Renewables-Based District Energy in Vancouver

Chris Baber, Neighbourhood Energy Utility Manager

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Outline

1) False Creek Neighbourhood Energy Utility

2) Renewable District Energy System Development in Vancouver

Southeast False Creek – Sustainable Community Design

- 80 acre Brown Field Site – 120 years of industrial use
- 6 million sq ft of development and 16,000 new residents by 2018
- Community built on environmental, social and economic sustainability principles
- Energy Strategy:
  - Green building design
  - Neighbourhood Energy Utility (“NEU”)


North Shore
Stanley Park
Downtown Peninsula
Burrard Inle
False Creek
Southeast False Creek

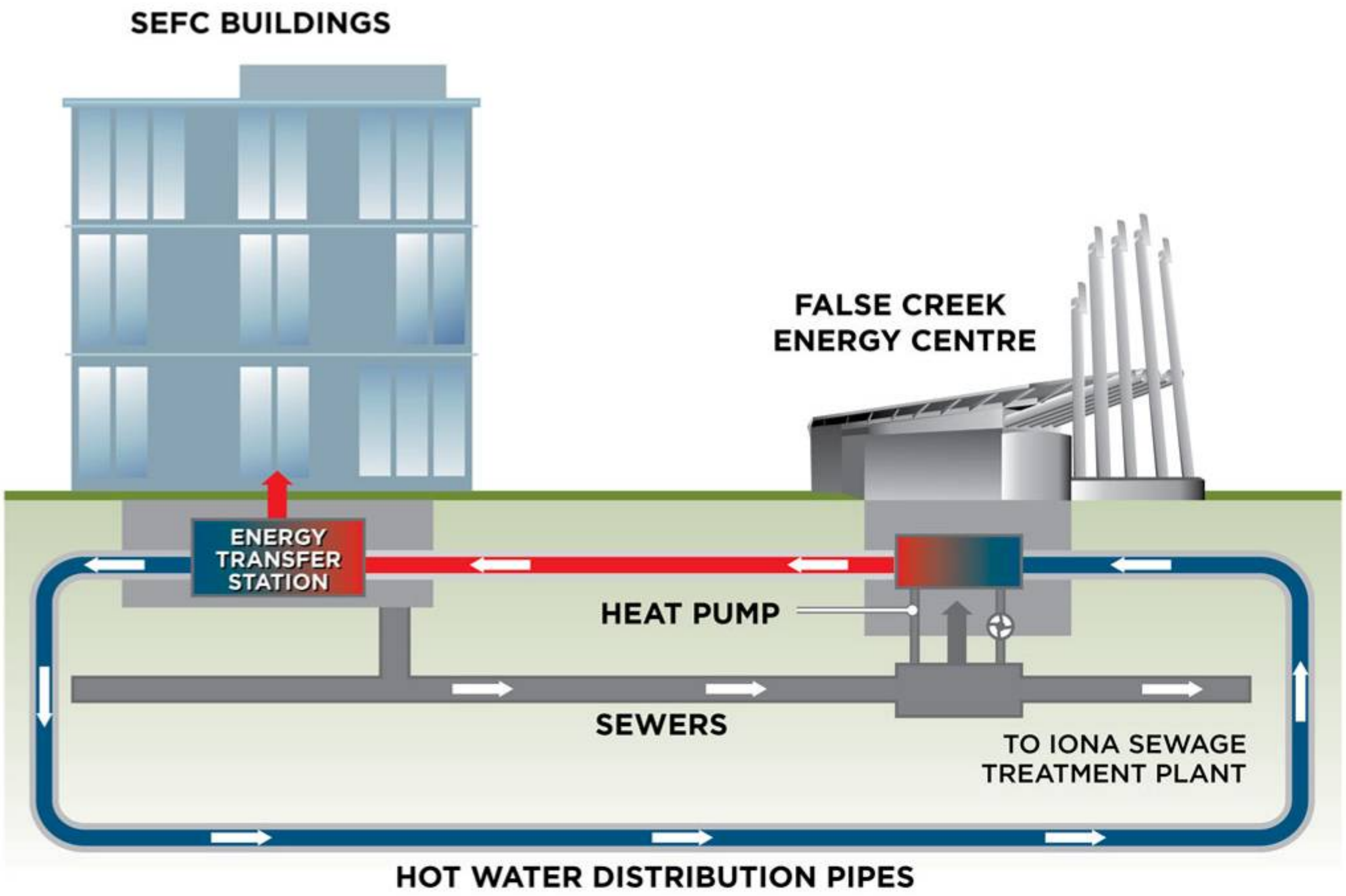
The SEFC Neighbourhood Energy Utility (“NEU”)

The NEU is a district energy system that supplies space heating and domestic hot water to all buildings within the SEFC neighbourhood.

Business Model

- **Ownership**
  - City of Vancouver
- **Governance oversight**
  - City Council (not BC Utilities Commission)
- **Operations**
  - Managed by the City's Engineering Department, integrated with other municipal utilities.
- **Funding**
  - Self-supporting via NEU revenues, not tax-supported. Because it serves a small section of the City, managed with a commercial model to realize a return on investment for the City.

NEU – Infrastructure



FALSE CREEK ENERGY CENTRE - How it works

NEU Infrastructure – False Creek Energy Centre

The *False Creek Energy Centre:*

- a centralized thermal energy (hot water) production facility, which is integrated with a new municipal sewage pump station.
- Sewage heat recovery is the primary "base-load" energy source and supplies 70% of the annual energy demand.
- Natural gas boilers used for back-up and peaking heat.

NEU Infrastructure – Distribution Pipeline System

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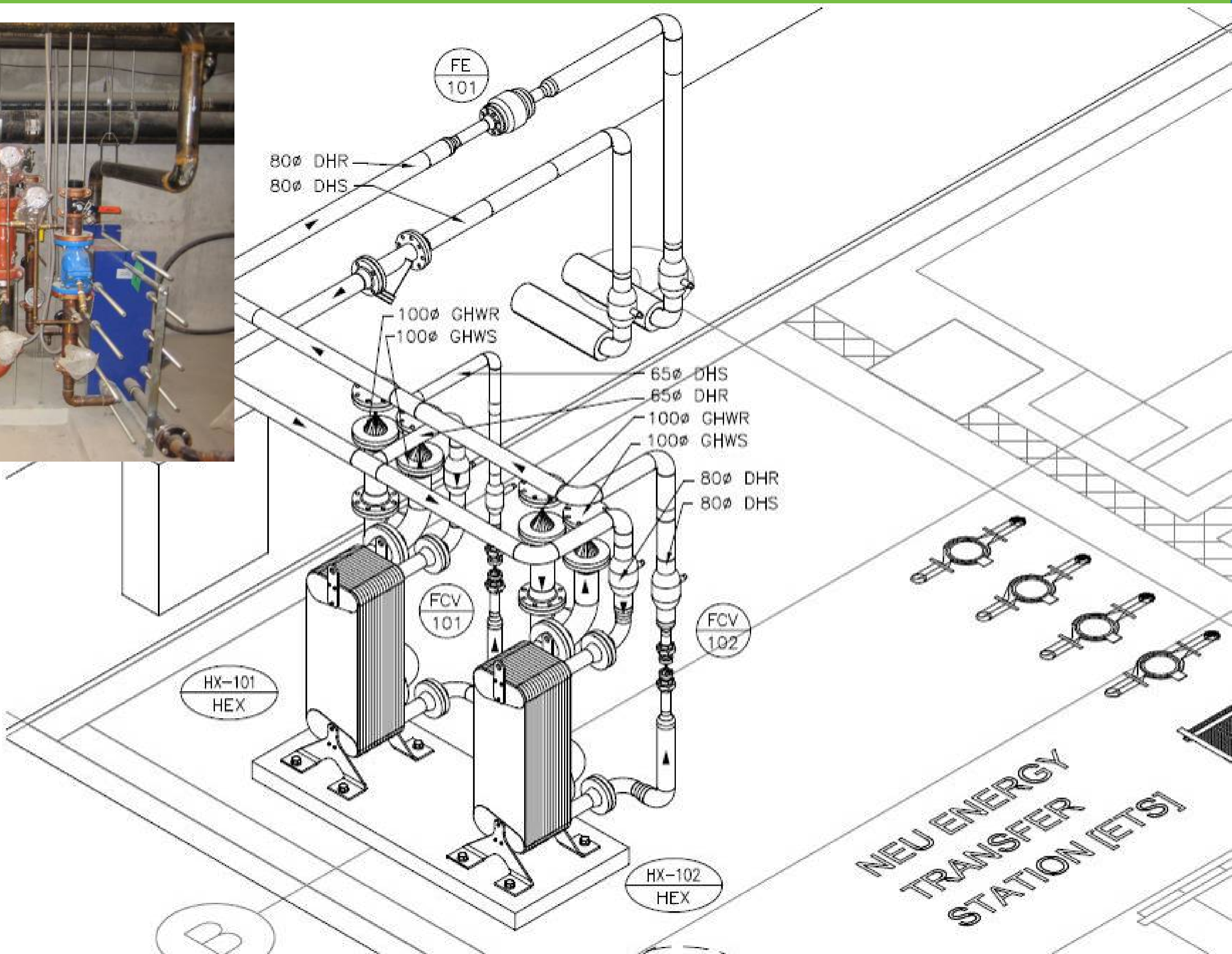
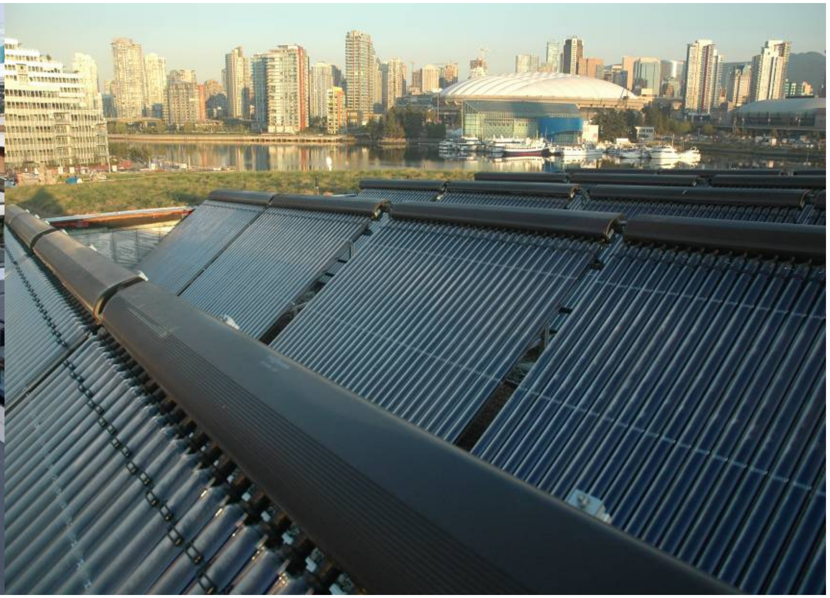
NEU Infrastructure – Energy Transfer Stations



NEU Technology – Customer Building Interface



Energy Transfer Stations are capable of moving energy in both directions between NEU and customer building system. In the first phase of development, 3 SEFC buildings have roof-top solar collectors that deliver energy not used by building to NEU. Building owners receive a credit for this.

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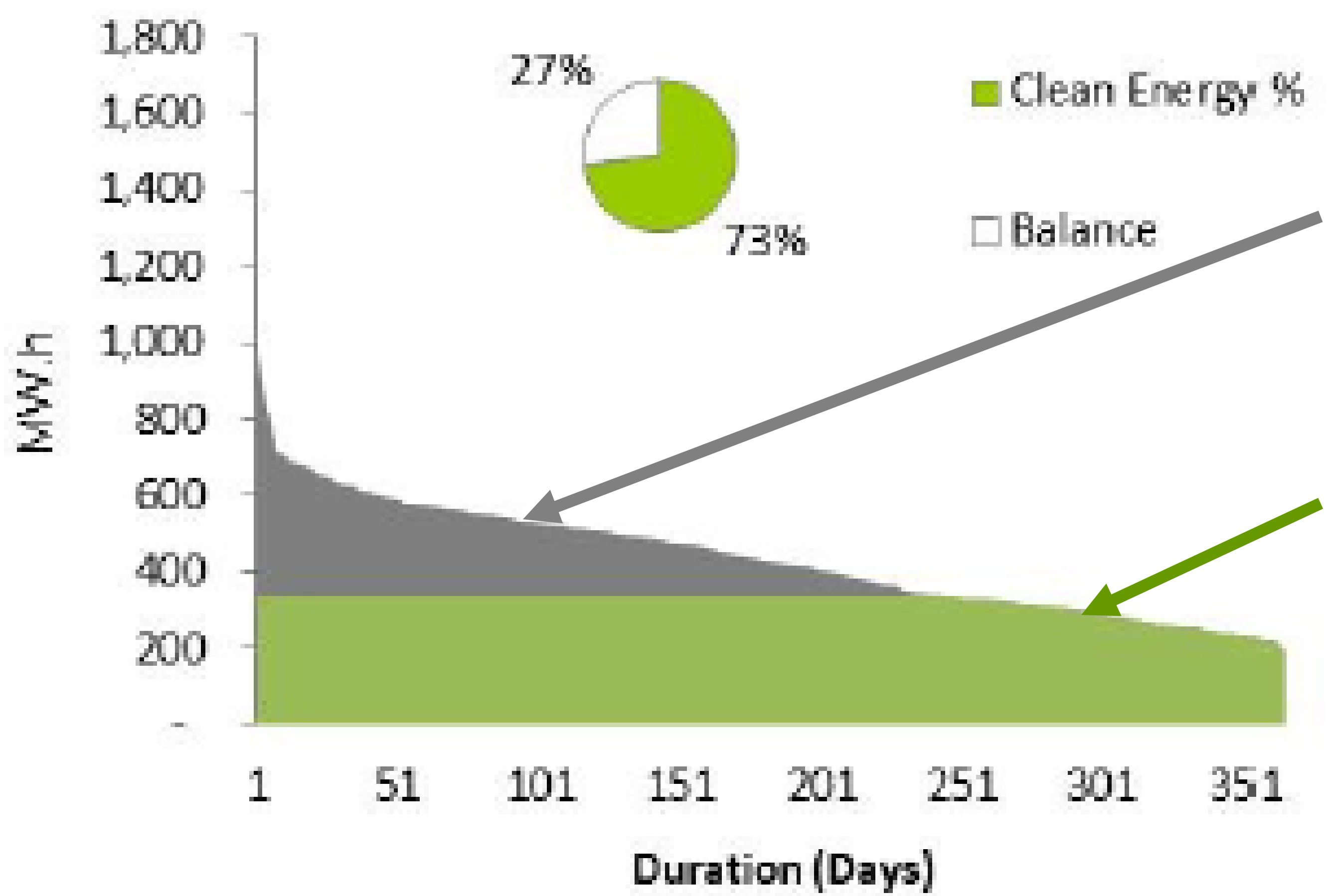
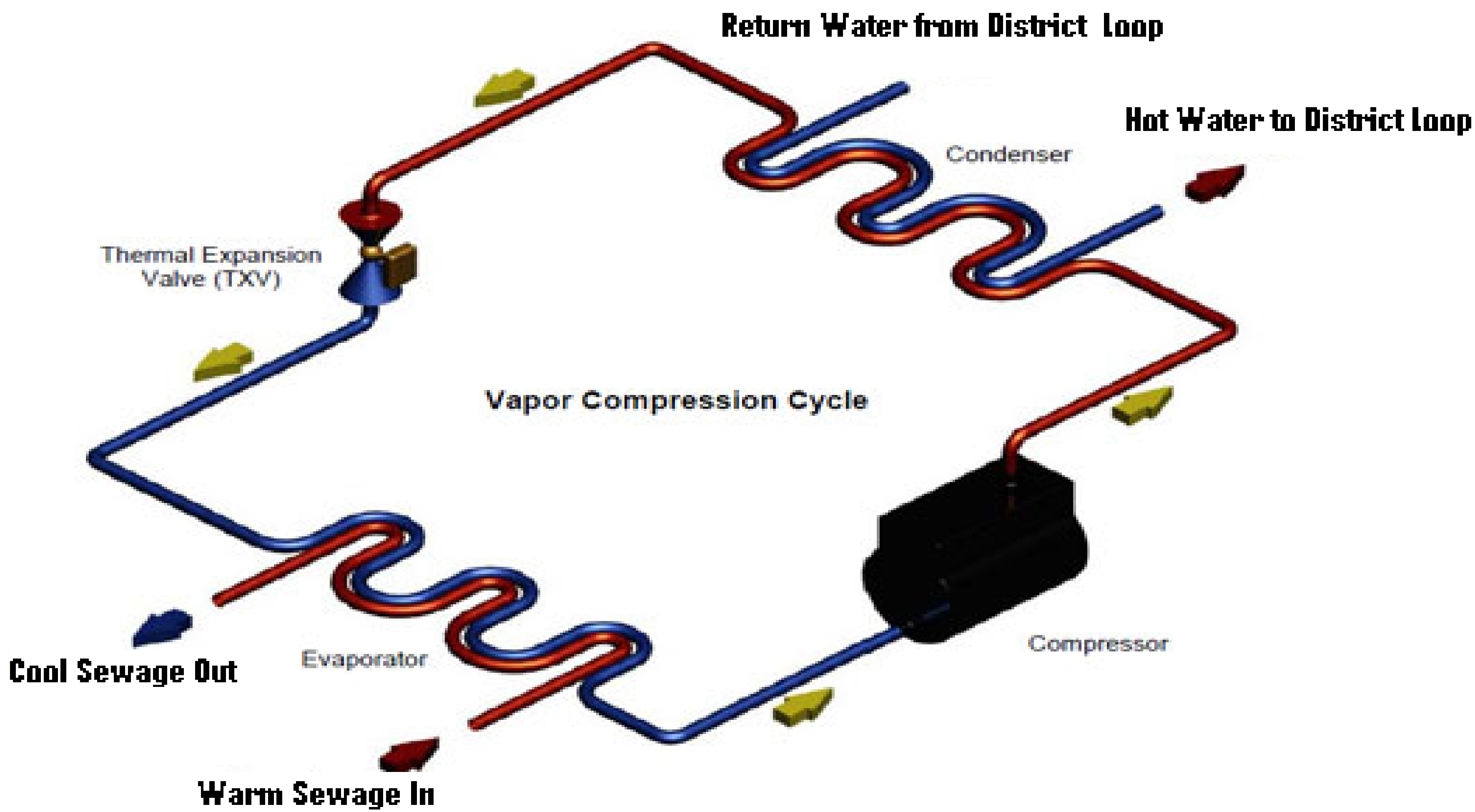
NEU Infrastructure – Green Base Load



NEU Infrastructure – Sewage Heat Recovery



Project Management Challenges

- Schedule: Needed to have unique system ready to provide heat and hot water to SEFC buildings

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- Budget: utility needs to pay for itself and be competitive with business as usual

- 20 separate Council reports, high proportion on critical path

- Stakeholder interests

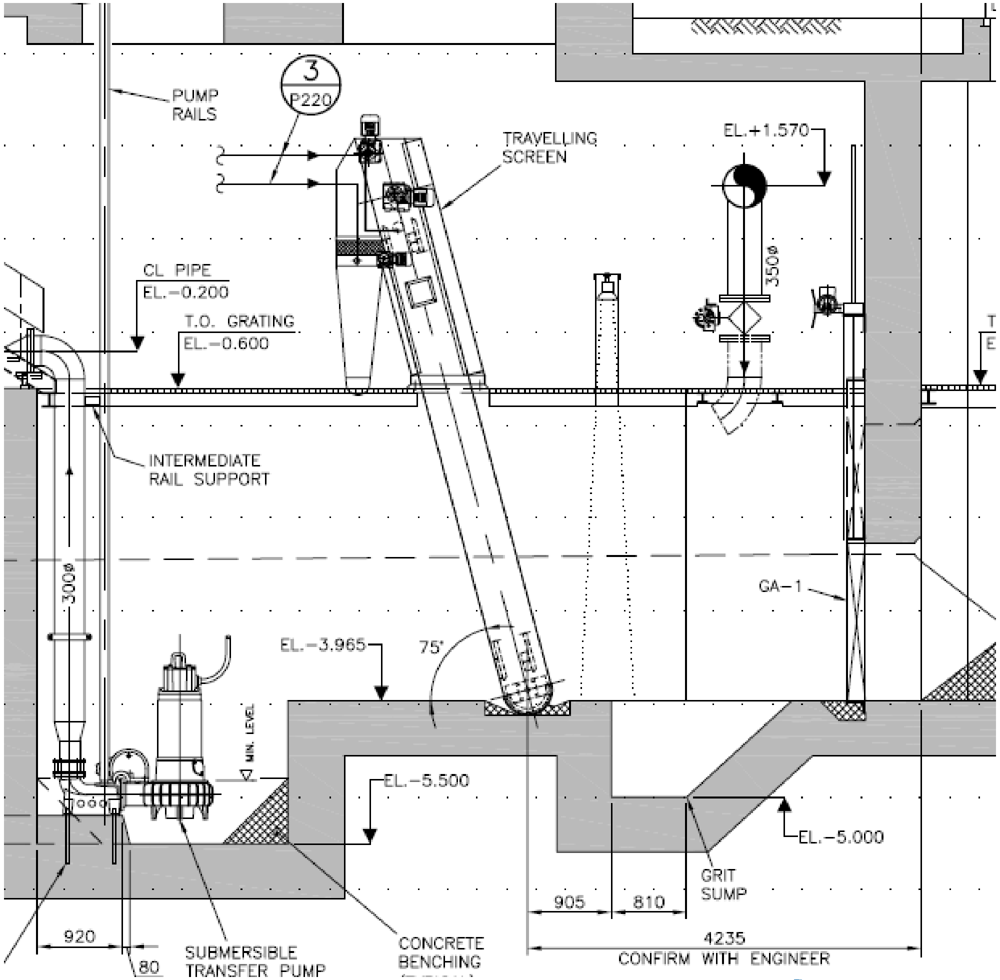
Sewage Heat Recovery – Technical Challenges

1) **Ensuring adequate and continuous sewage flows**
   - 100 L/s required for 3.5 megawatts sewage heat recovery
   - energy centre integrated with sewage pump station
   - additional sewage force main connection to secure adequate night-time flow

Sewage Heat Recovery – Technical Challenges

2) Maintaining Clean Heat Exchange Surfaces

- 2mm traveling screen
- 4-way valve for sewage flow reversal to minimize bio-films
- option to add add'l sewage filtration and heat exchanger brushes



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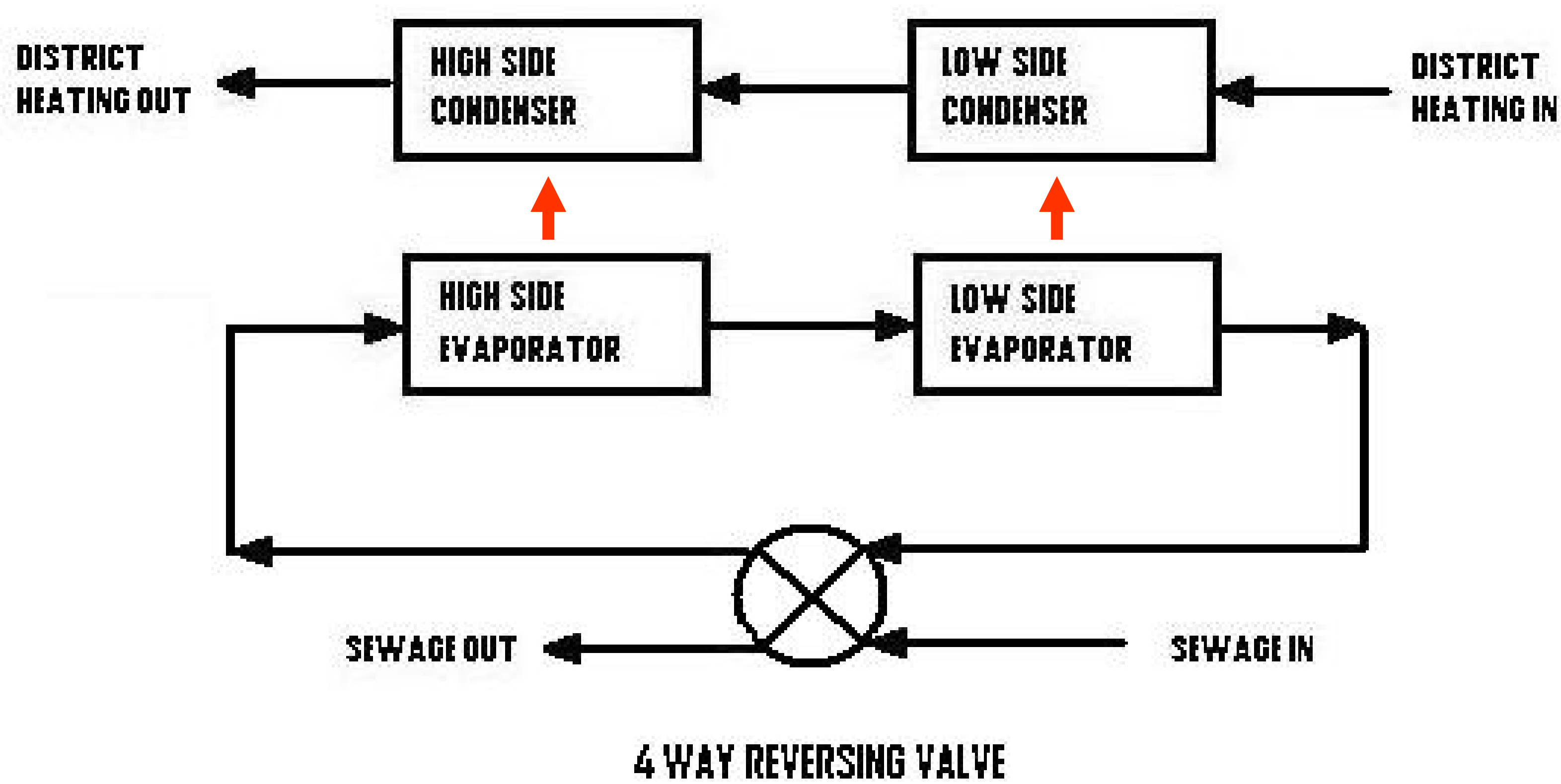
NEU Infrastructure – Heat Exchanger Cleaning System



Sewage Heat Recovery – Technical Challenges

3) Heat demand variability

- two stage heat pump system
- series/parallel flow arrangement
- condenser output temp 65 to 82 degrees C
- 5:1 turndown for low demand periods

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Challenge - Building Systems Integration

- Local mechanical design professionals have limited hydronic and district energy experience

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- Efficiency of entire system can be disrupted by one poorly performing building

- Technical direction has resulted in buildings that perform well. First Olympics where athletes had hot showers ☺

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Challenge – Heat Sources & Public Process

- Technology options – Biomass vs. Sewage Heat and other public-preferred "alternatives"
  - NGO & Public perceptions
- Plant Design and Development Permitting Processes
- Ongoing

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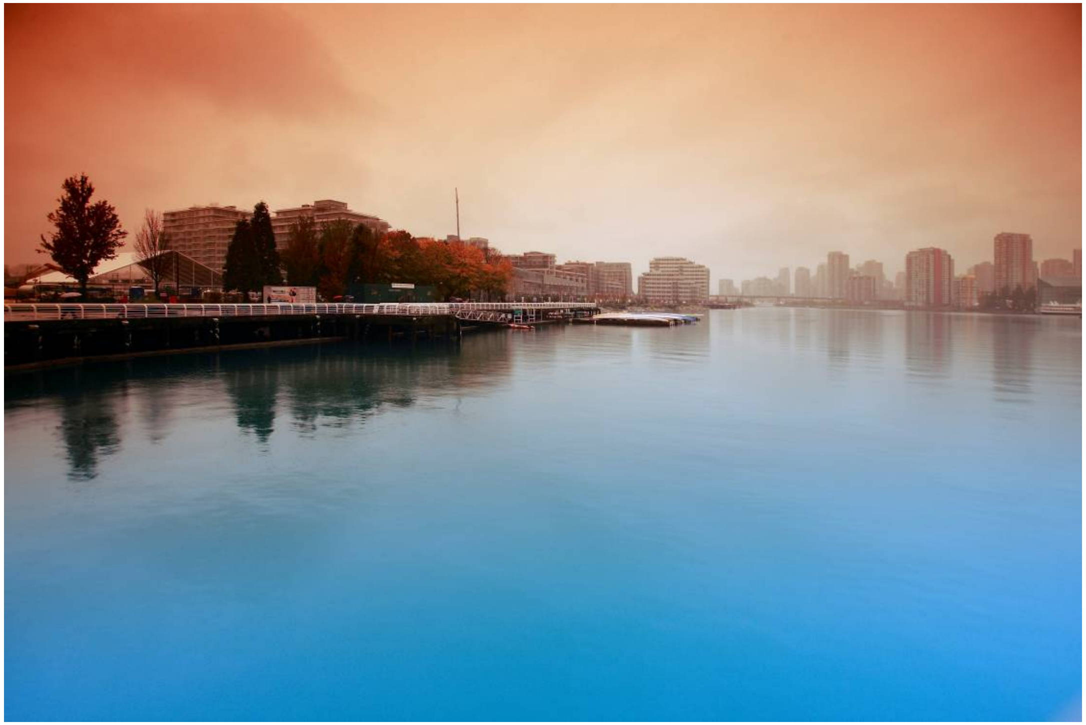
Benefits of the NEU - Environmental

- Renewable energy source, utility operated
- GHG reductions
- Lowered NOx, VOC's and other combustion by-products
- Hot-water radiant heating = highly efficient
- Adaptable - can accommodate different sources of energy



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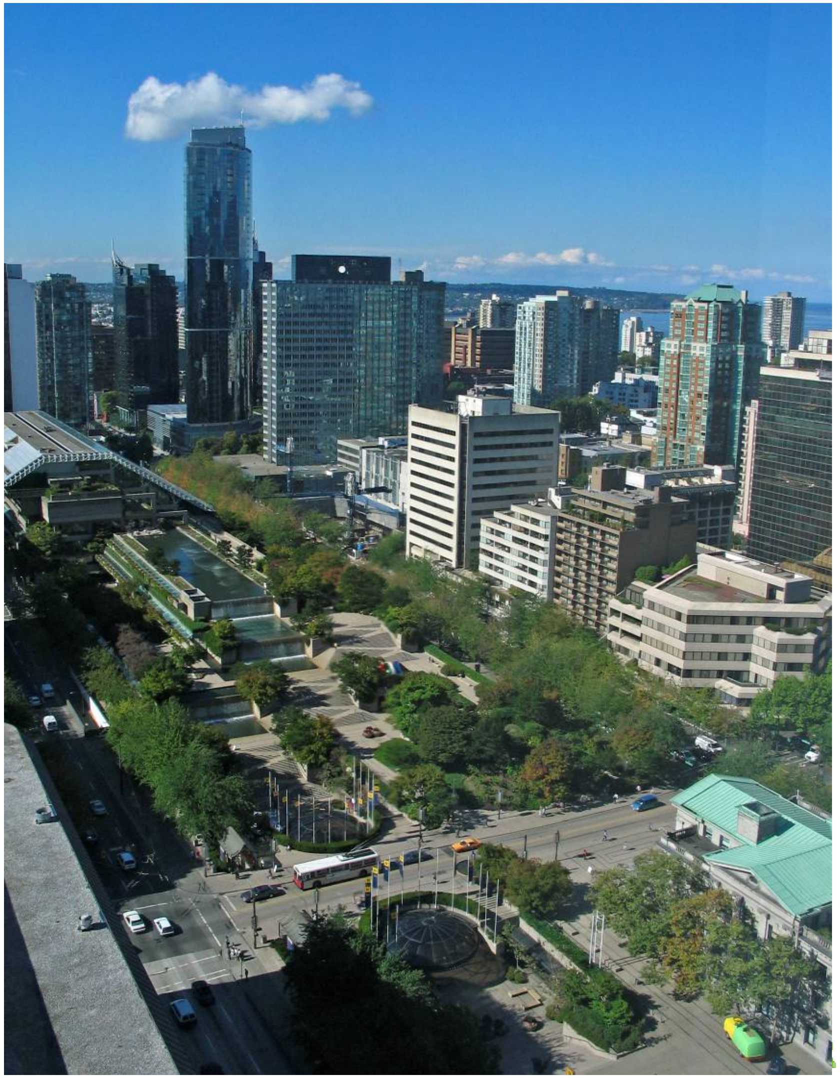
Benefits of the NEU - Social

- Reduced conventional energy use (natural gas and electricity) protects from volatility + inflation.
- Use of locally available sources improves energy security for customers
- High comfort level with low energy bills.
- Eliminates most heating and hot water equipment from buildings and building roofs



Benefits of the NEU - Economic

- Return to the City and competitive rates for customers
- Provides cost-effective means for more buildings to achieve efficiency and renewable energy supply objectives
- Benefits from longer amortization periods, lower carrying costs for capital, and economies of scale

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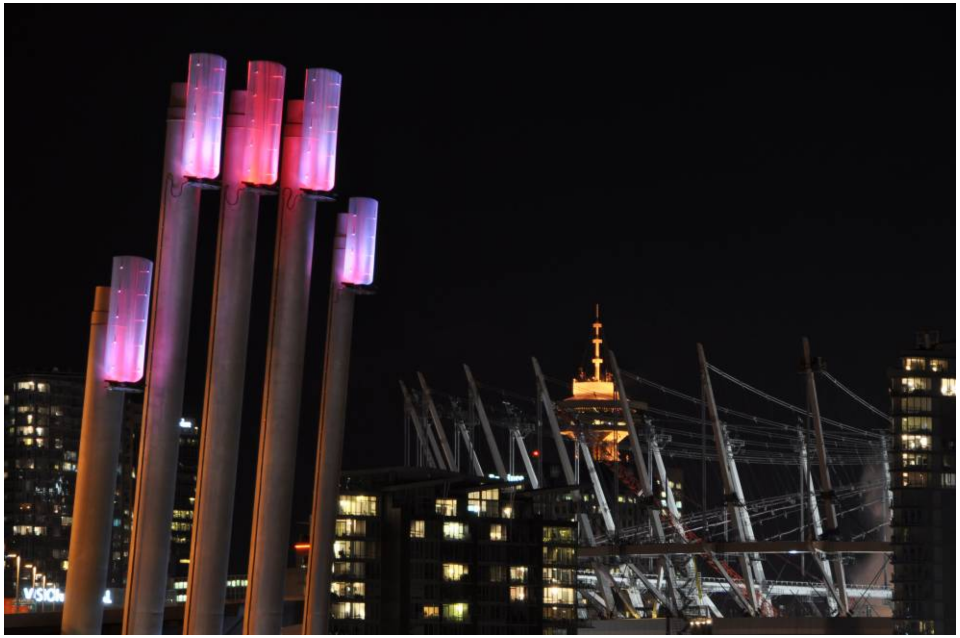
Lessons from SEFC NEU Development

Economic viability of systems strongly dependant on:

- heat load density
- matching size of green source to base load;
- installing green technology when there is sufficient demand



Long-term success depends on:

- Competitive rates
- Self-funding utility model
- Reliable, high quality service

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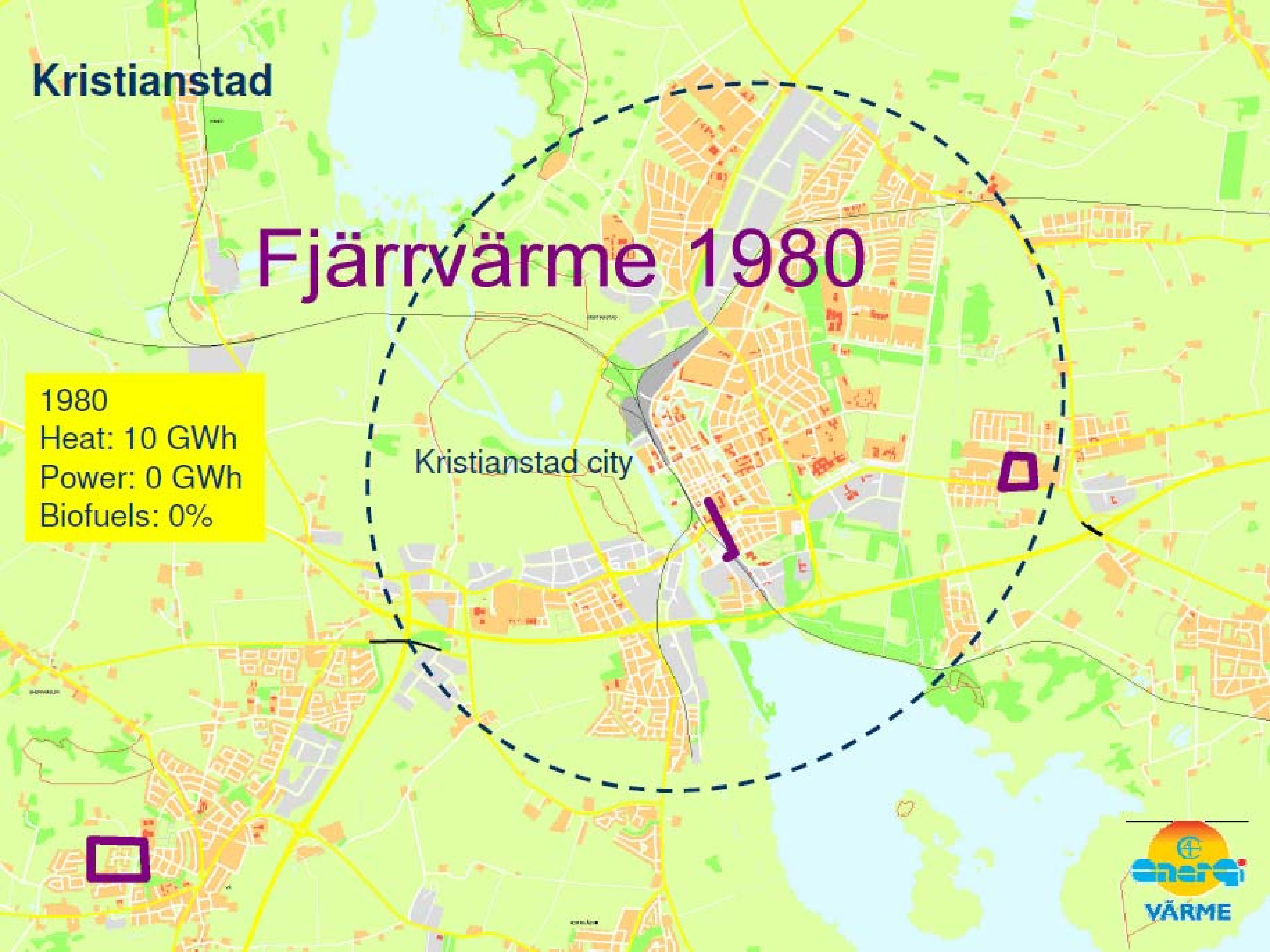
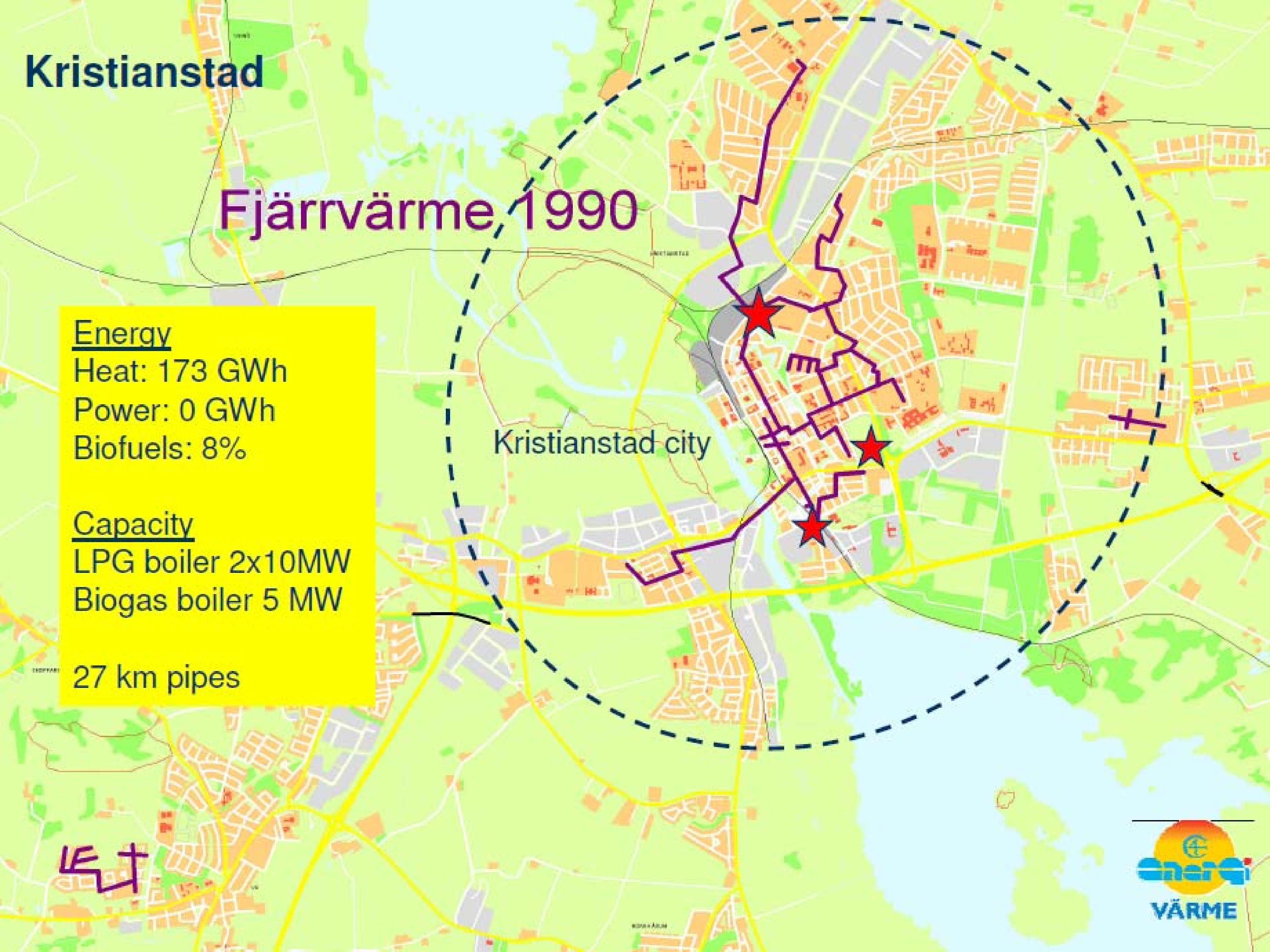
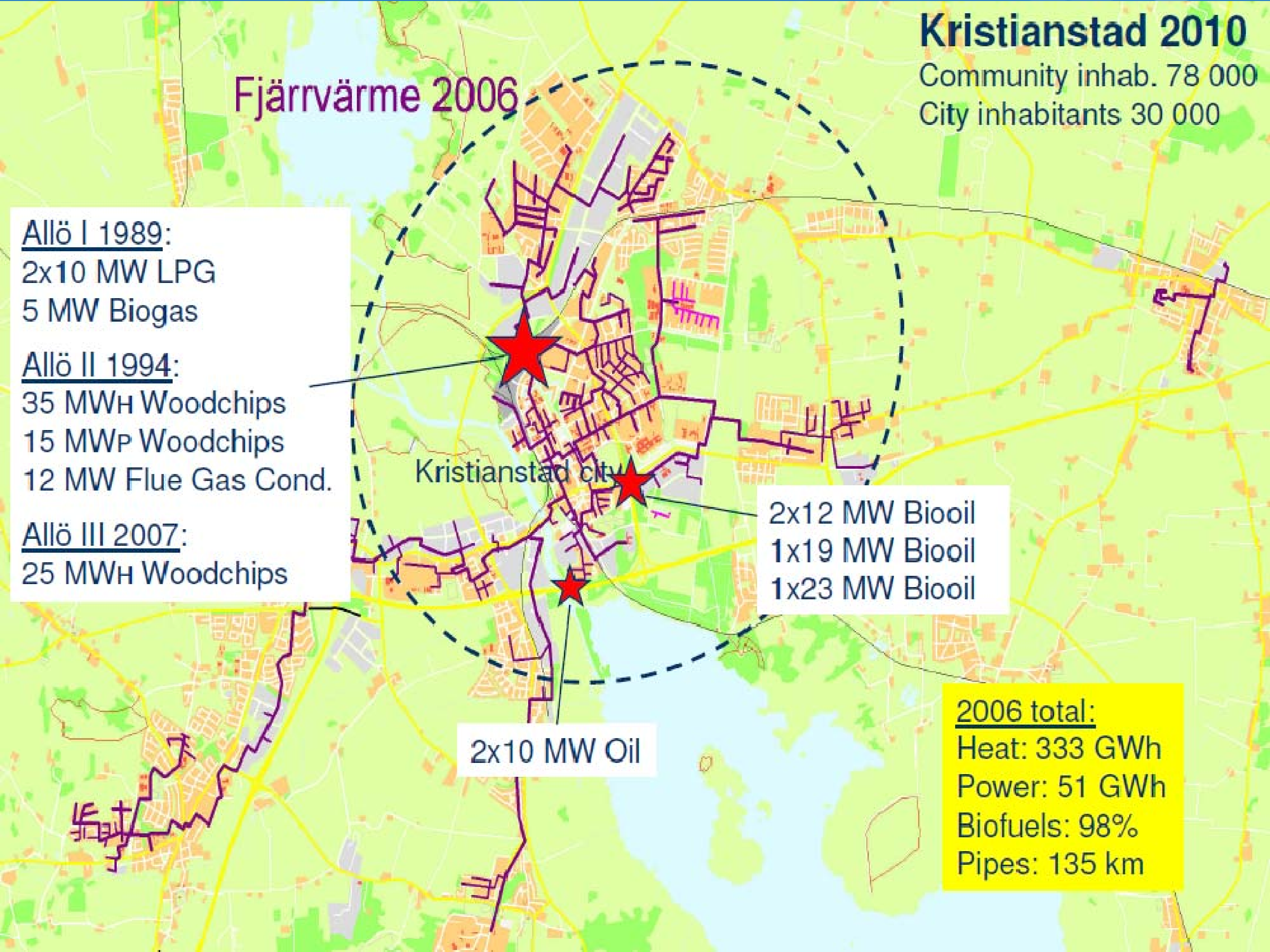
District Energy Growth

The Big Picture, District Energy

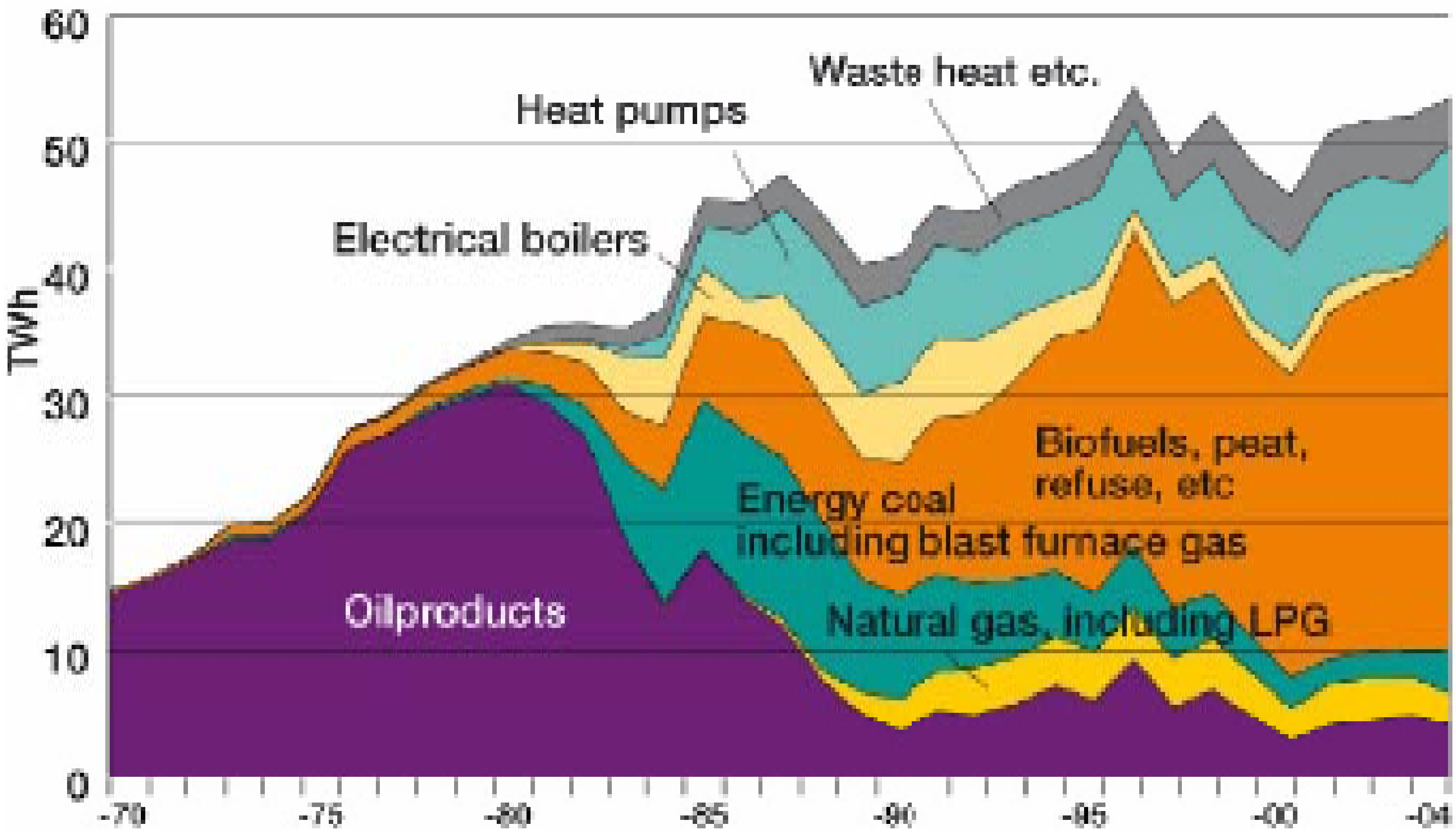
- Proven internationally
- Just another utility!
- Once established, can be expanded and replicated


Kristianstad
Fjärrvärme 1980
1980
Heat: 10 GWh
Power: 0 GWh
Biofuels: 0%
Kristianstad city
VÄRME

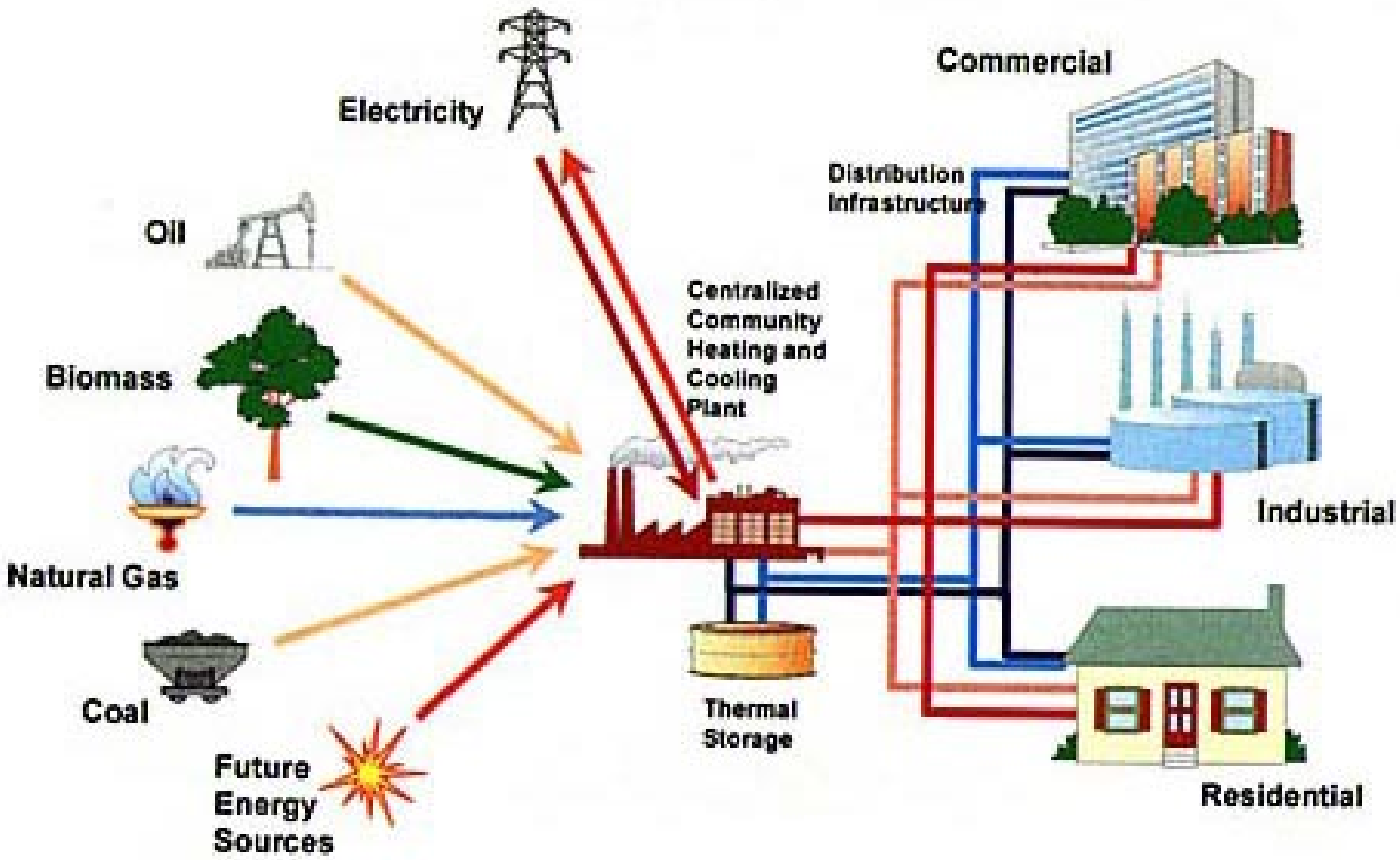

Kristianstad
Fjärrvärme 1990
Energy
Heat: 173 GWh
Power: 0 GWh
Biofuels: 8%
Capacity
LPG boiler 2x10MW
Biogas boiler 5 MW
27 km pipes
Kristianstad city
VÄRME


Kristianstad 2010
Community inhab. 78 000
City inhabitants 30 000
Fjärrvärme 2006
Allö I 1989:
2x10 MW LPG
5 MW Biogas
Allö II 1994:
35 MWH Woodchips
15 MWP Woodchips
12 MW Flue Gas Cond.
Allö III 2007:
25 MWH Woodchips
Kristianstad city
2x12 MW Biooil
1x19 MW Biooil
1x23 MW Biooil
2x10 MW Oil
2006 total:
Heat: 333 GWh
Power: 51 GWh
Biofuels: 98%
Pipes: 135 km

Swedish District Energy Growth & Fuel Sources



District Energy – Heat Source Options



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District Energy Expansion in Vancouver

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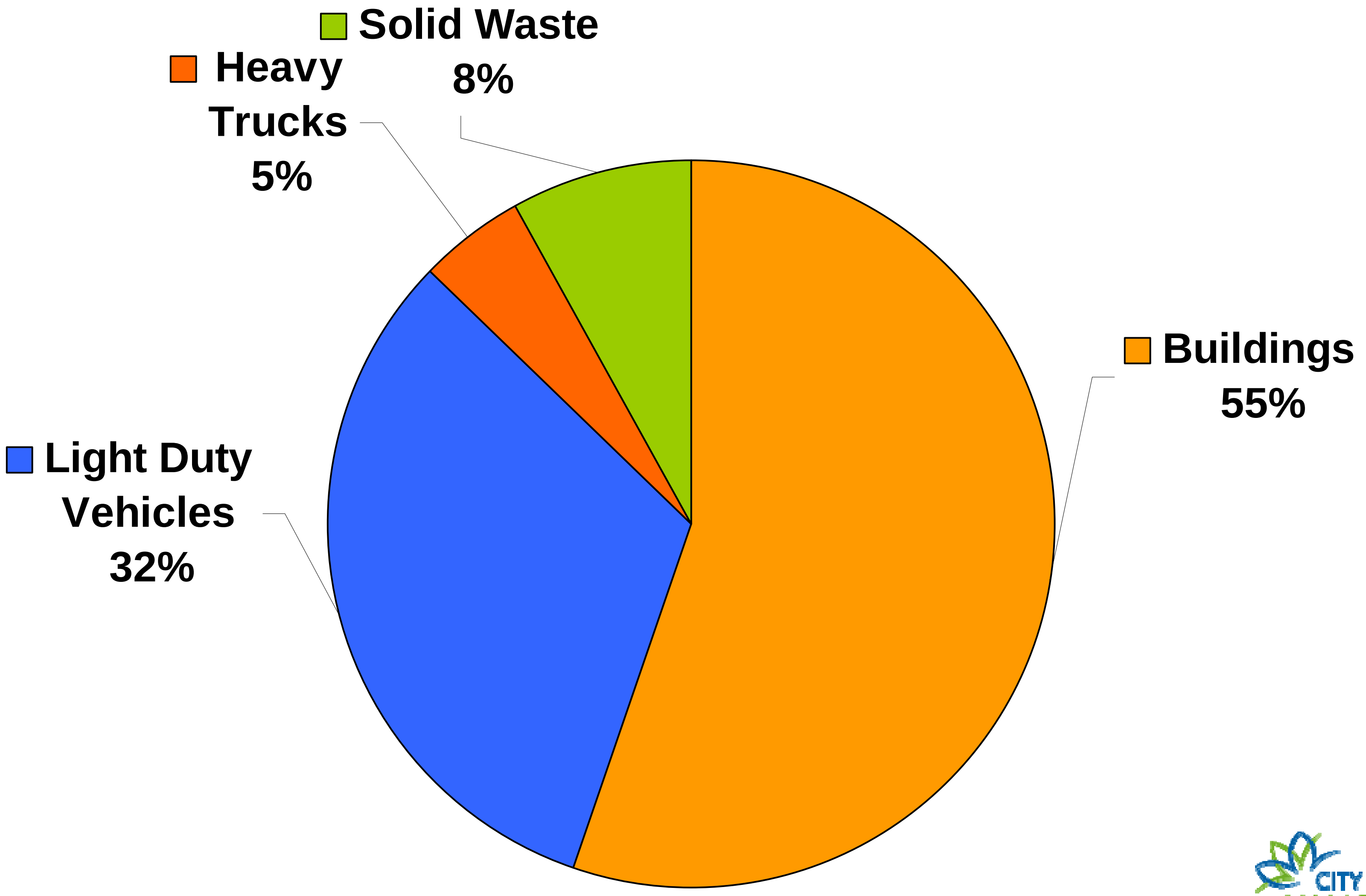
Vancouver's GHG Imperative: Annual Community GHG Emissions and Targets

2010	Municipal operations emissions — reduce 20% (achieved)
2012	Carbon neutral municipal operations Reduce community emissions by 6% (on track to achieving)
2020	Reduce community emissions by 33% to 2007 levels
2030	All new buildings are carbon neutral
2050	Reduce community emissions by 80%

Vancouver's 2008 GHG Emissions



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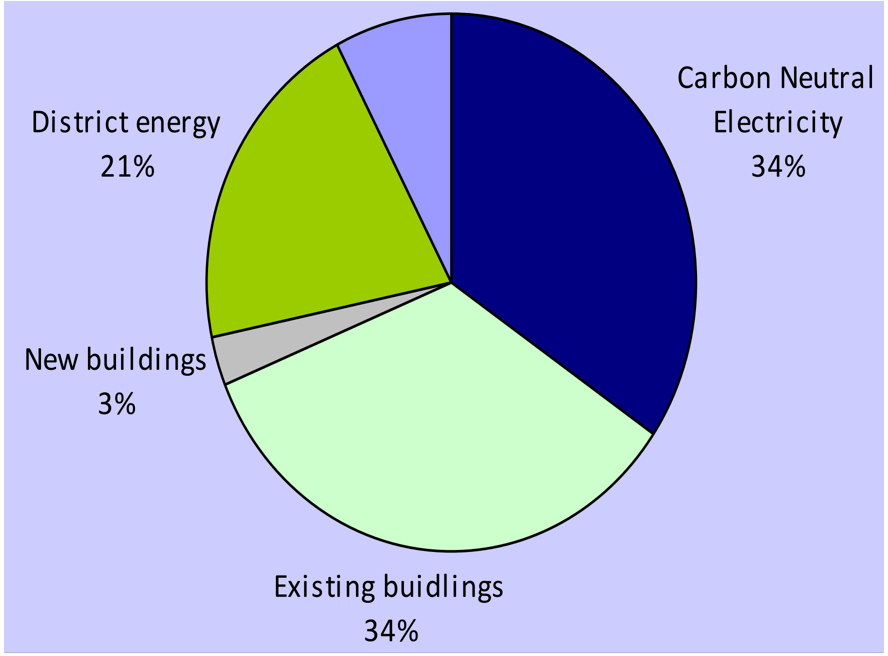
Target Areas of Emission Reductions for Buildings

- **Target:** 33% carbon reduction from 2007 levels by 2020. 55% of the reduction associated with energy use in buildings
- GHG reductions achieved in buildings as follows:
  - District Energy – 21%
  - Building Retrofits – 34%
  - Carbon Neutral Power – 34%
  - Large Emitters – 8%



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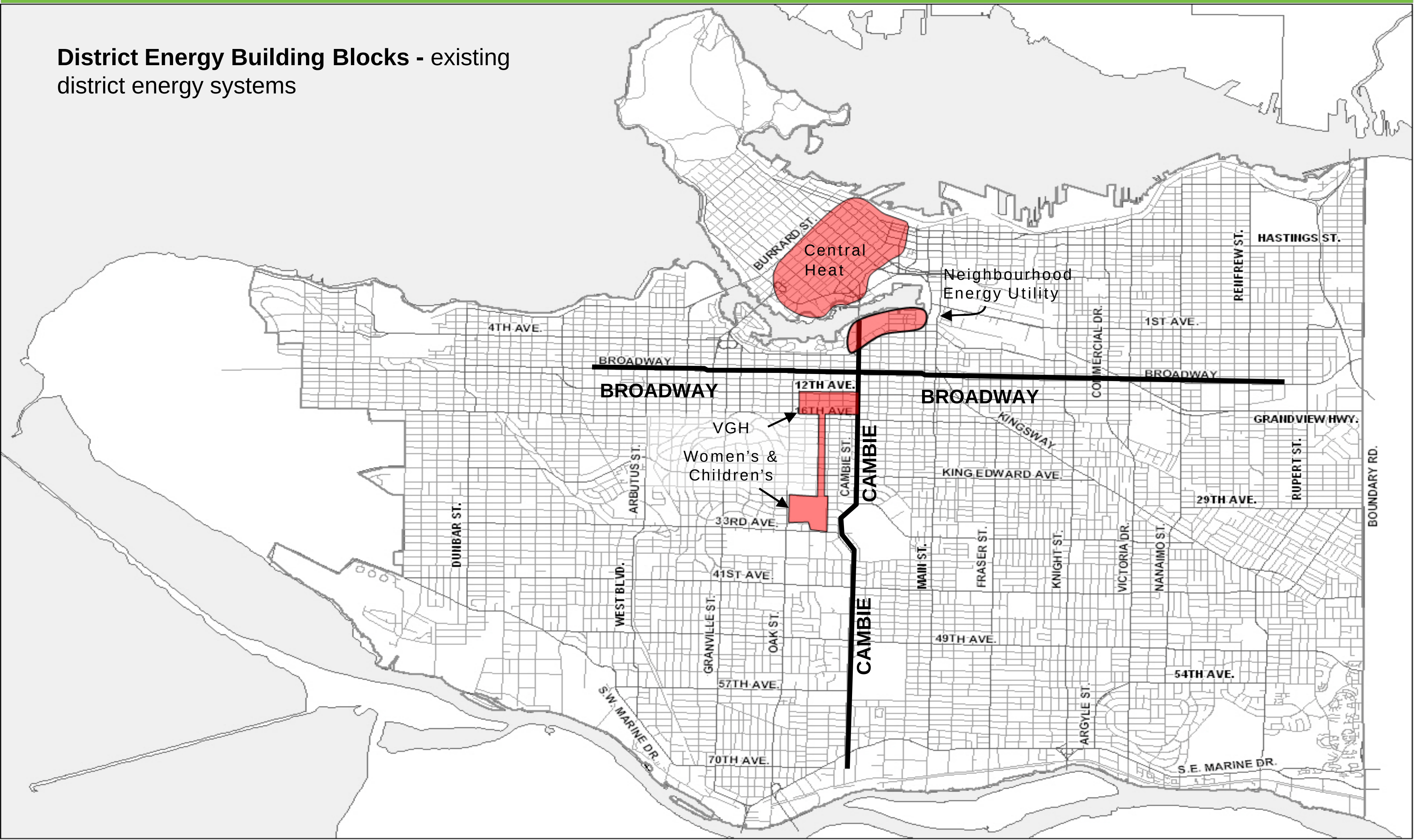
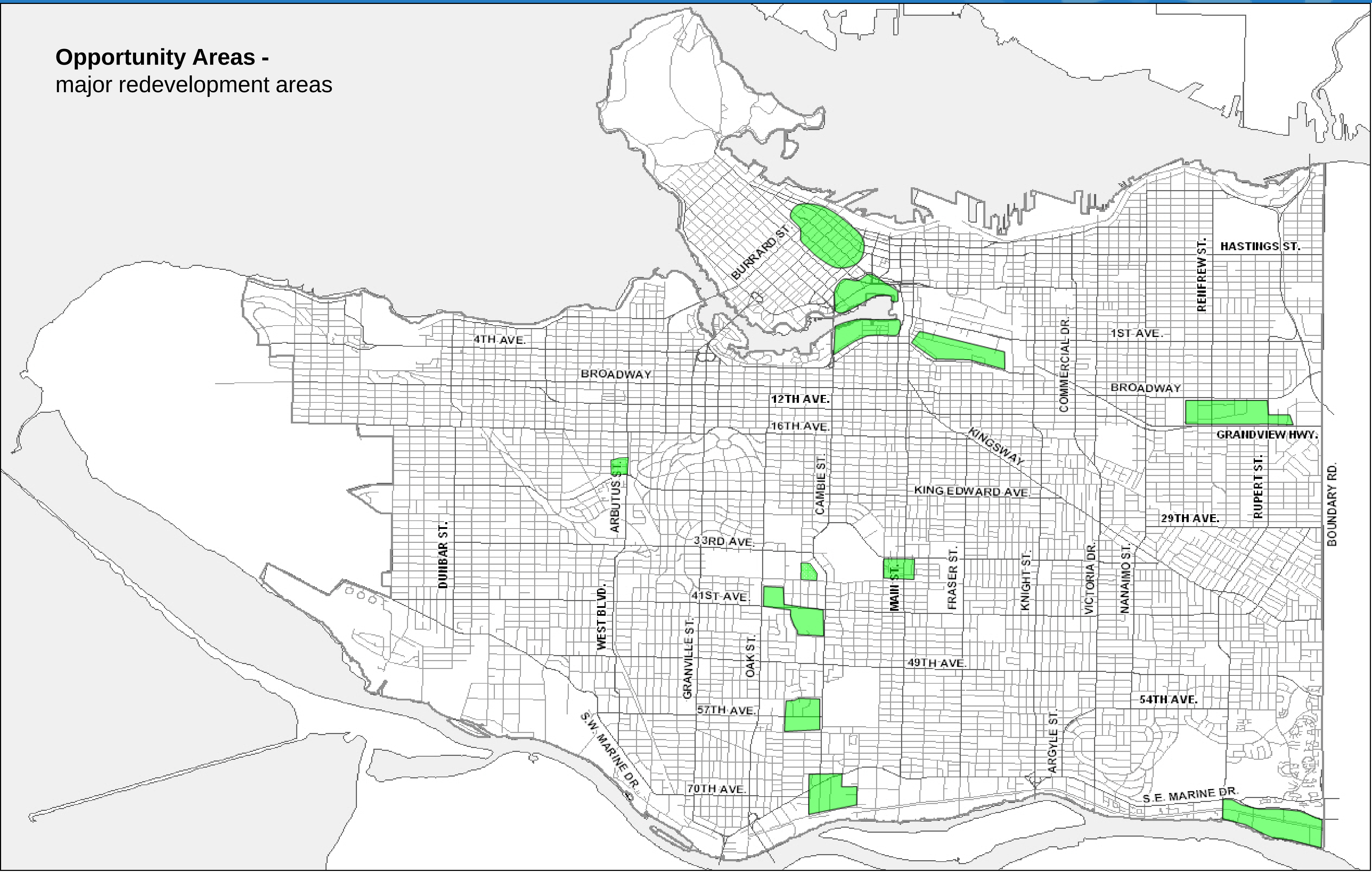
DE Expansion – Existing Systems

District Energy Building Blocks - existing district energy systems

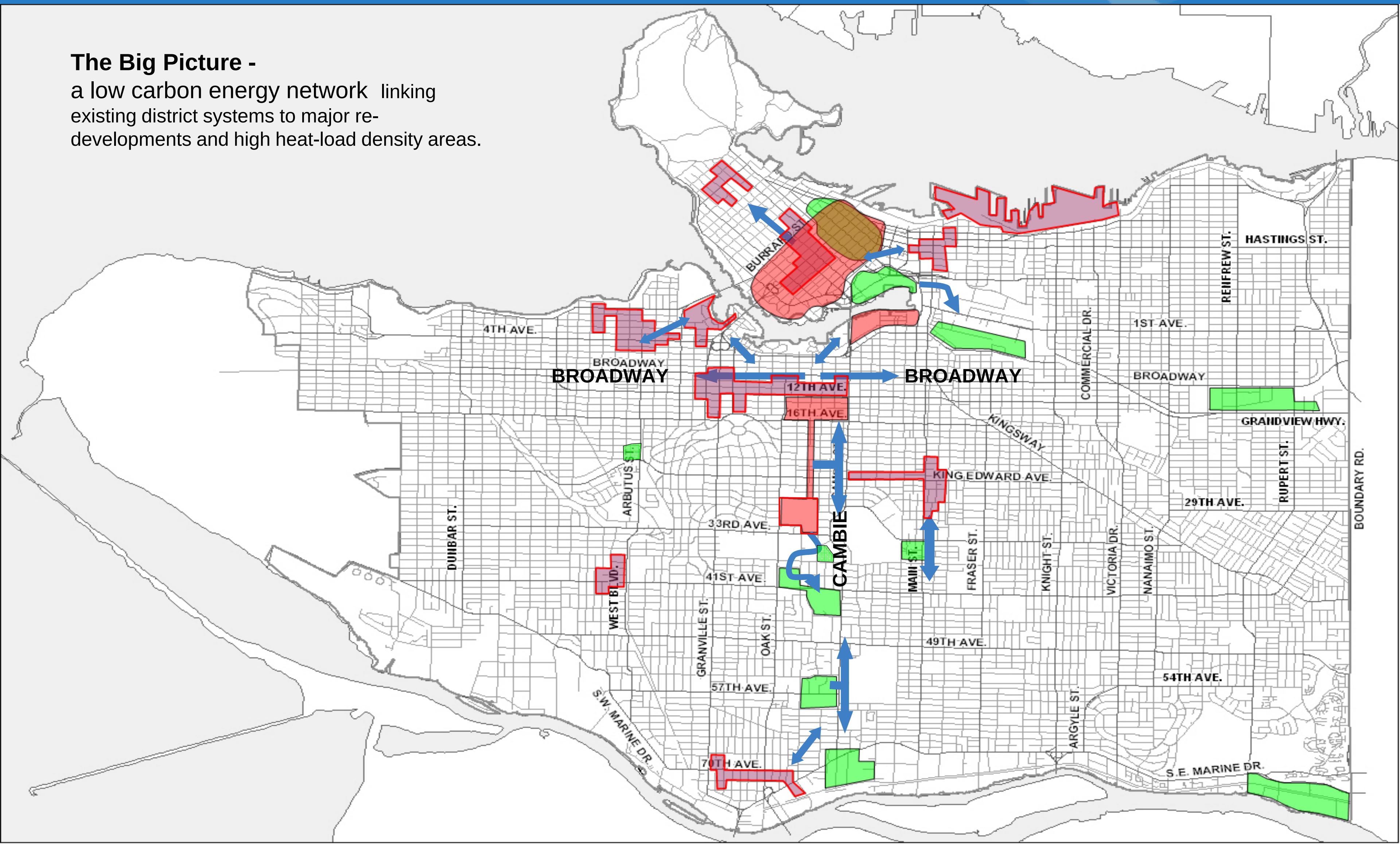


D.E. Expansion – Major Redevelopment Sites



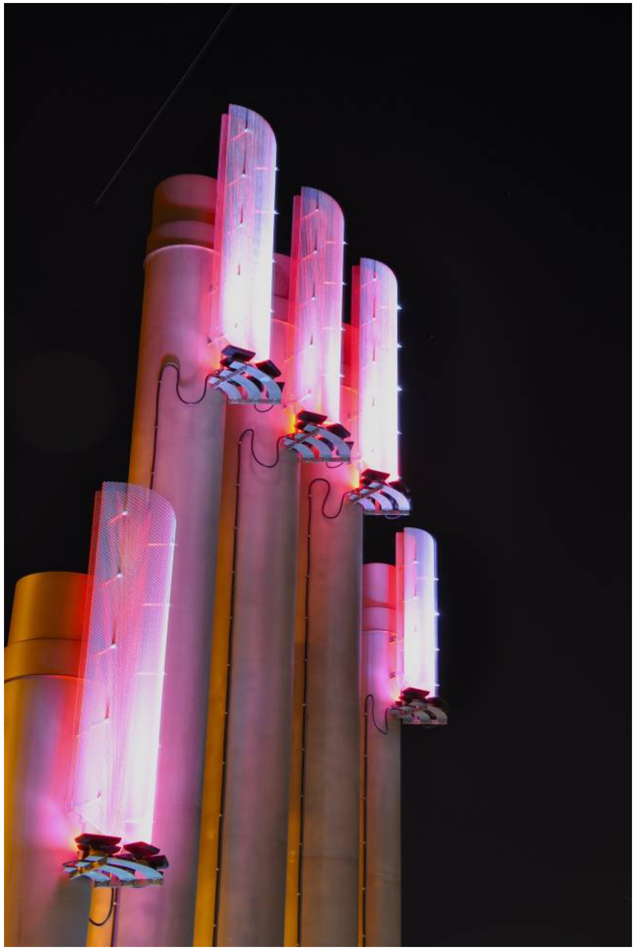
The Big Picture

The Big Picture -
a low carbon energy network linking existing district systems to major re-developments and high heat-load density areas.

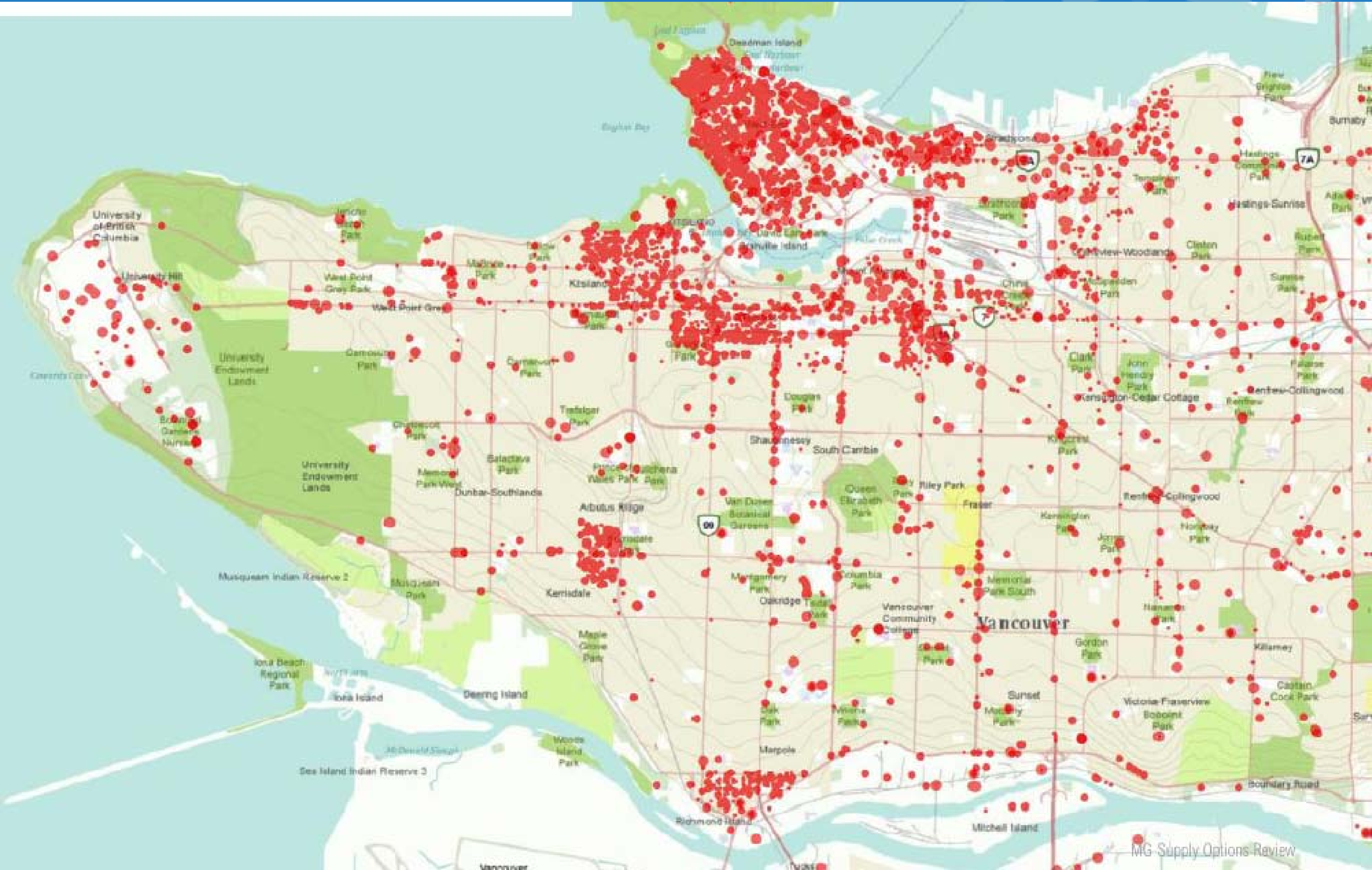


Identify Opportunities

- As a rezoning condition, any development site larger than 2 acres must complete a green energy supply pre-feasibility study
- Energy Opportunities Mapping – natural gas use, development sites and waste heat sources

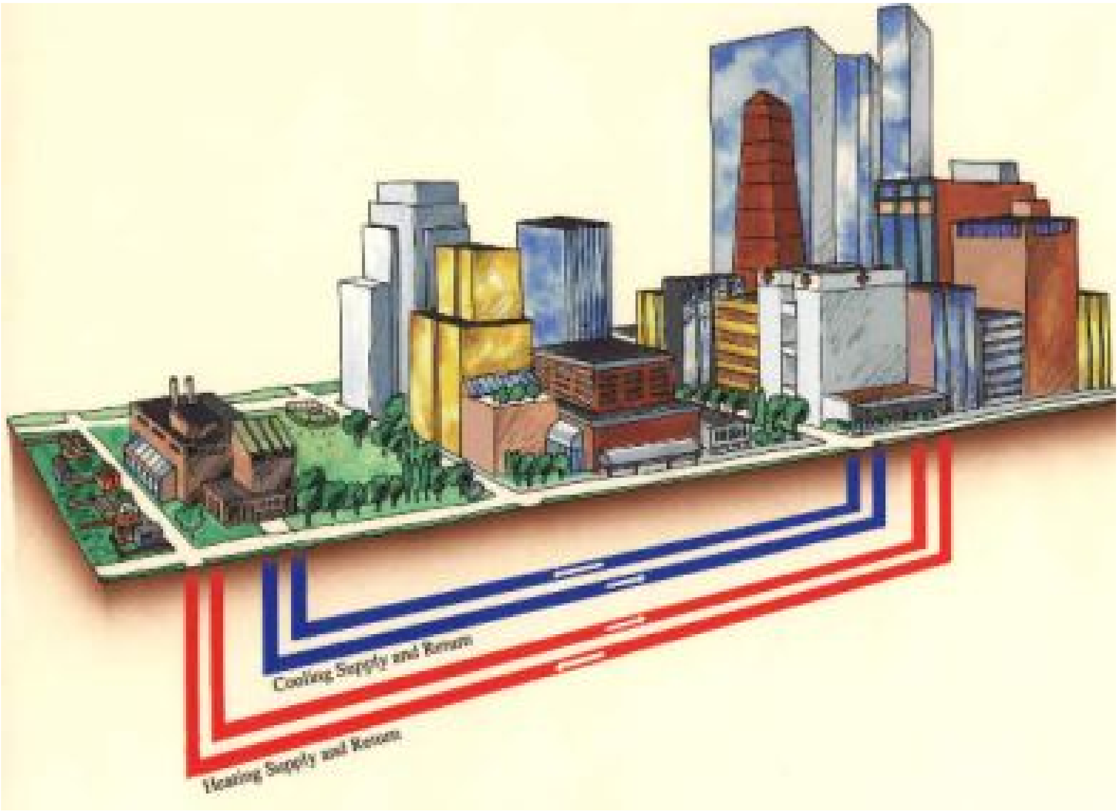


Opportunity Areas – D.E. Compatible Buildings



Develop Systems

1. City as developer of systems (e.g. SEFC)
2. City as facilitator to encourage development of systems by private sector



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Securing Uptake

- Mandate connection by bylaw (e.g. SEFC)
- Rezoning conditions to ensure new buildings are compatible with DE (e.g. Cambie Corridor)
- Rezoning conditions which make LEED Gold certification mandatory. Connection to DE becomes cost effective.
- Building code to be updated to ASHRAE 2010. Performance-based energy code which will discourage use of electric resistance heat
- Electricity price escalation

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Fuel Switching for Legacy Steam Systems

- Central Heat and institutional steam heat systems large carbon emitters – opportunity to use these to supply their customer buildings with renewable energy
- Work with system owners to facilitate transition to renewable energy supply
- Facilitate expansion of systems using low temp hot water

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Importance of Partnerships

- The City of Vancouver needs partnerships to achieve district energy GHG reductions. Our D.E. objectives align closely with interests of a number of stakeholder groups, which is helping us move quickly.

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Conclusion

- District Energy is a powerful tool for carbon reduction and energy security
- No additional cost to society, no behavior modifications necessary to achieve this
- Requires an integrated approach to land use planning and waste resource recovery
- Develop partnerships
- Learn from the experiences of others.

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Thank You!

Chris Baber
vancouver.ca/neu

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