Renewables-Based District Energy in Vancouver

Chris Baber, Neighbourhood Energy Utility Manager
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”)
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.
FALSE CREEK ENERGY CENTRE - How it works
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
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.
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

• 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
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
NEU Infrastructure - Heat Exchanger Cleaning System

Diagram showing the flow of heat through the system with control valves and sewage connection points.
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
• Local mechanical design professionals have limited hydronic and district energy experience.

• 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 😊
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
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
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
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
The Big Picture, District Energy

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

Fjärrvärme 1980

1980
Heat: 10 GWh
Power: 0 GWh
Biofuels: 0%

Kristianstad city
District Energy Growth

Fjärrvärme 1990

**Energy**
- Heat: 173 GWh
- Power: 0 GWh
- Biofuels: 8%

**Capacity**
- LPG boiler 2x10MW
- Biogas boiler 5 MW

27 km pipes
District Energy Growth

**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

**2006 total:**
- Heat: 333 GWh
- Power: 51 GWh
- Biofuels: 98%
- Pipes: 135 km

2x12 MW Biooil
1x19 MW Biooil
1x23 MW Biooil
Swedish District Energy Growth & Fuel Sources

- Heat pumps
- Waste heat etc.
- Electrical boilers
- Biofuels, peat, refuse, etc
- Energy coal including blast furnace gas
- Natural gas, including LPG
- Oil products

The graph shows the energy growth and fuel sources over the years, with specific emphasis on the increase in heat pumps, waste heat, and the declining trend in oil products and energy coal.
District Energy - Heat Source Options
Vancouver’s GHG Imperative: Annual Community GHG Emissions and Targets

- **2010**: Municipal operations emissions — reduce 20% (achieved)
- **2012**: Carbon neutral municipal operations
- **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

- **Buildings**: 55%
- **Light Duty Vehicles**: 32%
- **Heavy Trucks**: 5%
- **Solid Waste**: 8%

Total percentage: 100%
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%
DE Expansion - Existing Systems

District Energy Building Blocks - existing
district energy systems
D.E. Expansion - Major Redevelopment Sites

Opportunity Areas -
major redevelopment areas
The Big Picture - a low carbon energy network linking existing district systems to major redevelopments 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
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
Fuel Switching for Legacy Steam Systems

- Central Heat and institutional steam heat systems are 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.
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.
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.
Thank You!

Chris Baber
vancouver.ca/neu