Decarbonising Heating in Thunder Bay

Thunder Bay

Why District Energy Networks Work – Session 2

15th December

Peter Anderberg
Founder and CEO
pa@heatacademy.eu
+46 70 56 111 99

Thunder Bay

Why District Energy Networks Work – Session 2

HEAT ACADEMY INTERNATIONAL
Execution Intelligence

Professional Training

Decarbonising Heating in Thunder Bay

Why District Energy Networks Work

Introductory Session – II

15th December

10.00 – 12.00 *(EST)*

register@heatacademy.eu

Decarbonising heating is a top priority to reduce CO_2 emissions by 50% by 2030 and to hit net-zero emissions by 2050. District Energy Networks combined with measures to enhance building efficiency are critical components in making this possible. Investments in solutions to decarbonise heating will also improve air quality and generate inward investments, jobs and improved social welfare. But what exactly are the technologies and skills required to take projects from vision to operation, and how can training institutions and the local supply chain gear up to meet these needs?

Key topics addressed in this second session focusing on Thunder Bay include:

- Why District Energy Networks Work – recap of session 1
- Presentation of pre-feasibility study – conclusions and recommendation on next steps
- Strategy – Best Practice and reference cases from Nordic Region
- Process – Taking projects from Vision to Operations
- Capacity Building – securing local ability to deliver

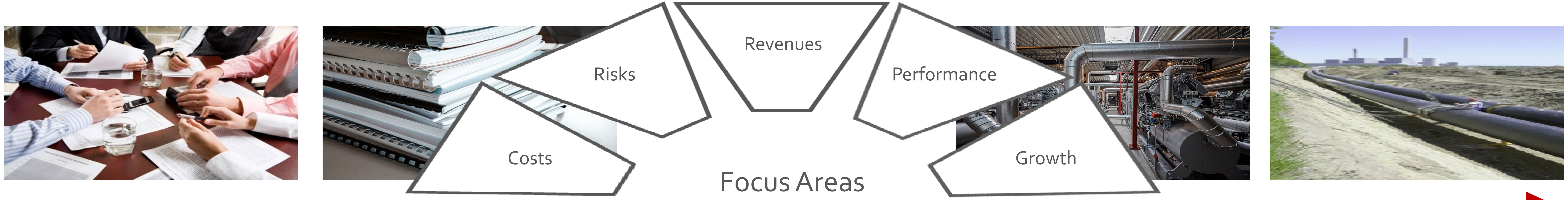
The overall objective is to share awareness of the opportunities and to mobilise local stakeholders to the critical task of developing the capability and capacity to deliver decarbonisation projects at scale

In collaboration with

Time	Topic	Speakers
10:00 – 10:05	*Introduction* – Module 2 • Welcoming words • Heat Academy • Local Partners	Chris Walton *CRIBE* Peter Anderberg *Heat Academy*
10:05 – 10:15	*Recap of Session 1* – Why District Energy Networks Work • The impact of heat • The Nordic experience - Socio-Economic opportunities • What District Energy Networks are • Where District Energy Networks work	Peter Anderberg *Heat Academy*
10:15 – 10:45	*Report* – Presentation of pre-feasibility study in Thunder Bay • Review of findings • Conclusions • Recommendations on next step	Kevin Kozar *Kozar Engineering* Vince Rutter *Biothermic*
10:45 –11:00	*Strategy* – Best Practice and Reference cases • Conserve – Connect – Convert • Business Models and Value Proposition • Collaboration and Replication of Best Practice	Peter Anderberg *Heat Academy*
11:00 – 11:15	*Process* – Taking projects from vision to operations • Heat Planning • Securing Buy-In – Stakeholder Management • Programme Management • Procurement of technologies and services	Mikael Jacobsson *Heat Academy*
11:15 – 11:30	*Capacity Building*– Securing Local Ability to Deliver • Training – professional and vocational • Developing the local supply chain	Peter Anderberg *Heat Academy*
11:30 – 12:00	*Next step* – Conclusions and Actions Activities and Time Schedule • Priorities • Roadmap • Q&A	Chris Walton *CRIBE*

Climate Bridge Group

Accelerating Decarbonisation of Heating and Cooling



Preparation → Delivery

Smart City Alliance | Local Partners

Facilitating International Collaboration & Replication

Mobilising Cities & Regions
Involving stakeholders

Membership services
Driving cooperation between Cities & Regions
Assisting in Stakeholder involvement

Capability to Deliver

Developing local capabilities in preparing affordable investments

HEAT ACADEMY INTERNATIONAL | Local Partners

Training and Innovation services
Professional & Vocational Training and local innovation platforms

Bridging Gaps

Resolving Challenges & Risks stopping projects

Nordic Heat | Local Partners

Advisory services
Sharing of know-how, experiences and best practice

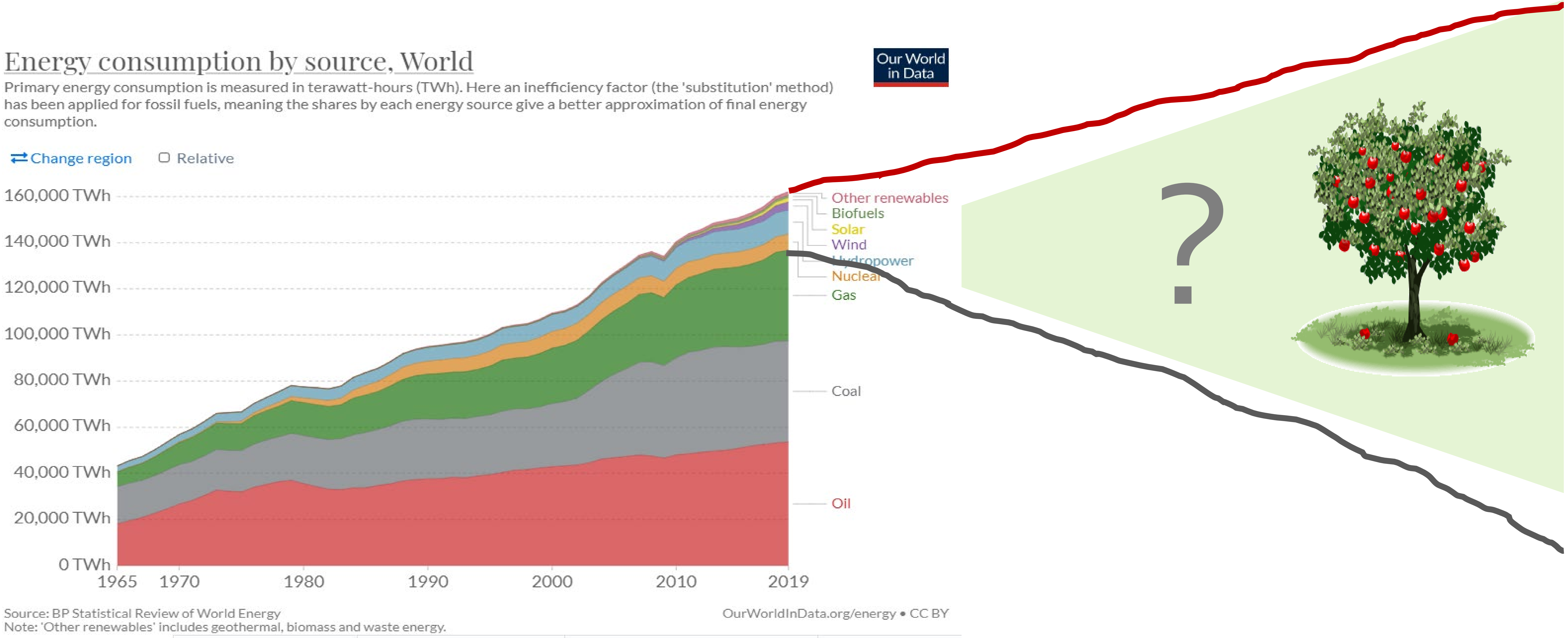
Capacity to Deliver

Developing local supply chain capacity to deliver projects

HEATNET GLOBAL | Local Partners

Supply Chain services
Facilitating market entry and local partnerships

Drivers


Energy consumption by source, World
Primary energy consumption is measured in terawatt-hours (TWh). Here an inefficiency factor (the 'substitution' method) has been applied for fossil fuels, meaning the shares by each energy source give a better approximation of final energy consumption.
Our World in Data
Change region
Relative
160,000 TWh
140,000 TWh
120,000 TWh
100,000 TWh
80,000 TWh
60,000 TWh
40,000 TWh
20,000 TWh
0 TWh
1965
1970
1980
1990
2000
2010
2019
Other renewables
Biofuels
Solar
Wind
Hydropower
Nuclear
Gas
Coal
Oil
Source: BP Statistical Review of World Energy
Note: 'Other renewables' includes geothermal, biomass and waste energy.
OurWorldInData.org/energy • CC BY
?

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Decarbonising Heating

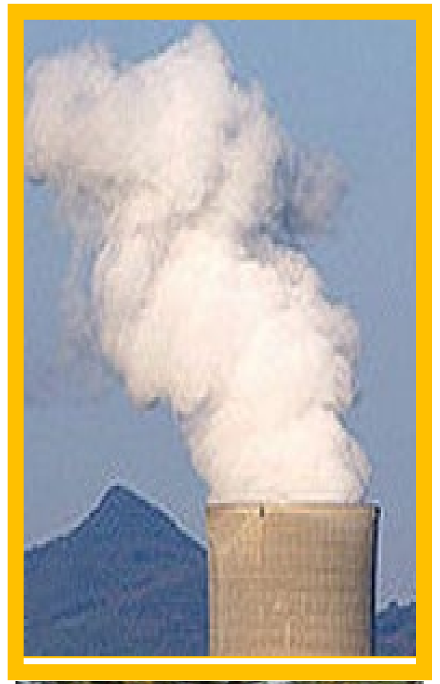
Core Strategy

Energy Security
Climate
Costs

Primary Energy Input

HEATING NEED

Energy losses



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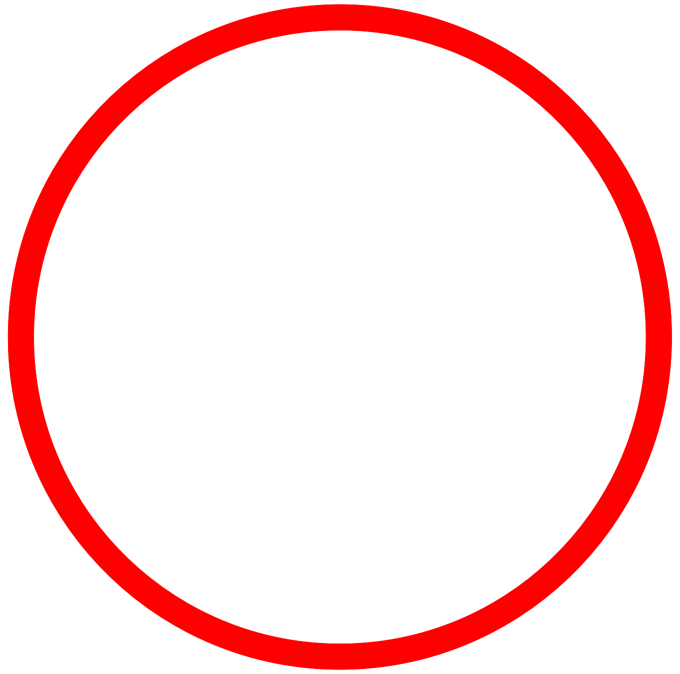
Decarbonising Heating

Core Strategy



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Decarbonising Heating

Core Strategy

Energy Security
Climate
Costs

Primary Energy Input

Energy losses

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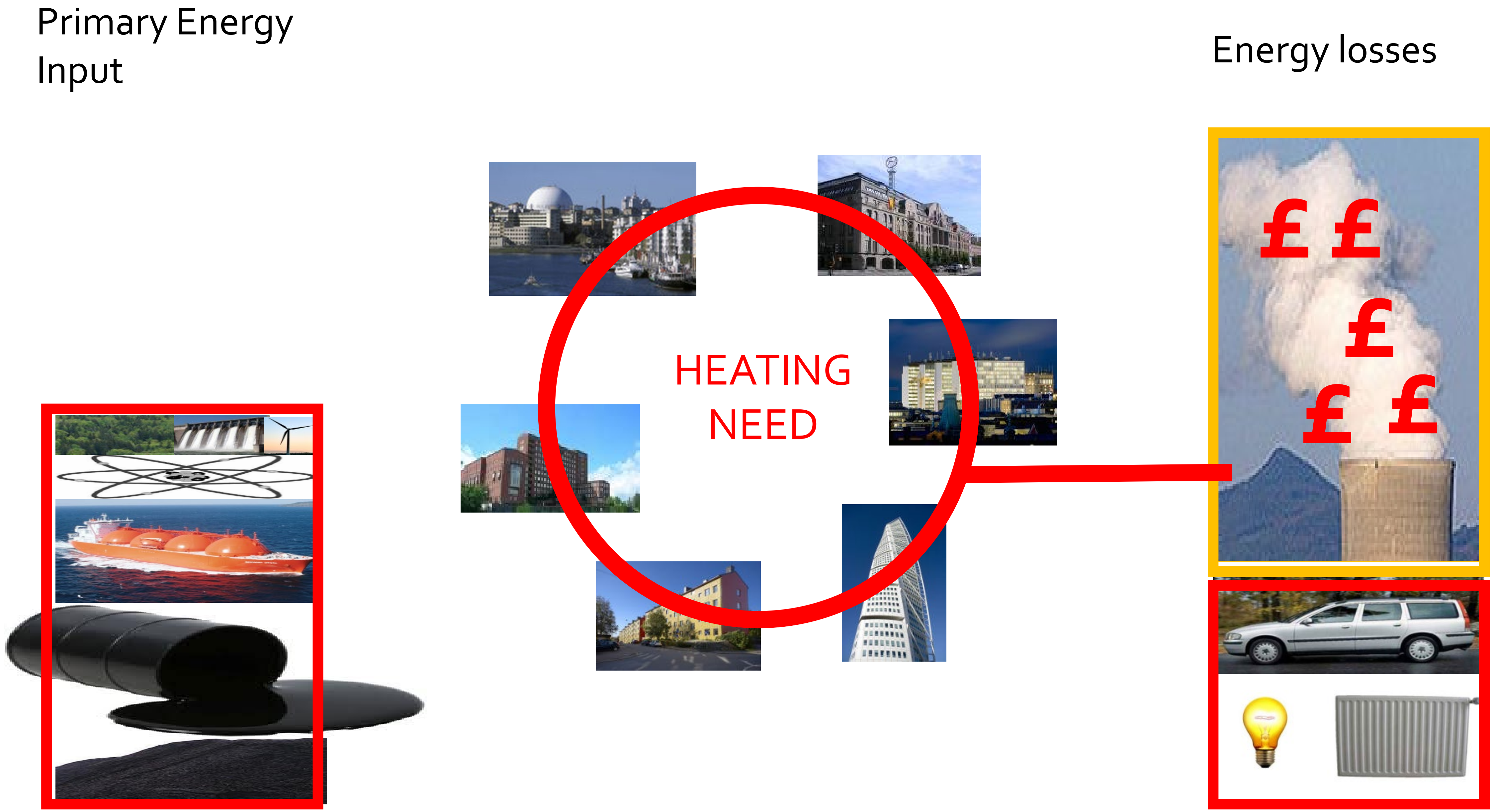
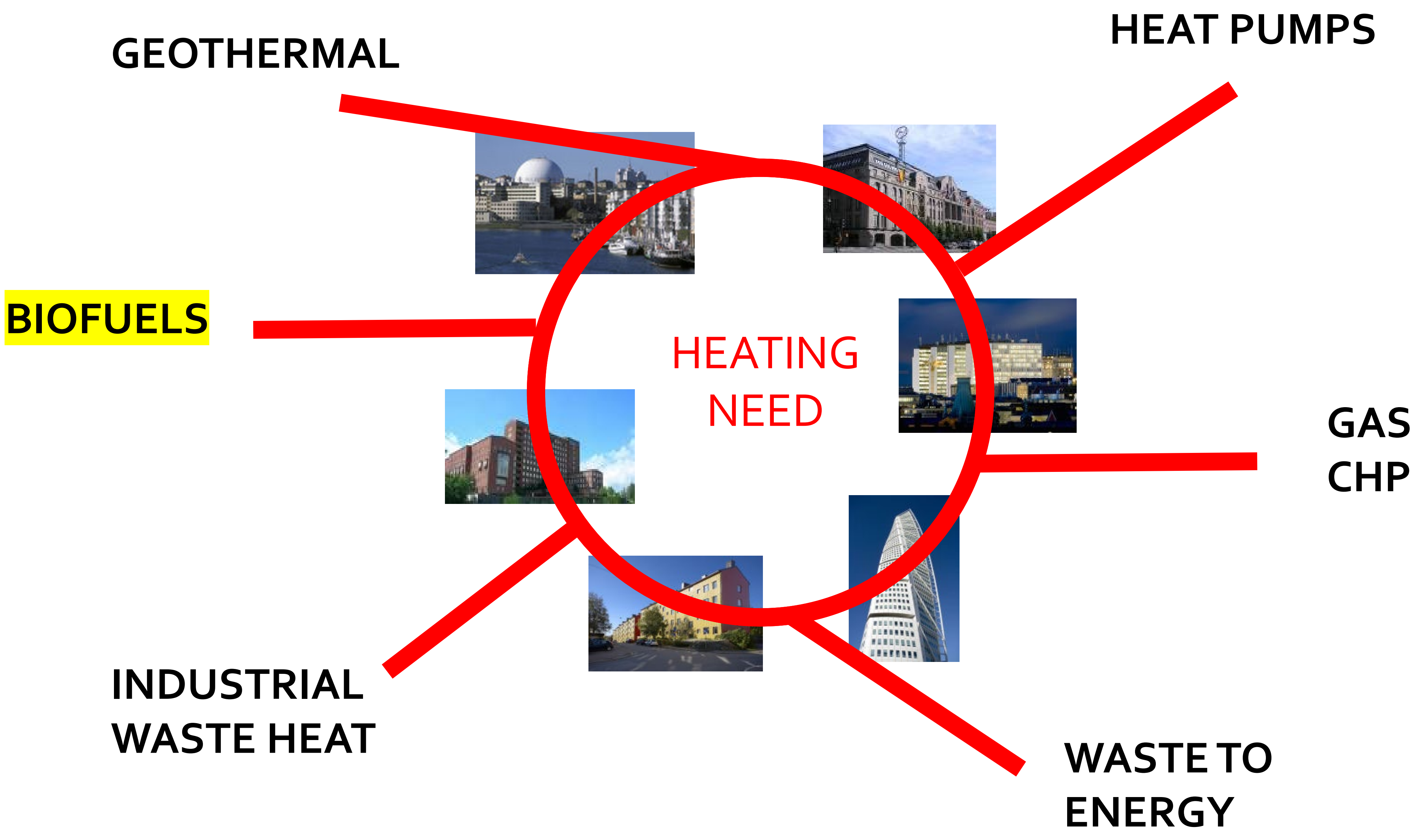
Decarbonising Heating

Core Strategy

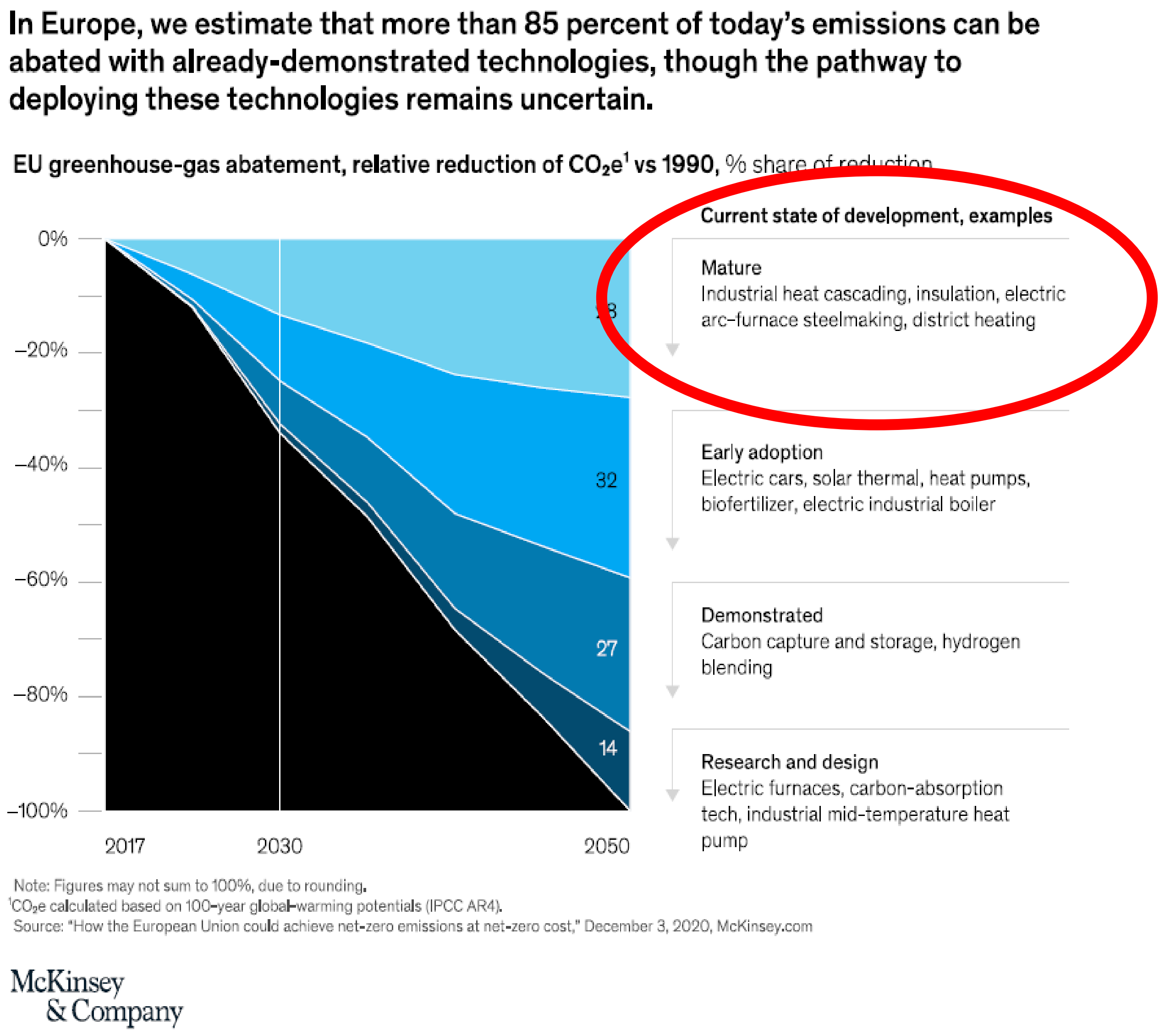


Decarbonising Heating

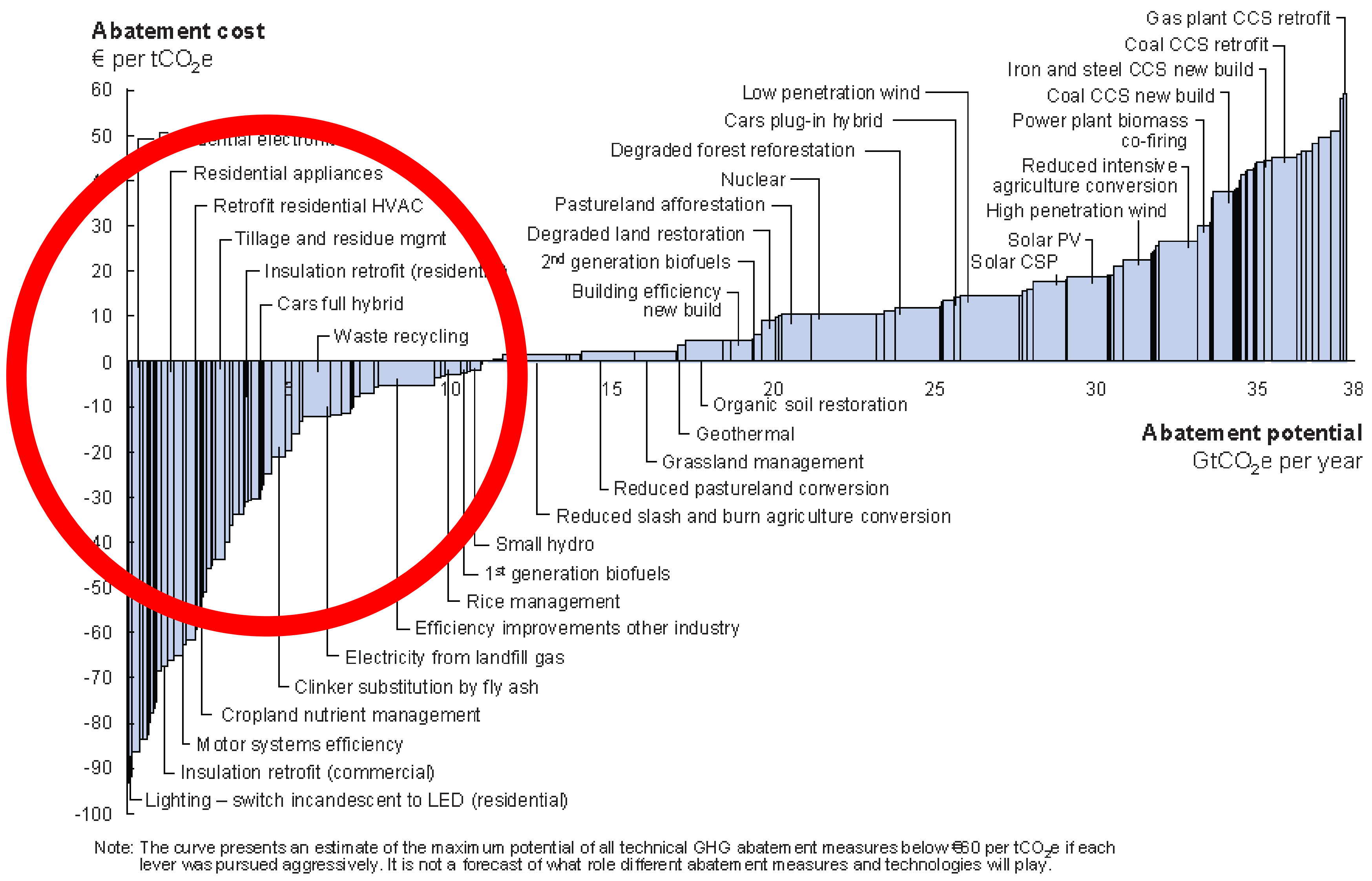
Core Strategy



Strategy
Heating



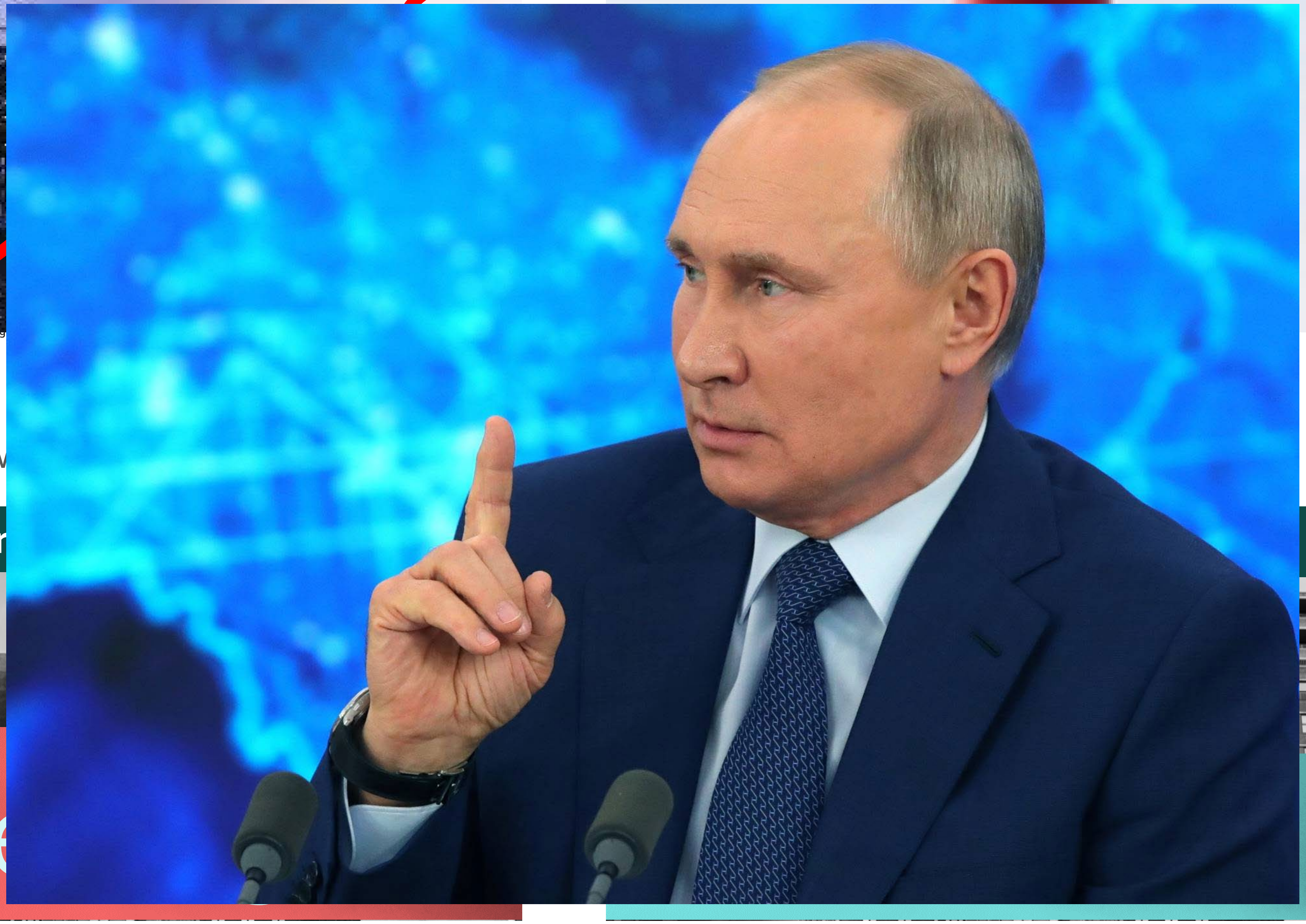
Strategy
Heating



Decarbonising Heating & Cooling

Drivers

Climate Emergency | **Cost of Gas** | **Decarbonising the Economy**



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Why Change?

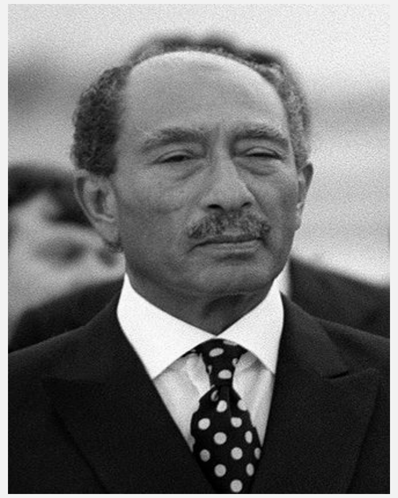
1964

1971

1973

(time)

1973



HEAT ACADEMY INTERNATIONAL

Why Change?

1964 | 1971 | **1973** | 1974 | 1978 | 2012 | *(time)*

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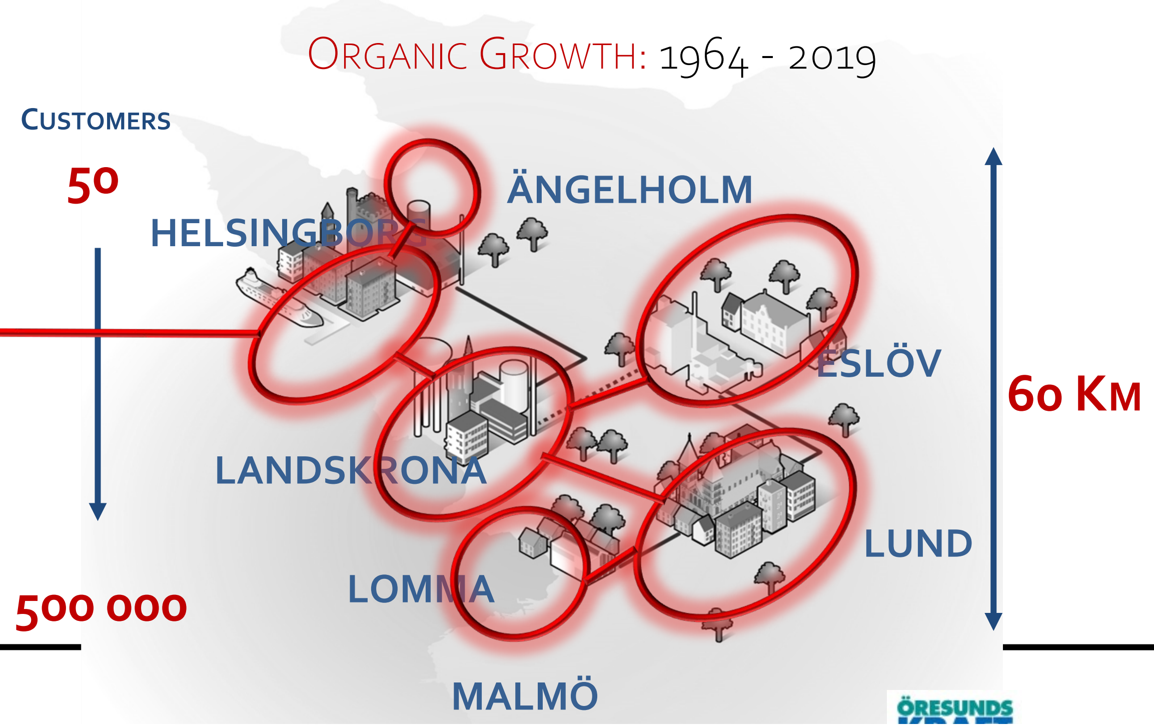
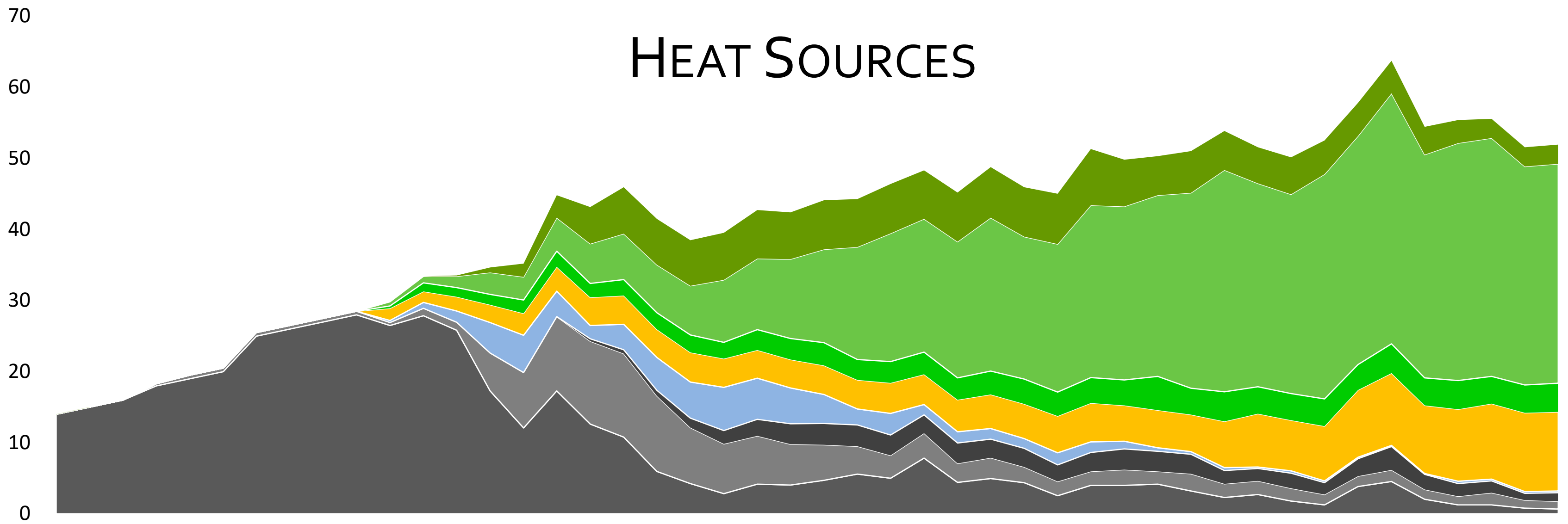
Why Change?

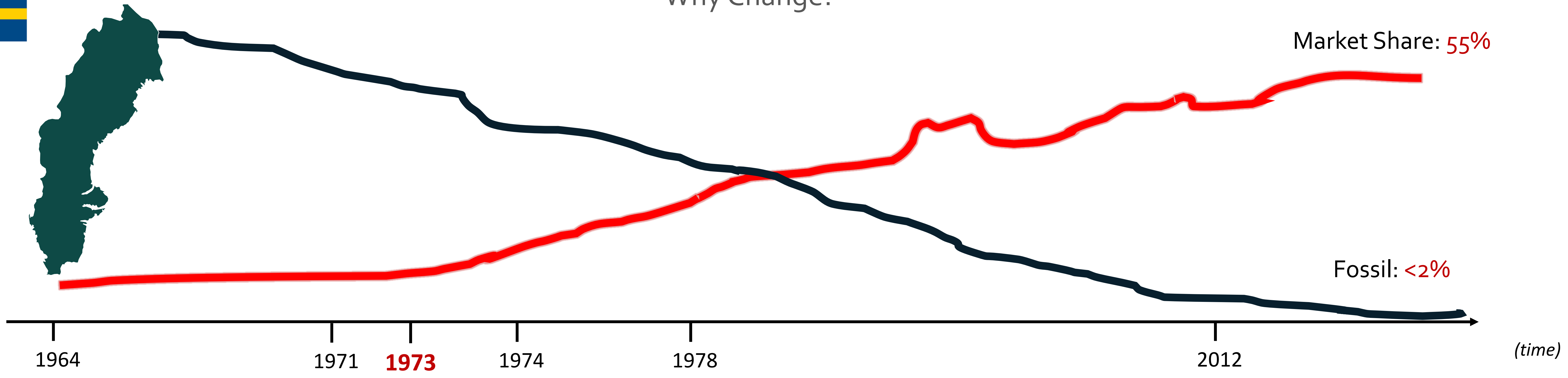


1964

(time)



Why Change?


Market Share: 55%
Fossil: <2%
1964
1971
1973
1974
1978
2012
(time)

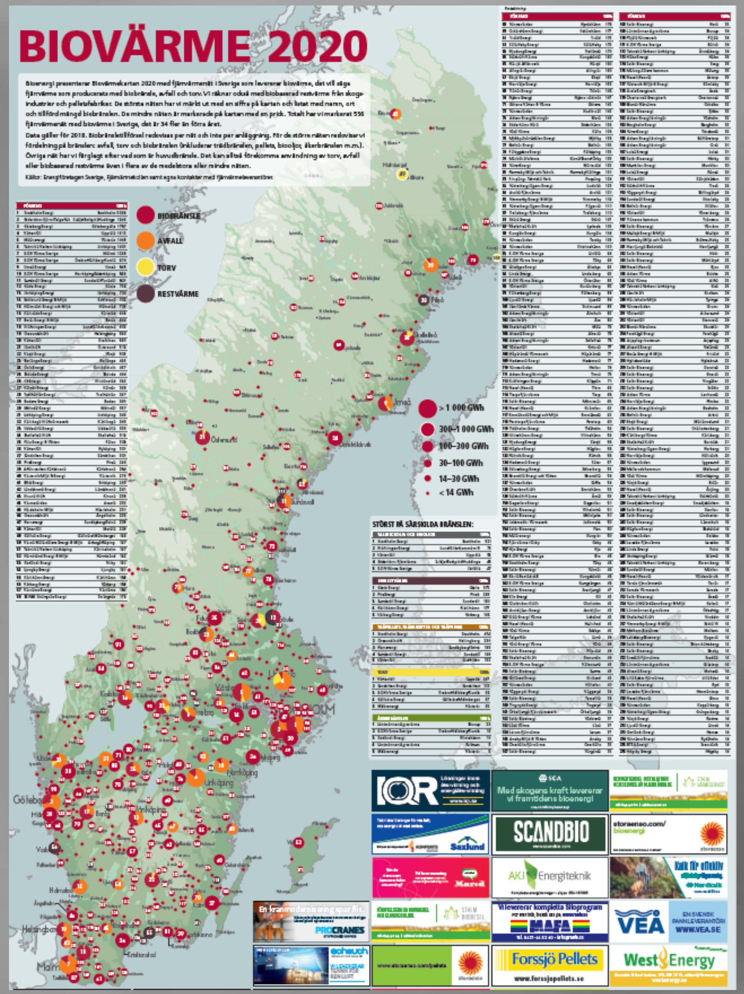

Stockholm:
Market Share: 90%

Rural Heat

Proven Solution

Rural Heat

Wide spread in Nordic region



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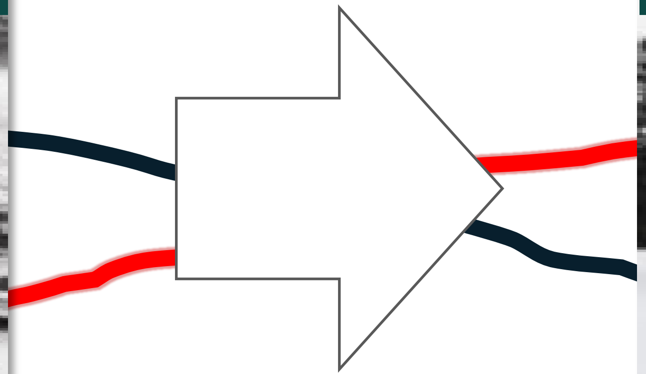
Decarbonising Heating & Cooling

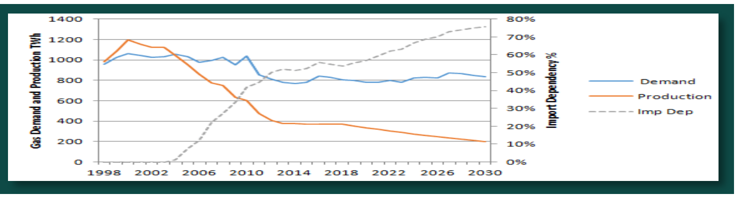
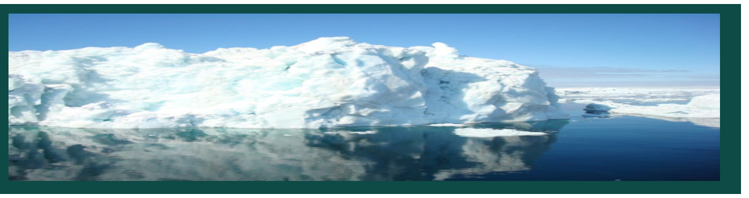
Benefits

1964



1984

1964 — 1971 — **1973** — 1974 — 1978 — 2012 — *(time)*

Energy Security		Climate Emergency		Cost & Convenience	
Balance of Trade		Reduced Pollution		Local Regeneration	
Local Resources		Circular Flows		Return on Investment	

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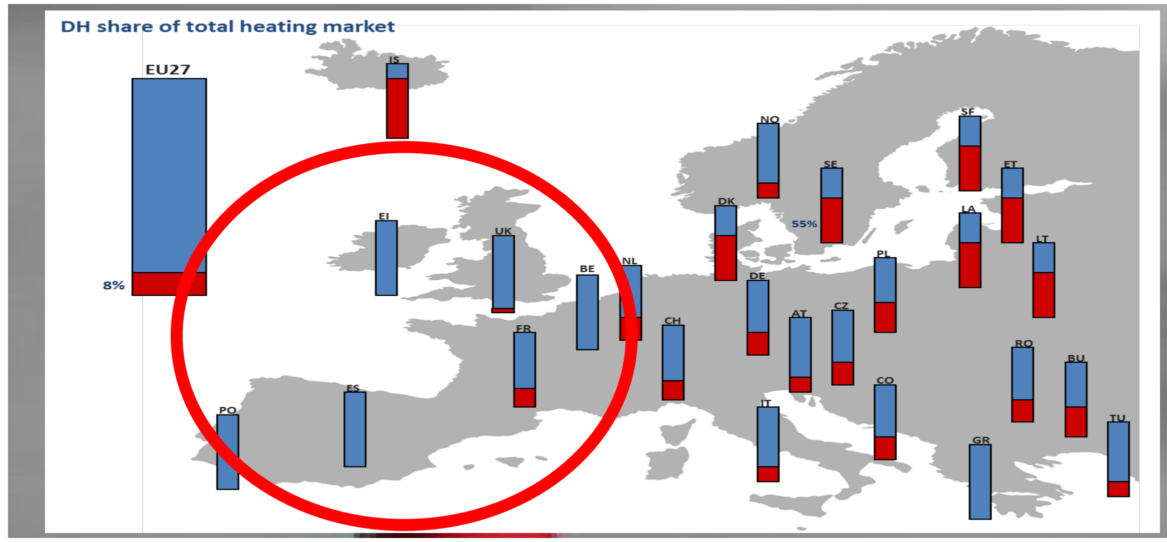
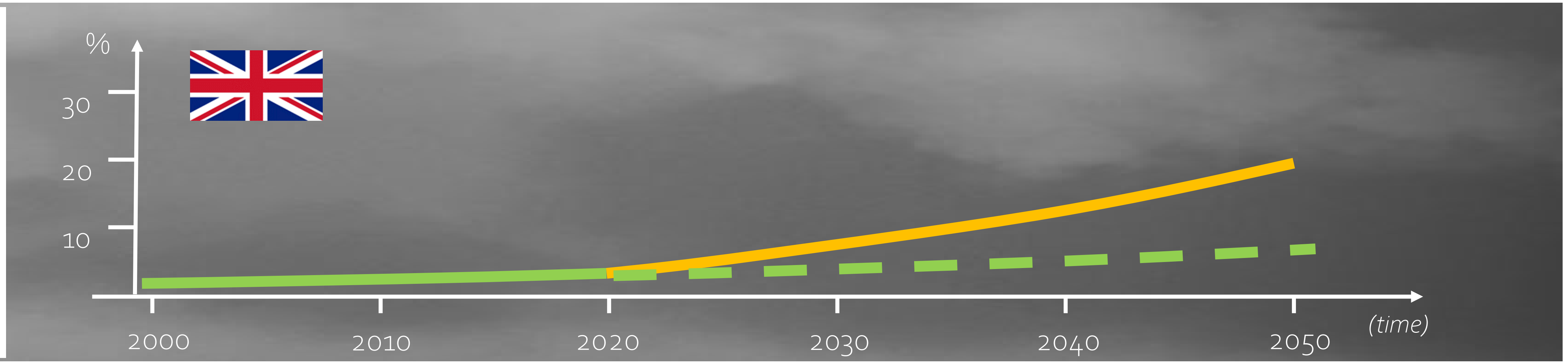
Decarbonising Heating & Cooling

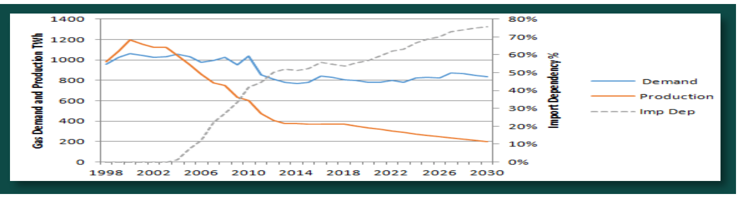
Heat Networks in focus





Socio-Economic Benefits

Energy Security



Climate Emergency

Cost & Convenience

Balance of Trade

Reduced Pollution

Local Regeneration

Local Resources

Circular Flows

Return on Investment

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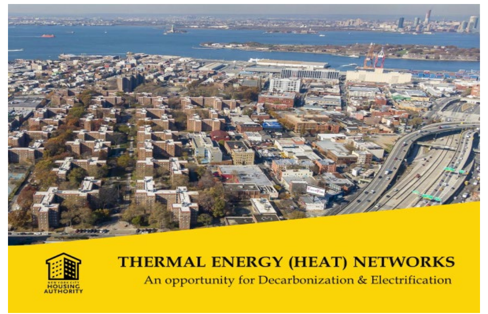
Examples on Projects

Hamilton

Thunder Bay

NewYork - NYCHA



Netherlands

Switzerland

ewb

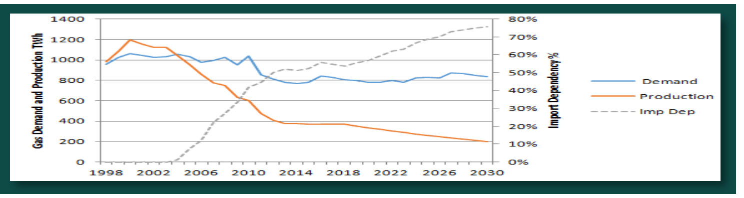
SIG

Preparation

Delivery

Push & Pull

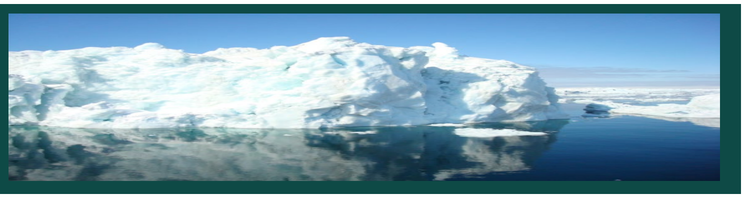
Energy Security



Balance of Trade

Local Resources

Climate Emergency



Reduced Pollution

Circular Flows

Cost & Convenience

Local Regeneration

Return on Investment

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Examples on Projects

Hamilton

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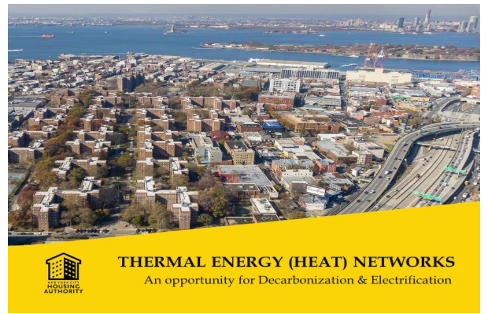
NewYork - NYCHA



Netherlands

Switzerland

Preparation

Delivery

Capacity to Prepare

Developing local capabilities in preparing affordable investments

Training and Innovation services

Professional & Vocational Training and local innovation platforms

Bridging Gaps

Resolving Challenges & Risks halting projects

Advisory services

Sharing of know-how, experiences and best practice

Capacity to Deliver

Developing local supply chain capacity to deliver projects

Supply Chain services

Facilitating market entry and local partnerships

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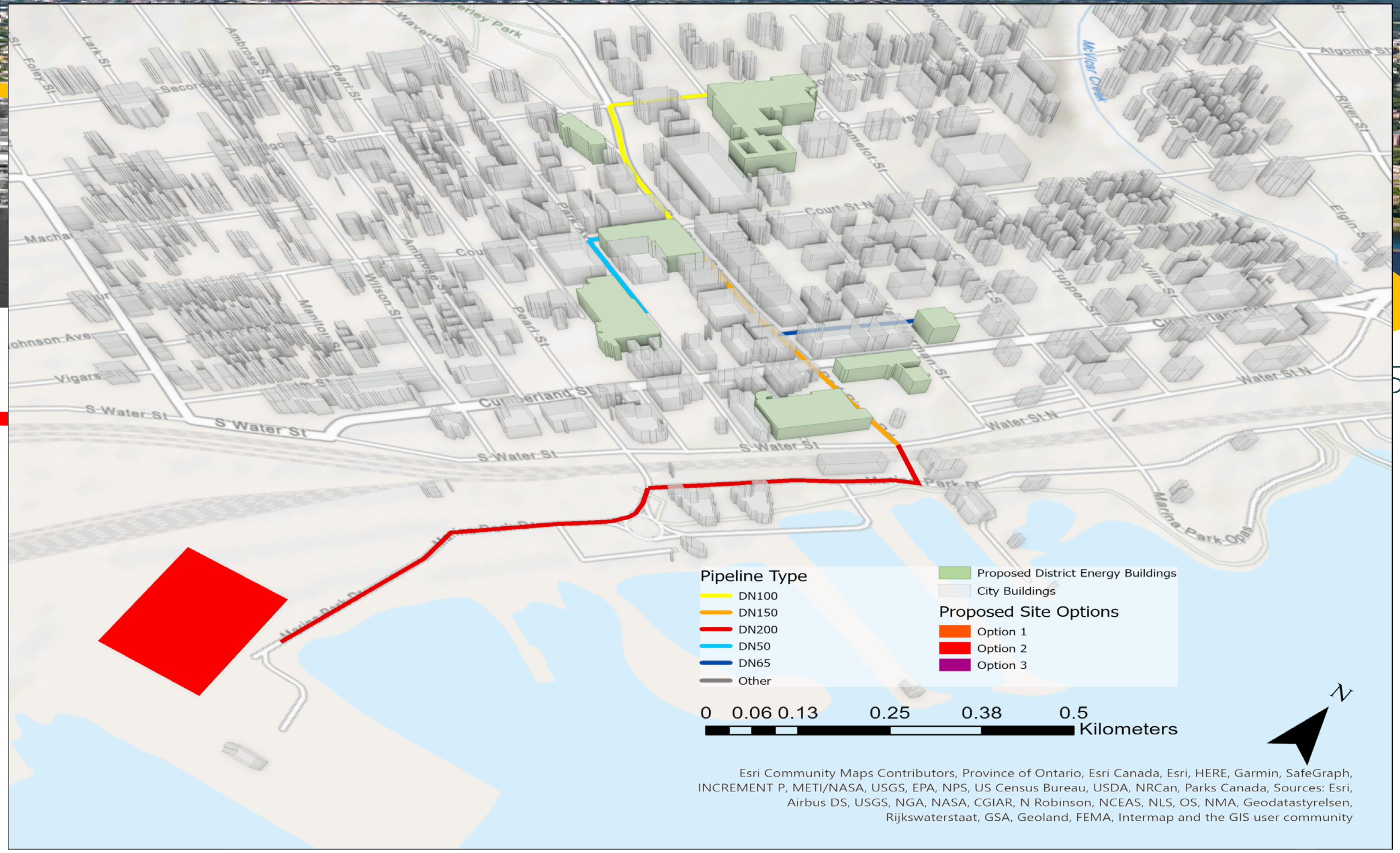
Decarbonising Heating in Thunder Bay

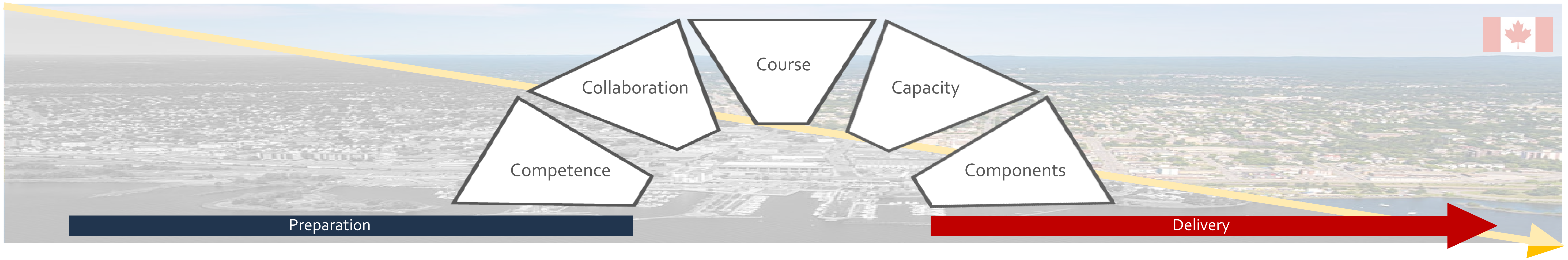


2020

50

BioHeat

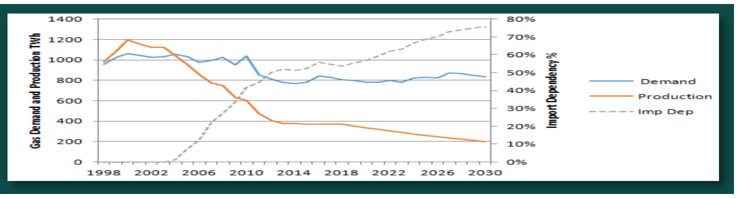
Decarbonising Heating in Thunder Bay



2020 2050

Push & Pull

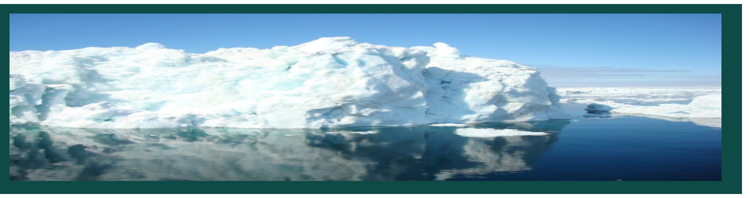
Energy Security



Balance of Trade

Local Resources

Climate Emergency



Reduced Pollution

Circular Flows

Cost & Convenience

Local Regeneration

Return on Investment

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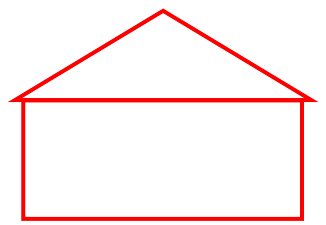
Decarbonising Heating

Core Strategy

1 Conserve

Reduce Heat Demand
Recover Waste Heat

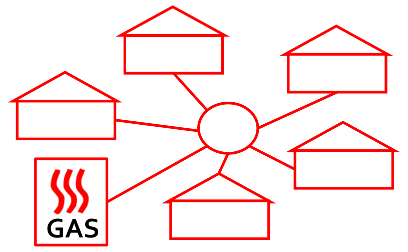


Building Efficiency
Insulation and digital solutions and insulation

Waste Heat Recovery & Storage
Sewage and other nearby sources

2 Connect

Replace Gas & Steam Networks

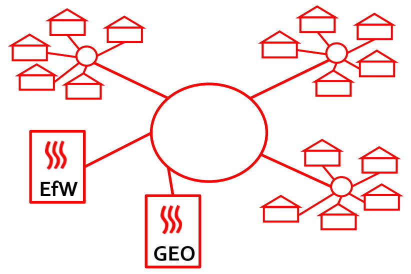


Thermal Energy Networks (TENs)
Install community heating networks (doughnuts)

Heat Pumps
Replace gas boilers and other fossil based equipment

3 Convert

Renew Heat Sourcing
Remove Old Technologies



Geothermal Energy
Install (deep) geothermal heating

Expand TENs
Connect the doughnuts into combined networks

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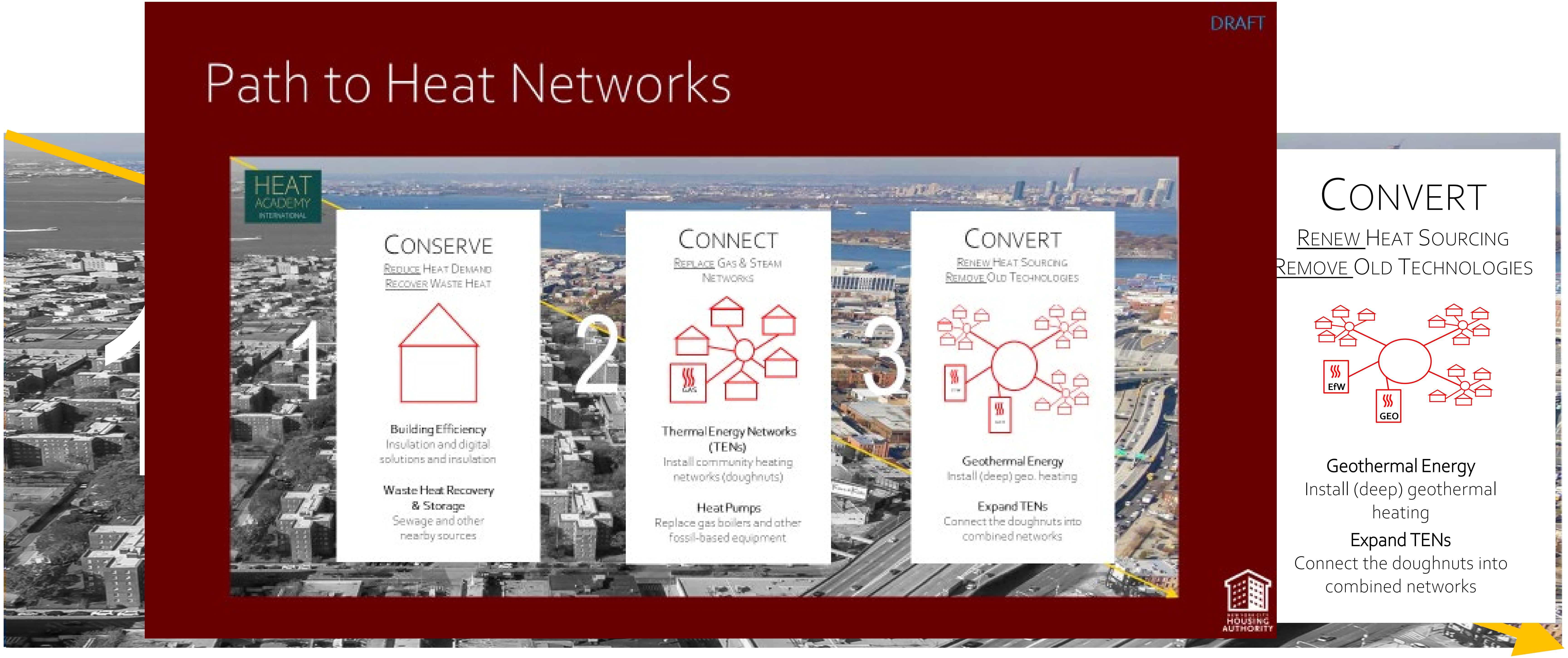
DRAFT
Path to Heat Networks
HEAT ACADEMY INTERNATIONAL
CONSERVE
REDUCE HEAT DEMAND
RECOVER WASTE HEAT
Building Efficiency
Insulation and digital solutions and insulation
Waste Heat Recovery & Storage
Sewage and other nearby sources
CONNECT
REPLACE GAS & STEAM NETWORKS
Thermal Energy Networks (TENs)
Install community heating networks (doughnuts)
Heat Pumps
Replace gas boilers and other fossil-based equipment
CONVERT
RENEW HEAT SOURCING
REMOVE OLD TECHNOLOGIES
Geothermal Energy
Install (deep) geo. heating
Expand TENs
Connect the doughnuts into combined networks
1
2
3
CONVERT
RENEW HEAT SOURCING
REMOVE OLD TECHNOLOGIES
EfW
GEO
Geothermal Energy
Install (deep) geothermal heating
Expand TENs
Connect the doughnuts into combined networks
HOUSING AUTHORITY

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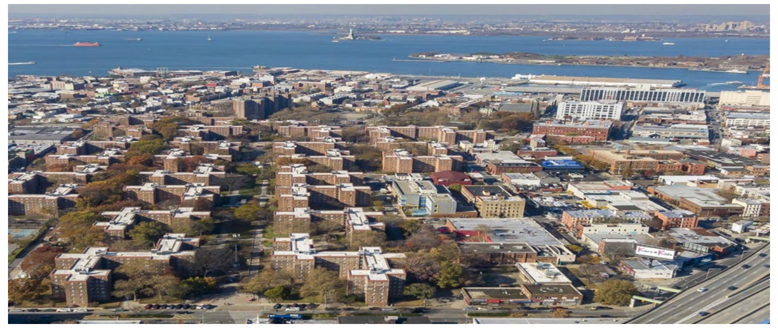
Decarbonising Heating

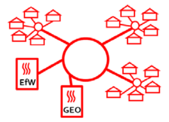
Size Matters

- Mine Heat
- Deep Geothermal
- EfW
- Industrial Waste Heat



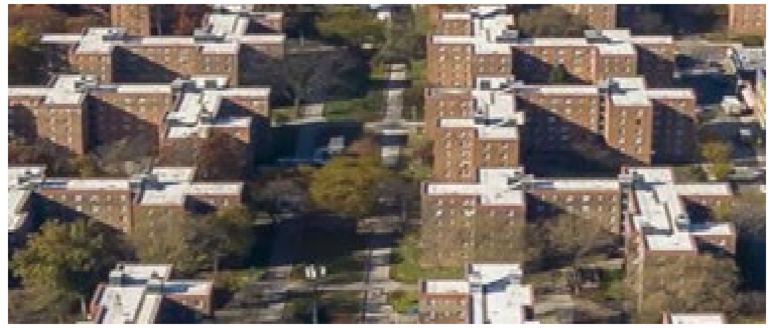
3

CONVERT
FUEL



SUSTAINABLE
HEAT SOURCING

- BioHeat
- Gas CHP
- GSHP Cluster

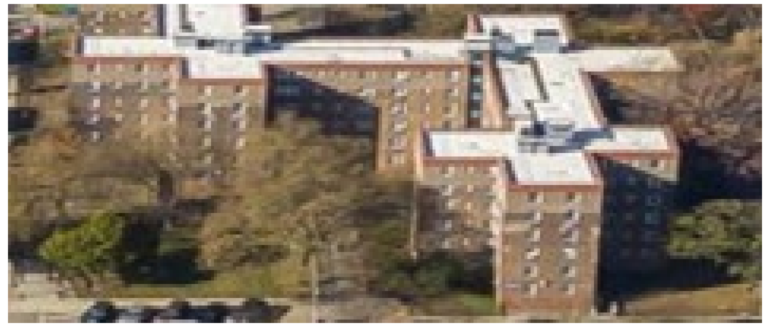


2

CONNECT
PIPES

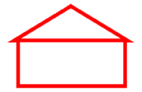
HEAT
NETWORK

- GSHP
- ASHP
- Gas/ Oil Boiler



1

CONSERVE
HOUSE



BUILDING
EFFICIENCY

THE CLIMATE BRIDGE GROUP

Peter Anderberg - pa@heatacademy.eu /+46 70 56 111 99

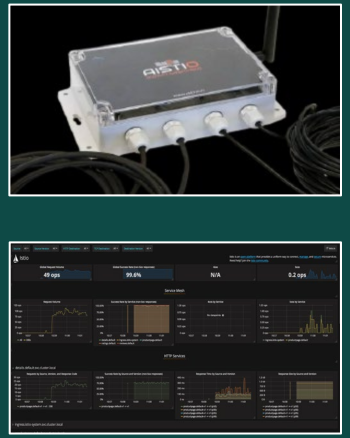
Decarbonising Heating

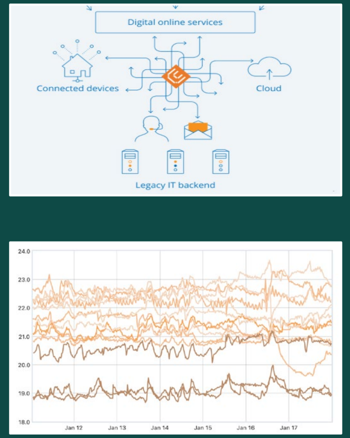
Conserve

CONSERVE

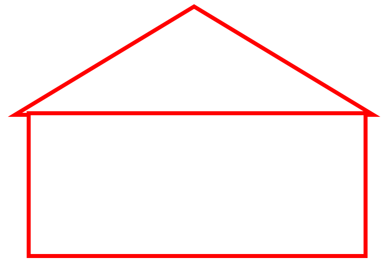
BUILDING EFFICIENCY

Data





Optimisation



10-15%

HEAT ACADEMY INTERNATIONAL
Execution Intelligence

Decarbonising Heating

Building Efficiency

Democratising Heating through Digital Technologies – saving energy in buildings

9th December

10.00 – 12.00 (CET)

register@heatacademy.eu

The vast majority of buildings in Western Europe are heated by natural gas. In fact, heating represents some 40% of the total primary energy consumption, and 35% of GHG emissions. Some 70% of the natural gas consumed in Western Europe is imported. Russia alone represents 40% of total supplies. Net imports are bound to increase further as production is rapidly slowing down in the Netherlands and in UK.

This situation involves significant risks for the population and wider economy in Western Europe. Soaring gas prices are already having a serious economic and social impact across Europe. Political leaders are also challenged by major geo-political risks in terms of short term energy security and loss of integrity in international negotiations and conflicts. Something's got to change. And fast. What to do, and where?

Reducing the need for heating is a good place to start. Investments in energy efficiency have a significantly better cost-benefit ratio than those focusing on production of energy. Traditional solutions for improving energy efficiency in buildings – windows and insulation – are still valid. However, recent digital technologies offer some new and very cost-effective opportunities to rapidly reduce the need for heat. These solutions, which can be retrofitted at scale in any type of building, will be in focus at this session. The agenda includes the following topics:

- *Reality check* – Driving Building Efficiency in various markets
- *Technologies* – Digital solutions reducing the need for heat – what, how, where
- *Initiative* – "Royal Heating – Democratising heating while reducing climate impact of buildings"

In collaboration with

vito, City of Gothenburg, Nordic Heat, NODA, Cetetherm, soficta, ENVISTA, hysopt

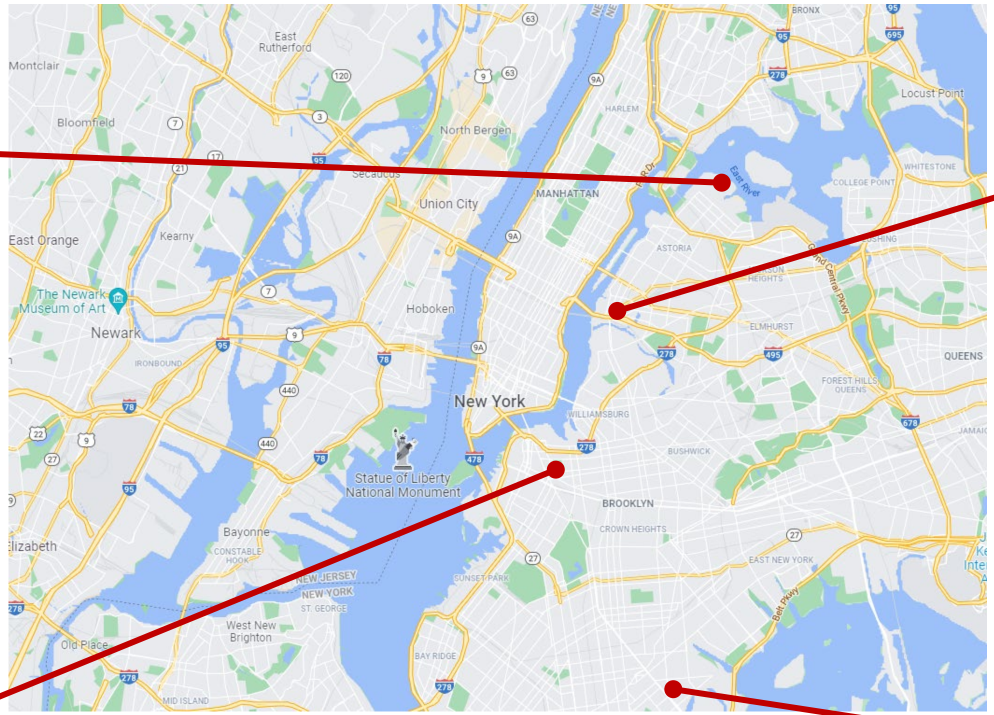
Decarbonising Heating

Selected Proof-of-Concept Projects

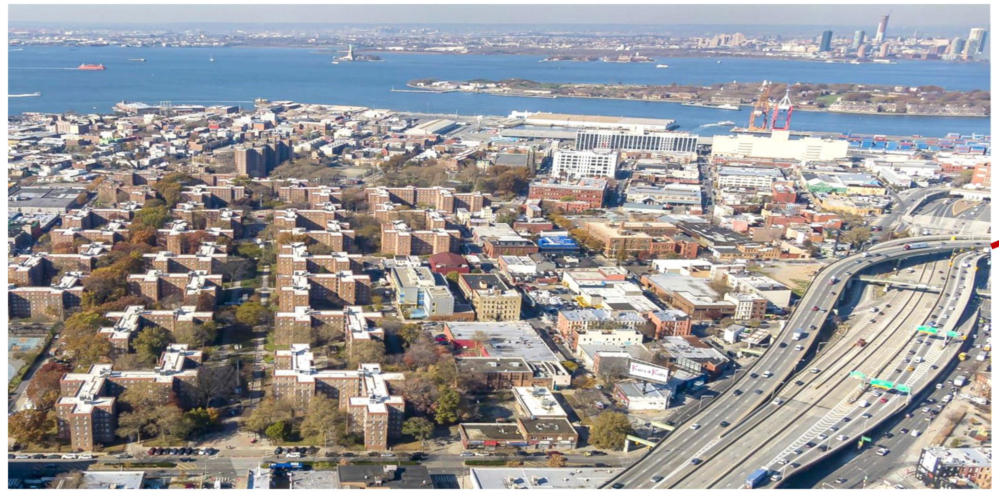
EXAMPLE

La Guardia

Queens

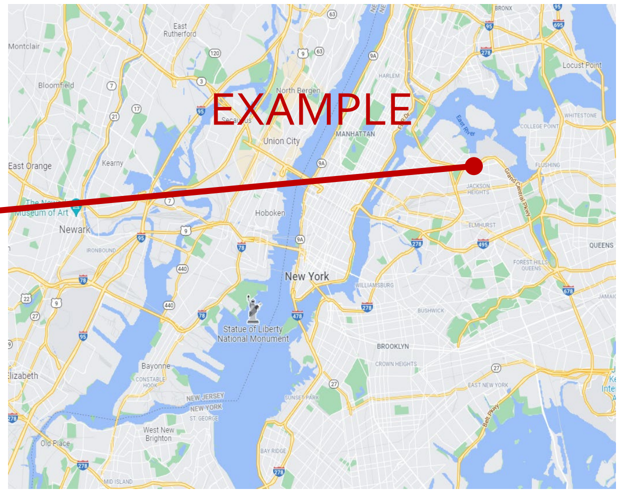


Brooklyn



Kingsborough

La Guardia



Facts

- No. of properties
- No. of apartments
- Average Size

KPIs – Status & Objectives

- Current heating solution
- Average heat consumptions last 5 years
- Average GHG emissions last 5 years
- …
- …

Initiatives

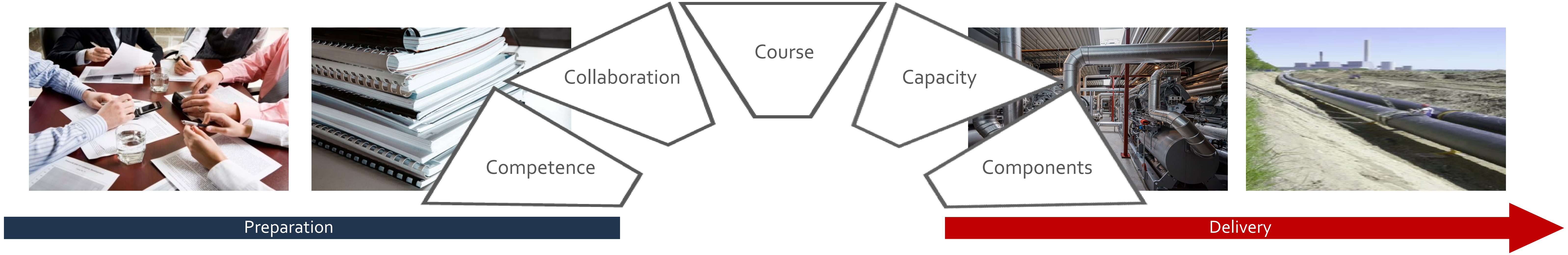
		Activity	*Capex ($)*	*Benefit ($, CO2, …))*
1	CONSERVE REDUCE HEAT DEMAND RECOVER WASTE HEAT  **Building Efficiency** Insulation and digital solutions and insulation **Waste Heat Recovery & Storage** Sewage and other nearby sources			
2	CONNECT REPLACE GAS & STEAM NETWORKS  **Thermal Energy Networks (TENs)** Install community heating networks (doughnuts) **Heat Pumps** Replace gas boilers and other fossil based equipment			
3	CONVERT RENEW HEAT SOURCING REMOVE OLD TECHNOLOGIES  **Geothermal Energy** Install (deep) geothermal heating **Expand TENs** Connect the doughnuts into combined networks			

Roadmap & Milestones

2021 — XX — XX — XX — XX — 2023

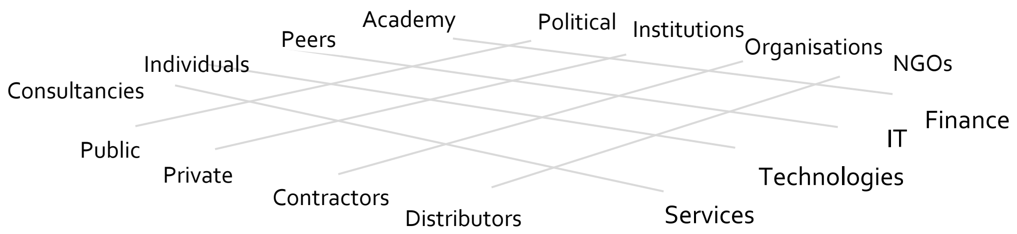
Climate Bridge Group

Bringing Projects from Vision to Operations



Local Partners

300+ experienced experts



Facilitating the process of decarbonising Heating and Cooling through local capacity building, collaboration and replication of best practice.

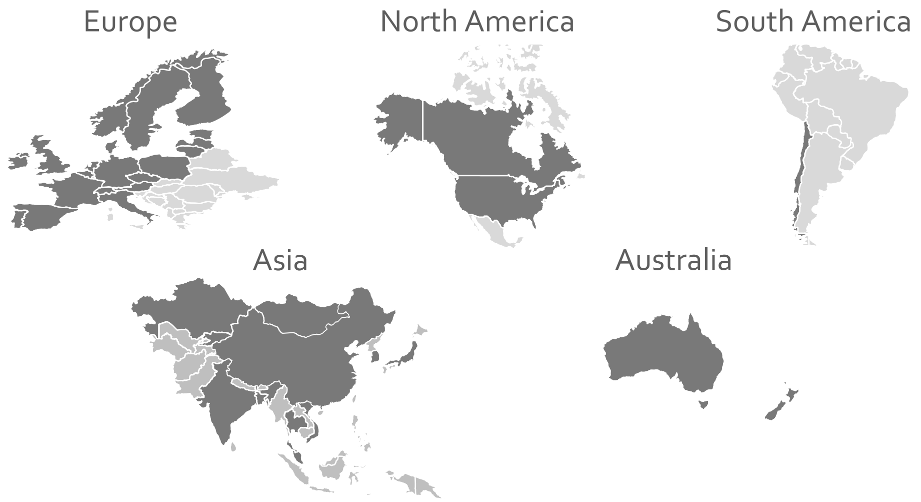
Training — Replication — Advice — Supply Chain

HEAT ACADEMY INTERNATIONAL — NORDIC HEAT — NXITY — HEATNET GLOBAL

THE CLIMATE BRIDGE GROUP

Global Presence

30 markets



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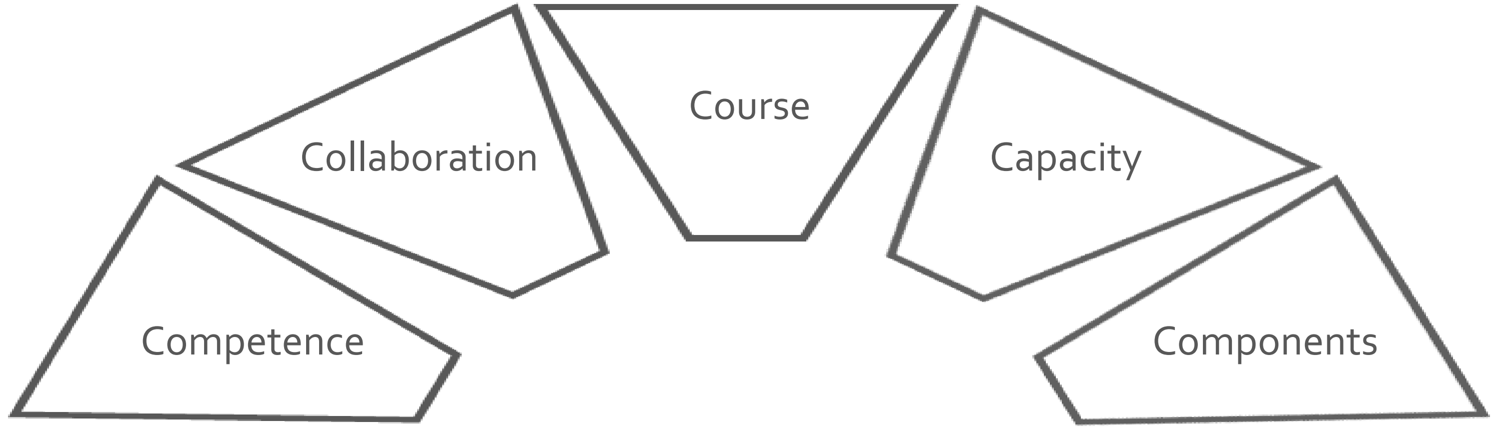
Climate Bridge Group

Contacts

Peter Anderberg
pa@heatacademy.eu



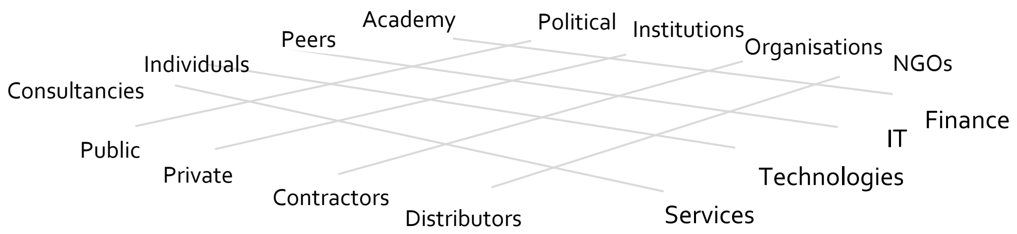
Mikael Jakobsson
mikael.jakobsson@nxity.com

Preparation

Delivery

Local Partners

300+ experienced experts



Facilitating the process of decarbonising Heating and Cooling through local capacity building, collaboration and replication of best practice.

Training	Replication	Advice	Supply Chain
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Global Presence

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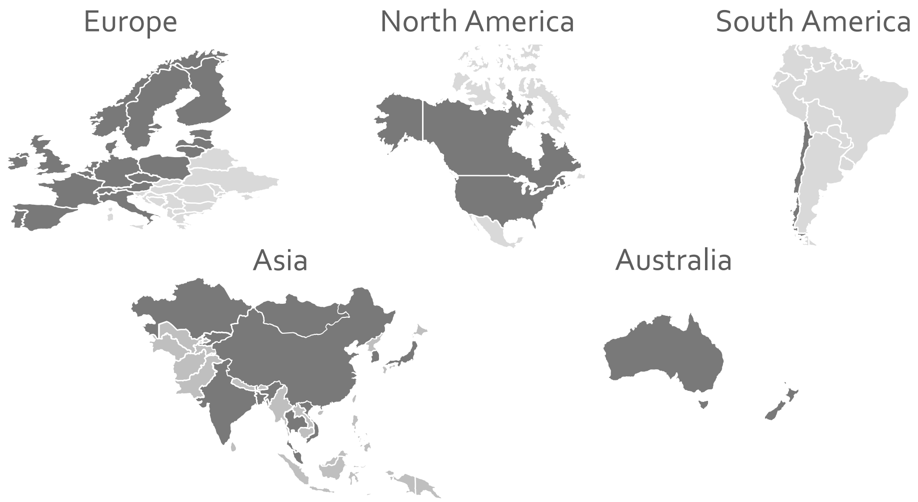

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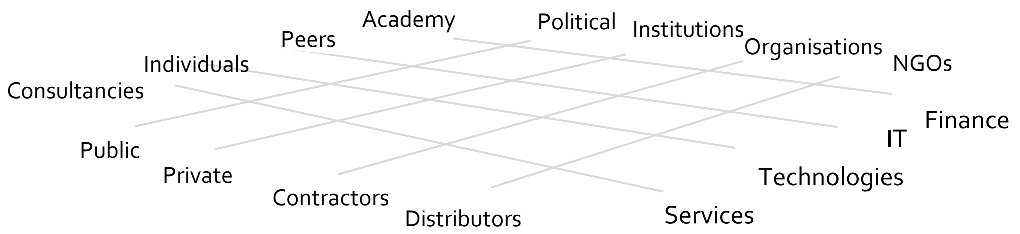
Examples on Customers

Preparation → Delivery

Local Partners

300+ experienced experts



Facilitating the process of decarbonising Heating and Cooling through local capacity building, collaboration and replication of best practice.

Training	Replication	Advice	Supply Chain
Heat Academy International	Nordic Heat	NXTY	Heatnet Global

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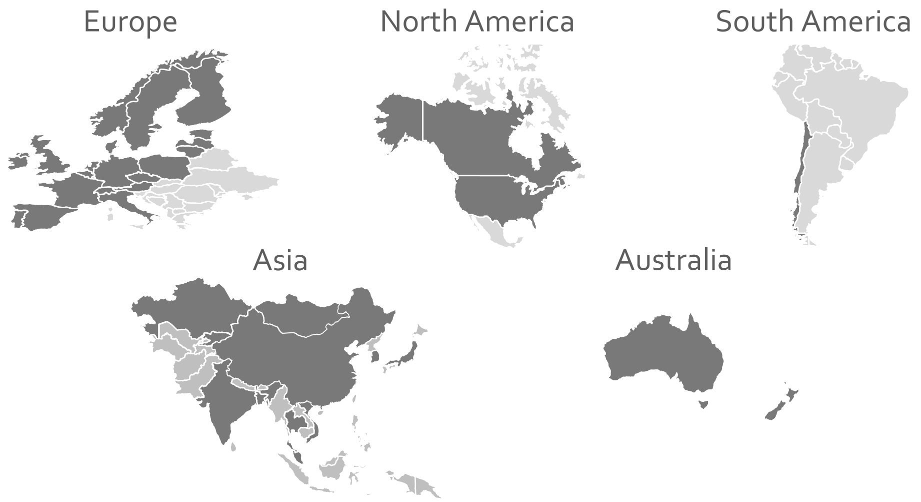
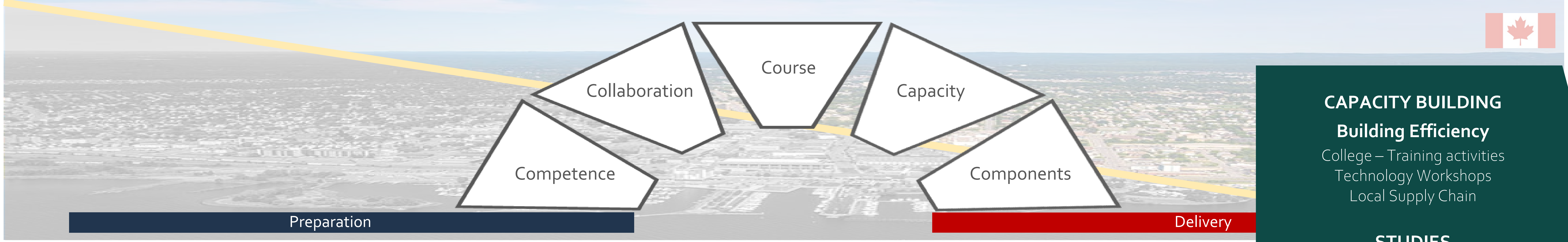
Global Presence

30 markets



Decarbonising Heating in Thunder Bay



CAPACITY BUILDING

Building Efficiency

College – Training activities
Technology Workshops
Local Supply Chain

STUDIES

Heat Network

Heat Plan
Extended Feasibility Study

2020 — 2021 — Sept. — Oct. — Nov. — Dec.

- 1st Sept. - Launch of pre-feasibility study
- 16th Sept. - Kick-off meeting and walk-about
- 13th Oct Heat Academy session - I
- 26th Nov.- Report from pre-feasibility
- 15th Dec.- Heat Academy session - II

Training and Innovation services

Professional & Vocational skills

Peer-to-Peer advisory services

Sharing of know-how, experiences and best practice

Supply Chain services

Facilitating market entry and partnerships

stronger business together

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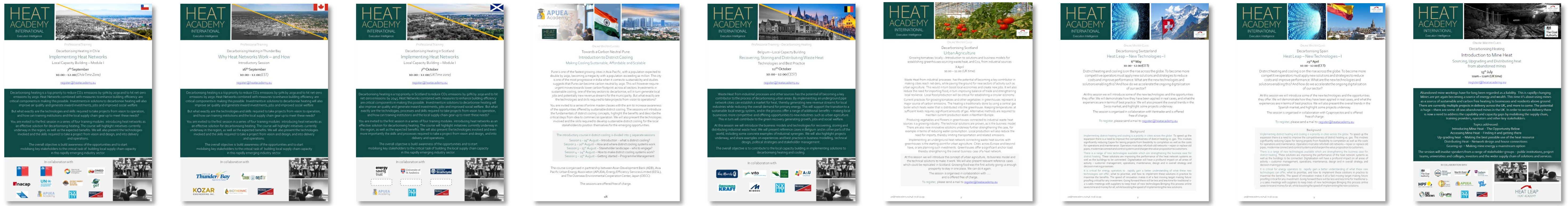
Regular Training Activities

Webinars, Local Seminars and Workshops

Chile | Canada | Scotland | India | Belgium | Netherlands | Switzerland | Spain | UK



Preparation → Delivery

Partners & Activities

Professional Training

Theoretical Skills to prepare and manage projects

Examples on topics:

Business Modelling, Logistics, QA, Programme Management, Digital Strategies, Legal Framework, Communication, Sales, Procurement, Health & Safety, O&M, Design, Customer Management

Local Partners

Collaboration with local colleges and universities in 30 markets

Examples on local partners:

University of St Andrews, University of Hull, University of Strathclyde, Imperial College London, LSE, Staffordshire University, Université de Genève, Keele University, The University of Edinburgh, Heat Academy International, Coleg Penybont Bridgend College, CATCH, Stoke on Trent College, North East Scotland College, SLC South Lanarkshire College East Kilbride, Edinburgh College, Glasgow Kelvin College, NSCG Newcastle and Stafford Colleges Group

Vocational Training

Practical Skills to implement and operate systems

Examples on topics

Drilling, Logistics, Energy Audits, Heat Pumps Installation, Welding, Metering, O&M, Health & Safety, Heat Interface Units, Energy Efficiency Retrofit

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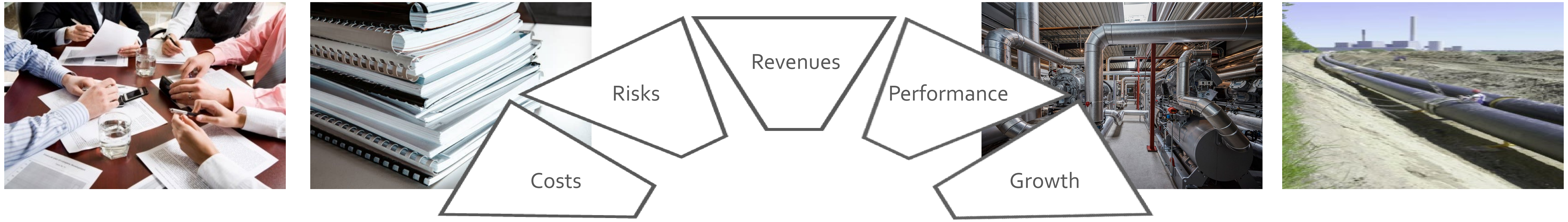
Draft

Regular Training Activities

Webinars, Local Seminars and Workshops

Capability to Prepare

Capacity to Deliver



Preparation

Delivery

Introductory Courses

Example – "Why Heat Networks Work"

1 Decarbonising Heating – drivers and strategies
- Objectives and regulatory framework
- Current status and priorities going forward
- Initiatives to accelerate investments
- Bridging capacity gaps

2 Why Heat Networks Work – socio-economic benefits
- The impact of heat
- The Nordic experience
- Socio-Economic opportunities
- The "New Heat Wave"

3 What Heat Networks are – basic components
- Basic Components
- Demand – Anchor load
- Supply – Sources of Heat
- Distribution – Connecting the dots

4 Where Heat Networks Work – reference cases
- Drivers – Making a Heat Leap
- Basic Approach – Demand, then Heat
- The Doughnut strategy
- Think big – Start small

5 Who makes Heat Networks work – securing buy-in
- Stakeholder Management
- Securing Buy-in
- Securing Leadership & Capability
- Securing Delivery

6 How to make Heat Networks work – strategy and processes
- Basic strategy – Conserve, Connect, Convert
- Business Models and Value Proposition
- Ownership models and financing solutions
- Risk management

7 Making it all work in practice – securing leadership
- Mindset – "Bring a Spade"
- Programme Management
- Critical Friends and Partners
- Collaboration and Replication

8 Capacity Building – securing ability to deliver
- Mobilising key leaders and influencers
- Bridging Gaps
- Training – professional & vocational
- Developing the local supply chain

Deep Dive Training Modules

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Overview of Topics

STRATEGY

Overall Heat Strategies
- Heat Mapping & Planning
- Strategies – Governance
- Collaboration & Replication
- Leadership & Communication

Stakeholder Involvement
- Political – regulations & benefits Industry – business opportunities
- Customers – value proposition
- Public – socio-economic benefits

Financing Strategies
- Ownership models
- Financing solutions
- Business modelling
- Approaching investors

Local Capacity Building
- Programme Management
- Bridging Gaps
- Training strategy
- Supply chain development

Beyond Heat
- Urban Agriculture
- Industrial Symbiosis
- Optimising local benefits
- Multi-Energy Systems (MES)

BUILDING EFFICIENCY

Retrofit Strategies
- Demand profiling
- Optimising
- Retrofit
- Heat recovery

Industrial Energy Efficiency
- Options & Strategies
- Industrial Utilities
- Building Efficiency
- Technologies & Best practice

HEAT SOURCING

Urban Heat
- Heat Sourcing Strategies
- Options – short & long term
- Low temperature heat sources
- Overcoming barriers

BioHeat
- Heat Sourcing Strategies
- Options – short & long term
- BioHeat
- Overcoming barriers

Energy-from-Waste
- Technologies
- Waste management
- Business models
- Overcoming barriers

Industrial Waste Heat
- Opportunity framing
- Technologies and strategies
- Business Modelling
- Stakeholder management

Heat Pumps
- ASHP
- GSHP
- Business Models
- Implementation strategies

Deep Geothermal
- Deep Geothermal
- Mine Heat
- Assessing the potential
- Accessing the heat

Mine Heat
- Accessing Mine Heat
- Business Modelling
- Technologies & Design
- Implementation and operations

Power-to-Heat (P2H)
- Heat Generation
- Heat Accumulators
- Distribution
- Connect & Control

Autonomous Heating
- Heat Sourcing & Distribution
- In-floor Accumulation
- Digital Solutions
- Design & Implementation

DISTRIBUTION

Network Design
- Rightsizing - Optimization
- Digital Twin
- Simulations and projections
- Strategic communication

Connect & Control
- Heat Interface Units
- Hybrid solutions
- Metering and Billing strategies
- End-user convenience

Network Asset Management
- Installation & Management
- Operations & Optimization
- Monitoring & Leak Detection
- Maintenance & Refurbishment

Next generation Networks
- 5G District Heating - overview
- Heat provision
- Distribution system
- Digital Solutions & AI

MANAGEMENT

Programme Management
- …

Procurement
- …

Health & Safety
- …

Operations & Maintenance
- …

Heat Leap – New Technologies
- …

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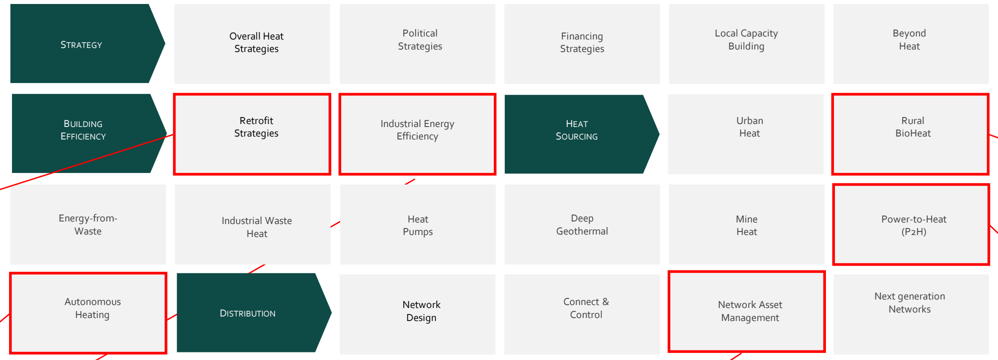
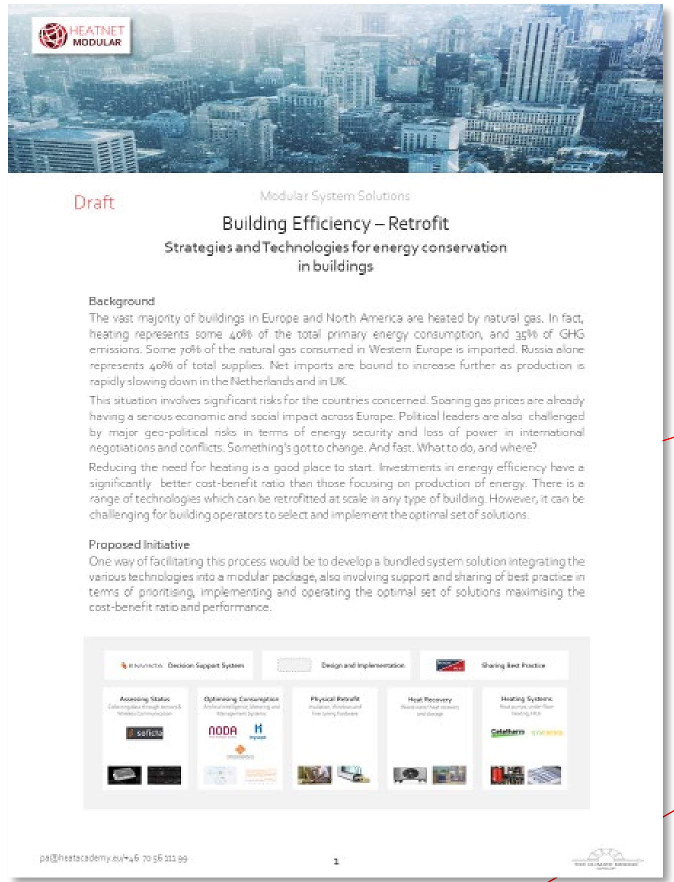
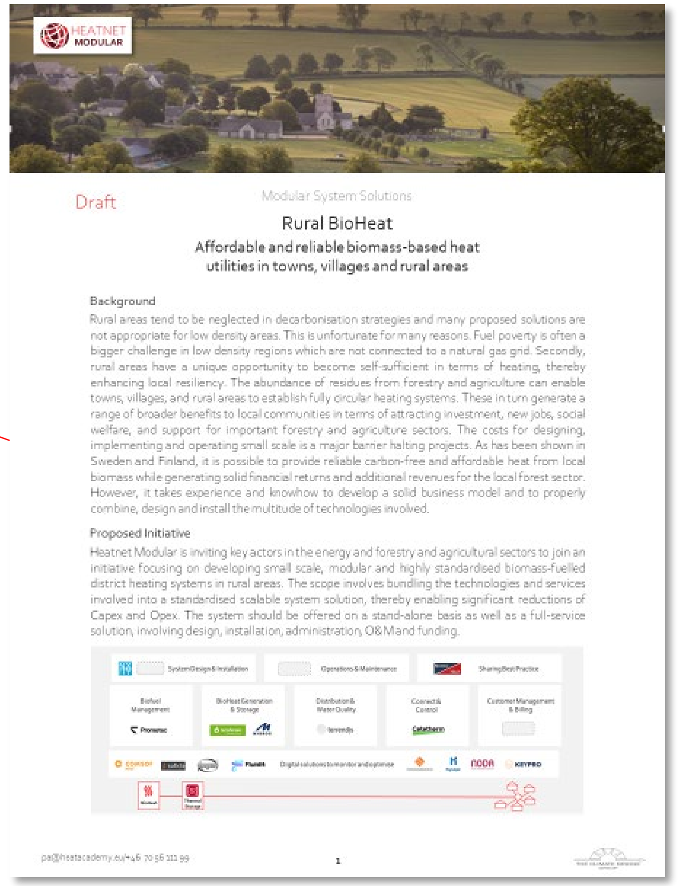
Peter Anderberg - pa@heatacademy.eu /+46 70 56 111 99

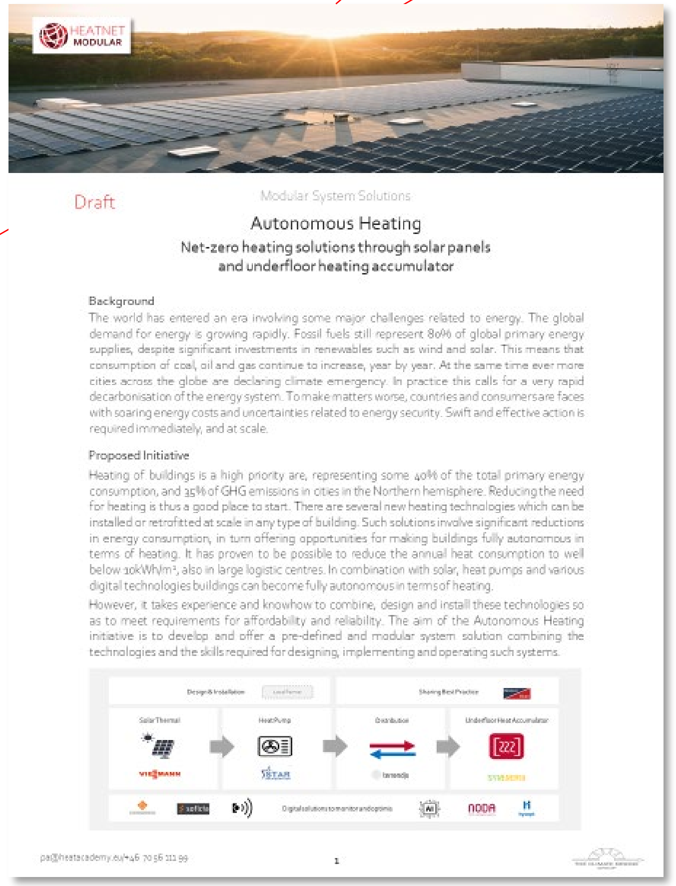
Initiatives - Overview

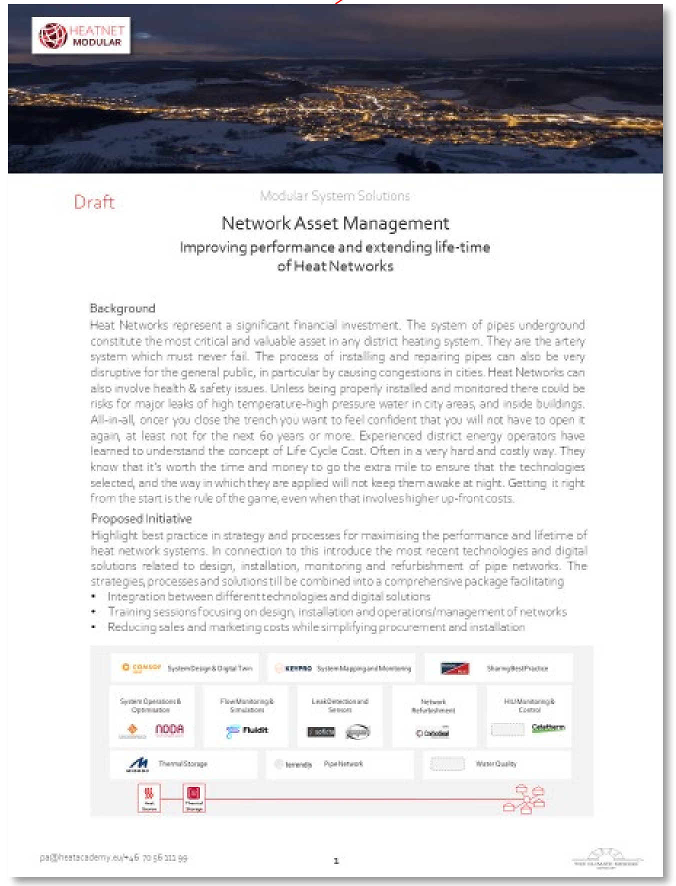
Overview of Initiatives

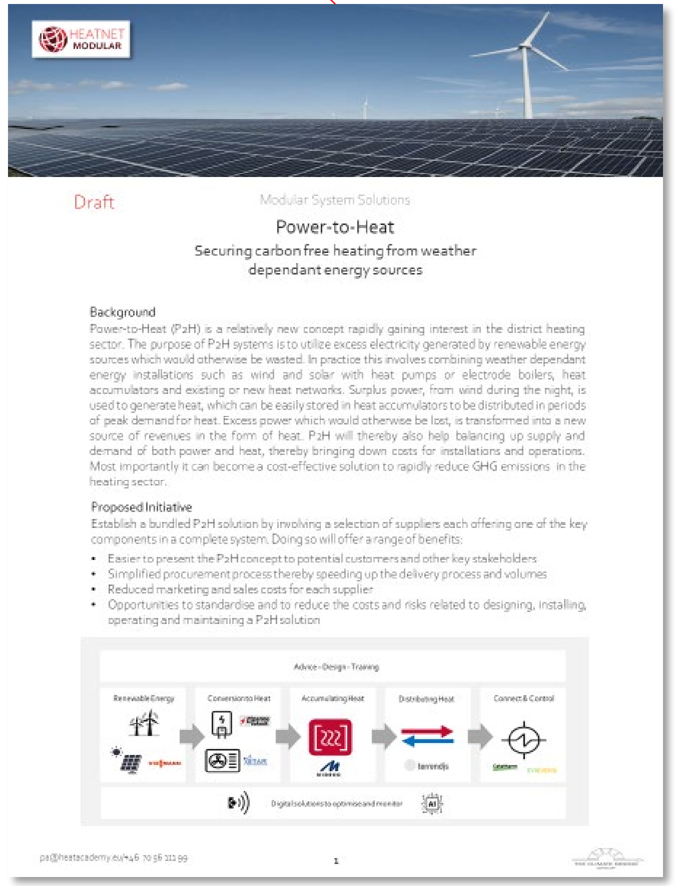








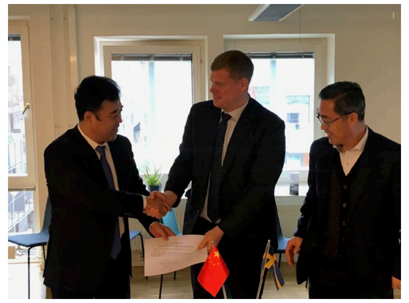


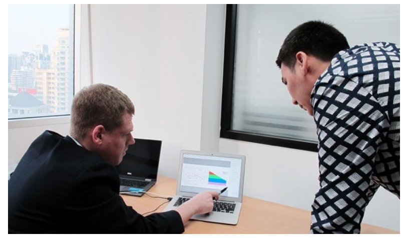


Industrial Energy Efficiency

Strategies and Technologies for improving energy efficiency of industrial installations

- District Energy (DE)
  - District Heating (DH)
  - District Cooling (DC)
- Thermal Power / Distributed Energy
  - Co-generation (CHP)
  - Tri-generation (CCHP)
- Industrial Energy Symbiosis
- Multi-Energy Systems (MES)
- Smart Energy City (SEC)





Mikael Jakobsson, CEO NXITY

Executive Director of Asia Pacific Urban Energy Association (APUEA)

Official District Energy Advisor to Qingdao Development and Reform Commission

Member of World Economic Forum (WEF), Energy Community China

Advisory Board Member of European Commission Horizon 2020 MAGNITUDE project

NXITY APUEA Asia Pacific Urban Energy Association European Commission Magnitude WORLD ECONOMIC FORUM

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NXITY, with its origin in Scandinavia, provides Project Management and Multidisciplinary Business Consulting for clients in the Urban Energy and Industry sector. NXITY, with offices in Bangkok, Beijing, Hong Kong and Stockholm, is specialized in developing and optimizing District Energy (District Cooling and District Heating), Distributed Energy (CHP and CCHP), Multi-Energy Systems (MES), and Smart Energy City (SEC) projects.

We strengthen client organizations and projects by adding value, filling management and engineering gaps, and minimizing risk exposure through project development, execution and operation. NXITY combine the vast experience within Energy Engineering, ICT Engineering, Water and Environment and Management to empower our clients. We often work as Client representative for Municipalities, Utilities and Investors.

NXITY personnel has experience optimizing the design and operation of the world's largest and most complex integrated urban energy systems with capacities above 10 GW. As client representative, NXITY has developed and implemented numerous integrated energy projects with investment levels above USD 400M in the region. NXITY has collaborated with EDF on multiple Urban Energy projects, both in Asia and Europe.

PROJECT MANAGEMENT

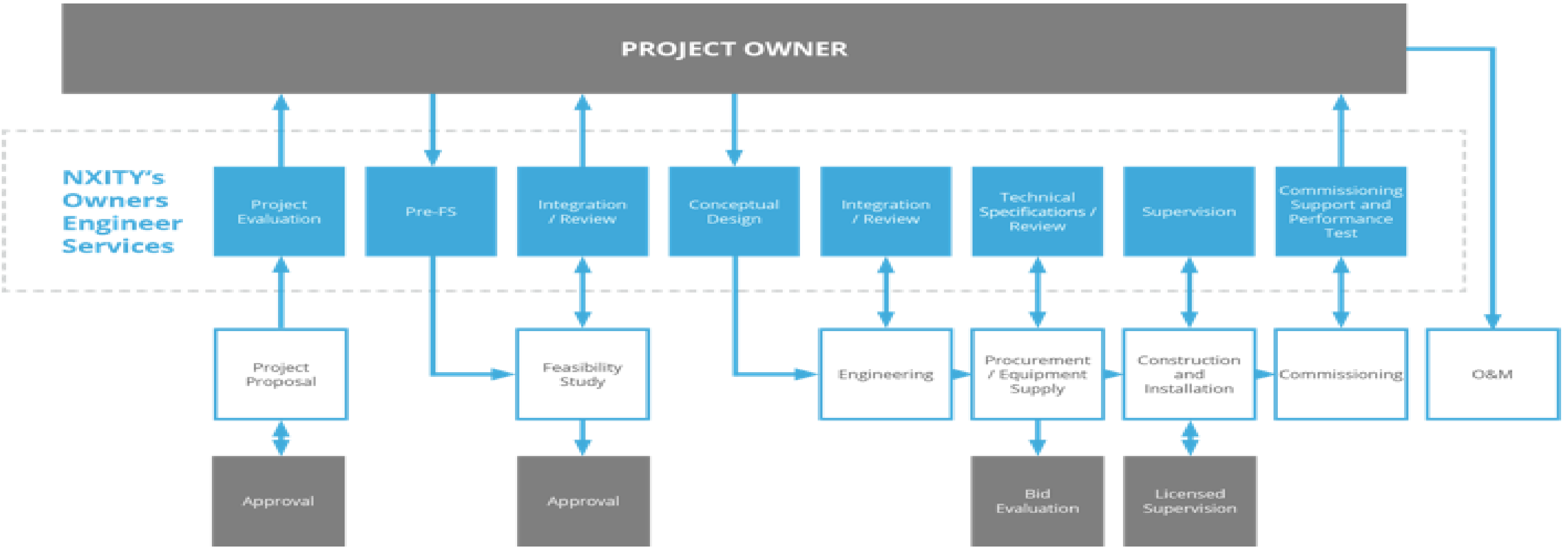
Client representative and multisector project management services to support your business objectives while delivering projects that meets quality, cost, and timeline.

BUSINESS CONSULTING

Multidisciplinary business consulting services to empower your organization and projects while adding value and filling management and engineering gaps.

ENERGY ICT SOLUTIONS

ICT solutions for District Energy and Thermal Power systems to support decision making along the entire project value chain and optimize O&M across entire system value chain.



Potential improvements

Cost for improvements

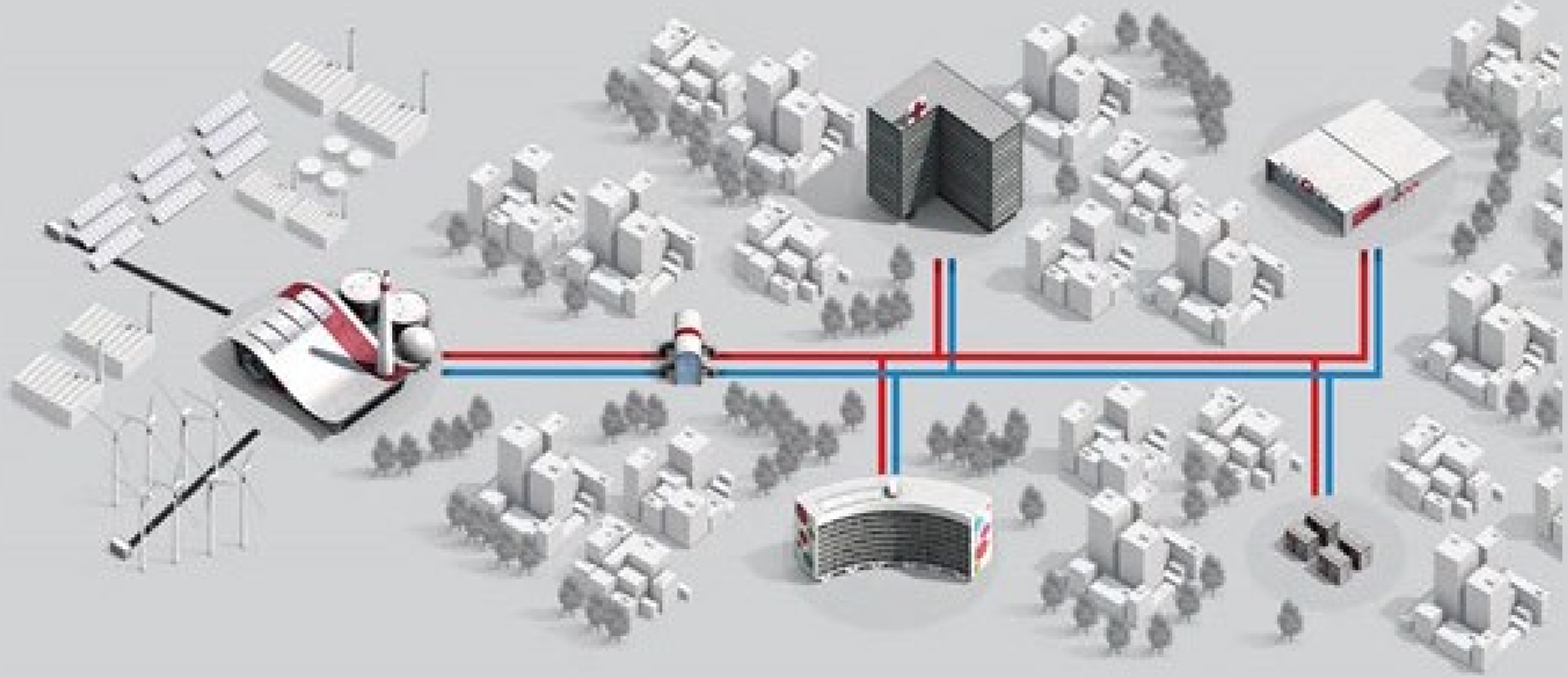
Owner's Engineer / Lender's Engineer (Client representative)			
Pre-design	*Design and Procurement*	*Construction, Installation and Commissioning*	*Operation & Maintenance*
Project Management – Contract Administration – Risk Management – EHSQ			
Market surveys Energy Development plans Tech. and Fin. Due Diligences Pre-FSR, FSR and FSR-review Mass- and energy balances Thermal and Hydraulic analysis OpEx/CapEx Modeling and Evaluation Risk Analysis Financial Analysis Business Case Analysis and Business Plans Financing support	Conceptual Design 2D and 3D Design Detailed design review Tender documentation - GCC and SCC Tech. spec. for tendering - Process Description - Functional Requirement - Equipment Requirements - Contractual Guarantee Requirements - Contractual Basic Data - Technical Standards	As-built design review On-site design coordination and clarifications QA/QC Supervision support Construction (progress) monitoring (Global) Performance test support Commissioning support	Operation optimization Maintenance planning Revamping, upgrading and optimization of energy systems CMMS implementation Heat load forecasting implementation EMS integration


2014


Today

"Heating system with (one or more) centralized production facilities for multiple buildings, where scale-advantages are achieved compared to individual heating technologies"

Financial and Economic benefits
Energy Efficiency
Environmental Efficiency
Other benefits



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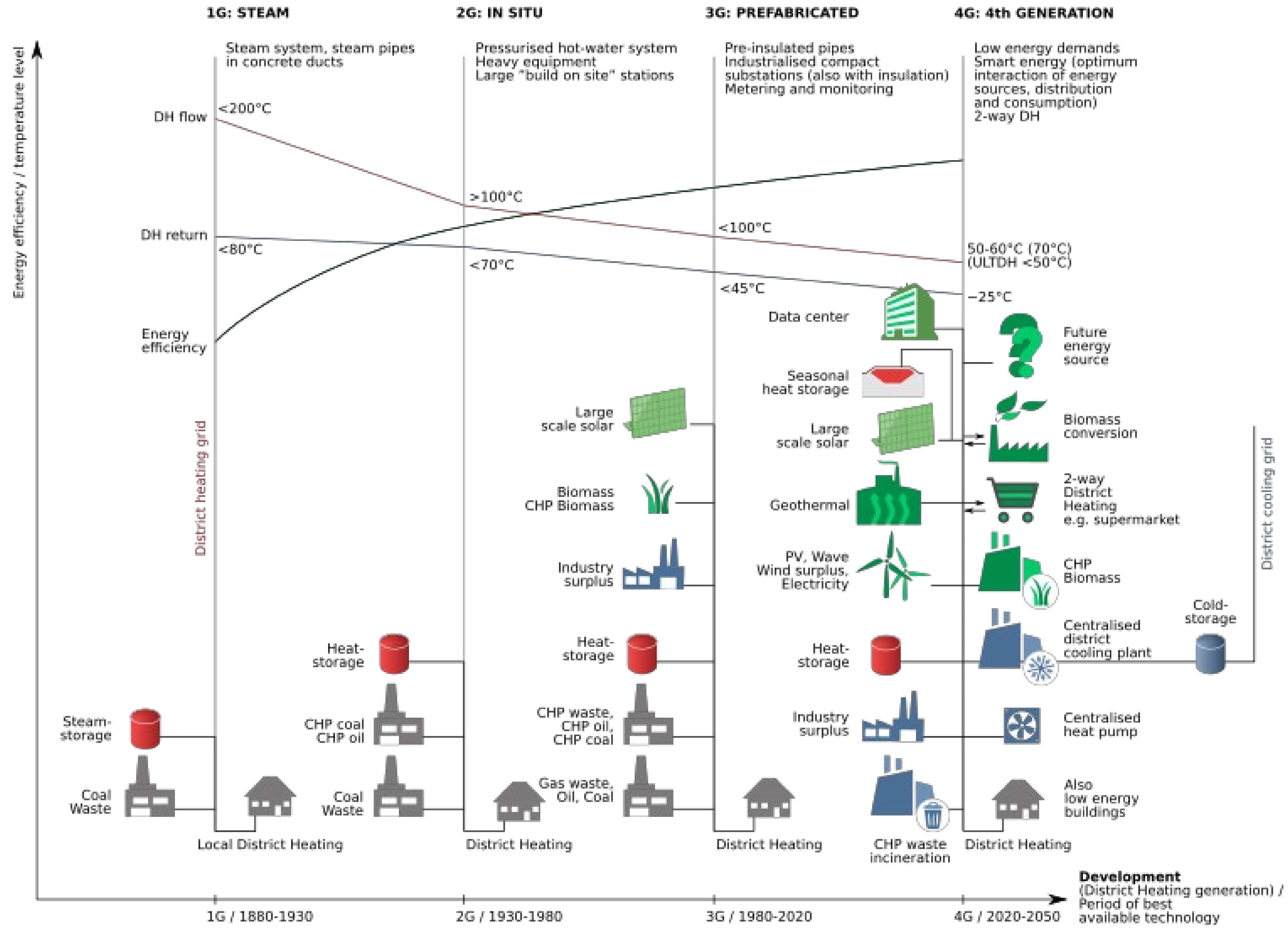
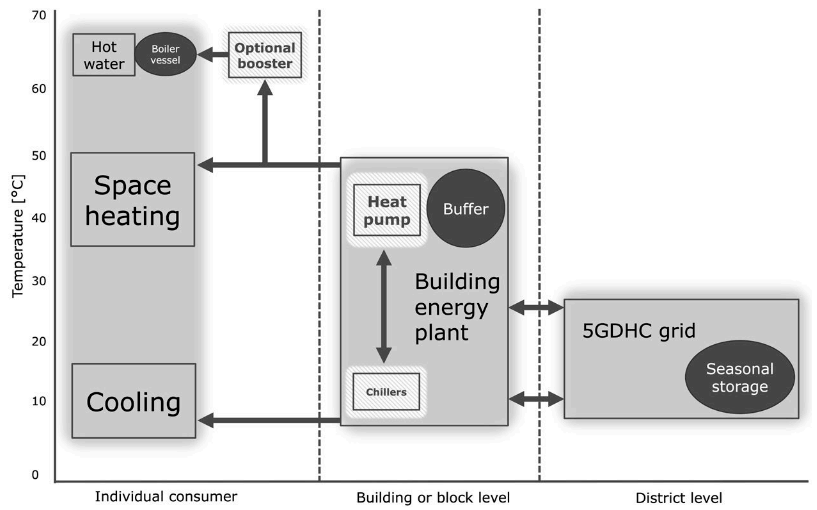
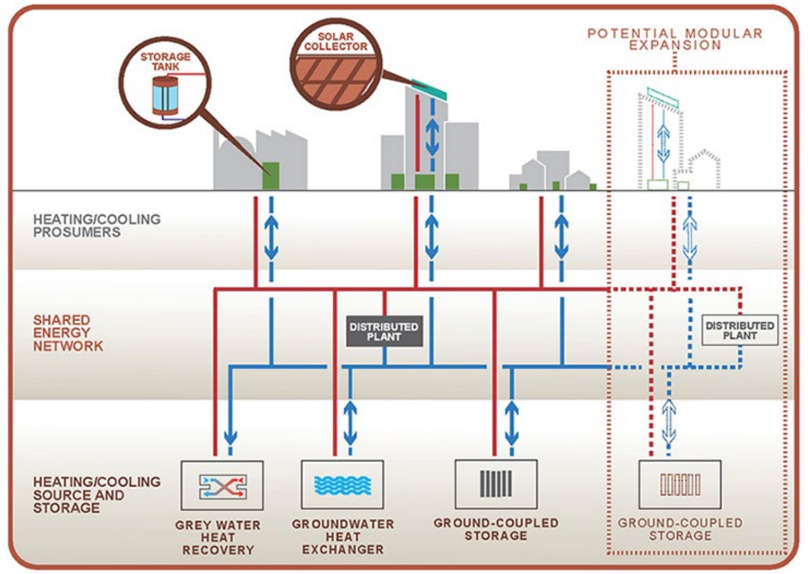


5G: 5th GENERATION

District Energy system simultaneously applied as;
- Heat source for Heating supply
- Heat sink for Cooling supply
- Thermal Storage for the Electricity Grid, and
- An integrted part of Multi-Energy Systems (electricity, gas, cooling, heating and storage)





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Flexible
Flexibility is the key for demand responses in a Smart Energy system, and to cope with future expansion, implementation and variations.

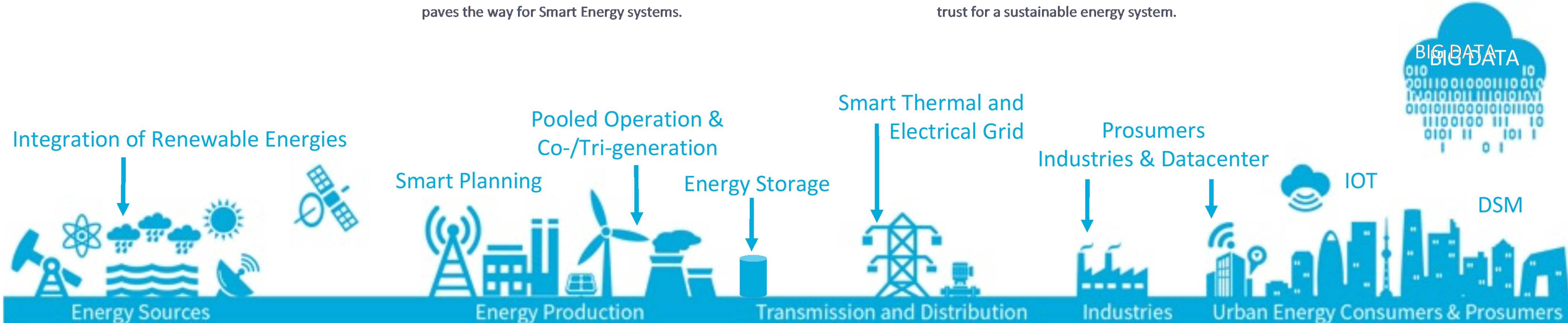
Intelligent
Innovative engineering solutions, in combination with intelligent planning and control tools is the foundation to collect, analyze, visualize and optimize the Smart Energy system.

Integrated
Integration between different energy infrastructure, through cross-sectoral planning paves the way for Smart Energy systems.

Efficient
By utilizing local resources and efficient solutions, along the entire energy system value chain, remarkable global efficiency can be achieved.

Competitive
A smart energy system must be financial viable and competitive with alternative technologies, often through OPEX/CAPEX advantages and increased life-span.

Reliable and Safe
Reliability and Safety are fundamental requirements to satisfy customers and earn the confidence and trust for a sustainable energy system.



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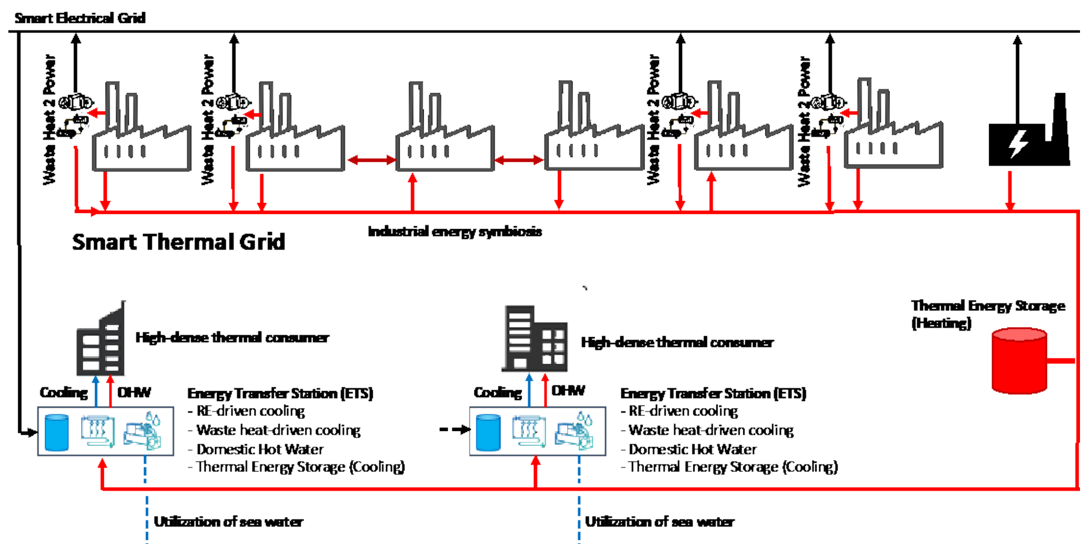


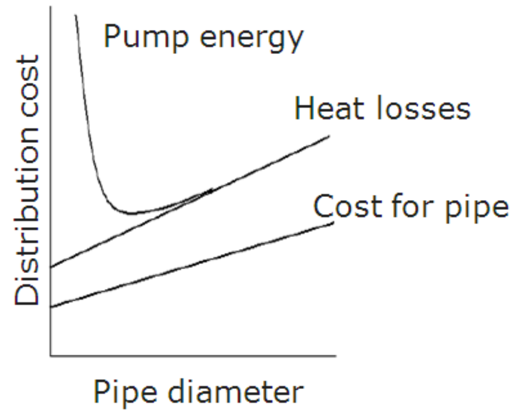
Heating demand density (GWh/km²)

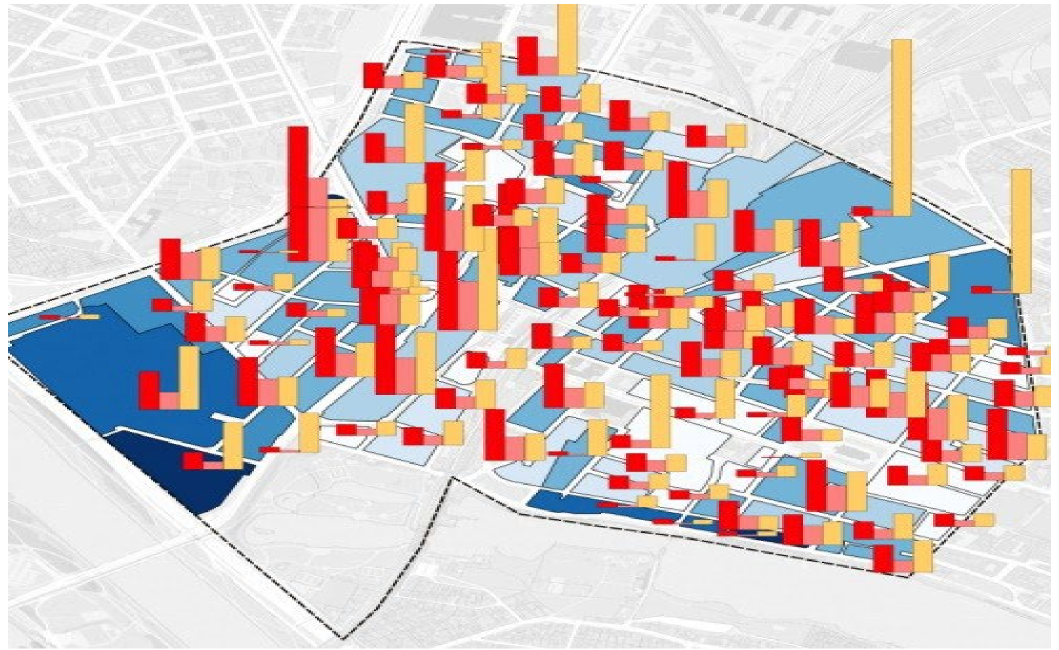
Network cost ($/km$_{pipe}$)

Production cost ($/MW$_{cool}$)

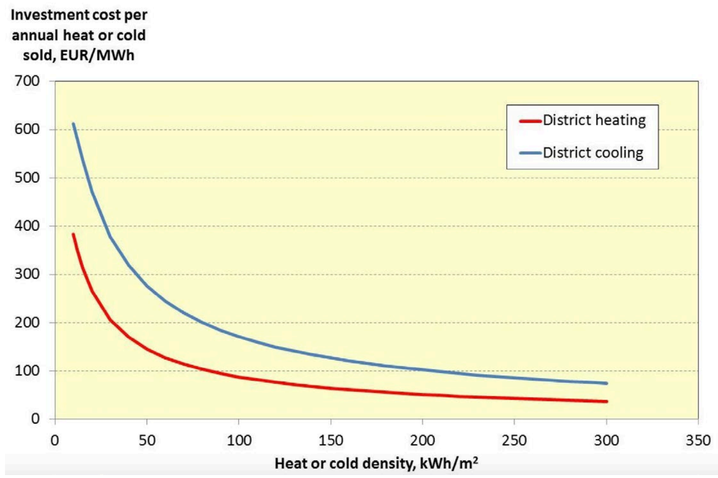
…

Optimal pipe dimension



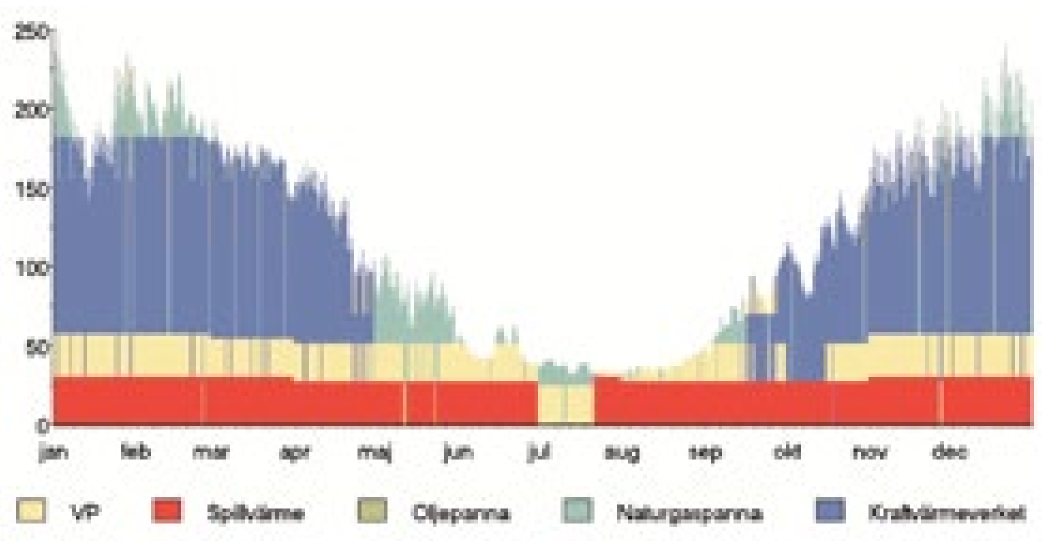


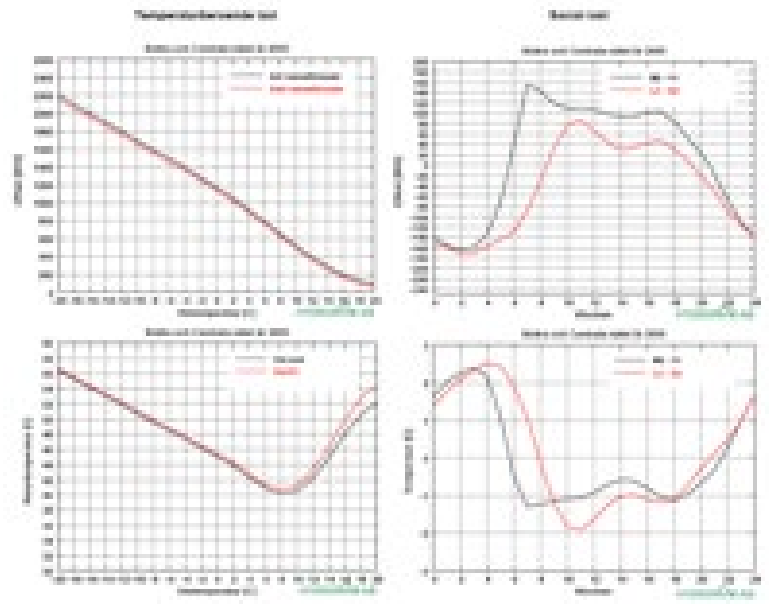
- Demand Assessment (inc. forecasting)
- Resource Assessment (inc. forecasting)
- Tariff Assessment (inc. forecasting)
- Scenario definition
- Scenario Analysis
- Technical, Financial, Environmental and Institutional benefit analysis
- Sensitivity Analysis
- Preparation of Energy Plan / Roadmap

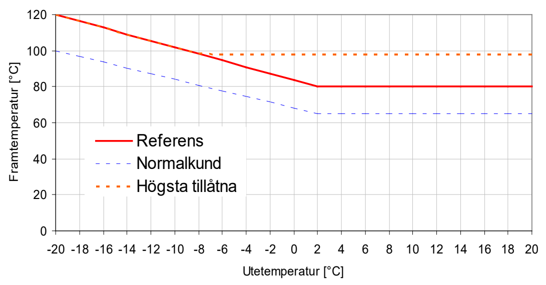


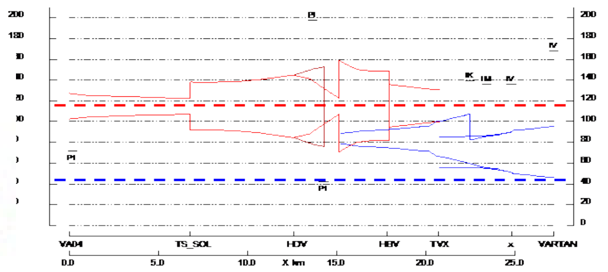
Source: STRATEGO project

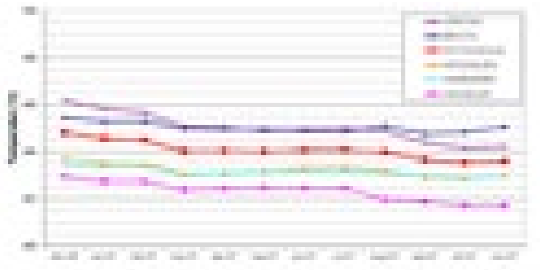
Heat Networks Design

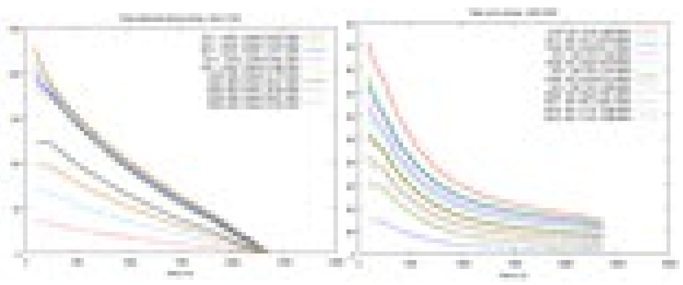


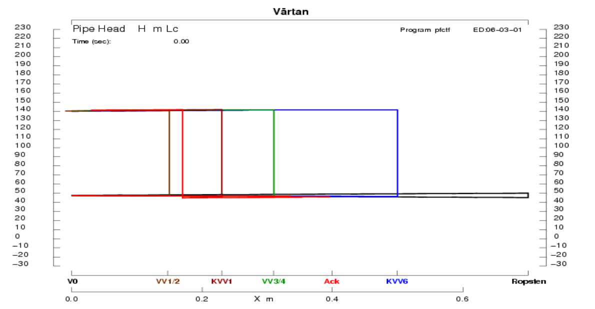


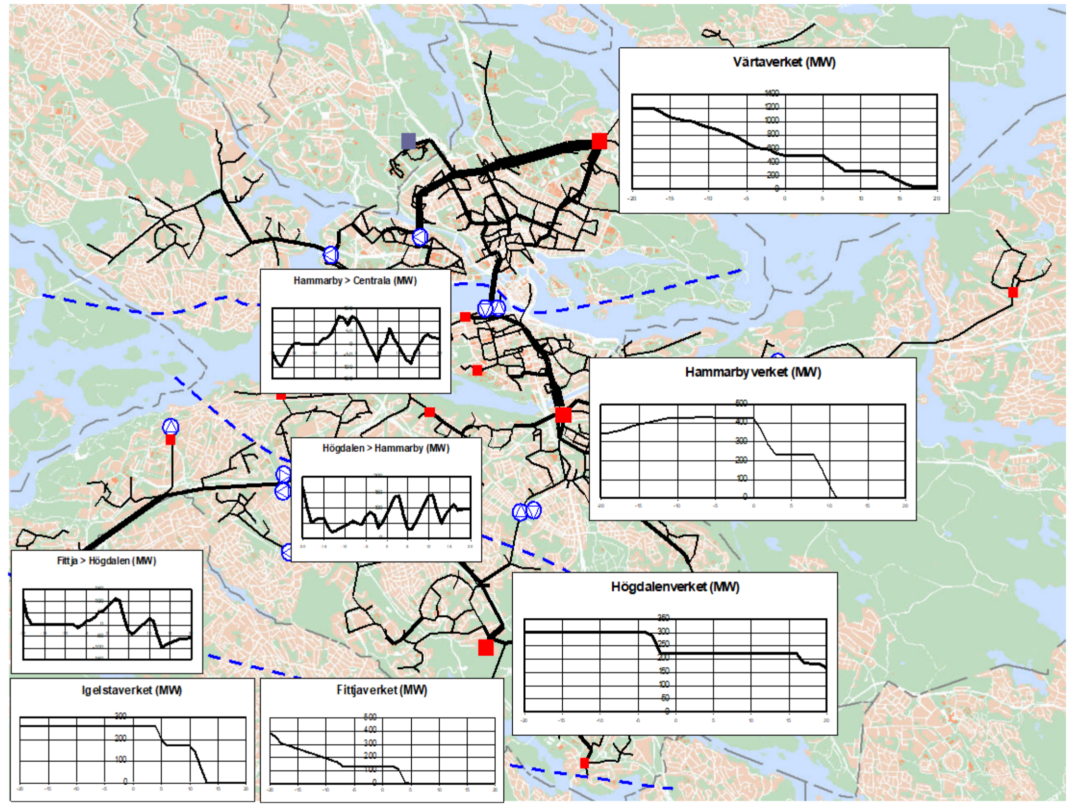


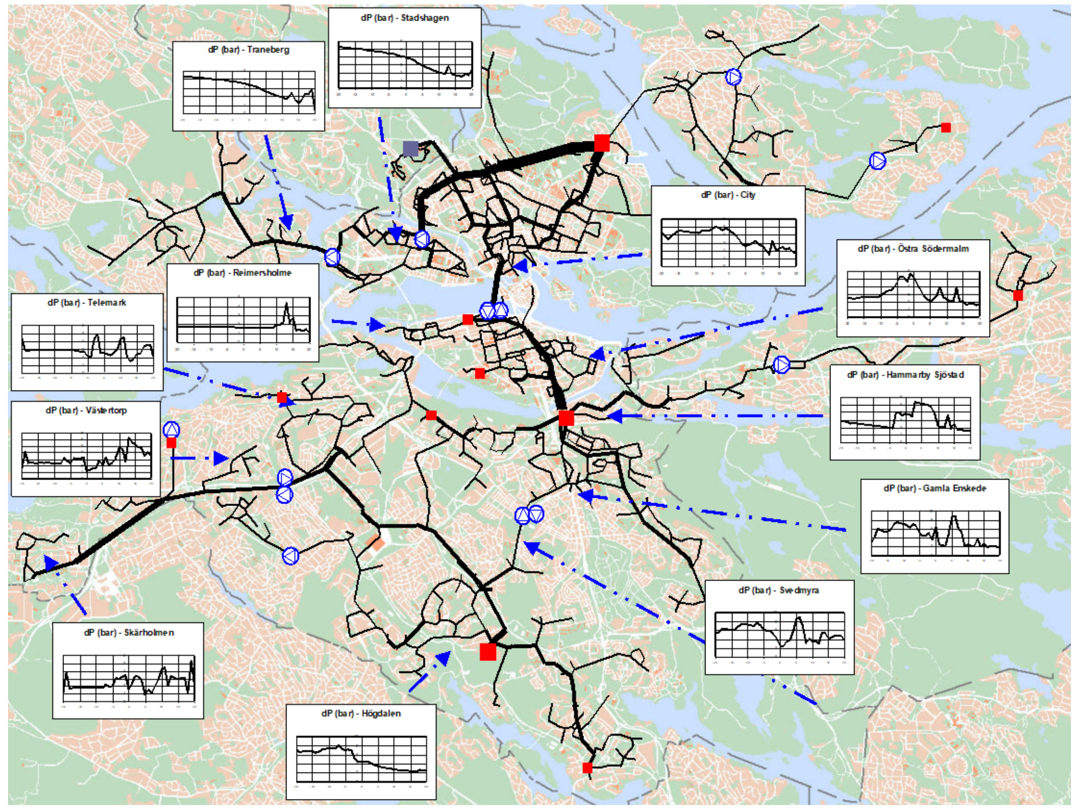


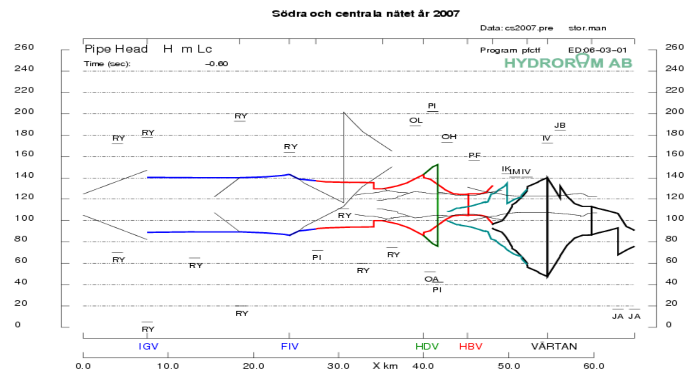


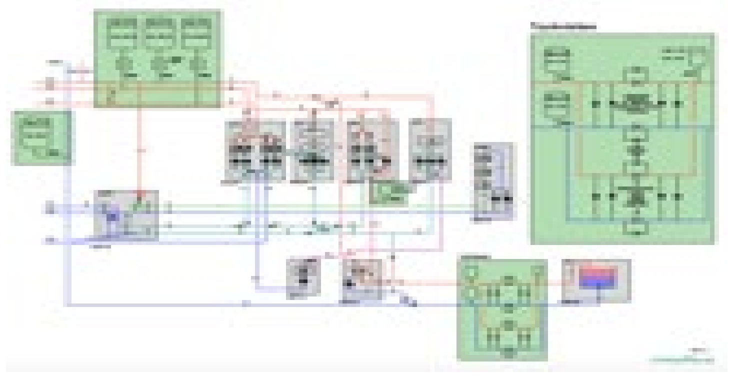


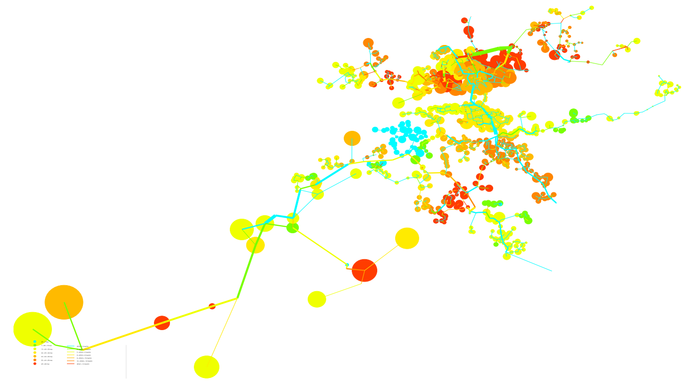


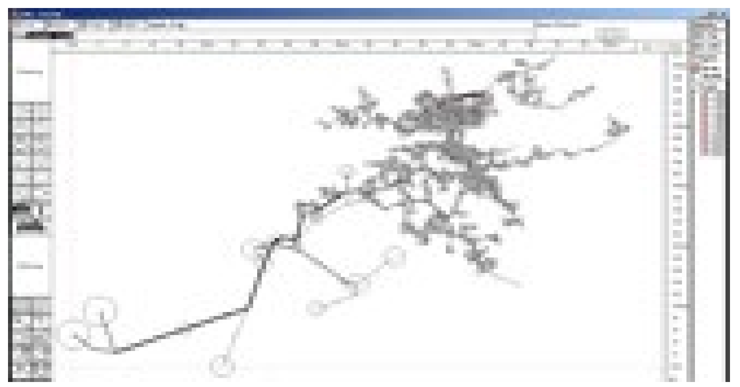




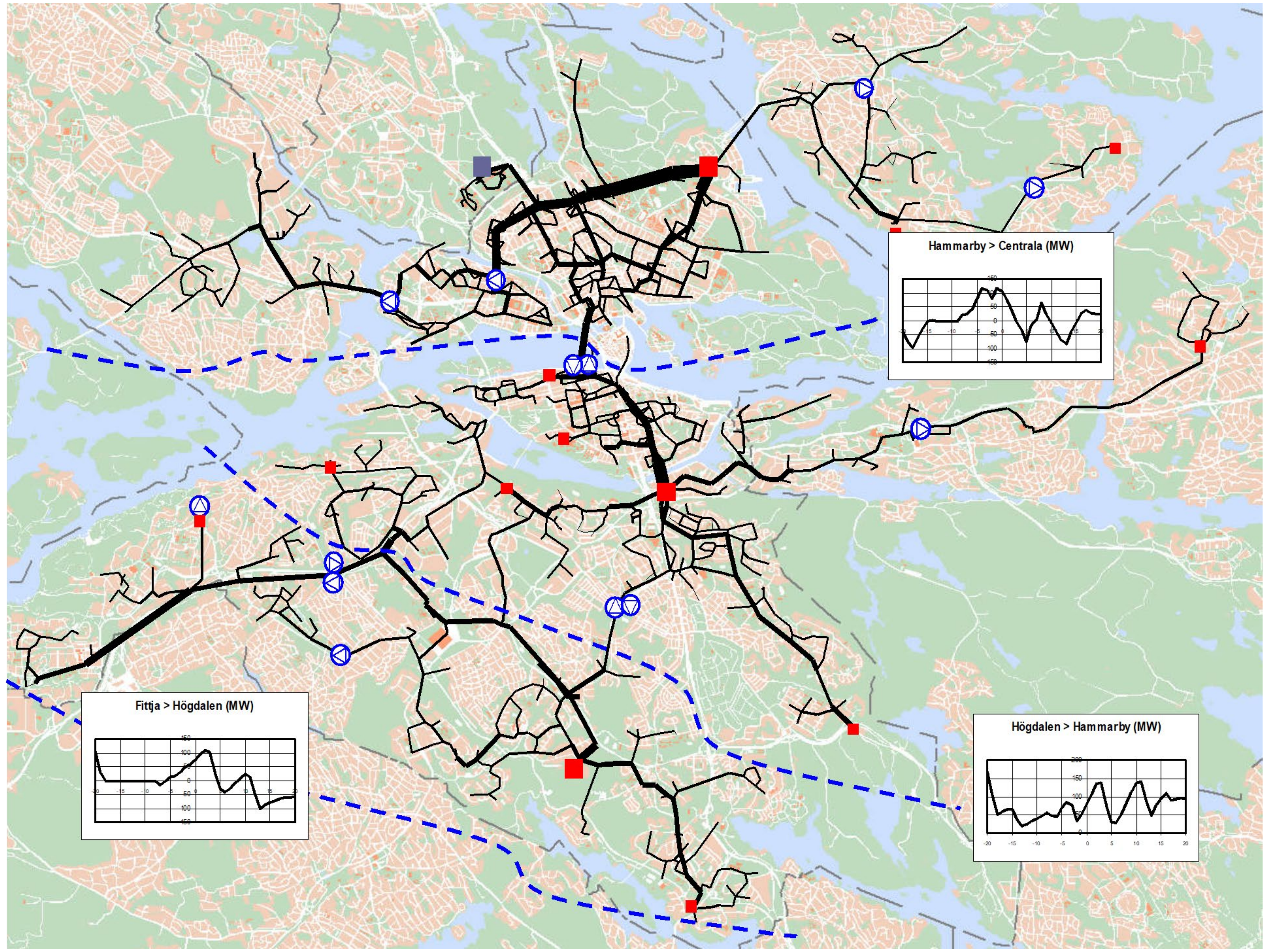


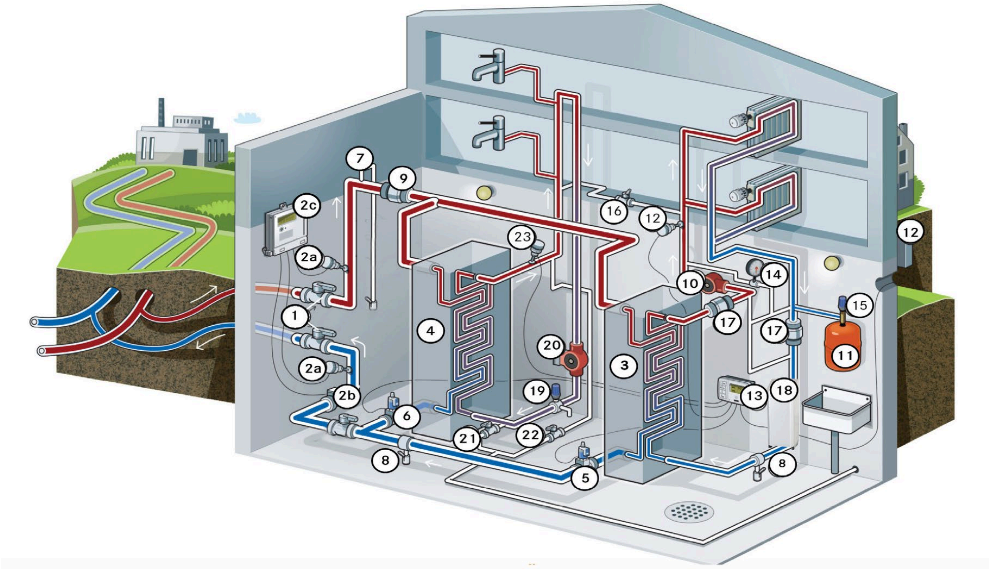


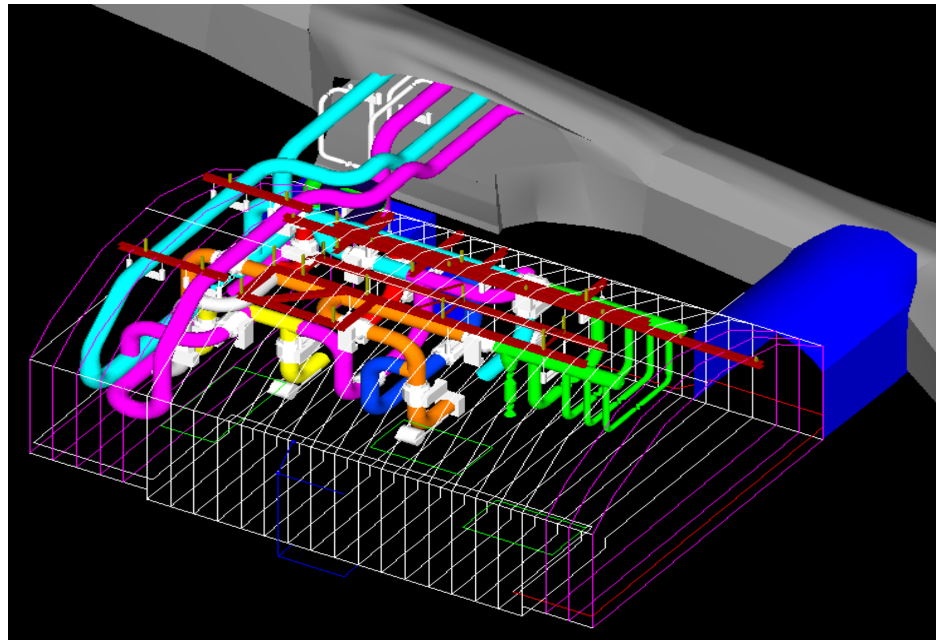


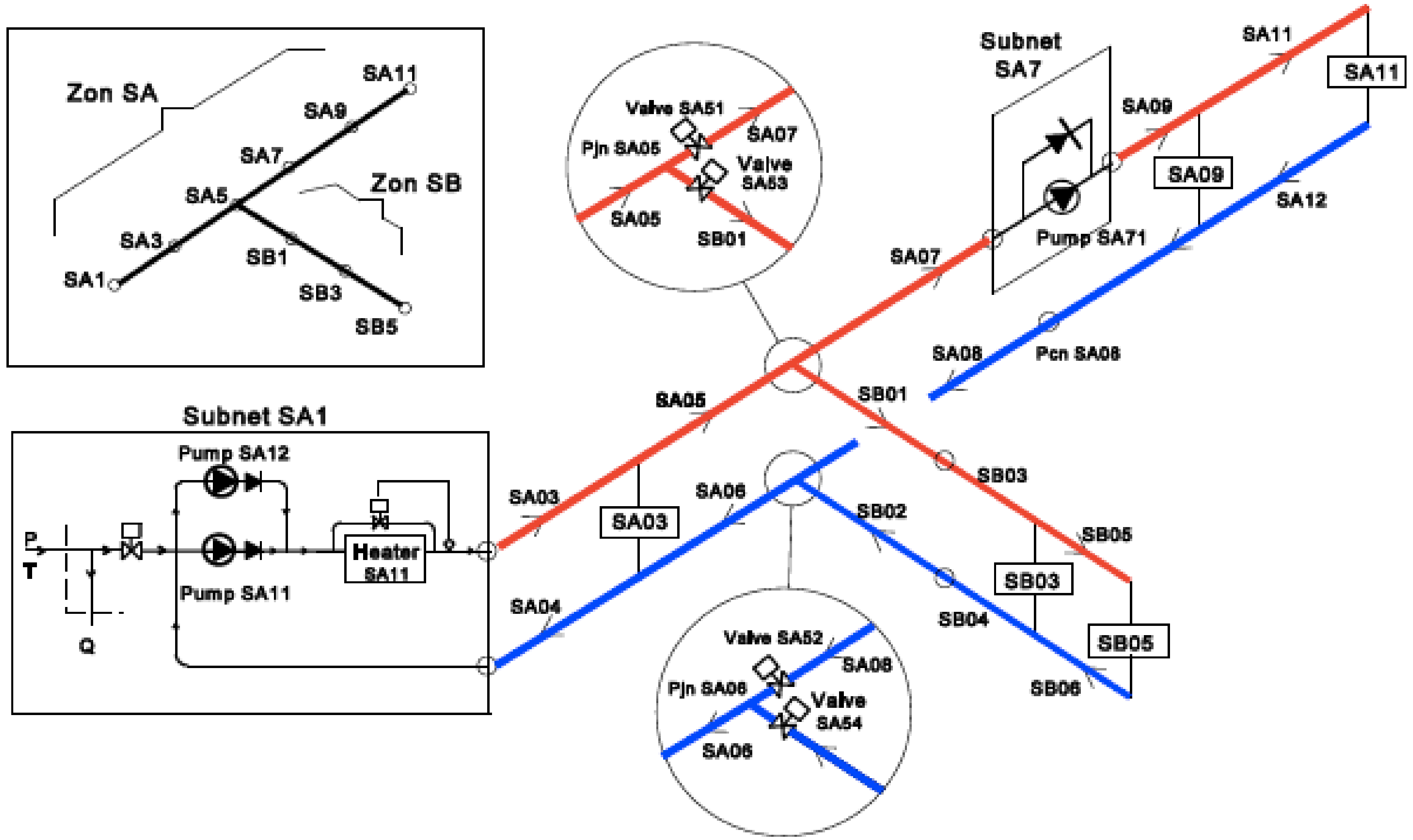


Heat Networks
District Heating System





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Zon SB
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SA3
SA5
SA7
SA9
SA11
SB1
SB3
SB5
Subnet SA1
Pump SA12
Pump SA11
Heater SA11
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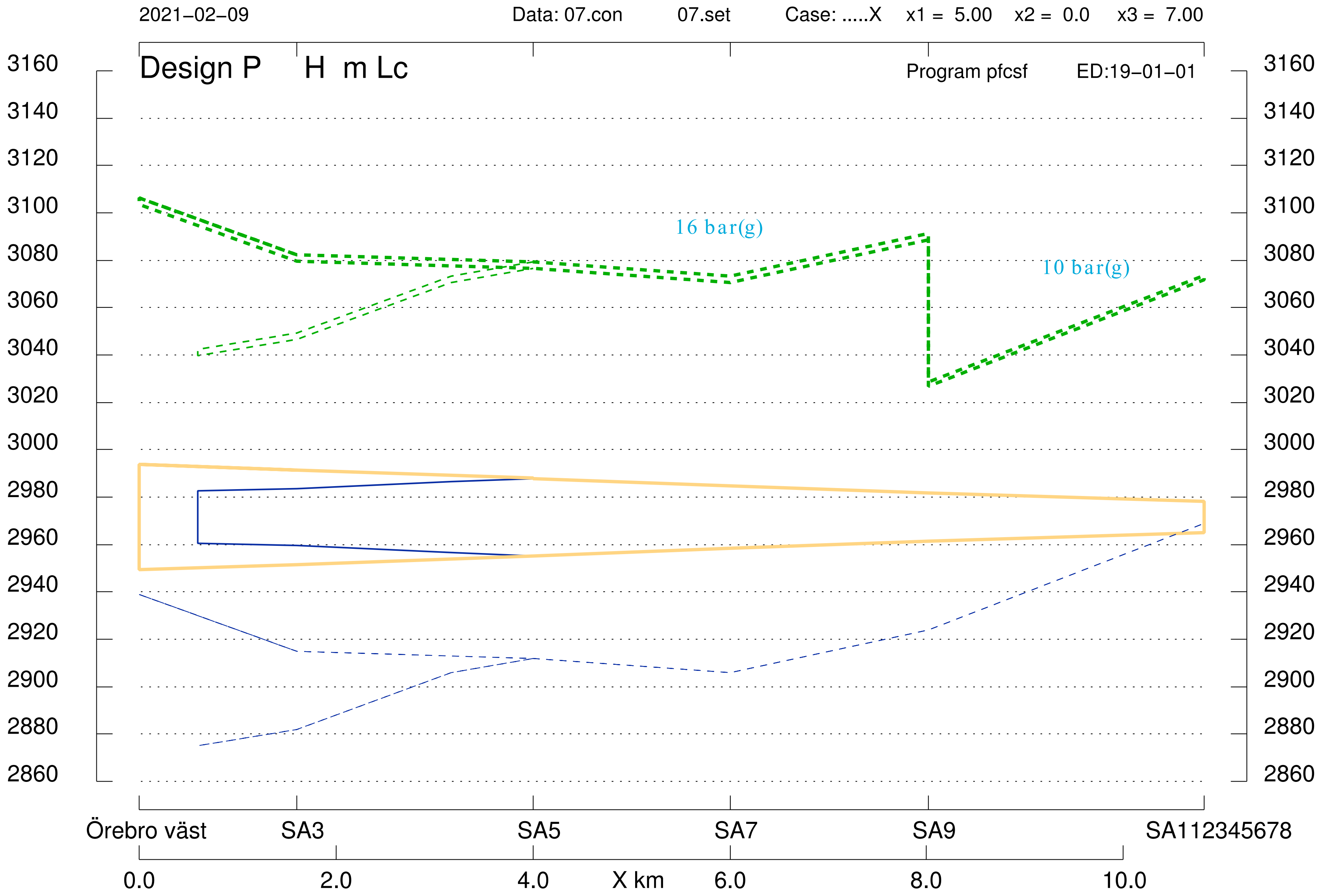
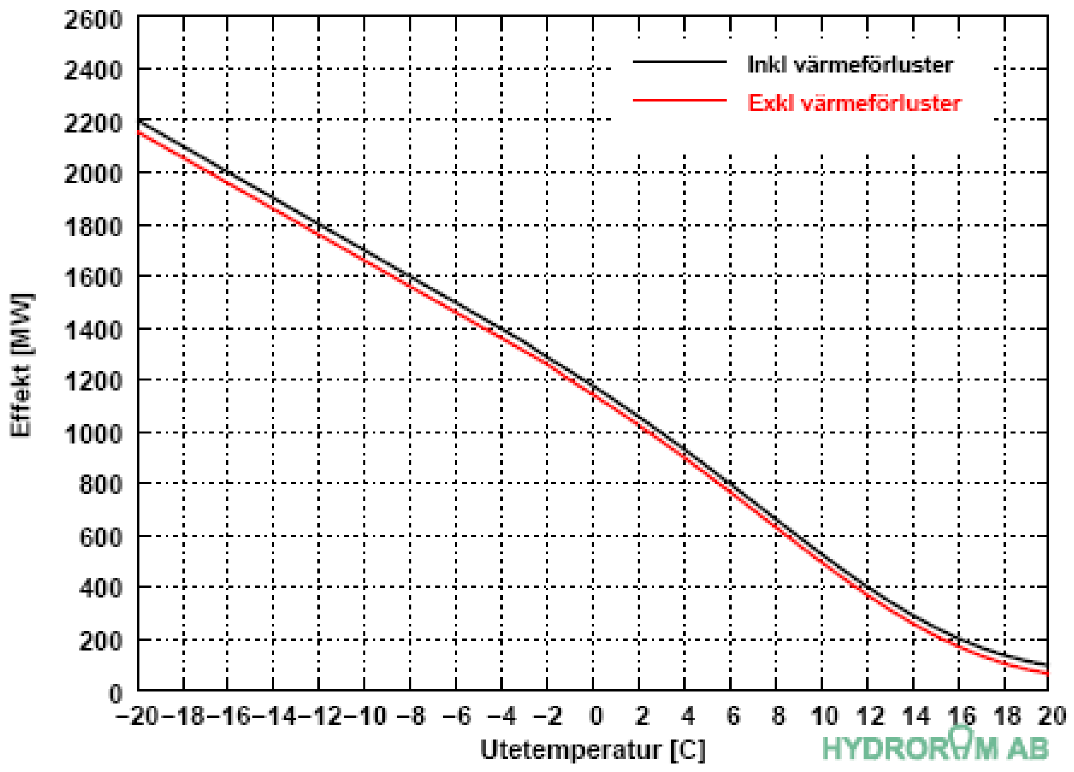
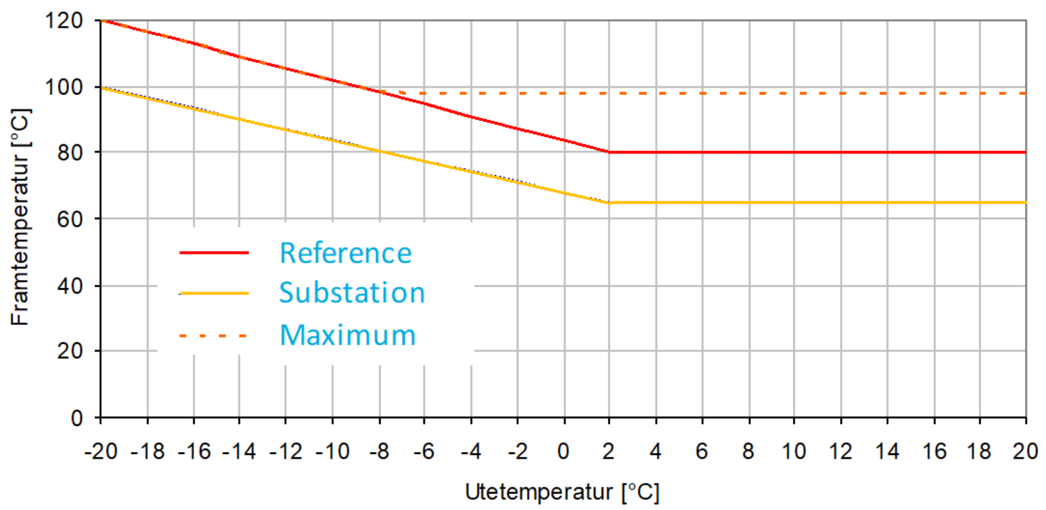
T
Q
SA03
SA04
SA05
SA06
SA07
SA08
SA09
SA11
SA12
SB01
SB02
SB03
SB04
SB05
SB06
Subnet SA7
Pump SA71
Pcn SA08
Valve SA51
Pjn SA05
Valve SA53
Valve SA52
Pjn SA06
Valve SA54

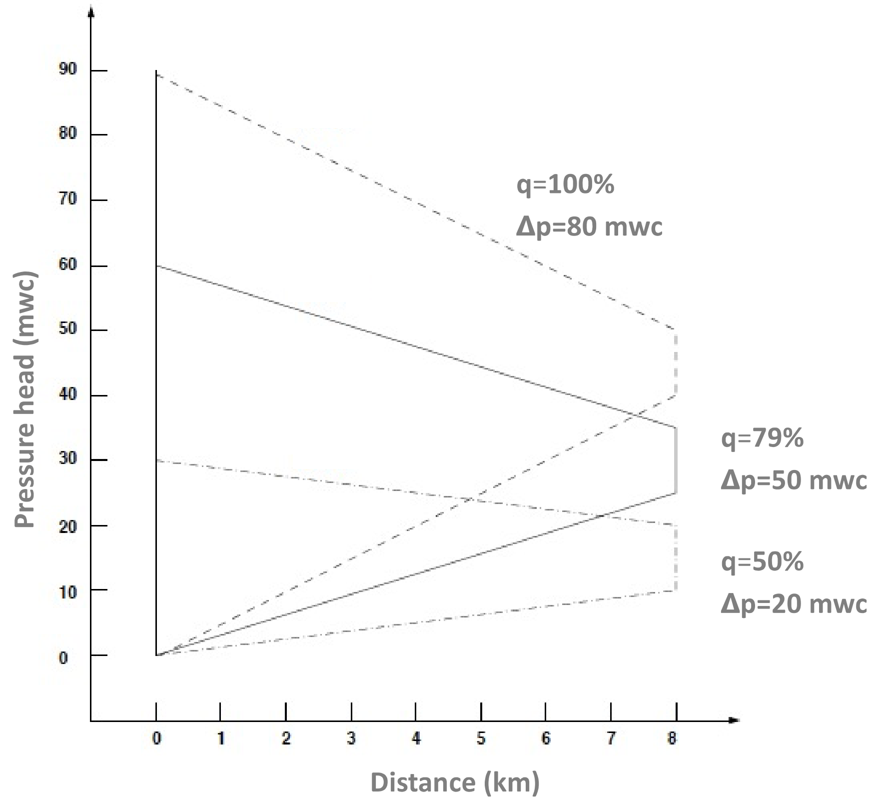

2021–02–09
Data: 07.con
07.set
Case: X
x1 = 5.00
x2 = 0.0
x3 = 7.00
Design P
H m Lc
Program pfcsf
ED:19–01–01
16 bar(g)
10 bar(g)
Örebro väst
SA3
SA5
SA7
SA9
SA112345678
X km

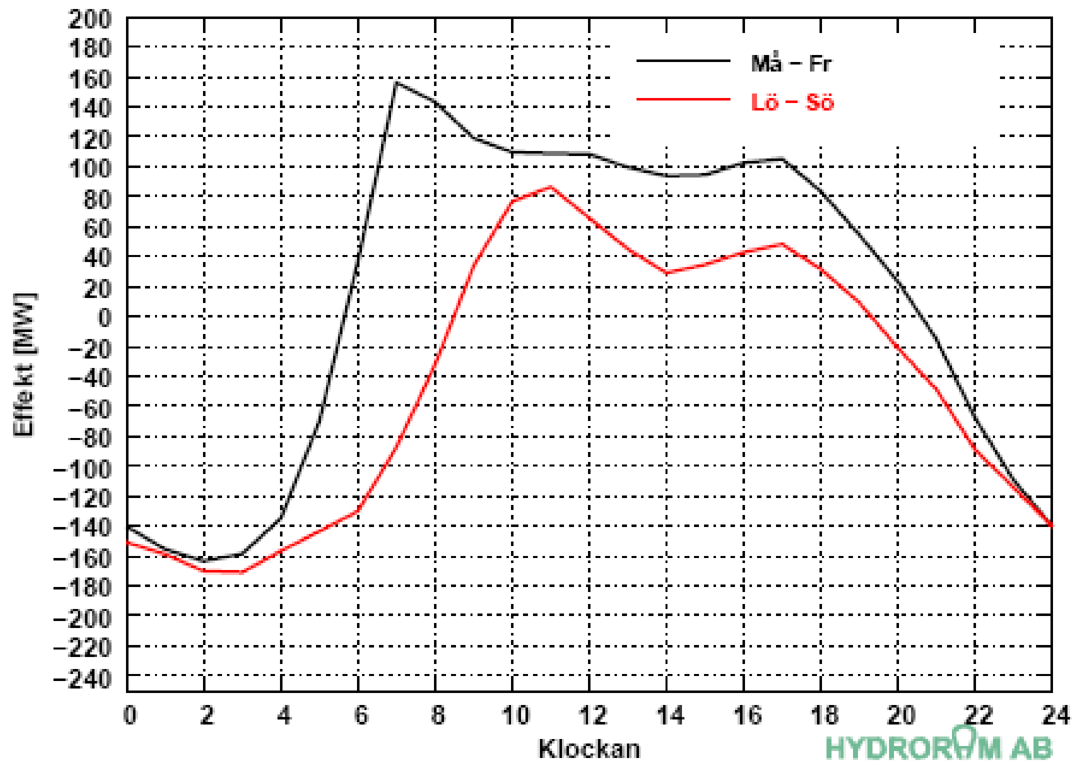
Heat Networks
District Heating System

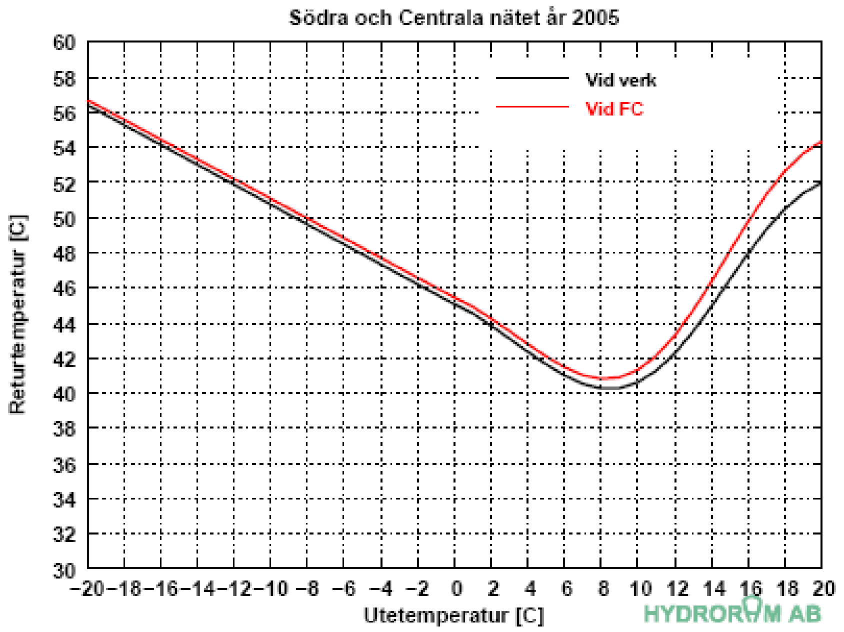
HEAT ACADEMY INTERNATIONAL

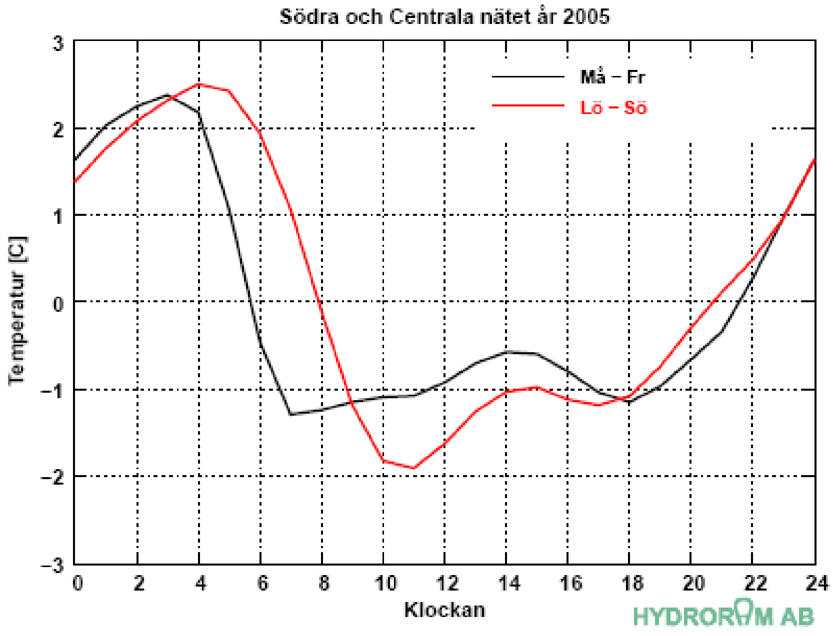


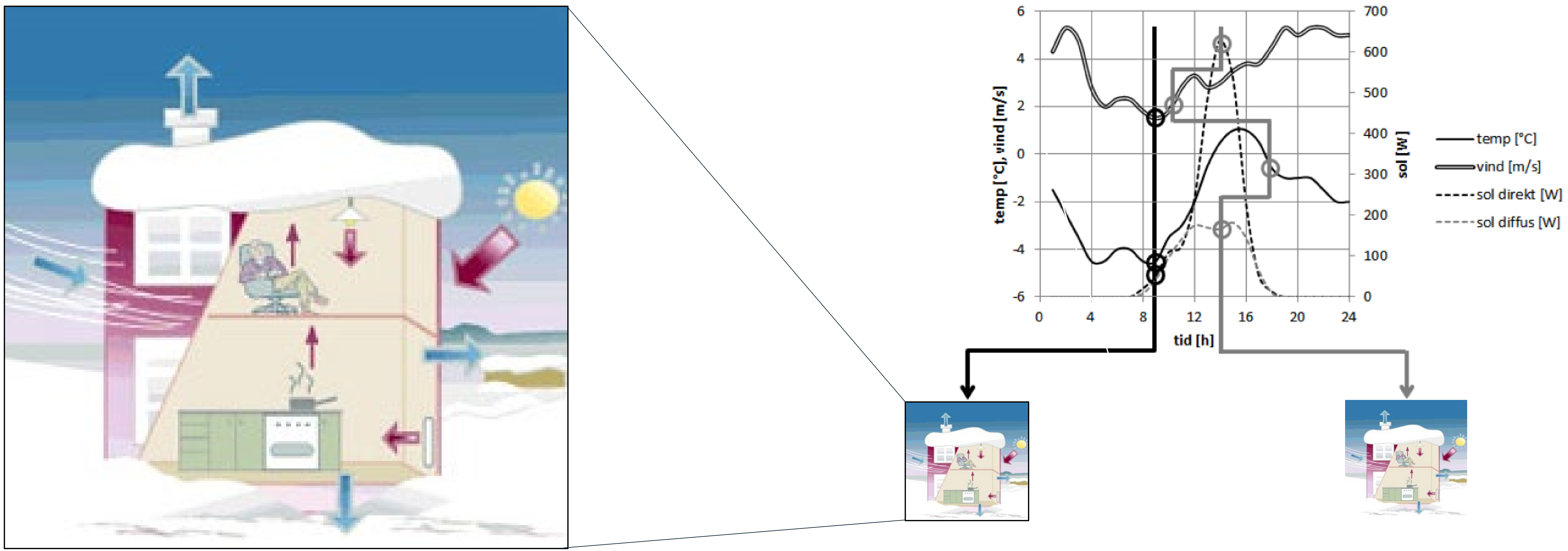


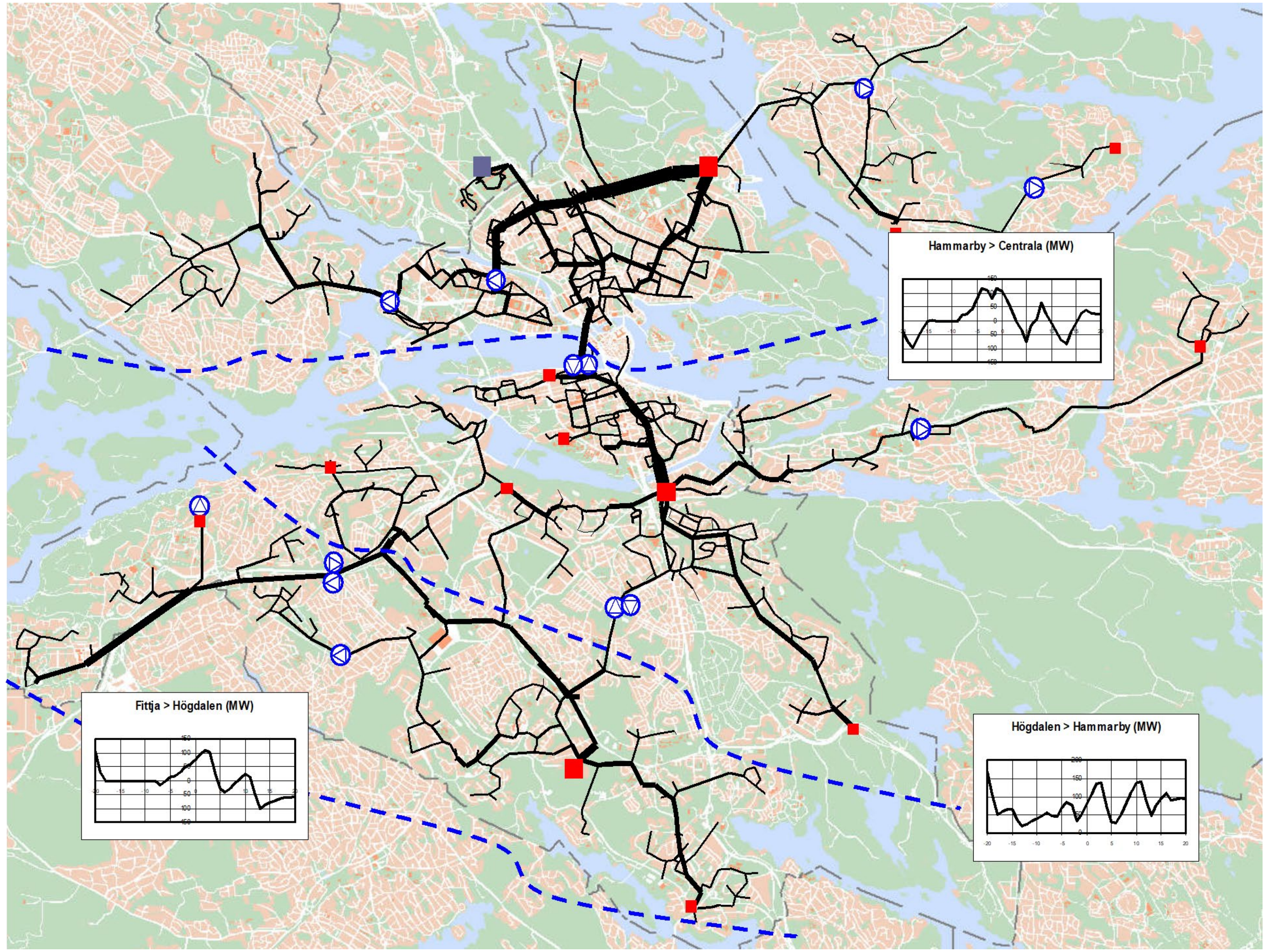


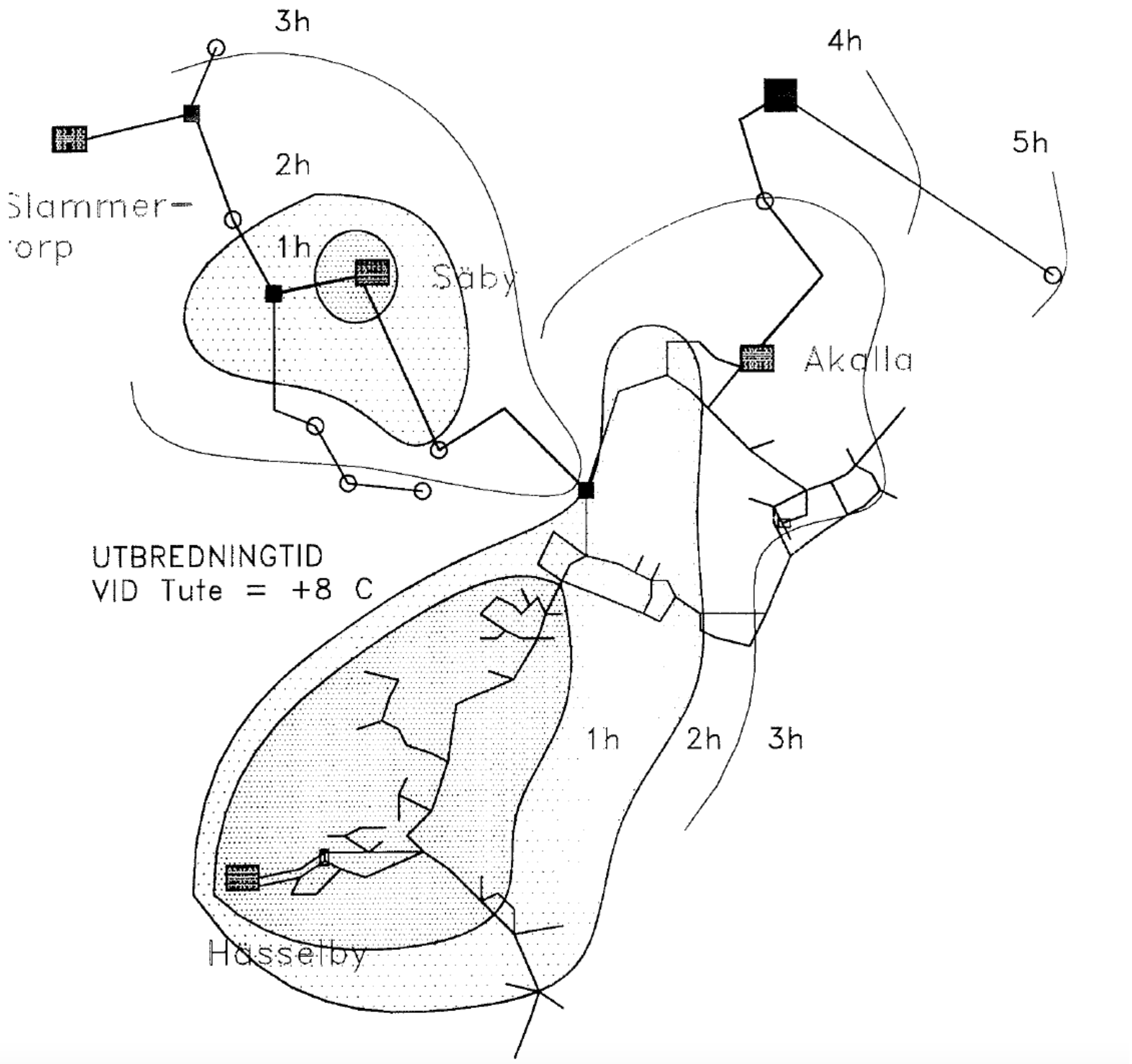


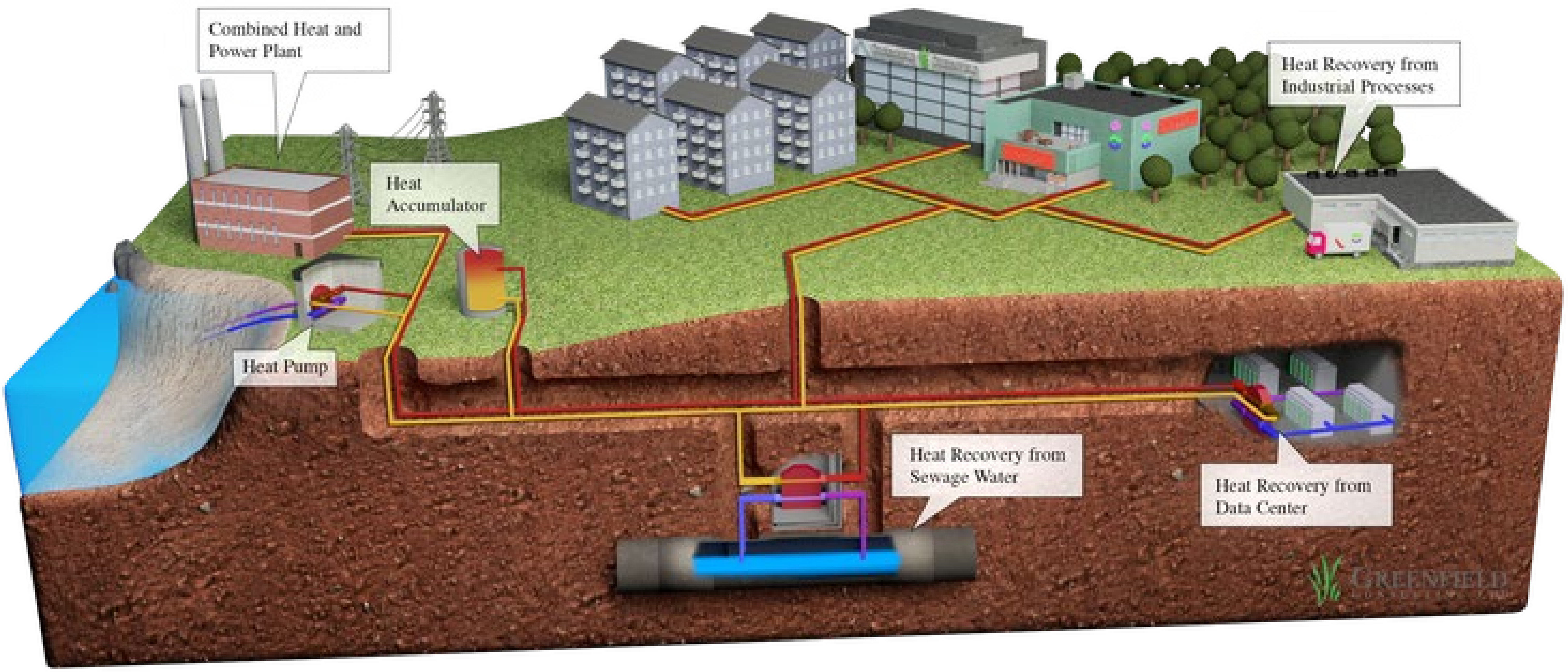





6
4
2
0
-2
-4
-6
700
600
500
400
300
200
100
0
0
4
8
12
16
20
24
temp [°C], vind [m/s]
sol [W]
tid [h]
temp [°C]
vind [m/s]
sol direkt [W]
sol diffus [W]

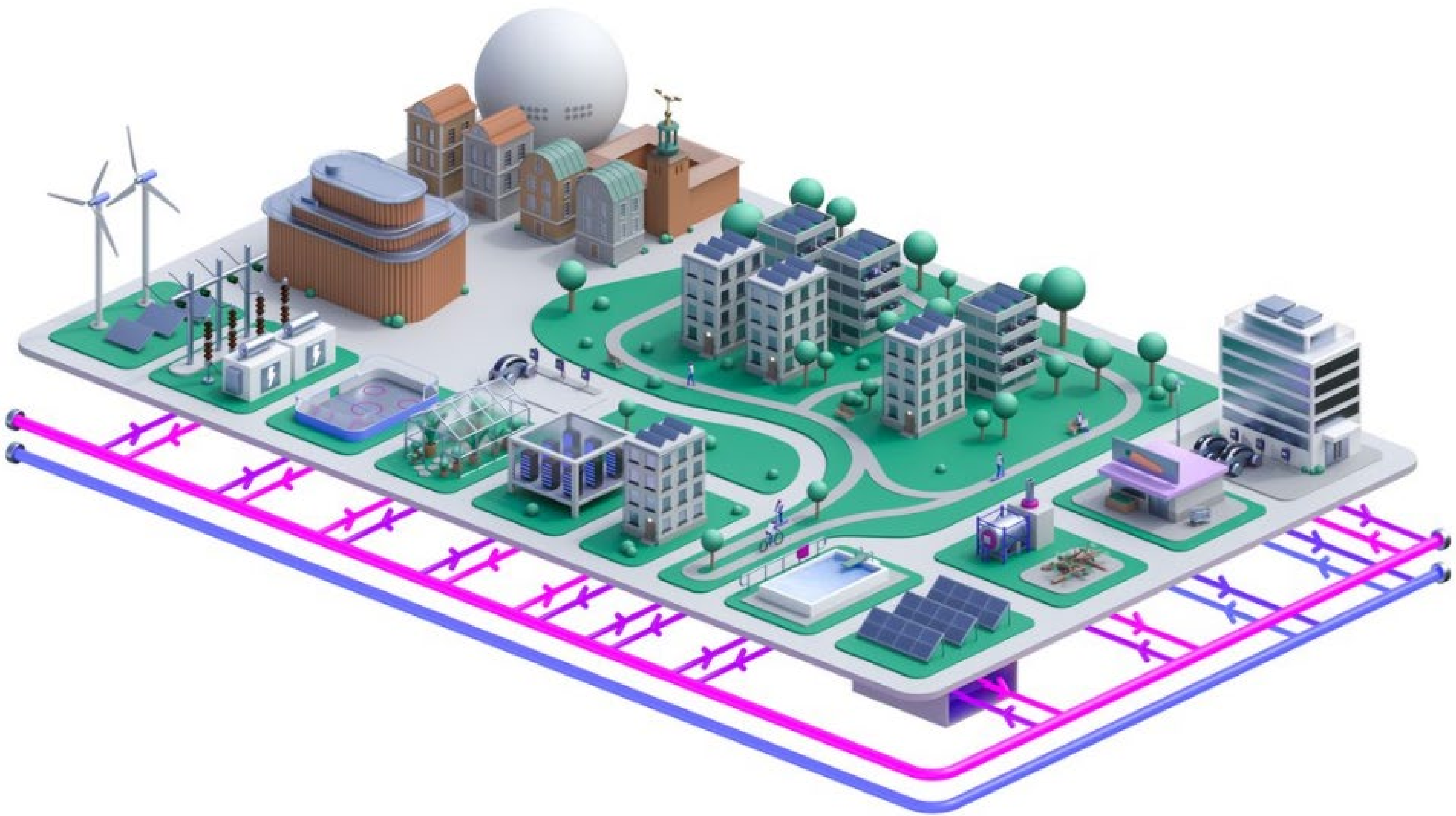

Hammarby > Centrala (MW)
Fittja > Högdalen (MW)
Högdalen > Hammarby (MW)

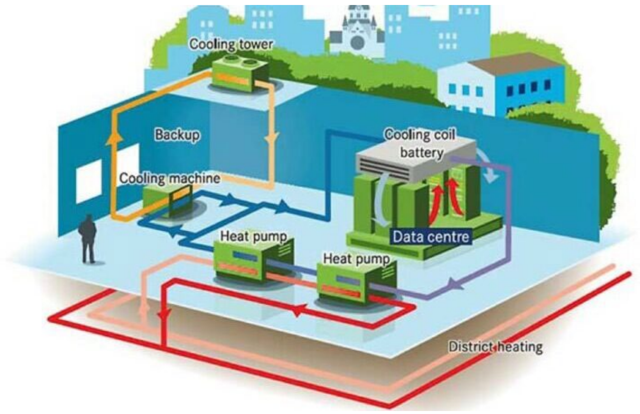

3h
4h
5h
2h
Slammer-
orp
1h
Säby
Akalla
UTBREDNINGTID
VID Tute = +8 C
1h
2h
3h
Hässelby

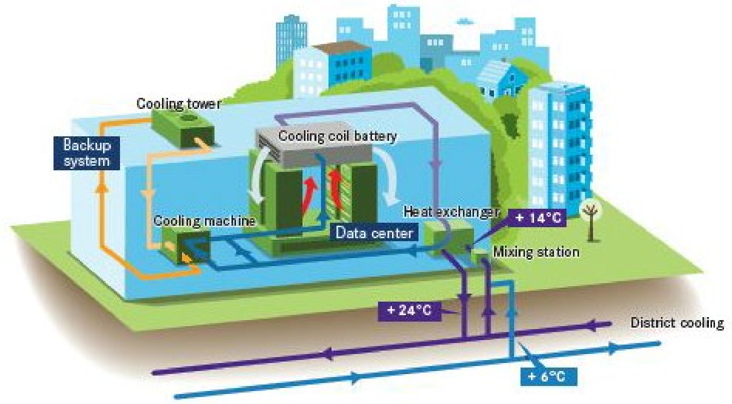

Combined Heat and Power Plant
Heat Accumulator
Heat Recovery from Industrial Processes
Heat Pump
Heat Recovery from Sewage Water
Heat Recovery from Data Center
GREENFIELD

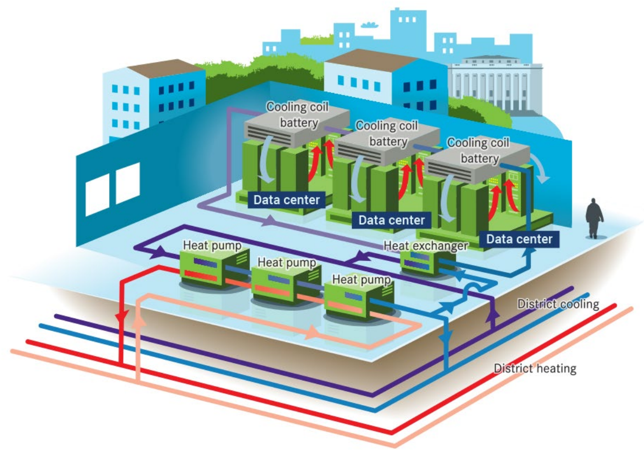
Heat Networks
Extended Heat Recovery, Prosumers and Energy Symbiosis

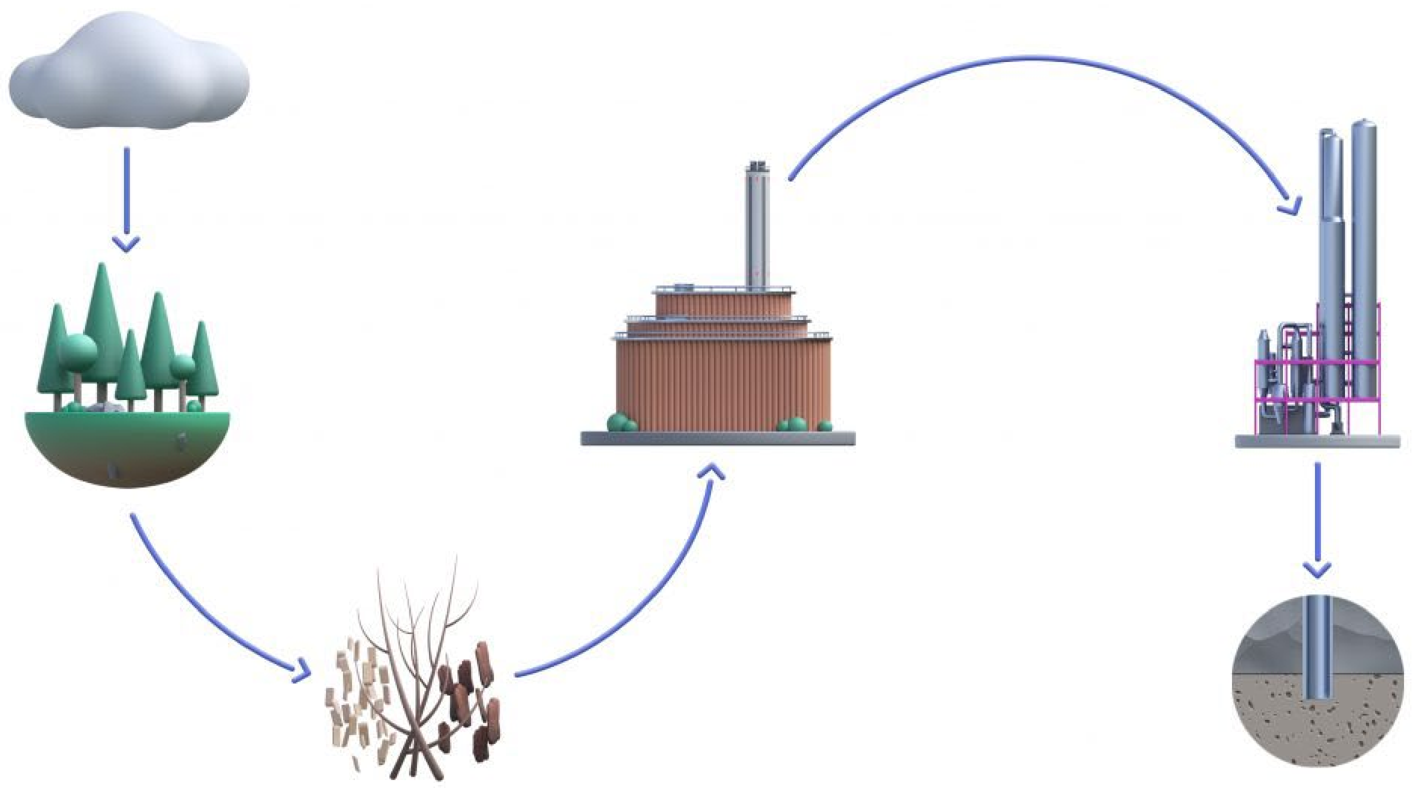
HEAT ACADEMY INTERNATIONAL

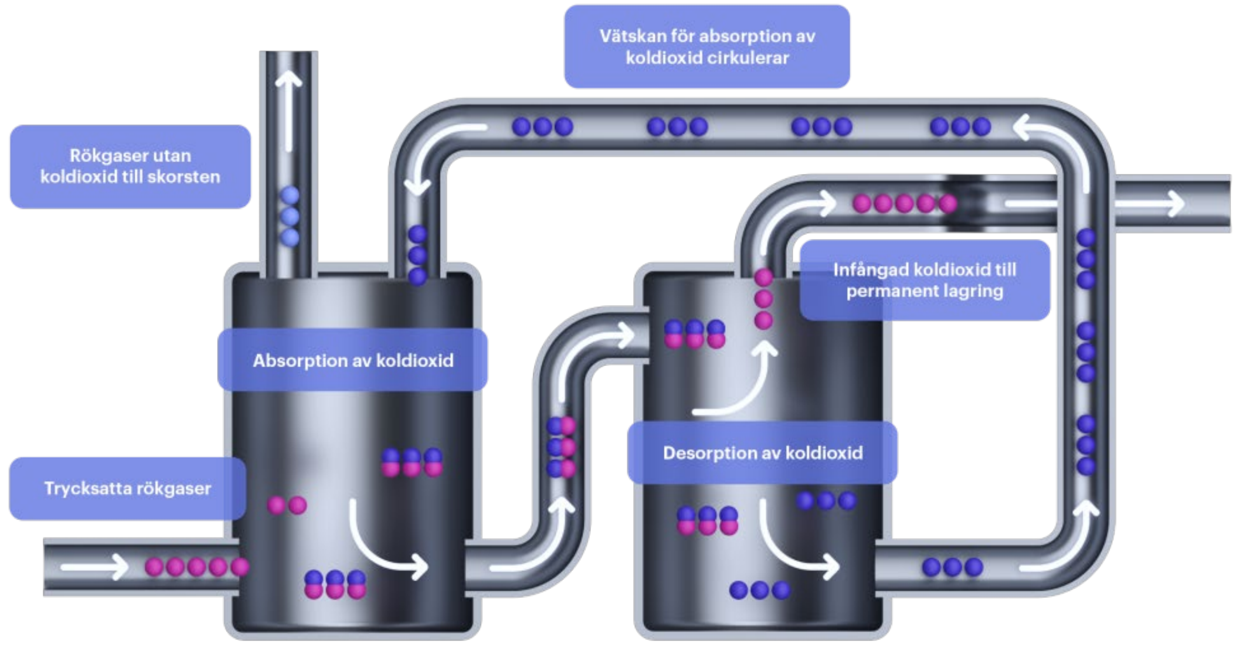


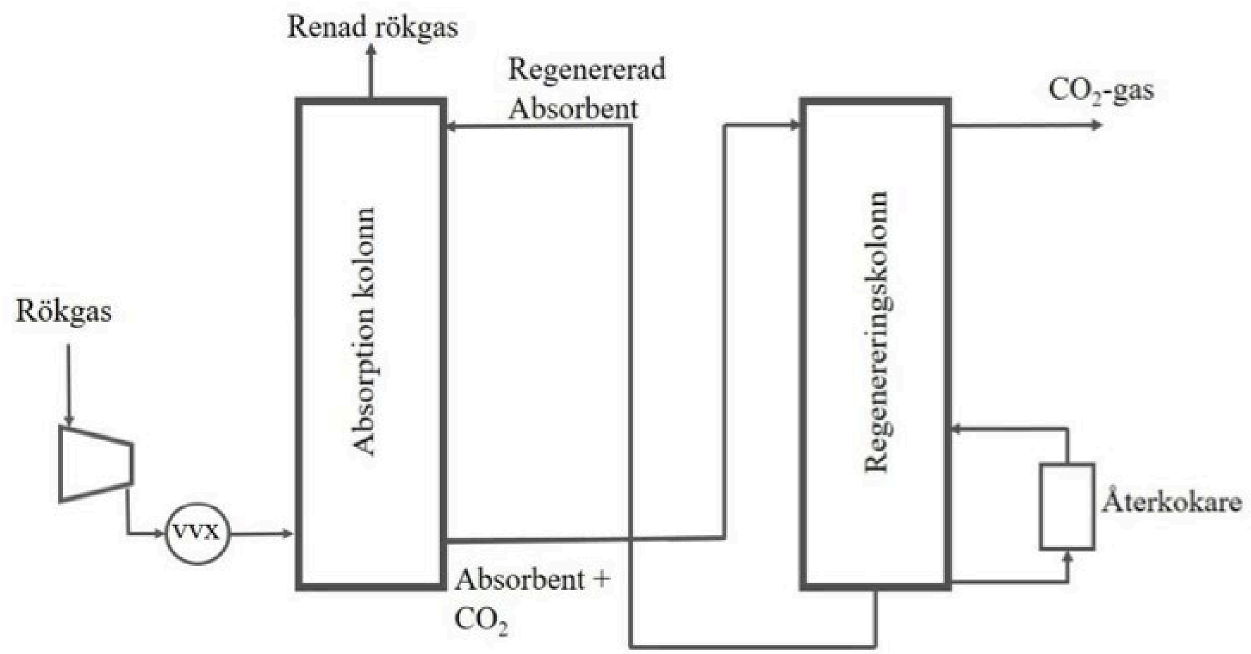






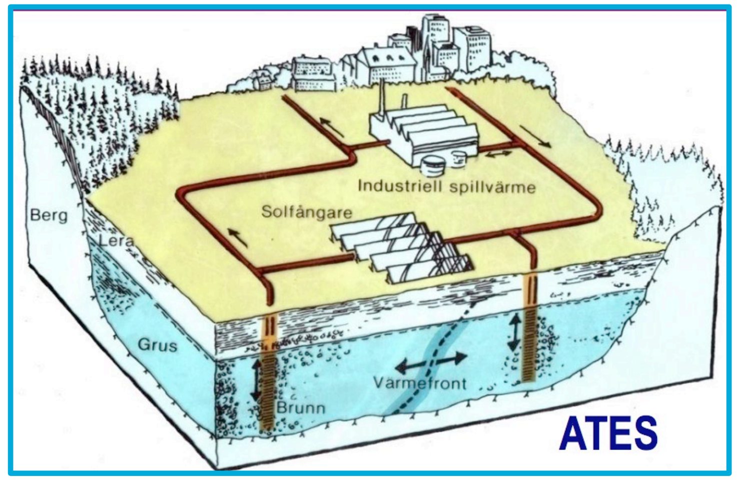


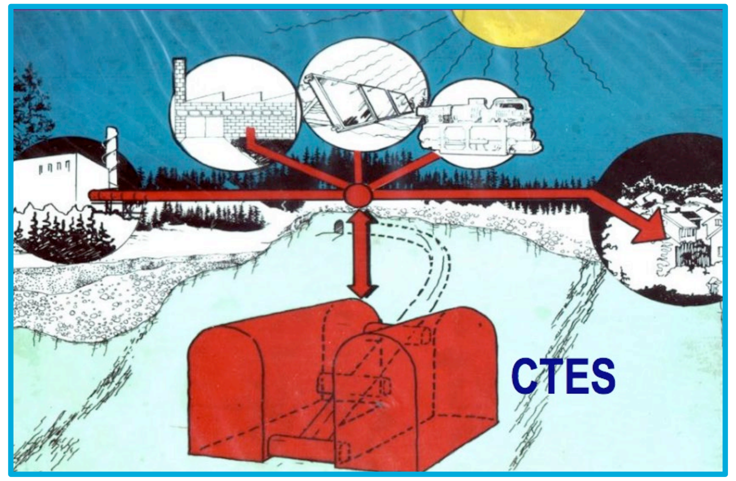

Vätskan för absorption av koldioxid cirkulerar
Rökgaser utan koldioxid till skorsten
Infångad koldioxid till permanent lagring
Absorption av koldioxid
Desorption av koldioxid
Trycksatta rökgaser

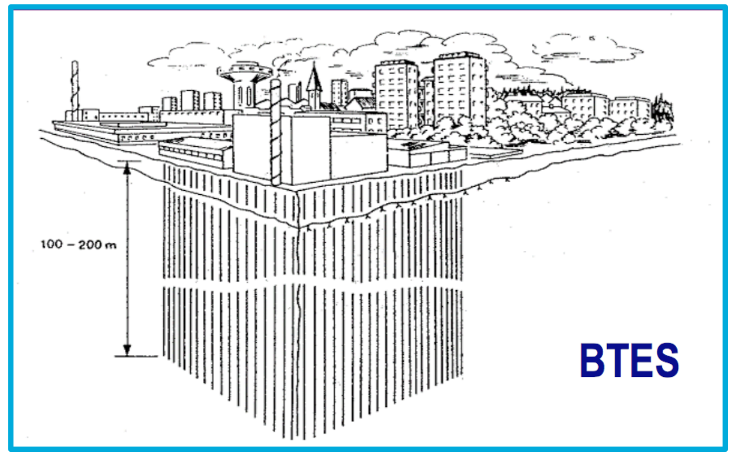

Renad rökgas
Regenererad Absorbent
CO_2-gas
Rökgas
Absorption kolonn
Regenereringskolonn
VVX
Återkokare
Absorbent + CO_2

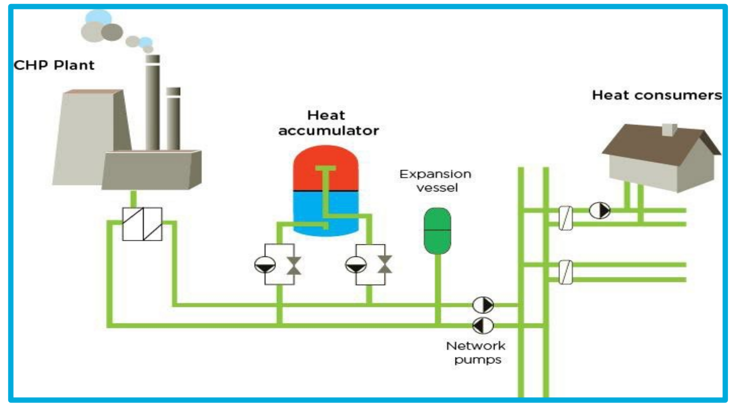
HEAT ACADEMY INTERNATIONAL

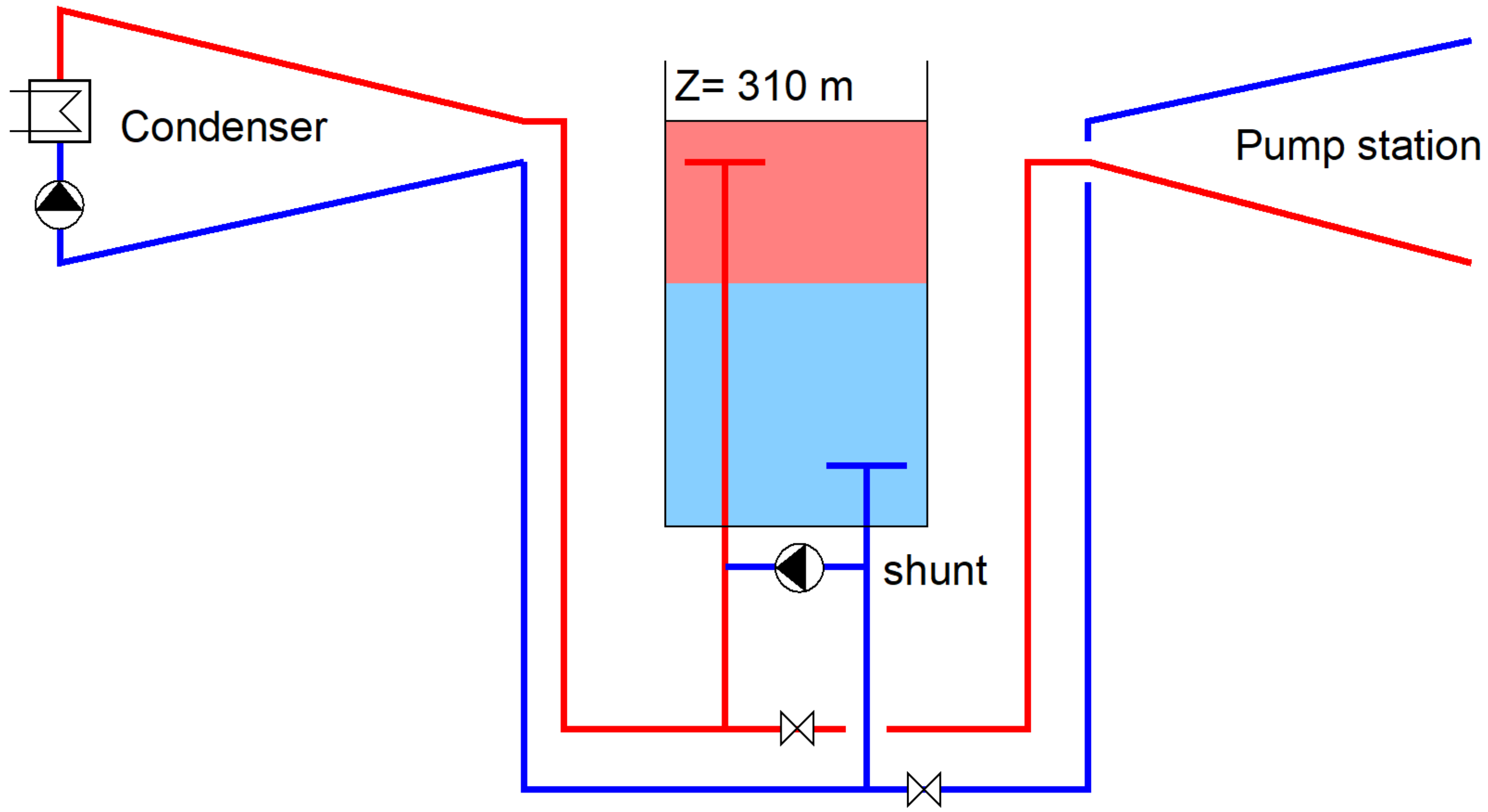
Purpose:	Power- vs. Heating optimization
	Seasonal vs. short-term
	Cooling and/or Heating
Type:	Sensible vs. UTES vs. PCM
Location:	Centralized vs. Distributed
Connection:	Direct vs. Pump/throttle vs. HX
Capacity:	Energy (MWh – Volume)
	Heat Power (MW – pump capacity)
Dimensions:	Height (pressure level)
	Area (storage capacity)

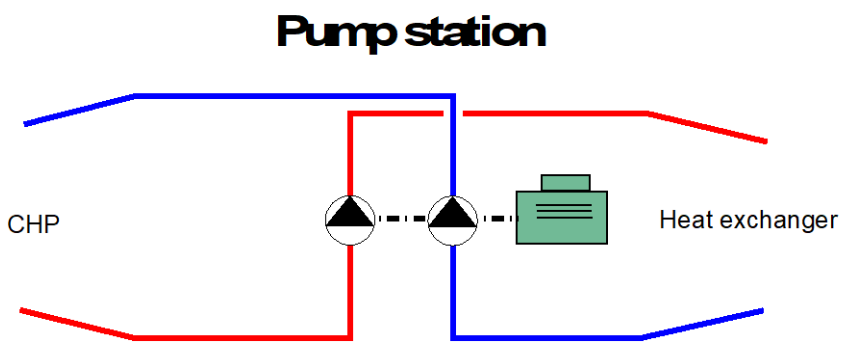


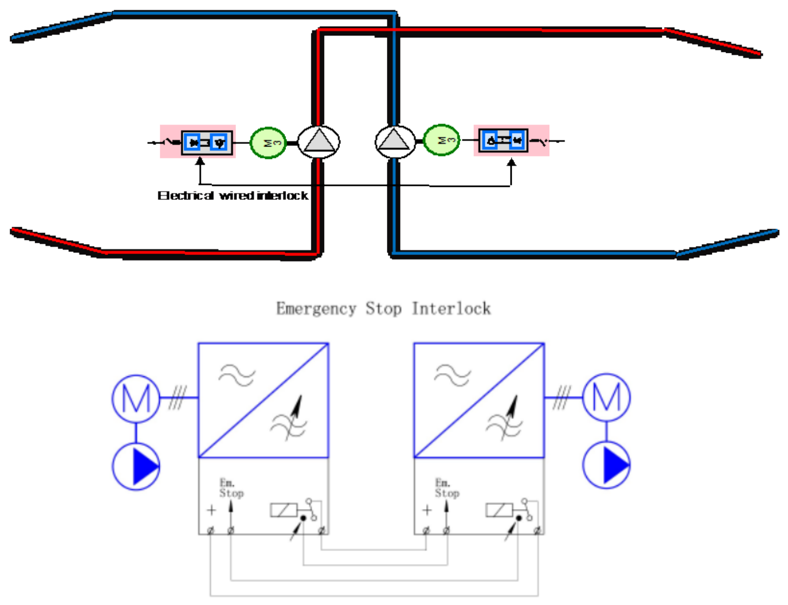


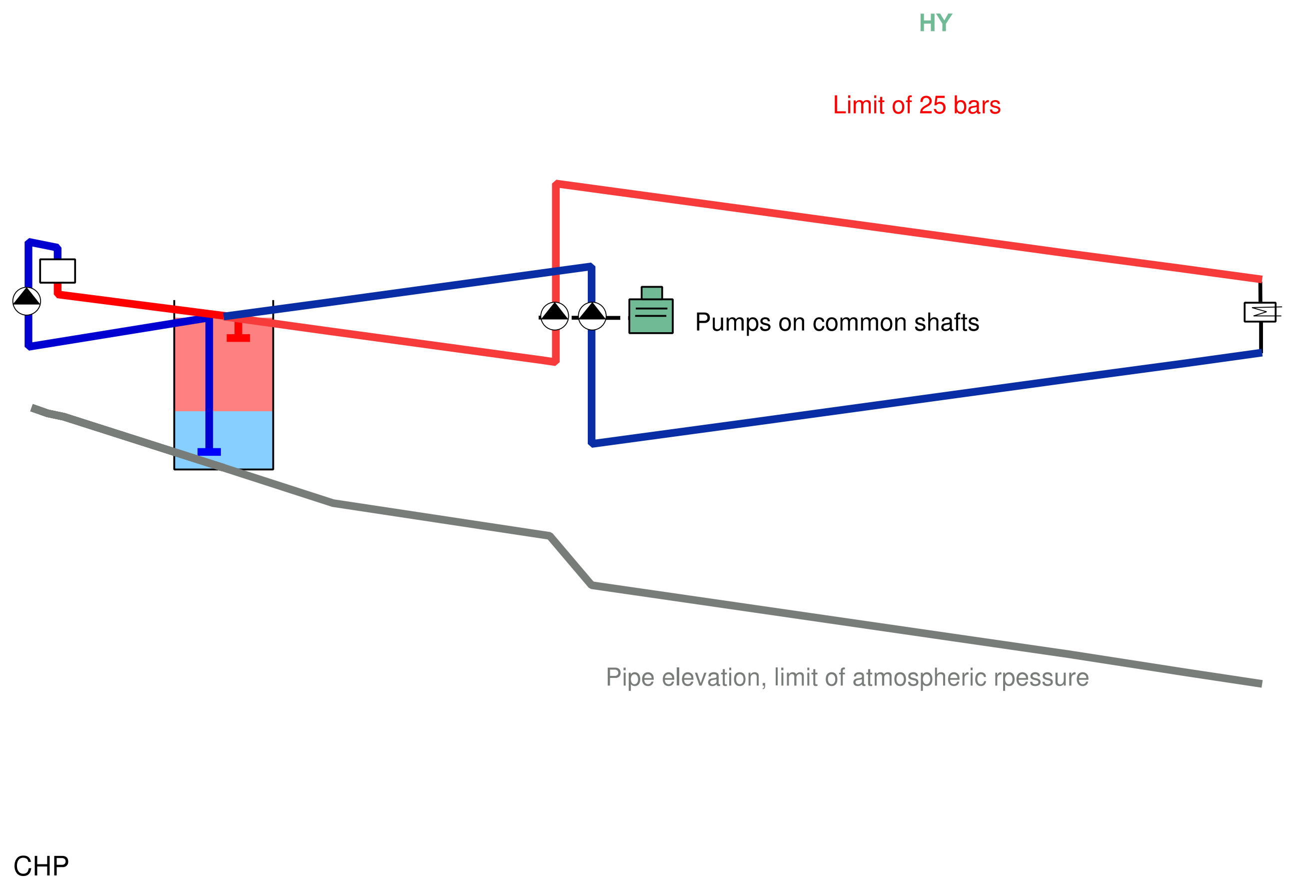


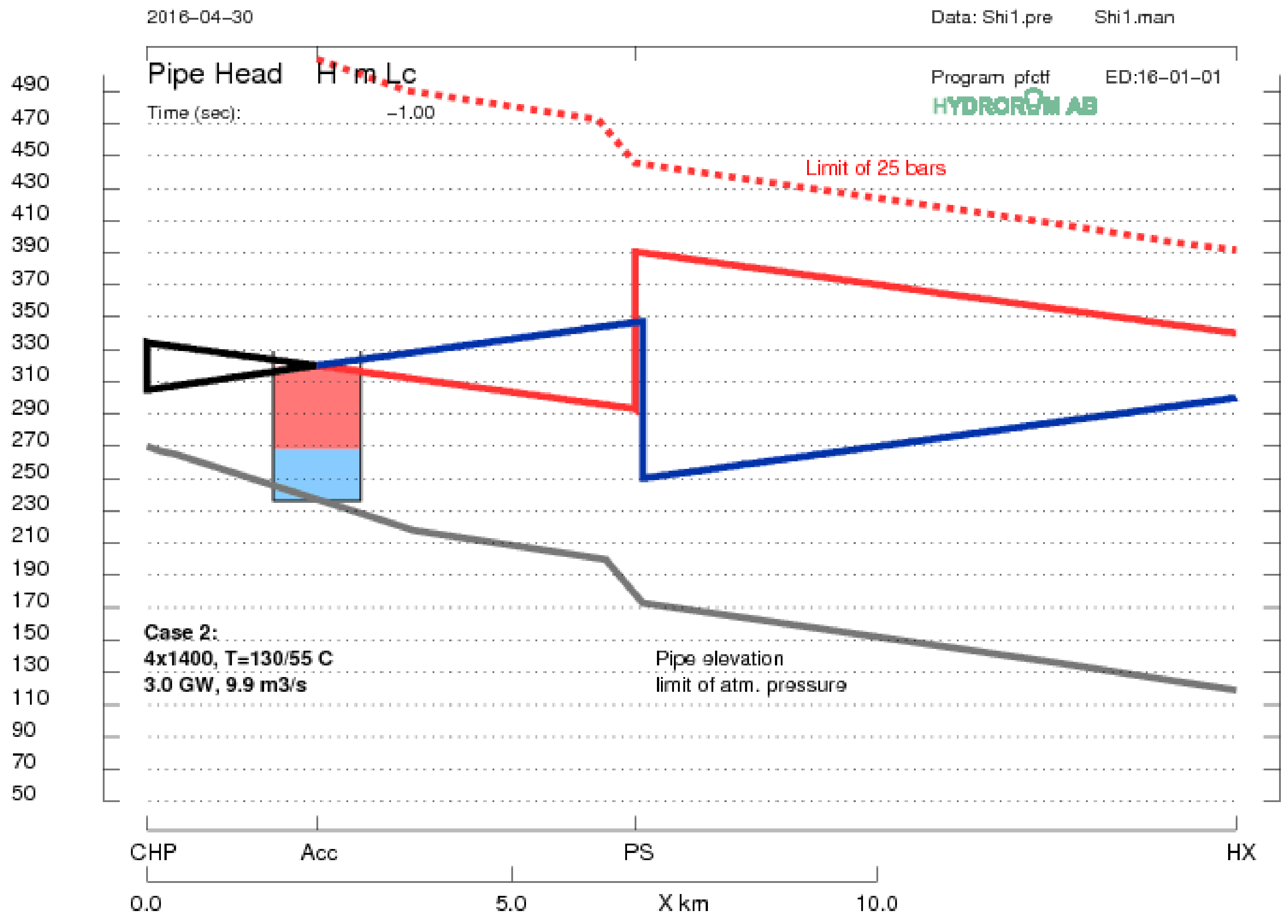



Condenser
Z= 310 m
Pump station
shunt


Pump station
CHP
Heat exchanger

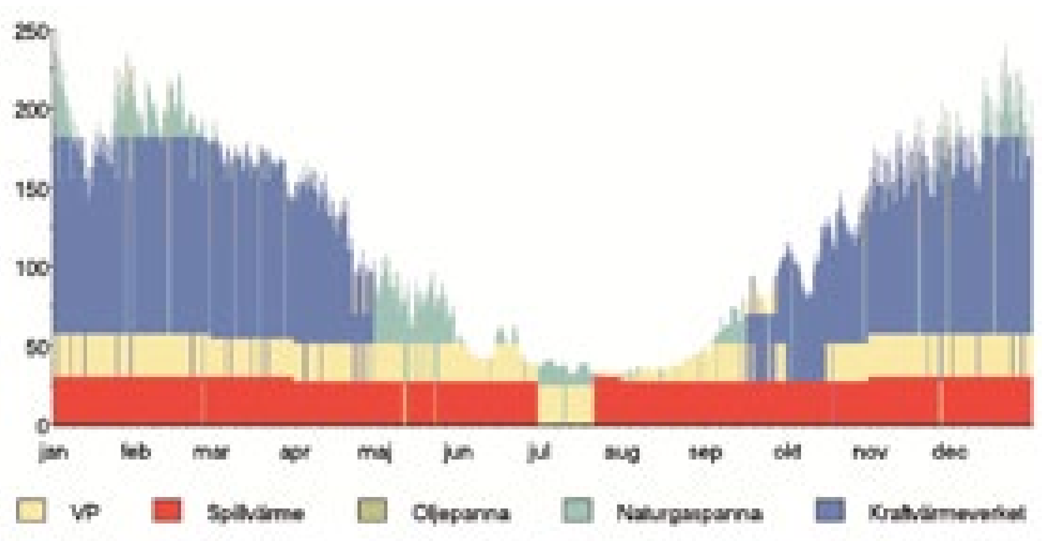

Electrical wired interlock
Emergency Stop Interlock
M
M

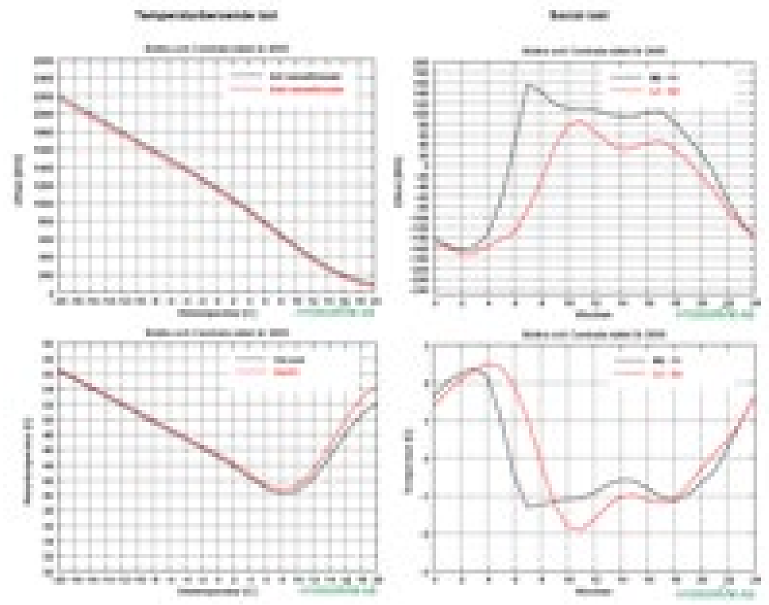

HY
Limit of 25 bars
Pumps on common shafts
Pipe elevation, limit of atmospheric rpessure
CHP

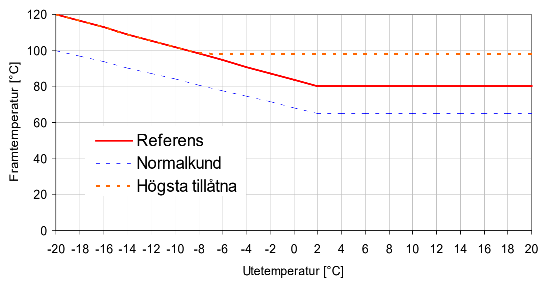

2016–04–30
Data: Shi1.pre
Shi1.man
Pipe Head
Time (sec):
–1.00
Program pfctf
ED:16–01–01
HYDROROM AB
Limit of 25 bars
490
470
450
430
410
390
370
350
330
310
290
270
250
230
210
190
170
150
130
110
90
70
50
Case 2:
4x1400, T=130/55 C
3.0 GW, 9.9 m3/s
Pipe elevation
limit of atm. pressure
CHP
Acc
PS
HX
0.0
5.0
X km
10.0

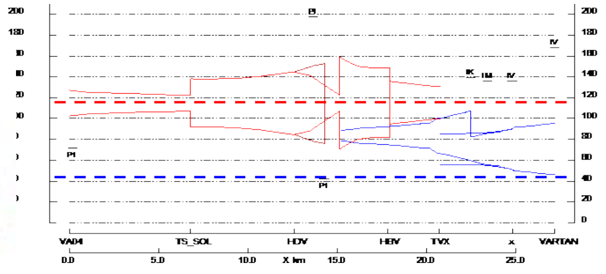
Heat Networks
Design

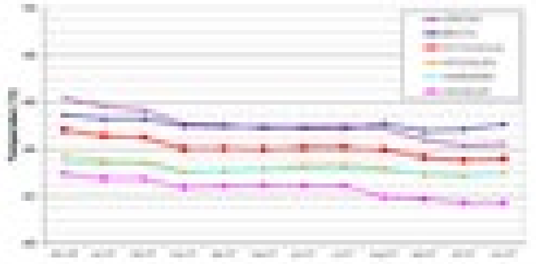
HEAT ACADEMY INTERNATIONAL

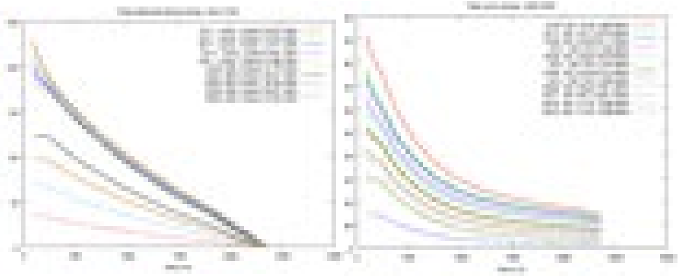


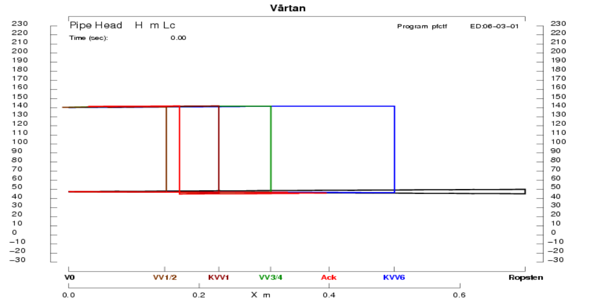


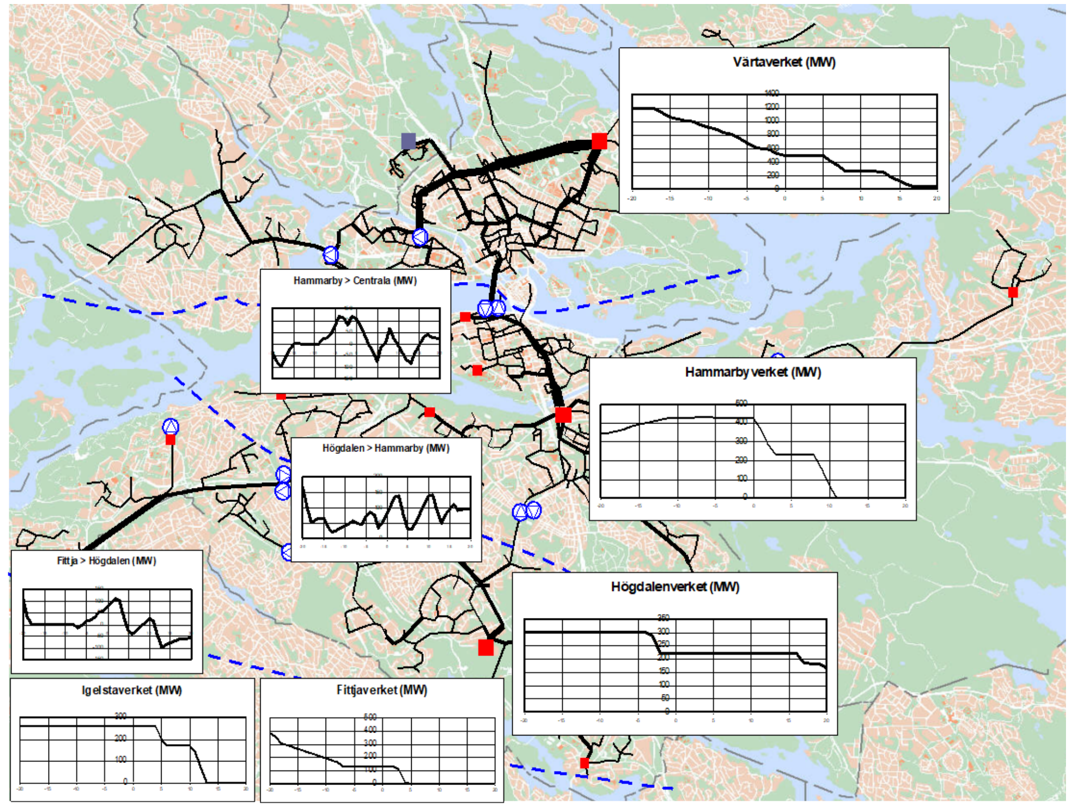


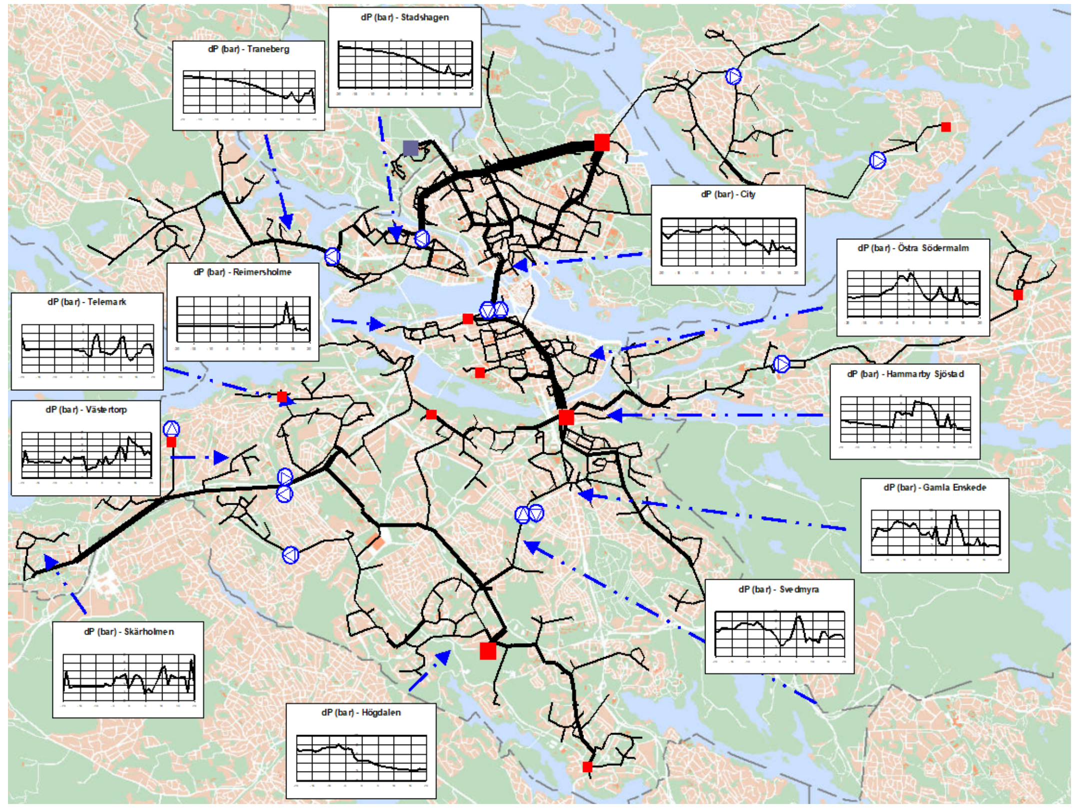


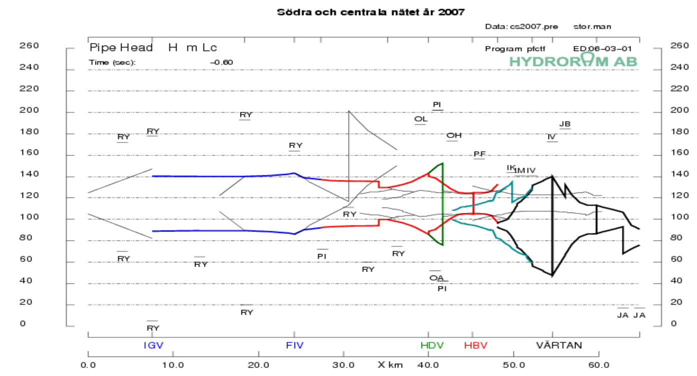


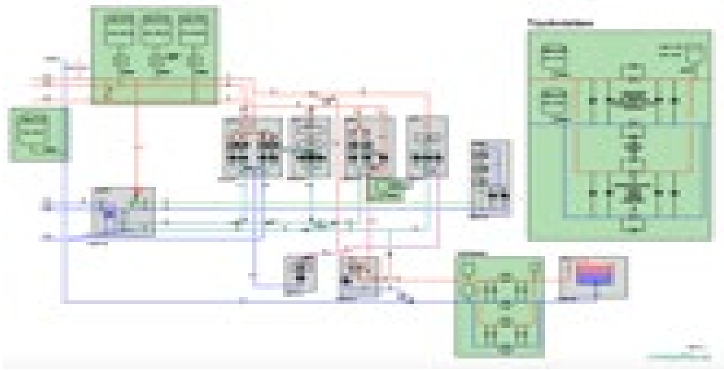


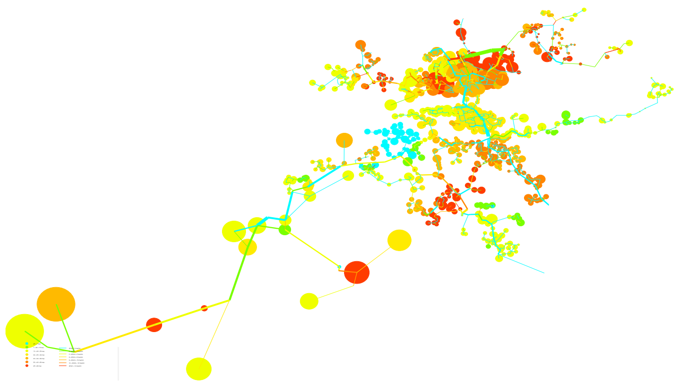


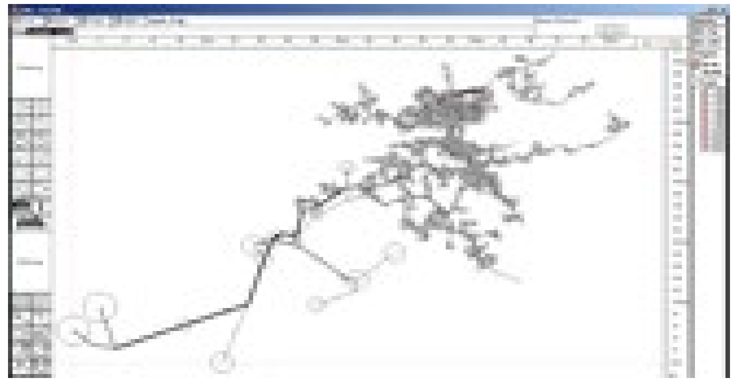


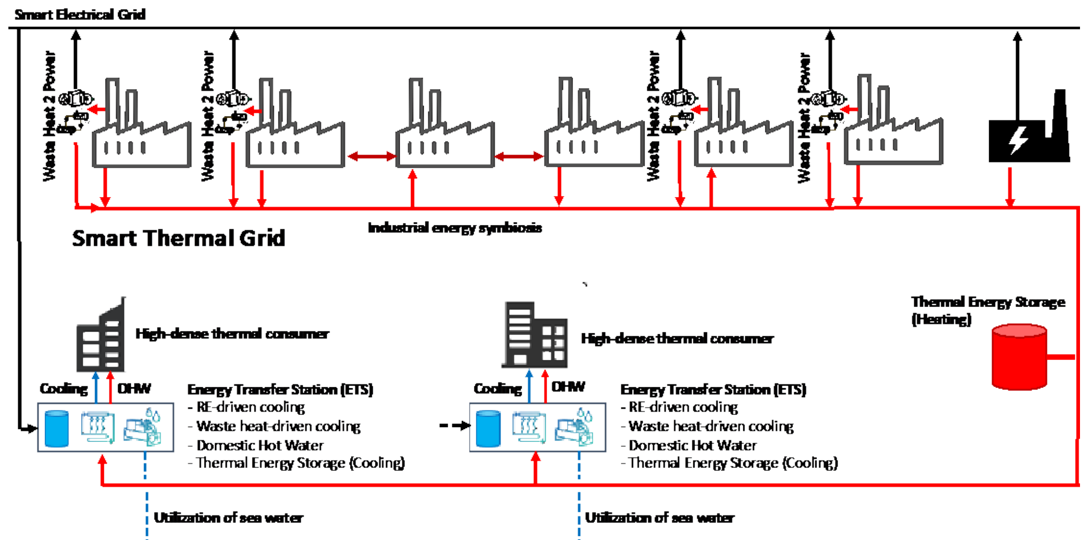






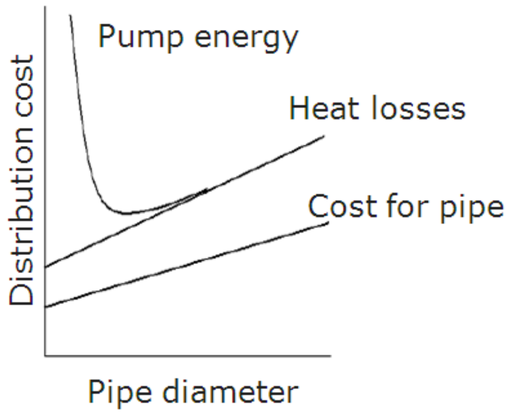


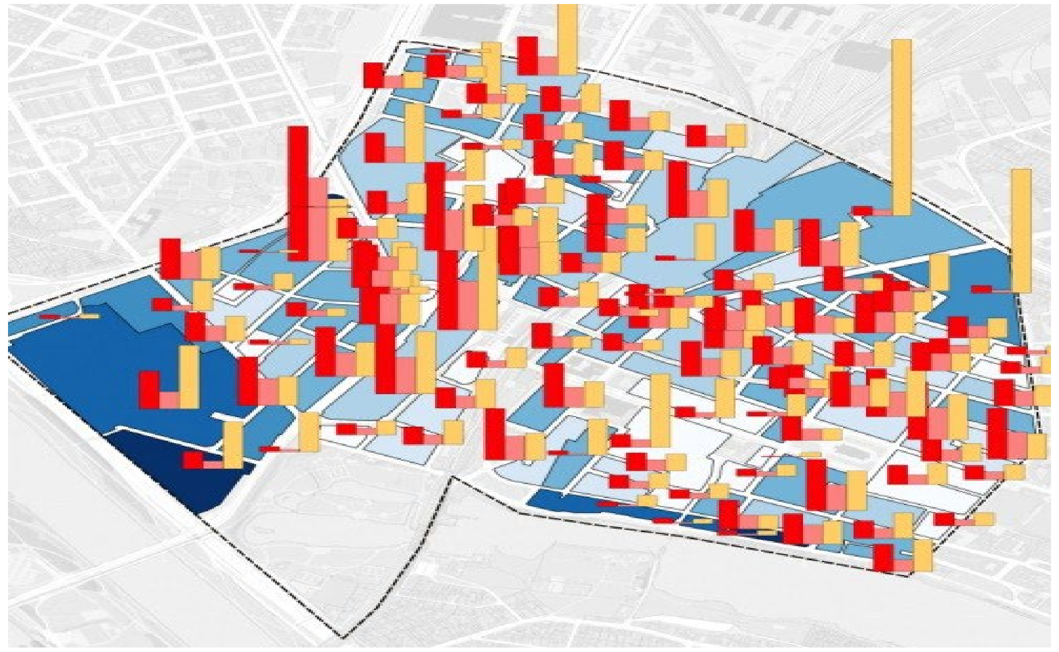




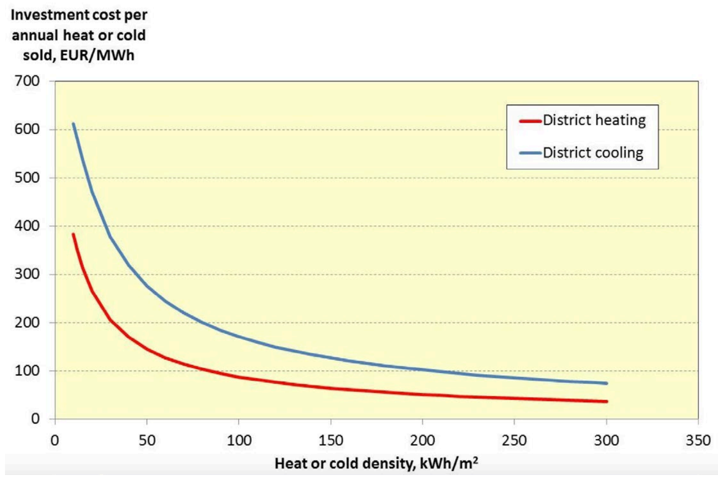
Heating demand density (GWh/km²)
Network cost ($/km$_{pipe}$)
Production cost ($/MW$_{cool}$)
…

Optimal pipe dimension

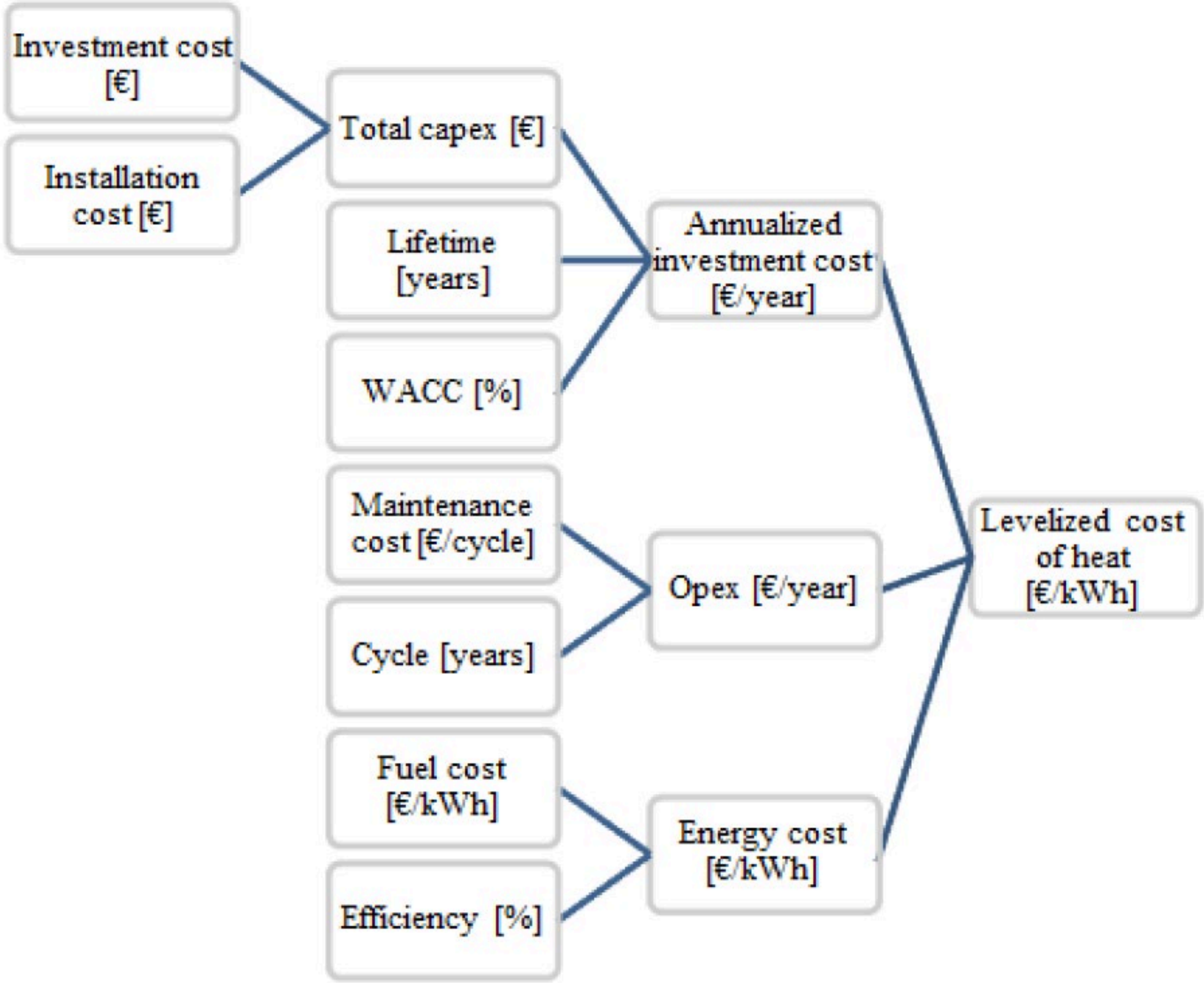




- Demand Assessment (inc. forecasting)
- Resource Assessment (inc. forecasting)
- Tariff Assessment (inc. forecasting)
- Scenario definition
- Scenario Analysis
- Technical, Financial, Environmental and Institutional benefit analysis
- Sensitivity Analysis
- Preparation of Energy Plan / Roadmap



Source: STRATEGO project



Type of area	Linear heat density GJ/m/y	Investment cost, green field area €/house	Investment cost, prebuilt area €/house
Inner city	15	1.400	1.950
Outer city	10	1.600	2.050
Park area	5	2.300	2.650

Distribution network investment costs

	Inner city	Outer city	Park area
Low energy buildings	0.050 €/kWh	0.051 €/kWh	0.060 €/kWh
Heat losses in network			
Low energy buildings	10%	20%	25%
Heat loss in consumer installation	2%		

Distribution grid and consumer installation cost per kWh

Heat plant type	Specific investment costs	Operating and maintenance cost	Efficiency	Technical lifetime
Centralized gas boiler	0,06-0,12 M€/MW	2-5% of investment costs	97-105%	20
Low temperature geothermal	1,7-1,9 M€/MW	2,5% of investment costs	100%	25
Biomass boiler, wood chips	0,3-0,7 M€/MW	1,8-3% of investment costs	108%	20

Heat plant cost table

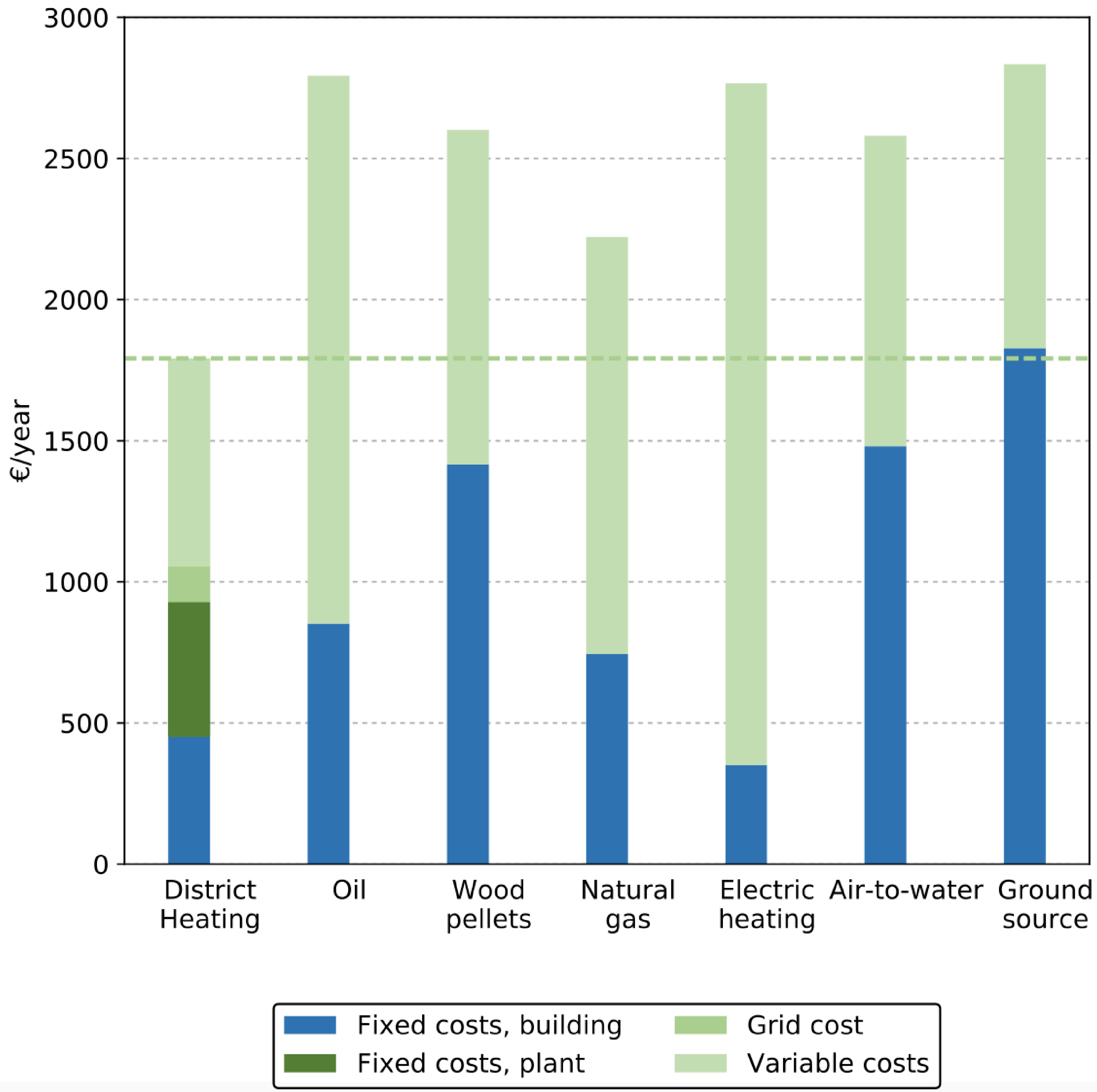
	Inner city				Outer city			
Country	**Gas boiler**	**Biomass boiler**	**Geothermal plant, low temperature**	**CHP Surplus / waste**	**Gas boiler**	**Biomass boiler**	**Geothermal plant, low temperature**	**CHP Surplus / waste**
Bulgaria	0,091	0,109	0,142	0,066	0,097	0,117	0,155	0,069
Denmark	0,126	0,109	0,144	0,066	0,137	0,117	0,157	0,069
Finland	0,106	0,106	0,143	0,066	0,114	0,114	0,156	0,069
Ireland	0,099	0,108	0,146	0,066	0,106	0,116	0,160	0,069
Italy	0,094	0,097	0,149	0,066	0,100	0,104	0,163	0,069
Latvia	0,092	0,104	0,145	0,066	0,098	0,112	0,158	0,069
Lithuania	0,103	0,102	0,145	0,066	0,110	0,110	0,158	0,069
Portugal	0,097	0,095	0,145	0,066	0,104	0,101	0,158	0,069
Slovakia	0,100	0,107	0,146	0,066	0,108	0,115	0,160	0,069
Slovenia	0,112	0,106	0,144	0,066	0,121	0,114	0,157	0,069
Sweden	0,117	0,110	0,143	0,066	0,126	0,118	0,156	0,069
United Kingdom	0,086	0,106	0,145	0,066	0,092	0,114	0,158	0,069

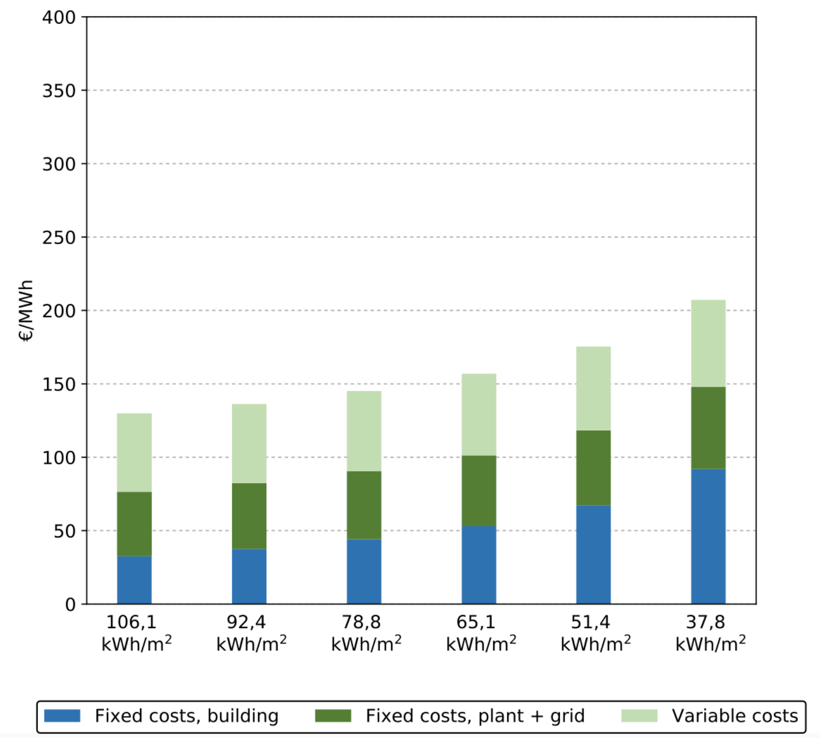
Cost of heat from different DH schemes for low energy buildings in €/kWh

Country	Gas boiler	Air source heat pump	Ground source heat pump	Solar thermal*	Electrical boiler
Bulgaria	0,116	0,161	0,199	0,121	0,118
Denmark	0,173	0,216	0,249	0,129	0,284
Finland	N/A	0,173	0,210	0,122	0,156
Ireland	0,129	0,193	0,228	0,125	0,216
Italy	0,156	0,194	0,229	0,126	0,218
Latvia	0,115	0,174	0,210	0,122	0,156
Lithuania	0,123	0,170	0,207	0,122	0,147
Portugal	0,141	0,188	0,223	0,125	0,199
Slovakia	0,120	0,184	0,220	0,124	0,188
Slovenia	0,148	0,178	0,214	0,123	0,170
Sweden	0,180	0,191	0,226	0,125	0,209
United Kingdom	0,128	0,187	0,222	0,124	0,196

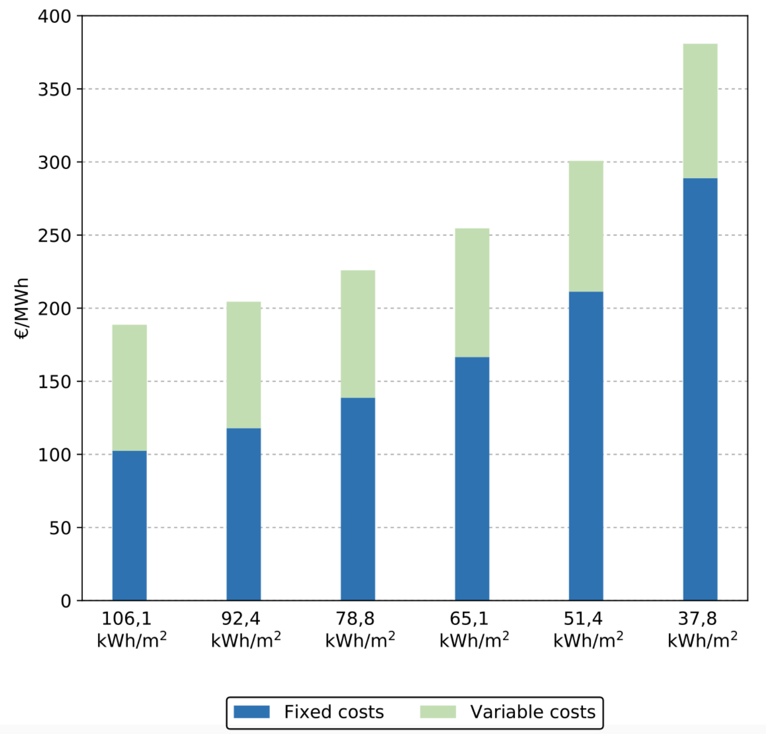
Cost of decentralized heating solutions in €/kWh

HEAT ACADEMY INTERNATIONAL

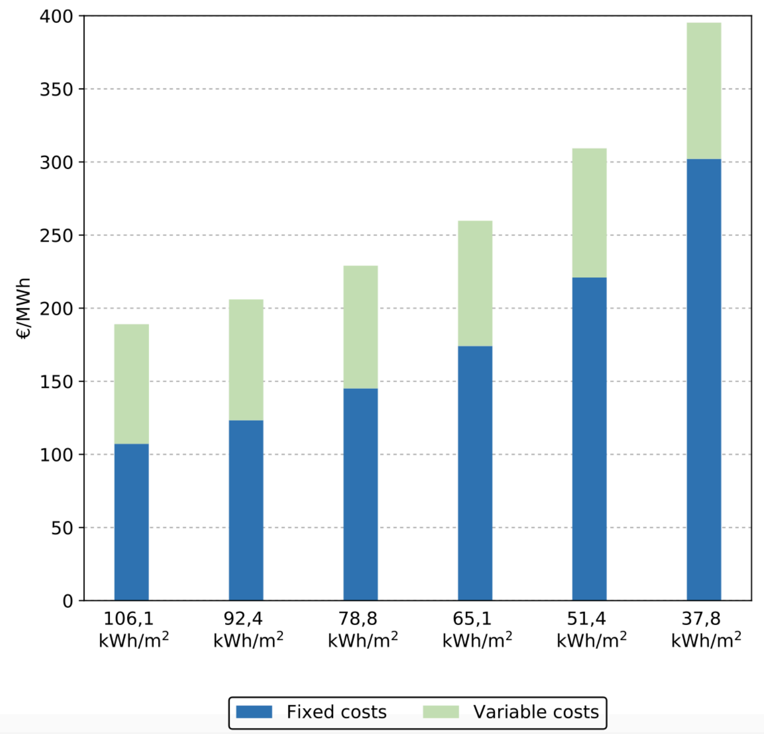




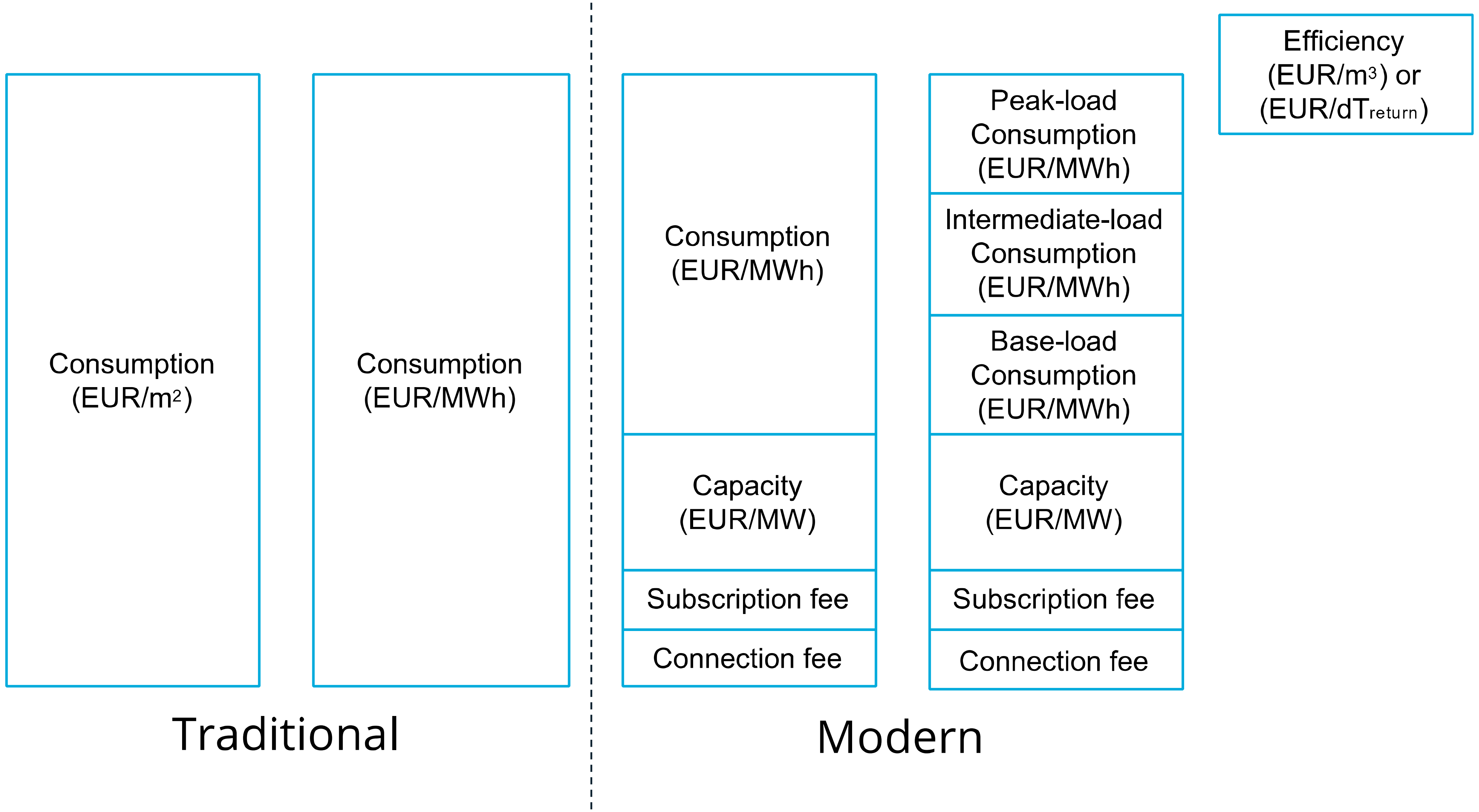
District Heating



Individual wood pellet boiler



Individual air/water heat pump


Consumption
(EUR/m2)
Consumption
(EUR/MWh)
Consumption
(EUR/MWh)
Capacity
(EUR/MW)
Subscription fee
Connection fee
Peak-load
Consumption
(EUR/MWh)
Intermediate-load
Consumption
(EUR/MWh)
Base-load
Consumption
(EUR/MWh)
Capacity
(EUR/MW)
Subscription fee
Connection fee
Efficiency
(EUR/m3) or
(EUR/dTreturn)
Traditional
Modern

HEAT ACADEMY INTERNATIONAL

The regulatory schemes in the district heating sector worldwide can be simplified and divided in three (3) categories: i) Social Regulation, ii) Market regulation, and iii) Economical regulation. Some countries are in transition from social regulation towards economical regulation.

Social regulation	Market regulation	Economical regulation	In transition
- Public sector dominates ownership **- Social objectives** **- Often subsidized** - Minimal regulation required **- Focus on heat supply** - Lack of incentives for modernization and energy efficiency - Not attractive for private sector	**- Limited influence by government** **- Minimal regulations** **- Need for customer protection** - Attractive for private actors - Development of district heating systems are market driven. - Incentives for EE and modernization - Attractive for private sector	**- High influence from government** **- Sophisticated regulatory framework and organization** - High admin. cost **- Reasonable pricing applied** - Incentives for energy efficiency and modernization through regulation - Attractive for private sector - Suitable for PPP	
Russia Kazakhstan Mongolia	Finland Sweden Turkey	Denmark Lithuania Poland	China Belarus Uzbekistan

The most common business models in district heating sector can be divided into three (3) main categories: i) “Wholly public” business model, ii) “Hybrid public and private” business model, and iii) “Private” business model. Below the characteristics of the three business models.

Type	Public sector control	Description
Wholly public	High	- Public sector demonstrating district heating - Public sector to improve cash flow - Public sector lower tariffs, allowing low IRR - District heating to meet social objectives
Hybrid public and private	Medium	- Public-private joint venture - Concession agreement - Community-owned not-for-profit/cooperative
Private	Low	- Privately owned project with public facilitation