Discussion Guide

Low Carbon Heating Options for Vancouver
A Round Table Dialogue with the City of Vancouver

SFU Centre for Dialogue
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The primary author for this discussion guide is Compass Resource Management. Shauna Sylvester and Sean Pander reviewed and edited the guide. We would like to thank Trent Berry, Todd McBride and Kayla Van Egdom for their contributions to the writing, copy-editing and formatting of this guide.

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INTRODUCTION

The City of Vancouver has set an aggressive goal to be the greenest city in the world by 2020. Significantly reducing greenhouse gas emissions and moving towards carbon neutral new buildings are key objectives in the Greenest City initiative. Natural gas used in buildings and industry account for nearly 50% of Vancouver’s greenhouse gas emissions. Much of this natural gas is used for space heating, domestic hot water and industrial process heat. The City wants to explore options for low carbon heating to inform the Greenest City 2020 Action Plan. Increased use of electric heating, specifically electric resistance heating, is often cited as a possible strategy for reaching this goal. In exploring this issue a number of questions emerge:

- How is heating currently provided in the City of Vancouver and what are the trends?
- What are the pros and cons of electric heat as a strategy for low carbon heating?
- What are alternatives to electric heat? And under what conditions could alternatives to electric heat be necessary or preferable?
- What role should the City and other organisations play in promoting low carbon heating and alternatives to electric resistance heating where available and preferable?

The focus of this guide is to stimulate discussion on the ways and means to significantly reduce the greenhouse gas emissions associated with heating in Vancouver by 2020. This discussion guide provides background on current sources of heat in Vancouver and their impact on Vancouver’s GHG emissions. It provides information on the costs and benefits of electric heat and some of the technological alternatives for reducing GHG emissions associated with heating existing and future buildings. In light of the goals set out by the City of Vancouver, and the strategies for achieving these goals, the use of biomass as a source of heating is discussed, along with a range of other renewable options.
CURRENT HEATING APPROACHES AND TRENDS IN VANCOUVER

Heating Accounts for Significant Portion of Vancouver’s GHG Emissions
Natural gas used in buildings and industry accounts for nearly 50% of Vancouver’s greenhouse gas emissions (Table 1). Much of this natural gas is used for space heating, domestic hot water (DHW), and industrial process heat.

Table 1: City of Vancouver GHG Emissions (tonnes/year)

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings - Natural Gas</td>
<td>1,410,000</td>
<td>1,370,000</td>
</tr>
<tr>
<td>Buildings - Electricity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Duty Vehicles</td>
<td>760,000</td>
<td>880,000</td>
</tr>
<tr>
<td>Heavy Duty Vehicles</td>
<td>85,000</td>
<td>125,000</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>380,000</td>
<td>220,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>2,735,000</td>
<td>2,740,000</td>
</tr>
</tbody>
</table>


The Amount and Type of Heating Varies Greatly Across Building Types and Processes
Building heating requirements vary greatly depending on building use and occupancy. Residential buildings typically have among the highest space heating and DHW requirements per unit of floor area. Amenities such as pools and fitness centres can further increase heating demands in residential buildings. Commercial buildings such as restaurants and laundries can also have high heating demands.

A recent study conducted of multi-unit residential buildings in Vancouver showed that space heating requirements varied greatly (between 40 and
120 kW.h/m2/year) and that here was no discernible trend in heating requirements based on building age. If anything, newer buildings looked to have slightly higher space heating demands (Figure 1).

**Figure 1: Space Heating Consumption in Multi-Unit Residential Buildings of Different Ages in Vancouver**

This chart illustrates how space heat consumption differs from building to building, as well as over time. Each point represents one building in the sample. The lower axis is the year the building was built and the left axis is the actual observed average heating requirement (end use) per square metre. Source: RDH Building Engineering Ltd. 2009. Energy Consumption and Conservation in Mid and High Rise Residential Buildings in British Columbia. Report #1: Energy Consumption and Trends. Prepared for CMHC, City of Vancouver, BC Hydro, Terasen Gas, and HPO.

According to Statistics Canada, in 2009 an estimated 30% of households in Greater Vancouver used steam or hot water (produced mainly with natural gas) as their principle source of space heat. Nearly 42% of households used gas-fired furnaces as their principle source of space heat, while the remaining 28% used electric heating. However, this breakdown in equipment type by household does not necessarily reflect the relative share of gas and electricity in overall building heat demands in the region. DHW, which represents a significant portion of total heat demands in the
region, is still most commonly supplied via natural gas-fired hot water boilers. Similarly, electric heat is more common in smaller units (townhomes and condos) which use proportionately less heating needs and make up a smaller share of total building stock. However, electric resistance heating is growing with the rapid increase in multi-family units in the region.

In multi-unit residential buildings with electric resistance heat, there is a common misperception that electricity supplies the majority of heating requirements. However, data on actual fuel consumption in these buildings suggests that 30 – 60% of the annual space heating requirement is still met with natural gas via gas-fired make-up air units that heat ventilation air. In addition, DHW, which typically comprises up to 30% of the total heating demands in residential buildings, is still commonly supplied via natural gas boilers even in buildings with electric resistance heating.

In addition to total heating demands, it is also important to consider the form of heat required in different applications. In new construction, it is possible to design buildings so that space heating needs can be met with relatively low supply temperatures, which can more easily be met with technologies such as geothermal heating. In older buildings, it is often necessary to supply heat at higher temperatures to maintain occupant comfort. Similarly, there are minimum supply temperatures for DHW to meet consumer expectations and health regulations to prevent the risks of Legionellosis. These higher temperatures may necessitate continued use of combustion technologies such as gas-fired boilers, either on their own or to top up heat from technologies such as geothermal.

Some Challenges with Vancouver’s 2020 GHG Reduction Targets
The City of Vancouver has a goal of becoming the greenest city in the world by 2020. In light of this, it has made a series of sustainability targets with different timelines. They are as follows:

- 2010 - Reduce municipal operations GHG emissions by 20% (achieved)

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1 Legionellosis is a potentially fatal form of pneumonia that has been linked to poorly maintained hot and cold water systems, air conditioners and hot tubs. Also known as Legionnaires’ Disease (severe form) or Pontiac Fever (mild form). Typically, standing water temperature needs to be above 60 deg. Celsius to prevent the development of Legionellosis.
- 2012 - Carbon neutral local government operations
- 2012 - Reduce community GHG emissions by 6% (on track to achieving)
- 2020 - Reduce community GHG emissions by 33%
- 2020 - All new buildings are carbon neutral
- 2050 - Reduce community GHG emissions by 80%

In order to reduce GHG emissions by 33% by 2020 and move towards carbon neutral new buildings, the City is investigating ways to reduce energy consumption while developing alternative ways to provide remaining heat and power requirements. The City of Vancouver expects envelope efficiency to improve as much as 25% over the next 10-20 years as a result of new financing tools, higher code requirements, improvements in construction industry practices, and better code enforcement. At the same time, there are other trends that could reduce some of the impact of envelope efficiency improvements, such as greater window area and increased efficiency of lighting and appliances (which can reduce internal heat gains). DHW consumption is also generally expected to decline as well due to water efficiency improvements and consumer education. However, there are limits to DHW reductions and other trends may counteract the effects of water efficiency (such as a trend to smaller household sizes).

Even if efficiency in new construction is improved dramatically, some growth in heating demands is still inevitable with growth in population and building stock. Heating demands in existing buildings may be reduced through retrofits but it is more difficult to reduce demands in existing building stock and most of the current stock will be in place for many years to come.

**Legacy Heating Systems**
Some commercial and industrial processes require higher supply temperatures for heating. For example, hospitals such as Vancouver General Hospital (VGH) and Children and Women’s Hospital (C&W) require steam for sterilization. Given their need for steam in sterilization processes, these hospitals were constructed to produce and distribute steam from a central plant to meet all of their heating and process
requirements, not just sterilization. Although it is now possible to meet sterilization needs through small-scale steam plants or chemical means, these hospitals have large legacy steam systems that will be costly and time consuming to convert to hot water. And if they were converted, the required supply temperatures for older buildings would continue to necessitate combustion technologies for some time.

Another example of a legacy steam system is Central Heat in downtown Vancouver. Central Heat was formed over 40 years ago to reduce heating costs and address air quality concerns associated with typical heating systems at the time. Today, Central Heat serves about 180 buildings in downtown Vancouver via a 10.5 km network of high-pressure steam distribution lines fed by natural gas boilers at its central heating plant. Again, it would be a costly and long process to convert this network to hot water to accommodate lower grade energy sources. Furthermore, even if these systems were converted to hot water they would still need to operate at higher temperatures to serve the older buildings connected to these systems.

Together, these three legacy steam systems alone – Central Heat, Vancouver General Hospital and Children and Women’s Hospital – account for nearly 10% of the existing GHG emissions from building-related natural gas use in the City of Vancouver. There are also other industrial needs within the City that will continue to require higher supply temperatures provided through some form of combustion technology.
**PROS AND CONS OF ELECTRIC HEAT**

Electric heat is often viewed as a cost-effective and environmentally friendly form of heat. However, as noted in the previous sections, there are some technical limits to the magnitude of total heating needs in Vancouver that could be met with electricity, even if this option was were cost-effective and environmentally desirable. There are also other potential issues to relying solely on electric heat for meeting Vancouver’s ambitious GHG reduction and greenest city goals.

In a discussion of electric heat, it is first important to make the distinction between electric resistant heating and heat pumps. While both use electricity, their efficiency is drastically different.

**Electric resistance heating** is currently the most common form of electric heating in Vancouver. Electric resistance heating involves passing electricity through a coil, wire or other obstacle to create heat. This process is 100% efficient in terms of converting electricity into heat. That is, for every unit of electricity input, one unit of heat is produced. This type of heating can be found in electric baseboard heating, electric furnaces and even the household toaster.

**Electric heat pumps** operate on a different premise. In an electric heat pump, electricity powers a compressor that draws in the heat from an outside source (the air, the ground, or a sewer system), and transfers this heat to the inside of a building. These heat pumps can be up to 400% efficient, meaning that every unit of input electricity can create up to 4 units of heat. Quite simply, this means that electric heat pumps can provide more heat with less electricity. However, the heat pump requires an outside source of energy.

There are also technical limits to the maximum output temperature of heat pumps, and their efficiency varies with both the temperature of the outside source of energy and the required output temperature of the heat pump.

Electric resistance heating is the cheapest (in terms of first costs) and most versatile form of electric heat. Heat pumps are more expensive and have a more limited range of heating applications, but they are also more efficient. Heat pumps can also supply both heating and cooling needs. In cooling
mode, the heat pump is basically operated in reverse, transferring heat from the space or water being cooled to a lower temperature heat sink such as the ground or air. For higher temperature heating demand (e.g., space heating in older buildings, DHW, steam systems, and many industrial process requirements) heat pumps may be limited to pre-heating. That is, they can be used to reduce but not completely eliminate the need for other sources of heat (primarily combustion) to meet the higher temperature needs of an application.

There are several possible issues with the increased use of electric heat, and particularly electric resistance heating in Vancouver.

**Costs of Electricity**

Electric resistance heating is often preferred by developers because of lower upfront (construction) costs. Historically, electricity costs have been low and relatively stable. As a result, lifecycle costs (capital and operating costs) for electric heat have been relatively low. However, electricity prices in B.C. have been rising rapidly and are expected to continue increasing.

Recent and projected increases in electricity rates are due to the need to renew, upgrade and expand B.C.’s electricity system. Many existing hydroelectric and transmission facilities in B.C. were built 40 – 50 years ago and must be renewed. Some of these facilities must also be upgraded to reflect more stringent seismic and environmental performance expectations. *Demand for electricity in B.C. is also growing*, requiring expansion of generating and transmission assets. *New generation is more expensive than historical generation.* This is due in part to the fact that we have already developed some of the largest, most accessible and cheapest hydroelectric sites in the province. It also reflects higher social and environmental constraints on new generation developments, including GHG requirements.

As a result, BC Hydro has moved towards the implementation of a stepped rate structure. Step 2 is intended to reflect the Long-Run Marginal Cost (LRMC) of new electricity in BC. This is the true opportunity cost of meeting new electricity demand. Consumers pay Step 2 rate on any consumption that exceeds a specified threshold in each billing period. As demand increases, BC Hydro intends to phase in rate increases until Step 2 reaches
the LRMC. As shown in Figure 2, average rates (blended of Step 1 and Step 2) are set to increase as much as 50% in the next six or seven years. This is over and above rapid increases that have already occurred in the past few years.

**Figure 2: Projected Electricity Rates in B.C**

![Projected Electricity Rates in B.C](image)

While only a small portion of total bills would be at Tier 2 rates, it is interesting to note that because of its seasonal nature, electric heat is most likely to push consumers into Tier 2 consumption and so from this perspective a relatively higher portion of electricity used for heating would be at Tier 2 rates. Figure 3 provides an illustrative example of modeled electricity consumption for a new mid-sized, electrically heated condominium in the Lower Mainland. As can be seen, space heating is seasonal in nature while other electricity uses are relatively flat. In this example, all Tier 2 consumption can be attributed to electric heat.
Developers are most focused on first costs. From a consumer and societal perspective, however, lifecycle costs (capital and ongoing operating costs) are more important. One market issue is whether the rising lifecycle costs of electricity are being factored adequately into building design and capital cost decisions by developers.

**Other Growing Demands for Electricity**
Another issue when considering the role of electric heat in meeting the Province’s GHG reduction goals and Vancouver’s greenest city goals is the demand for electricity to address other economic and environmental goals. Electricity, however it is generated, represents very high-grade energy and it is the only source of energy for many devices such as computers, lighting and electronics. It is also very easy to convert into other forms of energy. For example, electricity can be transformed into kinetic energy to power a car or a bus – another of Vancouver’s key strategies to reach its GHG reduction goals. There are other sources of low-grade energies that can be most efficiently used for heating than for powering computers or electric vehicles.
In theory, we could meet more energy demands with electricity. But this decision needs to consider practical constraints and other environmental and social impacts of electricity generation.

Figure 4 illustrates existing electricity demands in B.C. relative to potential incremental demands. By 2021, BC Hydro expects electricity demand to grow more than 15% from growth in core electricity loads (appliances, lighting, electronics, industry, etc.) alone, before conservation efforts (Demand Side Management).

Figure 4 also shows the additional electricity supply that would be required under a scenario to electrify all existing light duty vehicle trips in B.C. (before accounting for any growth in vehicles and trips) and all existing space and DHW heating not already met with electricity in B.C. in 2020 (only about 20% of total space and DHW in the province are currently met with electricity).

Meeting core growth, existing light duty vehicle energy use and all existing space and DHW heating requirements in the next 10 years would require a 75% increase in electricity generation in B.C. Admittedly, it is unlikely that all space heating and vehicles would be converted to electric in the next 10 years. But it does raise an important point. A key question is what are the needs that should be met first with electricity, (taking into account the impacts of electricity demand and other available alternatives)?
Figure 4: Current BC Hydro Electricity Demand and Potential Future Demands

Source: 2008 BC Hydro LTAP Evidentiary Update, December 2010

Environmental Profile of Electricity

Electricity is often viewed as an environmentally friendly and GHG free source of heating. There is no question that electricity in B.C. has lower GHG emissions than many other fuels. This is due to the large share of hydroelectric generation in B.C. However, B.C. also has some thermal sources of generation and must continue to add new sources of electricity to meet growth. In Province’s latest Energy Plan, BC Hydro must avoid or offset GHG emissions from all existing or new generation. As long as this policy remains in place, electricity in B.C. could be considered GHG neutral.

That being said, BC plays an important role in the larger regional power grid and is currently a net importer of energy from jurisdictions highly
dependent upon fossil fuel based generation. If BC can become a net importer of clean energy (by limiting new demand and developing new clean sources) it could play a significant role in substantial GHG reductions in nearby provinces and states.

Another key benefit of electric heating is the lack of local air emissions. However, this ignores upstream environmental impacts of electricity generation. Nearly 90% of the electricity consumed in the Lower Mainland is imported from other regions of the province. In the case of thermal sources (gas and biomass generation), these regions bear the brunt of local air emissions associated with producing electricity. In addition, virtually all sources of electricity have some form of environmental impacts. Hydroelectric facilities impact fish and wildlife habitat. They can also affect recreation and navigation. Although less of an issue in colder climates, GHGs such as carbon dioxide and methane are also produced as the organic matter in flooded valleys decomposes. Wind is also not without controversy: developing new access roads and transmission corridors will impact the land and wildlife; and wind farms themselves have some noise, visual and wildlife impacts. There are also potential upstream GHG emissions associated with the manufacture and construction of all types of electricity generation plants that are more complex and often overlooked in the comparison of alternatives.

Ultimately these upstream impacts may be found acceptable relative to the impact of other energy alternatives, but they should not be ignored when weighing and selecting among alternatives.
Alternatives to Electric Heating

Given some of the potential issues associated with using electricity for heating to meet GHG reduction and greenest City goals, what are possible alternatives to electricity heat?

Low Grade Heat
As discussed above, electric heat pumps represent a more efficient form of electric heating than conventional electric resistance heating. Heat pumps can be used to extract heat from many low-grade energy sources including geothermal sources, sewer systems, low-grade waste heat from industrial or cooling processes and even the air. For these low-grade energy resources some electricity input is required in order to raise temperatures to a useful level. As such, these resources do not fully displace electricity, but they may reduce our reliance on precious electricity resources.

Electric heat pumps are also useful due to their flexibility. A variety of different heat sources can be used, and in buildings where cooling is necessary, heat pumps can be used to supply cooling. This allows heat pumps to be tailored to the resources available, from industrial waste heat, to sewage waste heat, to geothermal heat.

Geothermal power (also known as geoxchange or GX) has a great deal of technical potential for heating in British Columbia. It requires a heat pump to transfer heat from the ground or a water body. The use of geothermal power is an excellent example of putting local resources to use. However, there is a wide range of implementation issues. It requires either access to adequate space for bore holes (in the case of a closed-loop system) or an accessible aquifer with adequate water flows (in the case of an open-loop system). Adequate space is a challenge in high-density applications and there are potential impacts on water tables and water quality from open loop systems. Compared to other areas of the province, geothermal is also
a more expensive heating approach in Vancouver due to the high capital costs relative to annual heating and lower cooling needs in Vancouver.

Sewers are also a viable source of heat for heat pump systems. There are two main approaches for recovering sewer heat – one in which sewage flows are diverted directly to a heat pump, and the other in which heat exchangers are installed in a sewer main and the heat transferred via a separate water loop to heat pumps. Sewers typically have higher temperatures than the ground, making them a more efficient source of heating. But temperatures vary over the year and depend on the type of sewer (e.g., combined vs. sanitary mains). Viability and cost is very site specific. A nearby sewer with adequate minimum sewer flows is required, and there are potential interactions between upstream and downstream sewer heat recovery systems that must also be accounted for in planning. As with other systems there can be considerable economies of scale with sewer heat (larger systems will often have lower unit costs). The Neighbourhood Energy Utility supplying the Southeast False Creek neighbourhood of Vancouver is an example of a large-scale sewer heat recovery project. There are also potential small-scale applications but these have not yet been implemented in Vancouver.

Industrial and commercial waste heat (e.g., from an industrial process and/or large-scale cooling operation such as an ice rink) is another potential source of heat for other residential and commercial uses. Low grade heat would require a heat pump to boost the supply temperature to a viable temperature for heating. Implementation must also consider the profile of waste heat supply relative to heating demands, and there are often concerns about the long-term persistence of waste heat from industrial and commercial sources which could close or relocate.

**High Grade Heat**

As noted previously, not all heating needs can be met with heat pumps. Higher grade energy sources, often involving some form of combustion, will continue to be required.

Some industrial waste heat (from combustion processes) is already at a temperature that does not require boosting with a heat pump. Industries such as oil refining, steel making and cogeneration plants create a great deal of high grade waste heat. This high-grade waste heat can be recovered
and used to provide heating without any additional heat pumps. A good example of this is the East Fraser Lands Development in south east Vancouver, which is expecting to capture waste heat from an existing waste-to-energy plant in Burnaby for use in a local district energy system for the neighbourhood.

Metro Vancouver, along with other cities all over the world, is considering ways to dispose of residual municipal wastes after recycling and composting programs. Expansion of **waste-to-energy** is one option under consideration by Metro. Such systems can be used to produce heat and electricity. Heat recovery is required to maximize resource recovery due to technical limits of electricity production. But these plants must often be of a large scale for efficient, safe and cost-effective energy recovery. They are best suited to supply a district energy system. No decisions have been made with respect to additional waste-to-energy plants in the Lower Mainland but Vancouver City Council has formally opposed developing new waste-to-energy facilities to deal with “residuals” in the municipal solid waste stream.

**Solar thermal hot water systems**, which convert solar radiation to hot water via a glazed or evacuated tubing collector, typically on a rooftop, presents a strategy to harness the power of the sun for heating. The heat produced by solar thermal is typically of an adequate temperature to meet space and DHW needs without the use of heat pumps or additional combustion. It is not suitable for many industrial and legacy heating systems. While it may play a role, there are other technical limits to solar thermal heat due to space requirements, the amount and seasonality of solar resources in Vancouver and system costs. In a single family residential home, it may be technically possible to supply as much as 50% of annual hot water needs on site from solar thermal. In a new high density residential development, it would be difficult to supply more than 10% of annual heating needs from solar thermal. Cost is also an important consideration. Because of the seasonal and uncertain nature of solar heat, considerable conventional seasonal peaking and back-up heating systems are still required, adding to costs.

**Bioenergy** is a large category and encompasses several fuel sources including:
- Wood waste from local industrial and commercial operations that currently goes to landfill (e.g., sawmill wastes, wood pallets from the shipping industry, etc.)
- Clean demolition and land clearing waste
- Trimmings from parks and landscape maintenance
- Food wastes
- Agricultural wastes, including crop, poultry and livestock wastes
- Imported bioenergy such as pellets and fuels

Bioenergy represents a significant resource for heating, particularly in BC. According to a report published by BIOCAP Canada in 2006, bioenergy has the potential to provide close to half of the Province’s annual energy consumption of 920 PJ. Sustainable forest biomass represents more than half of the total available biomass feedstock. This is particularly relevant considering the quantity of mountain pine beetle wood available for harvest, which represents a significant resource that has great energy potential and few other uses.

In addition, there are many technologies for converting biofuels to useful energy. These include direct combustion, anaerobic digestion and gasification followed by combustion, and liquefaction (biodiesel and ethanol) followed by combustion.

Examples of the use of biomass for heating in BC include the Dockside Green development in Victoria and the Revelstoke Community Energy Corporation. There are also many existing large commercial and industrial biomass heating systems in the Lower Mainland.

Biomass resources in BC provide a significant opportunity for developing clean energy technologies. Particularly with regard to heating, they also provide an opportunity to allow the already strained electric resources of the province with some relief from overwhelming demand. But there are also important concerns associated with bioenergy-based heating systems, including the sustainability of bioenergy resources, the location of bioenergy sources (long transportation distances reduce economic viability), local air quality considerations and other potential aesthetic considerations. Table 2 summarizes some of the most significant categories of potential high grade heat sources, and some of the pros and cons associated with each.
### Table 2: Examples of Significant Sources of High Grade Heat

<table>
<thead>
<tr>
<th>Source</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial waste heat</td>
<td>- No requirement for heat pump&lt;br&gt;- Often goes unused&lt;br&gt;- Potentially cost competitive with conventional heating in the right applications</td>
<td>- Must be located near end user&lt;br&gt;- Not always at adequate temperatures for every heating application&lt;br&gt;- Concerns about long-term supply (closures and relocations)&lt;br&gt;- Production profile may not match heating demand profile</td>
</tr>
<tr>
<td>Natural gas</td>
<td>- Highly versatile in terms of applications (size, form of heating requirements, etc.)&lt;br&gt;- Relative low local air emissions</td>
<td>- GHG emissions&lt;br&gt;- Non-renewable&lt;br&gt;- Imported fuel</td>
</tr>
<tr>
<td>Municipal Solid Waste (Excluding Clean Wood Waste and Food Waste)</td>
<td>- Divert waste from less desirable disposal methods</td>
<td>- Potential toxic air emissions&lt;br&gt;- Potential competition with other productive uses (recycling)&lt;br&gt;- Scale required for efficient, safe and cost-effective plants</td>
</tr>
<tr>
<td>Solar Thermal</td>
<td>- GHG neutral&lt;br&gt;- No direct local air emissions</td>
<td>- Suitable for space heating and DHW; limited industrial process applications&lt;br&gt;- Expense&lt;br&gt;- Seasonal profile of supply relative to demands (technical limits to percentage of heating that can be met with solar thermal)&lt;br&gt;- Space requirements (in high density neighbourhoods)</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>- Significant local fuel source&lt;br&gt;- Potentially renewable resource&lt;br&gt;- GHG neutral potentially cost competitive with conventional heating&lt;br&gt;- Local economic development with BC-based supply and technology providers</td>
<td>- Potential local air emissions&lt;br&gt;- Potential space, siting and access issues&lt;br&gt;- Long-term sustainability of supply</td>
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**District Energy**

No single resource can meet all of our heating needs, either because of siting or sizing constraints or the unique requirements of individuals. Some resources may require district energy systems to achieve sufficient scale and/or to access off-site resources.

District energy is a flexible platform for meeting heating requirements in a dense urban setting. District energy can rely on multiple sources of energy, which may also change over time.

District energy involves centralization of all or part of the heating system within a particular area. Vancouver already has four notable examples of district energy systems. Central Heat serves about 180 buildings in downtown Vancouver via a 10.5 km network of high-pressure steam distribution lines fed by natural gas boilers at its central heating plant at Beatty and Georgia Streets. Both VGH and Children & Women’s Hospitals are large complexes served by central steam plants. More recently, the City created a Neighbourhood Energy Utility to serve the former Olympic Village and surrounding lands in Southeast False Creek in part from heat recovered from passing through a local sewer pump station. The City and developers are actively exploring implementation of district energy in other areas of the City.

With the right application, district energy offers the following potential value propositions:

- A district energy utility can make the large-scale deployment of low carbon heating cost competitive with conventional approaches by lowering energy source costs and amortizing the higher technology costs over a longer period of time.
- District energy can access energy sources that may not be available at the scale of individual building sites (e.g., large open spaces for siting Geo-exchange wells or optimal locations for recovering heat from sewers).
- District energy can provide sufficient scale to make alternative energy sources more viable or affordable.
• District energy provides greater opportunities to integrate different sources of energy into a single system and to size individual systems more optimally.
• District energy allows rationalization and better utilization of heating capacity. Professional management allows optimal maintenance to ensure ongoing efficiency and environmental performance.
• District energy allows pooling of capital and risks for more expensive alternative energy systems across a larger number of consumers.
• District energy provides a flexible platform for adopting new technologies and fuels over time.
POTENTIAL ROLES IN PROMOTING ALTERNATIVE HEATING SOURCES

Given the contribution of heating needs to Vancouver’s GHG emissions, the expected growth in heating demands in Vancouver, the ongoing requirement for high-grade heat sources in certain applications, including large legacy heating systems within the city, and the mix of alternatives that will be required to achieve the City’s aggressive GHG targets as part of the Greenest City plan, what should we be doing to promote cost-effective and acceptable alternative heating options?

The following represents a short list of possible strategies for the City to pursue in encouraging the shift towards low carbon heating. It is by no means exhaustive, but is simply intended to elicit discussion on the topic.

- Partner with private sector to undertake research and mapping of renewable energy opportunities (waste heat such as large sewer lines and pump stations, effectiveness/limits of aquatic based heat pumps, business case for distributed solar utility, ground source conditions for effective GSHP, biomass availability and impacts, etc)

- Use large site re-zonings to require district energy connectivity and possibly the development of district energy systems where economically viable to achieve economies of scale and take better advantage of off-site heat sources in existing and new construction.

- Use the building code to require escalating amounts of renewable heat energy in new (or even existing) building development to foster market adoption of cost effective renewable energy solutions.

- Develop financing tools such as using the property tax system to amortize and collect payments for the incremental cost of renewable technologies to deal with market barriers and biases against systems with higher capital costs.

- Implement differential solid waste tipping fees, landfill bans and deconstruction regulations to maximize diversion of organics from landfill so they can be used beneficially.
Some of these tools available to the City may have universal application. Others may be targeted to specific neighbourhoods or types of development.

In order to be successful, the GHG reduction strategy for Vancouver will need to reflect the diversity of heating applications and heat sources. It will also require substantial leadership outside of local government and clearer roles/opportunities need to be identified for utilities, developers, technology providers, educational institutions, non-profits, and businesses.
CONCLUSION

The purpose of this document is to provide workshop participants with a starting point for our discussions on February 23, 2011. The information provided here is not intended to be a comprehensive, authoritative report on carbon neutral heat energy options. Instead, it is designed to trigger you to ask questions, consider options, and develop your own views on how best to work towards effective actions to meet the City of Vancouver’s carbon neutral strategy by 2020.

This is a very complex, multi-layered issue with many stakeholders and interest groups. Some questions for you to consider as you prepare for the workshop:

Should Vancouver ban or restrict the use of electric resistance heat?

Under what conditions should Vancouver allow or encourage electric heat pumps?

How should Vancouver best meet the needs for higher grade heating requirements in older heating systems and industrial processes considering both GHG reduction and greenest City goals?

How can Vancouver best understand and mitigate any residual environmental concerns associated with non-electric forms of heating such as local air emissions from bioenergy?

How can you play a leadership role in the transition to low carbon heating in Vancouver?
APPENDIX

ACRONYMS

C&W: Children's & Women's Hospital
DWH: Domestic Hot Water
GHG: Greenhouse Gas
GX: Geexchange or Ground Source Heat Pumps
kW.h: Kilowatt Hours
LRMC: Long-Run Marginal Cost
MSW: Municipal Solid Waste
PJ: Petajoules
VGH: Vancouver General Hospital

RESOURCES

http://www.bchydro.com/about/company_information/reports/gri_index/f2009_environmental_EN16_2.html
http://www.energyplan.gov.bc.ca/bioenergy/PDF/BioenergyInfoGuide.pdf