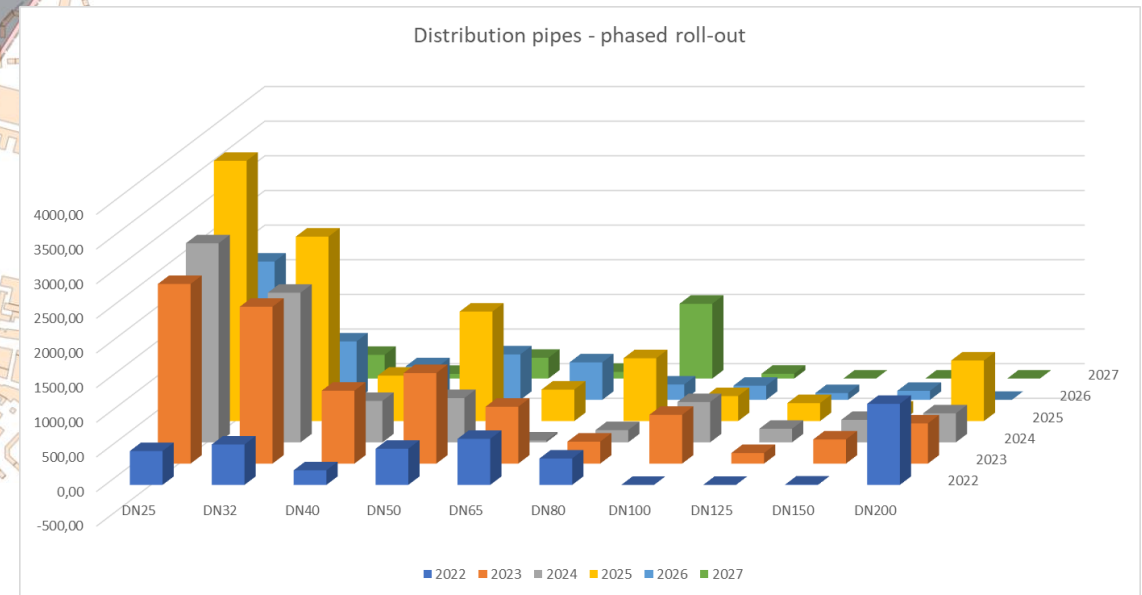
Cost Breakdown

	Network Cost	%
Service connection	£43,419,181.63	17%
Demand	£14,223,250.00	6%
Distribution	£108,498,847.76	43%
Energy center	£86,252,816.00	34%
Total	£252,394,095.39	100%

DEPLOYMENT PHASES – 2022 TO 2027



Distribution	2022	2023	2024	2025	2026	2027
DN25	488,29	2592,48	2872,77	3756,15	1995,53	958,98
DN32	582,73	2263,55	2159,06	2662,46	842,72	341,79
DN40	210,53	1052,38	598,03	655,83	484,00	67,90
DN50	521,65	1307,09	639,15	1580,19	655,75	299,54
DN65	663,80	820,77	27,42	454,67	540,79	96,78
DN80	380,72	317,14	176,36	907,03	221,27	1079,11
DN100	0,00	704,20	581,66	360,70	203,67	68,99
DN125	0,00	153,04	195,97	259,47	97,75	0,00
DN150	4,82	348,54	324,16	165,16	129,33	0,00
DN200	1169,28	580,42	418,97	874,15	0,00	0,00
Total (m)	4021,81	10139,62	7993,56	11675,82	5170,81	2913,09



INVESTMENT ANALYSIS RESULTS WITH 33 GBP AND 15 GBP AS COST OF HEAT PRODUCTION

Customer TARIFF – 6p, 8p, 10p, 12p / kWh

33 GBP	NPV	IRR	Payback time
6p	-187,318,676	-3.96	N/A
8p	-137,283,202	-0.49	N/A
10p	-87,247,727	1.47	43
12p	-37,212,252	3	32

15 GBP	NPV	IRR	Payback time
6p	-134,327,755	-0.35	N/A
8p	-84,292,280	1.57	42
10p	-34,256,805	3.08	32
12p	15,778,670	4.4	26

	0	1	2	3	4	5	6	7	8	9
Network & energy evolution										
Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Additional energy demand (solid) in year x	MWh	6521.00	15070.00	8579.00	13384.00	8071.00	15252.00	10138.00	9023.00	25283.00
Cumulative energy demand (solid)	MWh	6521.00	21591.00	30170.00	43554.00	51625.00	66877.00	77015.00	86048.00	111331.00
Heat Losses (distribution losses)	MWh	1396.93	3319.91	4518.77	5898.09	6948.59	8622.56	10047.86	11438.38	14269.50
Total energy demand production (solid-distribution losses)	MWh	7917.93	24910.91	34688.77	49452.09	58473.59	75109.56	87072.86	97486.38	125600.50
Total pipe network length in use	km	4.69	13.21	19.88	27.71	34.85	39.54	45.46	46.79	56.79
Pipe Network length deployed in year x	km	4.69	8.52	5.67	5.07	3.75	7.14	4.70	5.92	11.33
Cash out										
Investment costs										
Network deployment cost		£32,761,693.97	£19,557,698.12	£12,911,805.32	£32,979,197.95	£8,228,606.48	£17,280,528.51	£32,018,599.78	£12,840,812.22	£47,081,669.73
Cost of operation										
Heat production cost		£261,291.63	£822,000.10	£1,144,729.40	£1,630,862.82	£1,929,958.54	£2,498,415.59	£2,873,404.35	£3,217,050.48	£4,144,816.62
Pump energy cost		£5,762.97	£26,693.61	£44,570.92	£53,740.69	£59,798.48	£37,966.61	£101,925.29	£110,088.88	£156,779.00
Fixed operation and maintenance cost		£245,712.70	£392,395.44	£489,233.98	£738,577.97	£788,292.51	£927,898.48	£1,188,035.98	£1,284,342.07	£1,617,454.59
Variable operation and maintenance cost		£3,958.96	£12,455.46	£17,344.38	£24,710.04	£29,241.80	£37,854.78	£43,536.43	£48,743.19	£62,800.25
Total cash out		£32,761,693.97	£20,074,424.39	£14,165,409.93	£34,675,076.63	£10,674,498.00	£20,097,819.84	£35,580,433.24	£17,027,714.26	£51,721,894.35
Cash in										
Subsidy										
Government subsidy network investment										
Government subsidy on energy production										
Sales										
Total yearly sales turnover		£521,689.36	£1,727,353.12	£2,413,621.44	£3,485,151.36	£4,130,870.24	£5,350,996.96	£6,162,067.84	£6,883,907.84	£8,906,556.80
New connection fees										
Monthly fees		£5,580.00	£40,140.00	£62,280.00	£77,580.00	£95,400.00	£111,960.00	£131,760.00	£157,680.00	£192,000.00
Total cash in		£527,269.36	£1,767,493.12	£2,475,901.44	£3,562,731.36	£4,226,270.24	£5,462,956.96	£6,293,827.84	£7,041,587.84	£9,098,614.80
Cash flow										
Total cash flow		£-32,761,693.97	£-19,547,155.03	£-12,307,916.81	£-11,716,664.00	£-6,448,227.76	£-15,371,549.60	£-10,117,476.28	£-10,733,886.42	£-44,680,306.51
Cumulative Cash flow		£-32,761,693.97	£-52,308,849.00	£-64,706,765.81	£-76,423,429.81	£-82,871,657.57	£-98,243,207.17	£-113,360,683.41	£-124,094,569.63	£-133,193,204.43
NPV										
IRR										
Payback time										

	0	1	2	3	4	5	6	7	8	9
Network & energy evolution										
Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Additional energy demand (solid) in year x	MWh	6521.00	15070.00	8579.00	13384.00	8071.00	15252.00	10138.00	9023.00	25283.00
Cumulative energy demand (solid)	MWh	6521.00	21591.00	30170.00	43554.00	51625.00	66877.00	77015.00	86048.00	111331.00
Heat Losses (distribution losses)	MWh	1396.93	3319.91	4518.77	5898.09	6948.59	8622.56	10047.86	11438.38	14269.50
Total energy demand production (solid-distribution losses)	MWh	7917.93	24910.91	34688.77	49452.09	58473.59	75109.56	87072.86	97486.38	125600.50
Total pipe network length in use	km	4.69	13.21	19.88	27.71	34.85	39.54	45.46	46.79	56.79
Pipe Network length deployed in year x	km	4.69	8.52	5.67	5.07	3.75	7.14	4.70	5.92	11.33
Cash out										
Investment costs										
Network deployment cost		£32,761,693.97	£19,557,698.12	£12,911,805.32	£32,979,197.95	£8,228,606.48	£17,280,528.51	£32,018,599.78	£12,840,812.22	£47,081,669.73
Cost of operation										
Heat production cost		£261,291.63	£822,000.10	£1,144,729.40	£1,630,862.82	£1,929,958.54	£2,498,415.59	£2,873,404.35	£3,217,050.48	£4,144,816.62
Pump energy cost		£5,762.97	£26,693.61	£44,570.92	£53,740.69	£59,798.48	£37,966.61	£101,925.29	£110,088.88	£156,779.00
Fixed operation and maintenance cost		£245,712.70	£392,395.44	£489,233.98	£738,577.97	£788,292.51	£927,898.48	£1,188,035.98	£1,284,342.07	£1,617,454.59
Variable operation and maintenance cost		£3,958.96	£12,455.46	£17,344.38	£24,710.04	£29,241.80	£37,854.78	£43,536.43	£48,743.19	£62,800.25
Total cash out		£32,761,693.97	£20,074,424.39	£14,165,409.93	£34,675,076.63	£10,674,498.00	£20,097,819.84	£35,580,433.24	£17,027,714.26	£51,721,894.35
Cash in										
Subsidy										
Government subsidy network investment										
Government subsidy on energy production										
Sales										
Total yearly sales turnover		£662,111.70	£2,159,191.40	£3,017,026.80	£4,356,439.20	£5,163,567.80	£6,688,749.20	£7,702,584.80	£8,604,884.80	£11,133,193.50
New connection fees										
Monthly fees		£5,580.00	£40,140.00	£62,280.00	£77,580.00	£95,400.00	£111,960.00	£131,760.00	£157,680.00	£192,000.00
Total cash in		£667,691.70	£2,199,331.40	£3,079,306.80	£4,434,019.20	£5,258,967.80	£6,800,709.20	£7,834,344.80	£8,762,564.80	£11,325,253.50
Cash flow										
Total cash flow		£-32,761,693.97	£-19,416,732.69	£-11,966,076.53	£-31,596,769.83	£-5,415,530.20	£-14,838,832.04	£-28,779,727.04	£-39,189,369.46	£-42,996,464.55
Cumulative Cash flow		£-32,761,693.97	£-52,178,426.66	£-64,144,503.19	£-95,741,273.02	£-101,156,803.22	£-116,095,635.26	£-144,874,962.30	£-184,064,331.76	£-227,060,796.31
NPV										
IRR										
Payback time										

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The Decentralised Energy Awards 2020 SHORTLISTED

- GIS based Network Design Automation Software
- 50 employees and growing
- Founded in 1998
 - Comsof Fiber since 2011
 - Comsof Heat since 2018
- Clients in 70+ countries
- Main offices in
 - Ghent, Belgium
 - Toronto, Canada



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Simon Gunter - Minibems

Optimalisation of heat network installations by hard & software tools



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Wim Jacobs – Zerofriction

Data, monitoring, facturatie van gebruikers warmte netwerken



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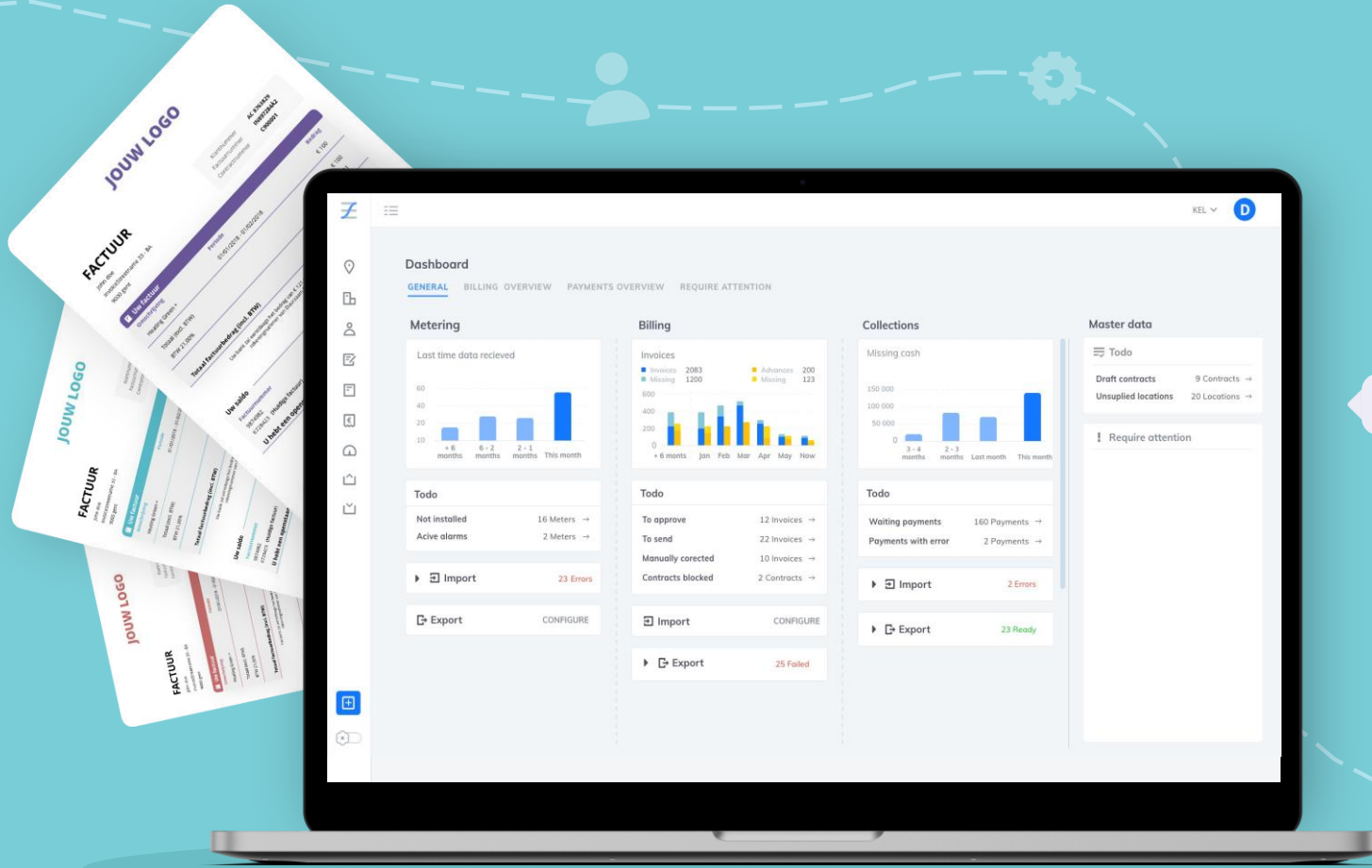
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**ZERO
FRICTION**

Afrekenen van collectieve warmte zonder zorgen

Betrouwbare en eenvoudige facturatie



De afrekening verloopt volledig automatisch met duidelijk overzicht van acties die ondernomen moeten worden.



Ik koppel het platform met meterhardware en boekhoudpakket naar keuze!



Met Zero Friction maak ik betrouwbare afrekeningen die automatisch op factuurdatum gemaakt worden.



Handig dat CRM, facturatie en betalingsopvolgingen gecombineerd worden op één platform!



Ons product



Meetdataverwerking & verbruikinzichten



Facturatie

Vaste tarieven

Kostenverdeling

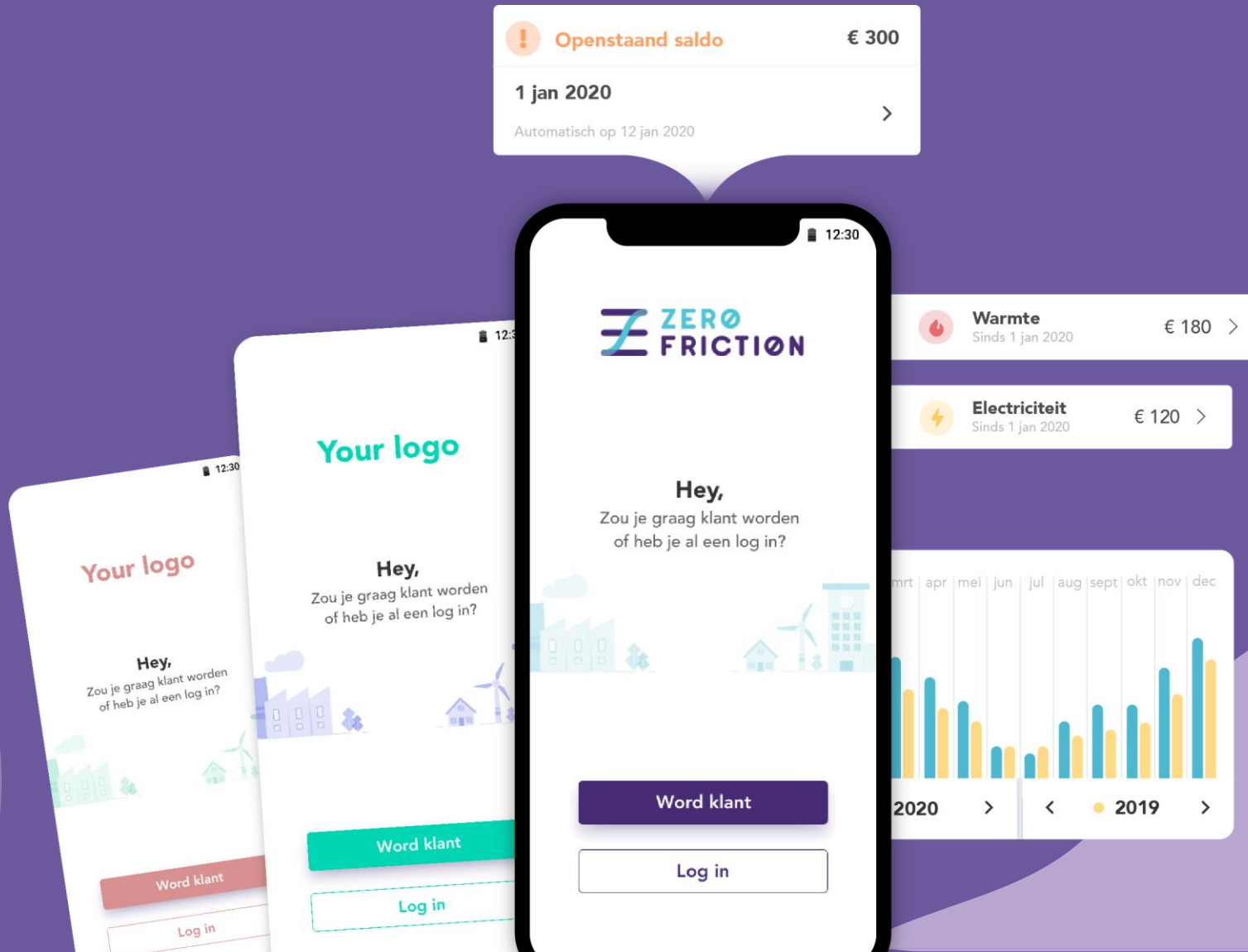
Betalingsopvolging

Klantenbeheer

Klantenportaal



Transparantie naar de eindgebruiker





Verbruiksdata

Voor wie



Warmteleveranciers

Zero Friction biedt een totaaloplossing voor de afrekening en dienstverlening van jouw warmtenet, ongeacht de omvang. Wij zijn jouw betrouwbare softwarepartner voor een langdurige samenwerking.



Gebouwbeheerders

Zero Friction neemt jouw complexe energiefacturatie uit handen. Zonder moeite voor elk gebouw een eigen inrichting en zicht op individuele of totale verbruiken, kosten en facturen. Snel, efficiënt en correct afrekenen van collectieve energie ligt aan de basis.



Energiedienstverleners

De Zero Friction software ondersteunt jouw dienstverlening op de collectieve energiemarkt. Groeien en moeiteloos meerdere organisaties bedienen met elk hun eigen inrichting? Wij zijn jouw softwarepartner.



Sociale huisvesting, zorgwoningen en woningcorporaties

Zero Friction verzorgt jouw energiefacturatie en minimaliseert de administratieve last. Koppel het Zero Friction platform met sectorspecifieke bedrijfssoftware, ERP-pakket of meterhardware naar keuze. Bied transparantie naar bewoners via het klantenportaal.



Projectontwikkelaars

Neem het Zero Friction platform mee in de overdracht naar de gebouwbeheerder zodat de afrekening van collectieve energie bij oplevering meteen vlot verloopt. Ook voor een ESCO-model is Zero Friction jouw oplossingsgerichte softwarepartner.

2 modellen



1. Software as a service (SaaS)

De Zero Friction software wordt in jouw bedrijfsvoering geïmplementeerd. De cloudsoftware bestaat uit een facturatieplatform met verschillende functionaliteiten die de afrekening van collectieve energie heel gemakkelijk maken.

2. Software en dienstverlening

Zero Friction neemt al uw zorgen rond administratieve verwerking van meetdata, klantenverwerking en facturatie weg. Binnen deze formule heb je te allen tijde zicht op de klantenportefeuille, terwijl wij zowel de administratie, kostenverdeling, facturatie en klantenservice van jou overnemen.

Sit back and relax!



Software as a service (SaaS)

Implementatie van de Zero Friction software in jouw bedrijfsvoering. De software bestaat uit een facturatieplatform met verschillende functionaliteiten die de afrekening van collective energie heel gemakkelijk maken.

- Contractmanagement
- Meetdata ontvangst via FTP, SFTP, email of API-koppeling
- Automatische meetdataverwerking en kostenverdeling
- Automatische facturatie door middel van gepersonaliseerde, duidelijke en transparante factuurtemplates
- Betalingsverwerking
- Verhuisprocessen
- Klantcommunicatie en support
- Built-in dashboards
 - Optioneel: eindgebruikersapplicatie



Software en dienstverlening

Zero Friction neemt al uw zorgen rond administratieve verwerking van meetdata, klantenverwerking en facturatie weg. Binnen deze formule heb je te allen tijde zicht op de klantenportefeuille, terwijl wij zowel de administratie, kostenverdeling, facturatie en klantenservice van u overnemen. Sit back and relax!

- Contractmanagement en het verwerken van verhuizen en leveringsovereenkomsten
- Uitwisselen van data via FTP, SFTP, email of API-koppeling
- Invoeren van de noodzakelijke gegevens met betrekking tot nieuwe klanten, aansluitingen en meters
- Genereren en digitaal versturen van facturen
- Eén gebruikersaccount met leesrechten
- Tweedelijns contactcenter
 - Optioneel: betalingsverwerkingsysteem
 - Optioneel: eerstelijns contactcenter en vast telefoonnummer
 - Optioneel: eindgebruikersapplicatie



tevreden klanten



Zero Friction is een jong, innovatief bedrijf dat alle administratieve processen die bij de afrekening van collectieve warmte komen kijken, op een solide en betrouwbare manier afhandelt.

Dick Maaskant

Directeur bij Duurzaam Energiebedrijf Roosendaal

Vooral de flexibiliteit, veiligheid, bedrijfszekerheid die Zero Friction garandeert is cruciaal voor Luminus. De snelle, automatische facturatie en storingdetectie besparen ons heel wat tijd en

kopzorgen.
Eric Perdu

Senior Commercial Manager bij EDF Luminus



zerofriction.co

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Vragen - Q&A



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Meld je aan bij 02025.nl



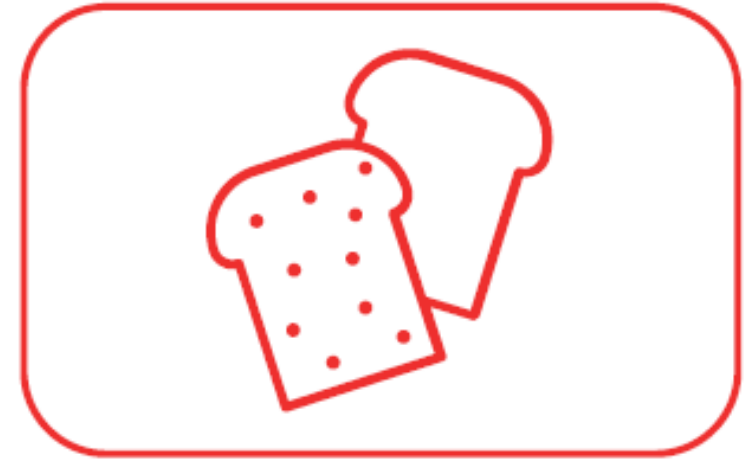
Netwerk

Ontmoet gelijkgestemden, vergroot je wereld en vind de juiste mensen om mee aan de slag te gaan.



Advies op maat

Onze experts denken graag mee over jouw vraagstuk.



Energieontbijt

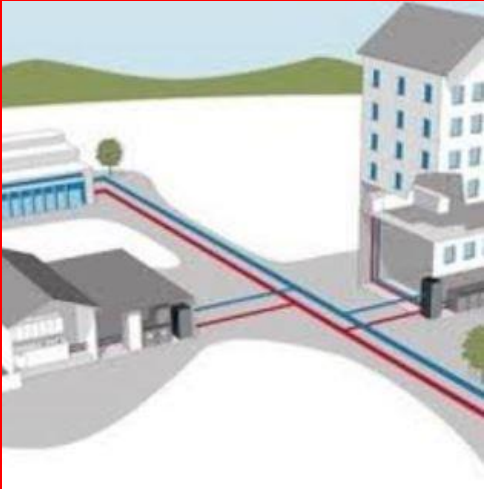
Ga aan tafel met energiepioniers uit jouw buurt, ontdek waaraan iedereen werkt en bundel de krachten ter plekke.



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Samen op weg naar mooie warmte projecten!

Contact : ronaldvanoijen@gmail.com



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