Appendix 1 – First workshop notes

Date: 10.30am – 3.30pm. Thursday October 8, 2009

Location: Salloum Rehearsal Hall, Rotary Centre for the Arts, 421 Cawston Avenue, Kelowna

Attendees: City staff, technical experts, local stakeholders

Purpose: Assess initial feasibility of district energy, and identification of best potential projects. Consider how to make district energy in everybody's best interests. Some consideration also of distributed energy options for new low density construction.

District energy

Overview

- District energy (DE) is a heating system that provides heat and/or cooling to more than one building. There are many benefits to a district energy system, mainly reduced greenhouse gas emissions and enhanced community energy security. The Canadian District Energy Association has many resources on district energy, available at: www.cdea.ca/.
- In Kelowna the most likely opportunities to supply energy to a district energy system will be waste heat recovery (from a variety of sources), and geoexchange.
- District energy systems tend to follow two broad concepts:
    - The equipment for the district energy system is **centralized**, distributing a "finished" energy source to buildings within a specific area, such as medium temperature hot water or chilled water. This type of system is the most common.
    - Another approach is to **decentralize** some equipment, distributing low temperature hot water (e.g. heat pumps and supplemental heating equipment for space heating and domestic hot water). These systems are less common, but gaining exposure in recent years.
- The four areas being considered for district energy in Kelowna are those which are designated as urban centres in the OCP: the City Centre, South Pandosy (including the hospital), Orchard Park / Highway Centre, and Rutland.

Policy – considerations for all 4 areas

- The Official Community Plan (OCP) already has draft language that is supportive of district energy overall, but this must go through the public and political process.

- The OCP is not the right tool to identify individual areas as district energy zones, but another mechanism would be needed to do this, e.g. Local Service Area bylaws. Once a district energy zone has been estlished, with its own Local Service Bylaw, any subsequent amendment to the bylaw would require a 2-3 month process, assuming you have all the information you need already in place.

- Establishing a Development Permit (DP) area is another possible tool, with partial mandatory provisions. It could include existing buildings (that meet certain criteria) and new buildings.

- A district energy DP area will not necessarily correlate exactly with the areas designated as urban centres in the OCP. If the DP areas need to be amended over time (e.g. to assist possible expansion of a district energy system), Kelowna's DP Procedures Bylaw process can ask for any information, and can go to the public, taking up to one year.

- Kelowna has no Community Energy Plan. There is an overarching Community Carbon Plan that will go before Council soon, which might lead to more detailed carbon planning at a community level (i.e., a Community Energy & Emissions Plan). The City has an integrated approach to dealing with both carbon-reduction and energy efficiency.

- It would be beneficial to have the same entity owning both City Centre and South Pandosy district energy systems, since these two systems are in proximity and might be linked in the future. There could be a strong corridor of development that connects the two areas.

- There are some institutional barriers for Health and School Districts to connect to a district energy system.

- Each area needs a rough screening (i.e., a "prefeasibility" or an "energy & carbon management plan"), to help determine the energy loads and energy sources, and approximately where and how district energy in that area is likely to be technically and financially viable. The OCP creates the supportive language for the screening process, and the business case and engineering feasibility study would follow.

- Developers operating within proposed DE areas need guidance on hydronic heating systems for new buildings, or alternatively, the cooling systems needed to reduce the heat loads of significant industrial processes or large-scale data centres, in order to facilitate future connection to district energy systems.

- Heat sources can be interrupted. As such, in order to maximise energy security, district energy systems avoid being tied to just one energy source (e.g., Swedish district energy systems typically have 3-4 energy sources).

- The local development community needs to be aware of the opportunities offered by DE systems. Bringing developers together is important. Developers may need to be incented to connect their buildings to the district energy systems (e.g., density bonuses).

- New buildings should be as energy efficient as possible, thus reducing the space heating / cooling requirements within each building. (This can be taken to a point where a district energy connection is no longer necessary or financially viable.)

- With respect to distributed energy systems (as opposed to district), if developers are required to install geoexchange systems the policy must be clearly written.

Utility ownership options – considerations for all 4 areas

- Options discussed include City ownership, ownership by a private utility, and Public Private Partnerships.

- The City has not previously wanted to own a district energy system, and there may or may not be benefits to the City in doing this. If the City owned a DE utility, it would want to ensure that it would not operate at a loss.

- If the City owned a DE system, it would be run like its other utilities.

- The City of Kelowna owns the local electric utility. The City and Fortis supply electricity to all areas of Kelowna.

- In some parts of Kelowna it may be logical for the district energy system to be City owned, due to rights-of-way / utility corridors, and ownership of facilities such as the WWTP.

- Financing options would depend upon who owns the DE system.

- Utility ownership also affects who will benefit from the sale of greenhouse gas emission credits. This may become a consideration if BC joins an emissions trading scheme or implements one internally.

City Centre

Technical viability

- Some City Centre buildings are on steam. There are ways for steam heat to be incorporated with a district energy system, despite technical challenges.

- The Grand is an unlikely candidate for a medium temperature centralized district energy retrofit, due to the existing heating system within the building (i.e., air ducting, electric reheating, etc.). However, the forced air units could be potentially retrofitted with a low-temperature decentralized DE system and water-to-air heat pumps, although the electric re-heats could represent a challenge.

- Along Industrial Avenue, several 20 storey residential buildings are under construction, although some of these are temporarily on hold until the housing market improves. At least one of the buildings in this area (currently under construction) will be installing electric baseboard heating. Electric baseboards are very difficult and expensive to retrofit to a DE system.

- For those buildings where construction on hold, if construction is at an early stage, it should be possible for the buildings' mechanical systems to be redesigned. The City could potentially negotiate with these developers. (Note that it takes about three years to develop a 20-storey tower.)

- Larger commercial developments, and some larger residential or mixed-use developments (such as those with heat gains from gas-fireplaces and/or projects with a lot of solar gain), require cooling even in winter months. Interestingly, this presents an opportunity to share energy between buildings that require cooling and those that require heating.

- Peller Estates, Sun-Rype, and Tolko confirmed that they are potentially interested in participating in a DE system, supplying it with waste heat from their operations.

- Calona Vineyards is the relevant Peller Estates winery operation, built around 1930. They have perhaps four chiller packs, but they do not know how much waste heat they produce. There are separate chillers for both beer and wine operations. There may be a significant cost in trying to capture this waste heat.

- For Sun-Rype there may also be a significant cost in obtaining the waste heat. They also have individual chiller units. Much of Sun-Rype's heat is process heat, but some heat could be recovered from the boiler stack.

- There may be an opportunity for recovering heat from the industrial wastewater treatment plant (WWTP).

- Tolko is the largest source of heat currently within the City Centre area. Tolko has been a heat source for a long time, and has considered DE in the past.

- Tolko has very large amounts of heat from the steam and flue gas that could be recovered. The hot water flow is not currently measured, but does vary over time.

- Tolko has a cogeneration facility on site, but does not always get the market price for the power that they produce. Tolko would like $120/MWh for electricity, but they currently get about $70/MWh. Selling heat might help the economics. With their current system they can generate up to 7 MWe, but due to lack of an economic incentive, they frequently generate less than they are able to. With the resources they have on site, they could potentially generate up to 15 MWe.

- There will be an up-front investment cost to recover waste heat energy from industrial processes. This may require an economic incentive to justify the investment.

- The ice arenas produce a relatively small amount of heat compared to Tolko's waste heat. It might cost $100,000 to connect each ice arena. The arenas would be a steady source of heat.

- Net heat metering is a possibility with DE systems, e.g. allowing solar hot water systems to generate revenue by selling heat into the loop.

- Kelowna could issue an RFP for an energy utility. The scale of this might limit the number of companies that would respond to the tender.

- The next step for Kelowna is a DE feasibility study. The City could approach the Federation of Canadian Municipalities' *Partners for Climate Protection*, and NRCan, and go for grants to conduct a feasibility study. Fortis might be able to provide some money for a feasibility study.

- Department of Fisheries & Oceans (DFO) may need to be contacted regarding potential use of lake water for cooling, and it may trigger reviews under the Canadian Environmental Assessment Act (CEAA) or British Columbia Environmental Assessment Act (BCEAA). Even if closed-loop geoexchange systems were used for cooling, DFO may still be concerned if it's close to Lake Okanagan. The City has an existing, currently unused, lake water licence in the City Centre that could potentially help with cooling.

Financial viability

- New multi-unit residential construction is likely necessary to ensure financial viability for heat recovery from the industrial sources. However, a considerable amount of new residential construction is anticipated over the coming years, including development permits that have already been issued.

- If new developments continue to be on hold due to market conditions, then the financial feasibility of a small scale DE system for the cluster of institutional buildings within Kelowna's City Centre should be investigated, potentially recovering heat from the ice arenas.

Risks and risk mitigation

- The lumber mill could move location, but this should not negatively affect the viability of a district energy system primarily designed to recover the mill's waste heat:
    - There are other local sources of waste heat: Sun-rype, Calona Vineyards, the ice arenas, and the tower blocks that would need cooling even in the winter months.
    - If the mill relocates, the cogeneration plant could stay. (Although the biomass currently burnt is a by-product of the mill's operations. As such, if the mill moves, other biomass sources will be needed, thereby increasing the $/GJ delivered.)
    - There are energy efficiency benefits to having a gas-fired DE system compared to stand-alone buildings having their own gas-fired systems, and capital equipment & maintenance cost benefits.

Data gaps

- More detailed information on the available sources of waste heat energy is needed.

- The economic cost of recovering the heat from the industrial sources.

- Uncertainty around how much of the potential new construction will actually happen.

South Pandosy

Technical viability

- Agreement that Pandosy Town Center area (with possibility of adjunct DE system stretching to Kelowna General Hospital) is likely best candidate for district energy in the near term. An Energy & Carbon Management Plan (aka prefeasibility study) would be required for the area. The area has strong potential for incremental DE development.

- Combine systems along the district energy zone for load sharing, with the hospital at one end of the DE loop and the City's waste water treatment plant (WWTP) at the other end. Note: It is only 1 km to the hospital from the WWTP.

- The piping for the DE system could be installed along Pandosy street.

- A DE system in South Pandosy would benefit from being able to use either the lake or the ground during the cooling season. Okanagan College has too much waste heat in the summer months, and has not been given permission to use lake water for cooling needs, (although the Hospital has a permit to use a specific volume of lake water, and heat it up to no more than a 4 degree C temperature difference). A future district energy system may have use geoexchange just for cooling.

- The hospital is already recovering all of its own waste heat, except in the laundry. The hospital is not able to shut down the laundry long enough to do the necessary work.

- The local geology would have to be examined to determine whether it is possible to store heat in the ground and recover it later (could be utilised for long-term thermal storage, e.g. seasonal). However, there are other methods of storing heat as part of matching heat supply with demand, such as using phase change materials (could be utilised for short-term thermal storage, e.g. daily).

- There are a couple of large multi-unit residential buildings to be built in Pandosy Centre, one of which includes a commercial component. In addition, Stober Developments is now ready to redevelop the campground trailer park at the corner of Watt Rd and Lakeshore. This development features a large multi unit residential building, only one block from KLO Avenue.

- If the City had a DE framework / plan for South Pandosy, developers could prepare to come on board and connect with this system. New development intending to be underway over the next 12-18 months could incorporate the necessary piping and other infrastructure into these new buildings at the design and construction stage, so that they could be connected to the South Pandosy DE system once it is in place. The City would have to send a clear signal to developers that it intends to create a DE system in this area. Opportunities for new development to connect to this system would be lost if there is uncertainty that a DE system would be created for South Pandosy.

- Potential for also reclaimed water use using the WWTP effluent, but there are regulatory barriers with regard to using "purple pipes" for non-potable water recovery, e.g. with Provincial Health Authority.

- For a decentralized DE system the WWTP effluent would need to be distributed, and a 3-meter separation is needed between effluent pipes and drinking water pipes. Unanswered questions include: Is this viable in South Pandosy? Where are the drinking water pipes currently located? Is moling an option, or would it be necessary to dig?

- There may be an opportunity to use the sewage pipes that carry sewage into the WWTP for heat recovery in the immediate institutional area.

Financial viability

- Wastewater to District Energy cost is $600-700/kilowatt. In comparison, generation at municipal landfill it is $1000/kW.

- Financing a future DE system would be challenging. Revenue would have to be recovered over a long time period. However, predicted energy savings does indicsate a compelling business case for a DE system, without even considering carbon credits.

- The City would need to consider its role as the utility provider and possible financier.

Risks & risk mitigation

- There is low risk with the proposed energy source (i.e., heat recapture from WWTP effluent). The WWTP always needs to be pumping, and it has backup power systems in case of grid failure, therefore the district energy system might not need any backup.

Data gaps

- Need to determine the energy demand of the hospital, and forecast demand from new multi-unit residential buildings. The energy demand from future commercial and institutional growth would also have to be determined.

- The precise location of drinking water pipes in the area.

Orchard Park / Highway Centre

Technical viability

- Significant residential development will occur along the southern and northern edges of the area.

- Active developers in Orchard Park / Highway Centre include: Leddingham McAllister, Stober, Society of Hope, Callahan Properties, Plum Realties, and JABS.

- An existing 16-storey building (Park Place) has distributed heat pumps in place, and an open-loop geoexchange system has been installed in the New View building.

- The existing shopping facilities cannot easily be retrofitted. Technical barrier: rooftop air heating/cooling units difficult to retrofit to a centralized medium temperature DE system, although it may be possible to retrofit them to a decentralized low temperature DE system and replace the rooftop units with water to air heat pumps. Administrative barrier: current leasing arrangements that have tenants pay the same amount for their utilities regardless of their energy consumption, and building owners have little incentive to alter the status quo – (although if building owners can reduce energy consumption by retrofitting to district energy yet still charge tenants the same, there is a clear financial incentive).

- When fully developed, the RackForce Data Centre 'GigaCentre', will have a huge excess heating load. Data centres operate continuously, and offer great potential for district energy. Further studies are needed concerning the planned mechanical heating /cooling systems within the GigaCentre. Note: RackForce planned expansion is predicted to occur within the next 18 months.

- RackForce will need guidance on cooling system design, to allow for future DE integration. RackForce would need indication from the City that a future DE system is intended for this area. The GigaCentre might eventually have 500 tons of cooling (right now they have 70). Heat output could be 200 watts/m^2.

- There are a number of planned multi-unit residential projects in the vicinity of RackForce GigaCentre. It is feasible to run DE distribution pipes along the ROW that is parallel to the railway track on the north side of the Orchard Park / Highway Centre area. The GigaCentre could supply waste heat to these residential developments.

- The group felt that the best strategy would be to "localise" one or two smaller district energy systems within Orchard Park / Highway Centre, and have it incrementally grow over time.

- The Landmark office complex (along Highway 97) already shares heat, and one tower (Landmark 4) has a geoexchange system. There is potential to recover waste heat from the Landmark buildings and redistribute it to the Parkinson Recreation Centre across Highway 97. DE piping could be slung underneath the new pedestrian/bicycle bridge planned to span the highway at this location.

- The City Yards could be a potential future location for an energy centre, supplying a district energy system to the Orchard Park / Highway Centre area.

- Need to get the development community engaged on this, and explore ways of connecting planned residential development to a local DE system.

- Medium density residential development will also occur in the Benvoulin Area, with potential DE opportunity there as well.

Financial viability

- The GigaCentre opportunity stands out as a clear opportunity.

- No group consensus on the business case for DE in the Benvoulin Area, and more work needs to be done to determine if there is a compelling opportunity.

Risks & risk mitigation

- Although the GigaCentre is likely to remain in Kelowna for the long term, data centres can move based upon economic conditions, so the district energy system in the Orchard Park / Highway Centre area should not rely solely on just one energy source.

Data gaps

- The amount of heat that will be available from the GigaCentre is unknown, so more work needs to be done on deriving an accurate number.

Rutland

Technical viability

- A tricky area. Current energy demands consist mainly of low density strip retail and surrounding medium- and low-density housing. It is not clear where new construction could take place.
- A potential opportunity exists with the ice arena and pool, and the nearby schools (note: only 300 metres between the ice arena and pool).
- A project recovering heat from the ice arena for the pool may complement the pool's new solar water heating system well, although it may reduce the demand for heat from the solar system. The pool recreation centre may also be expanded soon.
- Potential DE opportunity with a development application for a 6-storey office building.
- Concerns about open-loop geoexchange in this area, although it is important to consider that concerns should be substantiated by facts:
    - Some people had environmental concerns about using the aquifer as a heat source, although the risks can be low if designed, installed, and managed properly.
    - Some people maintained that you must avoid putting heat back in to the aquifer.
    - If you cool down aquifer water before it is used for drinking, would local residences need to burn more gas to heat that water back up? It is possible this would partially mitigate the carbon reductions and increase energy costs for some local residents, although the water should warm back up somewhat as it travels through the pipes to the residences. This aspect could require further investigation.
- At the workshop, some people maintained that closed-loop geoexchange system is likely superior from an environmental perspective.
- Some people maintained that with geoexchange systems, that ideally there should be no net impact on ground temperatures.

- Current legislation treats open-loop and closed-loop systems differently. Any large-scale geoexchange system of any kind could be designed with 'future-proofing' in mind, and going beyond current minimum legislative requirements.

- The group discussed individual biomass plants being used to heat clusters of residential uses, with potential to incrementally link up these small district energy systems over time. A potential way to push the envelope. Existing single-detached homes could also be retrofit to these systems as their furnaces are replaced over time.

- Air quality concerns with biomass heating were also discussed. Particularly given the Okanagan Valley's temperature inversions in the winter, trapping particulates.

- About 40,000 tonnes a year of wood and other biomass goes to the Glenmore landfill. This could potentially be recovered and used for the biomass plants.

- Approximate costs for biomass heating are $1-2/GJ at Dockside Green, and $0.5/GJ for the system in Revelstoke.

- A possible energy security issue with biomass in that as petroleum prices go up, the price of delivered biomass will also increase to some degree.

- Residents within the Rutland area will need to be engaged in discussions on any potential DE system.

Financial viability

- The pool / ice-rink project would have a very short payback. System could then expand to the schools and potentially beyond.

- No other district energy opportunities stand out in Rutland.

- More work would need to be done to determine if there is a compelling business case for a DE system for Rutland based upon open or closed-loop geoexchange, or biomass.

- Some people maintained that open-loop geoexchange systems are cheaper to install than closed-loop systems but have higher maintenance costs, and that over the systems lifecycle closed-loop is probably superior. There is debate around these points, and the reverse may also be true in some circumstances.

Risks & risk mitigation

- There are no significant risks identified with recovering heat from the arena for the pool.

Data gaps

- It is challenging to evaluate a district energy system based solely on general predictions of new construction in Rutland. There is a data gap on what the eventual residential density will be, and where new development would be located.

Suggested order of project preference by workshop attendees

1. South Pandosy with WWTP heat recovery, including the hospital
2. Rutland arena heat recovery for pool and schools
3. City Centre with industrial heat recovery
4. GigaCentre heat recovery project for residential in Orchard Park area

Low Density Residential Construction

Technical viability

- Thus far, 350 homes have been built at Wilden Estates in Kelowna. This development may eventually contain 1,500 homes. Wilden may also have one multi-family building near Still Pond, as well as a future school. Heating options for low-density residential are: (a) gas furnace, or (b) geoexchange system. Note that approximately 98% of the most recently built homes in Wilden have opted for geoexchange.
- The Prospect development at Black Mountain has mandatory requirements for individual geoexchange systems in each home.
- Sun Rivers Golf Resort Community in Kamloops was the first true multi-utility development in BC. 600 homes have been constructed so far, 300 more are under construction, with 2,000 homes at full build-out. Land is leased from the local First Nation. The developer controls infrastructure, easements and street design aspects. Geoexchange systems are mandatory for heating homes. Natural gas is only allowed for BBQs and fireplaces. With respect to water use, Sun Rivers is also innovative in that they have two pipe sets for water, one for treated drinking water and one for irrigation water, with different meters and rates (irrigation water is cheaper). The Provincial Health Authority requires that there is no connection between potable water and irrigation water systems.
- The geology in South West Mission and the Ponds area is not ideal for closed-loop vertical geoexchange systems. Horizontal geoexchange systems will still be viable, and open-loop ground water systems may also be viable.
- The geology in Wilden, Black Mountain, and Kirschner Mountain, and many other areas of Kelowna is quite condusive for closed-loop vertical geoexchange systems.
- The group discussed the comparative merits of having individaul geoexchange systems (one per home) compared with having a central plant that has a lower net capacity by balancing heat loads through preconditioned space. A centralized system may be less expensive overall than individual geoexchange systems.

Financial viability

- At Wilden, homeowners have the option of installing geoexchange through Geotility's private utility TerraSource, at no extra cost. The homeowner also has the option to not using TerraSource but directly paying for drilling instead.

- At Sun Rivers they created a bundled utility. The homeowner gets one invoice with 7-8 items on it. The synergies are huge. Overall it was an easy sell to the homeowners.

- The City could have a similar 'bundled utility' opportunity. The City owns Kelowna's electric utility, which is advantageous.

- With Geotility's TerraSource, the cost for accessing to the geo field is normally the same as the savings made by not using natural gas, so the cost nets out even to the homeowner. Future utility charges are linked to the consumer price index.

- Geoexchange systems in new developments are an easy sell today, but many developers are missing the boat on this proven technology.

- Homebuilders like the utility methodology used in Wilden, because they do not have to pay the upfront capital cost of a geoexchange systems. This cost is passed on to the home buyer.

Policy

- The City of Kelowna could expedite green development by faster permit approvals. This could be in conjunction with a sustainability checklist.

- The City would need the assistance of the development community to design this "fast track."

- One possibility is to require that new homes be EnerGuide rated.

- A renewable energy resource map (e.g. EBA's Whitehorse study, or Hemmera's City of Surrey: Grandview Heights study) could be an excellent complement to the sustainability checklist. A map could show areas where different technologies are viable, e.g. closed/open-loop geoexchange or sewer heat extraction.

- Education of builders, planners, and architects in renewable energy technologies is also very important.

Appendix 2 – second workshop notes

Date: 10.30am – 3.30pm. Thursday December 3, 2009

Location: Salloum Rehearsal Hall, Rotary Centre for the Arts, 421 Cawston Avenue, Kelowna

Attendees: City staff, technical experts

Purpose: Consider the optimum paths towards district energy implementation in Kelowna, for the key projects identified in the first workshop. Focus on: technical details, policy, overcoming barriers, utility ownership options, next steps.

Overview

- District energy systems tend to follow two broad concepts:
  - The equipment for the district energy system is **centralized**, distributing a "finished" energy source to buildings within a specific area, such as medium temperature hot water or chilled water. This type of system is the most common.
  - Another approach is to **decentralize** some equipment, distributing low (or ambient) temperature hot water (e.g. heat pumps and supplemental heating equipment for space heating and domestic hot water). These systems are less common. In the second workshop this type of system was favoured.
- The four areas being considered for district energy in Kelowna are those which are designated as urban centres in the OCP: the City Centre, South Pandosy (including the hospital), Orchard Park / Highway Centre, and Rutland.

Policy and policy implications

- Policy should be considered in the context of the benefits of district energy:
  - Low / fixed energy costs for households
  - Long-term energy flexibility
  - Reliability and redundancy
  - Reduced carbon emissions
  - Possible lower costs for developers
- The city should encourage/mandate development to be DE-ready, specifically:
  - 120 degree Fahrenheit max heating system (when connecting to a low temperature district energy system)
  - Heat-pump ready (when connecting to a low temperature district energy system)
  - Interface with future heat transfer

  - Ideally, hydronic heat
  - Ready for DHW pre-heat

- Any Local Service Area bylaw though needs a minimum building size, and/or minimum heating/cooling demand. At current energy prices it is unlikely we would want to connect single family dwellings for example.

- With a Local Service Area bylaw, in some areas we may be faced with a chicken and egg situation, where we are waiting for a critical mass of district energy ready buildings to be built until the economics justify the construction of the district energy system. As it may take a substantial length of time for sufficient heat demand to get built, some buildings may be built several years before a district energy system. This could be problematic for developers if there is a substantial additional cost in designing a building to be district energy ready, if that benefit is not being received immediately.

- The issue of the additional cost to developers could be especially problematic to developers with regards to high temperature district energy systems. With low temperature district energy systems it is much less of an issue as all they require is for a building to have a low temperature water loop and individual heat pumps for each unit, which is how the majority of new developments are being built. This would also force developers away from using electric baseboard heating. The water loops in these buildings only need 70°F water, which works great with an ambient temperature district energy loop.

- A low temperature district energy system would also be more flexible at incorporating future energy sources.

- What carrots or sticks could be used to encourage existing developments (e.g. multi unit residential buildings - MURBs) to tie into a district energy system?

- On the downside, retrofits can cost a lot and can include disruption of the operations of the building. Also need to convince the residents in the building, whose concerns include:
  - Escalating costs
  - Flexibility
  - Reliability and backup (although we generally don't have electricity backup in our homes)

- Should a density bonus be used as an additional incentive for developers?

- Can we strongly discourage or prohibit electric resistance heat (e.g. electric baseboards) in the Official Community Plan, Development Permit Areas, or some other kind of policy?

- Should we mention green building methods such as LEED or Built Green in the Official Community Plan or Development Permit Area chapter?

- Is it possible to introduce a bylaw that forces developers to look at the full lifecycle costs of building energy systems, say from a 25 year lifecycle perspective?

Ownership and other considerations

- How will customers be billed? Debate around metering (which costs money to install and read), or just having a flat charge (which does not encourage conservation). Smart meters may help, because they usually automatically communicate information back to the utility electronically.

- Many partnering options exist for the city and the utilities. E.g. for Regent Park in Toronto, Corix has a 40% stake with Toronto Community Housing having 60% and Corix operates it. The City of Langford's sewer system is owned, operated, and maintained by Corix, but the City retains control over rates, quality of service, and performance.

- The utility should be designed / structured as though it will be regulated, just in case it will be in the future.

- There may or may not be revenue potential for the city – depends on the financial case and the utility model.

- The City is very unlikely to sell its electric utility for the foreseeable future.

- Different ownership models and considerations discussed for each:

- **City ownership**
  - Revenue potential for the City
  - City can pursue other objectives for the district energy system beyond profit, e.g. maximising carbon emission reductions even when business case less favourable

- **Public Private Partnership**
  - Costs & revenue shared between the City and private sector, depending on partnership details
  - Public & private funds can leverage each other

- **Private ownership**
  - A utility (e.g. Terasen or Corix) could pay for the district energy system
  - City would still need to be involved, e.g. in setting policy

South Pandosy

- The hospital uses a high temperature heating system that would not be compatible with renewable district energy, though district energy could potentially be used to pre-heat.

- The hospital is using lakewater cooling currently.

- The hospital could potentially supply heat to the district energy system.

- Have to be careful about using wastewater treatment plant effluent for cooling – Ministry of Environment may not allow a rise in the outflow temp. Also, have to be sure that if the system is very successful and there is a lot of energy demand that the outflow temp does not drop below 5°C.

- Suggested system design for South Pandosy is a heat transfer station transferring heat from the effluent to a closed-loop low-temp distribution loop with heat transfer interfaces to customer closed-loop systems with building heat pumps being owned by the customer (possible exception for a utility like Terasen or Corix to own the plant room and staff for very large buildings).

- There is also a medical building at the end of Lakeshore Rd, where it meets Richter. It has a geoexchange system and is heavily glazed, it has two MRIs, and so probably has a large cooling demand.

City Centre

- Tolko have started running their cogeneration plant less frequently, and they may stop running it in January or February. They have started diverting their fuel to Armstrong. Some of the cogeneration plant that they have may get shipped out too, but probably not all of it. From around 7.2 MWe that they could generate they are down to about 3.5 MWe right now. This is due to BCUC and BC Hydro regulatory reasons, so Tolko do not get a very good price for their electricity. Tolko could always start cogenerating biomass again in the future though (and thus generating a lot of waste heat), provided the mill doesn’t move.

- Discussion over whether there is sufficient space for Central Green to be entirely heated by a closed-loop geoexchange system. Needs to be looked into, but other options may need to be looked at, such as natural gas cogeneration, heat recovery from the nearby high-flow sewage lift station, or an open-loop geoexchange system if there’s an aquifer. Like all of the new development in Kelowna and the City Centre, Central Green will take a while to build out – therefore a district energy system here will need to be modular.

- Wescorp may have to look at district energy for the CD21 Comprehensive Development Zone. As well as Central Green, this is another prime district energy opportunity area for the City Centre.

- Local Service Area bylaws in the City Centre area should be required for the CD21 and Central Green areas at a minimum, and potentially for the whole City Centre area.

- Discussion around City of North Vancouver style unstaffed mini plants, using natural gas as an energy source, and then expanding into other energy sources. But a low/ambient temperature district energy system was eventually considered to be the best option for Central Green, CD21, and other areas, for the reasons outlined in the policy section.

- In the City Centre, many of the existing residential buildings, for example along Ellis Street between Doyle and Cawston, have water loops, and so could connect to a district energy system. Discussion over how these buildings could be made or encouraged to tap into a future district energy loop.

- In the City Centre we may have to start off with separate district energy systems serving different opportunity areas, and join them up over time. Once they are joined up we will be able to balance energy demands and sources better – there will be better synergies.

- A great advantage of the City Centre is that it has very mixed use – residential, commercial, institutional, and industrial.

- There's also a lot of available energy in the City Centre. From Tolko, the arenas, lake water, the possibility of natural gas, etc.

- For the Memorial Arena, the possibility of recovering the heat from that and putting it into the theatre has been looked into.

- The RCMP building is also going to get rebuilt relatively soon, and that could get tied into a future district energy system.

- The Caravel building by City Park currently uses lake water for cooling.

- Some new developments are unfortunately still putting in electric baseboard heating.

- The City would connect its existing buildings into a district energy system wherever there is a good economic case. However whenever the buildings get replaced, then they would definitely be designed to plug into a district energy system.

- One issue with district energy in the City Centre is that it is difficult to run the distribution pipes deep underground because of the water table. The water table is at its highest at the end of June, maybe just 3 feet below ground.

- Belief raised that the engineering of a City Centre district energy system is possible, and that the economics of it could be made to work, but that the only real point of concern is if we can get the stratas and the developers to connect into the system? Which is about whether we can get the right policies in place.

- A district energy system in the City Centre would be very complicated to manage, with the mix of residential, commercial, industrial, and institutional buildings. It may be beyond the capacity of the City to manage this by itself. Perhaps this could be a joint utility with the private sector, a public private partnership, with the City developing bylaws etc. It could potentially also be a separate privately-owned utility.

Orchard Park / Highway Centre

- There's an Interior Health Authority Data Centre on Dayton Avenue.

- Concern about the Landmark loop and its size (in tons), if we intend to recover heat from it and put it into the Parkinson Recreation Centre. Although Landmark 6 is going in soon and there may be even more available waste heat.

- The water table at Landmark is only a few feet deep. A high water table is beneficial for closed-loop geoexchange systems.
- The reason that heat was not recovered from the Landmark buildings and used to heat the new residential building the 'Mode' was because of time.
- Orchard Park may become two storey, and they are considering a geoexchange system. Currently Orchard Park uses about 300 old rooftop units. Orchard Park will mainly have a cooling demand. Perhaps this heat could be used to heat nearby new residential buildings.
- The Park Tower building is on a geoexchange loop.
- In considering heat recovery from the data centre and going into new buildings, what should the radius of the Local Service Area bylaw be around the data centre? That depends on the economics of it.
- A contract / MOU with RackForce would be necessary in case the GigaCenter moves. E.g. the MOU with the City & Okanagan College is 20 years, and once that the term of that is completed both parties have to agree for it to be extended. Would RackForce want to sign a contract / MOU for such a long period of time? Could be unlikely given the rate of technological change with computers.
- There is a risk to having a district energy system reliant on one source of heat, if that source stops becoming available. This is demonstrated by the UBCO system which is based on the availability of the aquifer, and if the aquifer could not be used any more then it would cost about $50 million to retrofit the system to use another energy source like natural gas. At Okanagan College however, if the wastewater treatment plant effluent stops becoming available, all they have to do is turn their boilers back on.

Rutland

- Economics of arena heat to the swimming pool or middle school (300m) are questioned. Also it is possible that all of the waste heat can be reused within the arena.
- Could use a borehole to act as a thermal store for heat from the arena, in order to help match supply of heat with the demand from other buildings.
- The high school does not have any building energy systems that can use low temperature heat from the arena, but the low temp heat could be used as pre-heating before the boiler.
- Stand-alone geoexchange systems (i.e. distributed geoexchange systems rather than a district energy system) are a possibility throughout Rutland.

Next steps

- The City has got a lot of information now to go through to RFP. The road is much clearer now than it was. The RFP could go through with other institutional parties too, such as Interior Health and the School District. It should come out in January.
- Question over whether the utility ownership model will be part of the RFP?
- The City should not try to predetermine the result of the RFP by the way it is written. They must try to allow the consultants to be balanced. On the other hand, Kelowna should not waste money in the RFP looking at options that are known to be uneconomic, such as solar photovoltaics.
- There is great potential here, but potential pitfalls, for example the cost of electricity may increase, which would affect certain types of district energy systems and certain energy sources.
- There are obstacles to going ahead with this, but they are not insurmountable.
- Need to be innovative.
- There is a huge cooling load in the summer to take care of.
- The School District is potentially interested in anything. It needs to save the school money or be at least revenue neutral, and reduce CO_2 emissions. It's got to make sense.
- The Interior Health Authority sees lowering greenhouse gases as important, but the big stumbling block is financing retrofits. An internal report will be written now for the Facilities Management group so that they can take over. Incidentally, energy only consists of about 1% of IHA's budget, so it is hard for it to get the attention of the people running IHA, compared to for example, patient safety.
- Corix believe that the best opportunities often come out in the wash, i.e. as the City continues to look into this opportunity.
- Terasen would like to own a potential district energy system, and would also be happy with a partnership. Terasen see this as a great opportunity, and of huge value to the City.

Appendix 3 - Open House survey results

Do you live in/near any of the suggested project areas, or do you work/own/operate a business in/near any of the suggested project areas?

	City Centre	South Pandosy	Orchard Park	Rutland	Other	No answer
Live	0	2	2	2	6	0
Work, or own/operate business	2	1	3	3	2	1

How do you feel about district energy for Kelowna overall? Please elaborate

Very positive	Positive	Neutral	Negative	Very negative
9	2	1	0	0

- It is the future
- It seems like a great way to use wasted energy, cut energy costs, while reducing energy demands
- Seems to me like a win win for everybody
- Great to see excess energy put to good use
- Energy reclamation is the best way to increase available energy without new energy production
- I believe that energy reclamation will just empower the city's ability to sustain [hard to read] and also to help the environment
- I am an engineering consultant involved with the study & design of treated effluent heat recovery systems, and district energy systems
- I like the idea of sustainable energy and efficiency
- Efficiency, morally correct
- Environmental benefits
- It is the responsible way to go for the future
- Relatively [hard to read] about source, this helped alot

Do you have any concerns about district energy? Please elaborate

Yes	No
5	7

- Still fairly ignorant about district energy systems
- I'm unclear of the costs it would take to start up and also I'm unclear about how long will it take for the city to [hard to read] money from district energy
- I would like to know why 200 Dell Rd is excluded. Does this plan include geothermal exchange?
- Economics - longer payback
- Long-term reliable heat source
- Source needed to accommodate any increase in population

Would you like to see the OCP altered with respect to district energy? Please elaborate

Yes	No
10	2

- More solar to help with the energy supply
- Draft policies sound good
- Civic properties may be placed in close proximity
- Energy production should be decentralised.
- Encouragement of district energy for any new large developments or re-developments.
- Large pool at Athans and Parkinsons seems obvious for a heat sink.
- Check effect of using waste H20 on vegetation, vineyards, & grasslands, before implementing.

Would you consider renting/purchasing a property that was supplied with heat from district energy? What concerns/questions would you have?

Yes	No
10	2

- The specifics of where the energy was coming from and if it subsidized the cost of heating the building.
- Cost compared to conventional heating/cooling
- How much energy may be relied upon
- Cost
- Reliability
- Are solar panels and two way metering a part of the plan?
- Cost & increase of cost

Overall, did the information presented help you understand the scope of the project?

Yes	No	Provided another answer	No answer
9	1	Wrote – yes 6/10	1

Was the information presented in an understandable format?

Yes	No	No answer
10	0	1

Was there enough information for you to provide an informed opinion on the nature of the proposed projects? If not, what type of information was needed?

Yes	No	No answer
9	2	1

- Potential options for each section
- Because of leafs, grass, and pruning, cellulosic ethanol or bio-butanol could be considered district energy. This partnered with a oil company will help the City profit.
- Effects of cooling & [hard to read] lake water

Was staff able to answer all your questions?

Yes	No	No answer
10	1	1

How did you hear about the Open House?

Newspaper Ads / City in Action	Kelowna.ca	City E-updates	Green Drinks	Word of mouth	No answer
2	1	3	3	2	1

Please make any additional comments on the proposed district energy systems

- It would be great to see this go a step further to other sustainable energy systems such as wind or solar.
- Further detailed study is required in order to determine economics, and the potential to acquire utility customers for D.E.S.'s
- Thank you for the opportunity to give input
- Divert sewers to water trees & ornamental sidewalk greenery

Appendix 4 - background information on renewable energy sources for district energy systems

Air Source Heat Pumps

Air source heat pumps, or 'heat pumps' for short, extract heat from the air in the same way that geoexchange systems extract heat from the ground (see the geoexchange section below). As they do not require digging into the ground they are relatively cheap to install. As air temperature has a higher variability than the ground, air source heat pumps are less efficient overall; they work best in the mildest parts of the province, the Lower Mainland being ideal. Heat pumps are not usually used to supply a district energy system, but are highly suitable for individual building installations such as residential and small commercial buildings. Even on most typical building installations, they require a gas backup to supply additional heat at the coldest times of the year (below about -10˚C).

Typical domestic-scale air source heat pump installation   Source: York, Johnson Controls

Case Studies

There are hundreds if not thousands of domestic installations of air source heat pumps in BC. A notable non-domestic installation is Colwood City Hall which has several air source heat pumps on the roof to heat the 14,000 ft² single-storey building.

Geoexchange

Geoexchange system under construction. Source: Geotility

The number of installed geoexchange (ground-source heating) systems in BC has grown very rapidly in recent years. BC's ample supply of cheap and renewable electricity from its legacy hydro means that geoexchange systems (which typically use electric heat pumps) are in many cases, a cost effective way of providing renewable heat with zero impact on air quality. Although usually more expensive to install than conventional heating systems, they are often cheaper to run.

Geoexchange systems can be installed to serve individual buildings or district energy systems. The former is by far the most common, but the benefits of having a geoexchange district energy system compared to stand-alone systems can arise in several circumstances:

1. If there is some advantage in having the trenching or borehole in a particular place
2. If the buildings have different and complimentary load profiles that allow the heat pumps to be sized smaller than if the buildings were on individual systems
3. Where the ground heat exchanger cost is not directly proportional to the output capacity (only applies to open-loop systems)
4. Where there are energy sharing benefits between buildings (some buildings require cooling while others require heating)
5. Where other energy sources can be integrated with the district energy system

If none of these circumstances is present, then usually there is no advantage to having buildings on a district energy geoexchange system as opposed to individual geoexchange systems, as the cost of district energy pipes usually makes it more expensive.

The exchange of heat with the ground can take three main forms:

1. Closed-loop trenching (horizontal ground loops)
2. Closed-loop borehole (vertical ground loops)
3. Open-loop well(s) (i.e. ground water heat exchange)

Trenching is feasible for individual buildings provided they have sufficient ground space and soil is not too rocky; trenching is unlikely to be feasible for a district energy system due to the amount of space required.

Closed-loop borehole systems are suitable provided ground conditions are suitable.

Open-loop borehole systems can be suitable where wells in an area produce a large amount of water.

CSA 448 should be standard practice for both residential and commercial geoexchange systems. It is not specifically referred to in the building code, but it is a requirement for the Provincial and Federal incentive programs. Designers, installers and drillers must be accredited by the Canadian GeoExchange Coalition (CGC) and installations must be certified by CGC to qualify. The CGC uses CSA 448 as the standard for their certification. Municipalities in BC could potentially use CSA 448 as a standard for geoexchange systems through a policy bylaw, but at present CEA are not aware of any that do so.

Case Studies

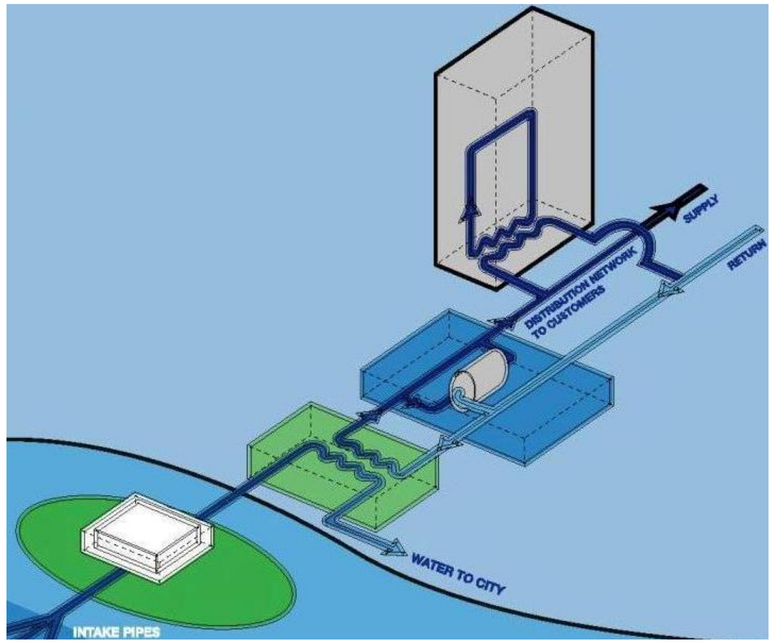
There are many examples in BC of geoexchange systems. A few are presented below:

- Trenching – Rutland & Chute Lake Elementary Schools
- Closed-loop borehole – The Wilden Estates, Sun Rivers Resort Community (near Kamloops), district energy system at Pacific Sands Resort (Tofino)
- Open-loop well – Castlegar City Hall, Ice Box Arena (Kamloops), district energy system at UBC Okanagan (Kelowna)

Outside of BC, a notable closed-loop borehole district energy system is the one under construction at Ball State University, Indiana, a retrofit that will heat & cool the entire 660-acre campus (about 45 buildings).

Lake Water

Just like the ground with geoexchange systems, lakes can represent an excellent source of energy for both heating and cooling.
This can be achieved through lake source heat pumps (similar to geoexchange systems above but running a coil into a body of water), or also through extracting lake water and running it through a heat pump, and then either returning that water to the lake or utilising it for some other purpose, e.g. drinking water.



Simple schematic of the deep lake water cooling system at the Enwave district energy system in Toronto
Source: Enwave Energy Corporation

Case Studies

There are examples in Kelowna of using the lake as a source of energy:

- Kelowna General Hospital – utilises the lake to provide sufficient cooling for the entire existing hospital, so that the 500 tons of chillers they have installed have to date never been used. Although the hospital is currently expanding, they are not permitted to utilise more lake water for cooling. The water is returned to the lake after use.
- The Caravelle – this 18 unit apartment building on Abbott Street in downtown Kelowna utilised the lake for cooling, until a water main failure in the street meant it had to start using the drinking water supply instead. A 2005 study by Stantec looked at the costs and benefits of re-utilising the lake as both a source of heating and cooling for this building.

Outside of BC, Enwave Energy Corporation in downtown Toronto has the world's largest lake-source cooling system. It utilises deep water from Lake Ontario to provide the equivalent of about 59,000 tons of refrigeration, which is enough cooling for about 34.4 million square feet or 100 large office towers. The cold water is distributed through a district energy system to downtown high-rise buildings, reducing their air conditioning bills and in the process saving 61 MW of electricity. After use the lake water is fed into the city's drinking water supply.

Sewage

Heat recovery from sewage can present a better opportunity than heat recovery from other sources such as the ground, because it is generally at a higher temperature. Sewage does however have a variable temperature based on time of year, and has both daily and seasonal flow variations.
Heat can be recovered from sewage at three stages:

1. While untreated sewage is in transit through the sewer lines
2. While untreated sewage is passing through lift (or pumping) stations
3. At the wastewater treatment plant from the treated effluent

Obtaining heat from the untreated sewage while it is in transit is a technology that can be retrofitted wherever there is a suitable sewer line. Sewage pipelines could be retrofitted with this technology, although it is cheaper for it to be installed when either a new sewer is being built or work needs to be conducted on a sewer line. In the City there are several existing large sewer lines, and several new sewer lines due to be installed in years to come, some which may present an opportunity for heat recovery. Whether it is economic or whether sufficient heat can be recovered for the application, are issues that must be taken up on a case-by-case basis, whenever the following criteria are met:

New sewer pipes with heat exchangers
Source: Rabtherm

1. Sewage pipe minimum diameter 400mm (new), or 800mm (existing)
2. Average wastewater volume minimum 12 litres / second
3. Heat exchanger lengths minimum of 9m, maximum of 200m
4. Minimum consumer demand to be connected 80kW
5. Distance of sewer line to consumer demand maximum of 200m (built up) 400m (undeveloped)
6. User maximum heating feed temperature 70˚C

Factors that affect how much heat can be extracted from a sewer line include wastewater flow volume, flow temperature, and the rate at which pollution in the stream forms a drain skin reducing the heat transfer.

Obtaining heat from untreated sewage as it passes through a lift/pumping station is a possibility; heat can be extracted by pumping the sewage directly through a heat pump. To assist with the economics it is helpful for a project to be integrated with any new lift station being built. A flow of 100 litres per second of untreated sewage, if its temperature drops by 5°C, would provide about 2.1 MW of heat.
Extracting heat from untreated sewage prior to it reaching the wastewater treatment plant might negatively affect the treatment process by decreasing the temperature of the sewage. Metro Vancouver for example is concerned about this.
Heat recovery from treated sewage can occur at wastewater treatment plants. These have the advantage that all the sewage flows throughout the community are agglomerated, and so present a larger potential heat source.

Waste heat is ideal for space heating and heating of hot water; it often cannot be used for applications requiring heat greater than approx 70˚C, so cannot be used for many industrial heating applications that require higher temperatures.

Case Studies

Sewer lines: 25 applications of this technology worldwide as of 2008, mainly in Switzerland and Germany, feeding both individual buildings and district energy systems.

Lift stations: A handful of applications of this technology around the world (in Norway, Russia, Japan, and Canada), almost universally feeding district energy systems. South East False Creek Athletes Village is the only example in BC (or Canada).

Treated sewage heat recovery: There are many applications of this technology around the world. In BC examples include Okanagan College in Kelowna, the Whistler Athletes Village district energy system, and the new Saanich district energy system (that will also recover heat from two ice arenas).

Solar hot water

Solar hot water systems can be an excellent source of additional energy for buildings or district energy systems in BC, when used in conjunction with other systems. According to SolarBC most of the province receives more annual sunshine than Miami. Solar hot water systems can not be the sole energy source for a district energy system unless they have seasonal thermal storage, and this is still innovative (see Drake Landing case study below). It is more normal for solar systems to be used as a seasonal supplement to other more constant sources of energy. As solar systems provide their peak heat in the summer, they are normally sized to supply hot water demand rather than heating.

Solar hot water system on District of North Vancouver library, feeding a district energy loop. Source: N Harris SolarBC

Solar hot water systems can also be used to provide some heat balancing for ground heat exchangers where they face a large net heat extraction. In some cases this can significantly reduce the size of the heat exchanger (which can be useful where space is constrained), or is occasionally cheaper than the cost of the additional ground heat exchanger.

Advantages of solar hot water systems:

- Silent
- Produce zero air emissions
- Low maintenance
- Long lasting and durable
- Can take pressure off other energy sources
- Provide insurance against future energy price rises
- Provide a visual representation of environmental commitment

According to Taylor Munro Energy Systems, systems in BC can provide heat with a net present value as low as $0.02/kWh (equivalent to $5.6/GJ). Kelowna has one of the best solar resources of any community in the Province, and is a designated 'solar community' through SolarBC.

Case Studies

Solar hot water systems are one of the most common renewable energy technologies worldwide. Good examples include:

- City of Kelowna – installing solar hot water on the Athans Pool in Rutland
- District of North Vancouver library – BC's largest solar hot water installation feeds into one of Lonsdale Energy Corporation's natural gas-fired district energy loops
- South East False Creek – systems will be installed on some buildings with net metering, so that they can sell excess heat into the sewage-source district energy loop
- Drake Landing, Okotoks – this innovative residential development has a solar hot water only district energy system, with a seasonal thermal store

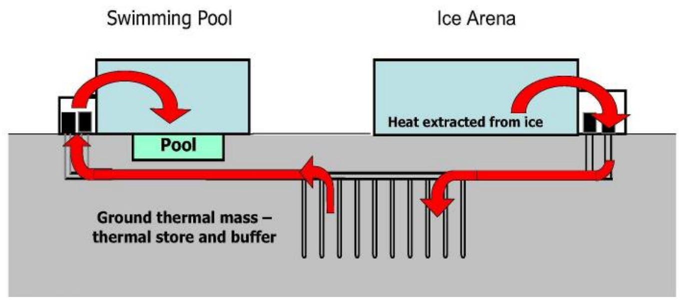


Diagram of inter-building ice arena waste heat utilization Source: EBA Consulting Engineers

Waste heat

Waste heat from buildings and industrial processes can be an excellent resource for a district energy system.

Waste heat can be obtained from certain facilities, such as sewage (covered separately above), ice arenas, some industrial and commercial facilities, and even some high-rise residential buildings.

Economics for utilizing waste heat can make it the 'low hanging fruit' of renewable energy opportunities, but the economics are specific to each case.

Waste heat often cannot be used for any application which requires heat greater than approx 70˚C, so cannot be used for many industrial heating applications that require higher temperatures. It is ideal for space heating and hot water.

Heat exchanger transferring arena waste heat to Juan De Fuca Pool Source: Accent Refrigeration

Case Studies

Examples in BC of systems utilizing waste heat include:

- Waste heat from Burnaby Waste-to-Energy plant is sold to a local paper recycling mill
- The City of Quesnel intends to use waste heat from a local sawmill to supply a new district energy system to heat buildings downtown
- Grand Forks and District Aquatic Centre recovers heat from the local ice arena (100 feet away), complementing a solar hot water system on the aquatic centre
- Heat recovered from Juan De Fuca Arena & Curling Club heats Juan De Fuca Pool (250 foot piping run). The project had a 2 year payback
- In Langford, the Westshore Arena will supply heat to the Westhills housing development district energy system in 2010, when work is completed
- The Capital Regional District's Panorama Recreation Centre recovers heat from two ice arenas for the pool, and in 2010 this system will link in with the new Saanich district energy system that will also recover heat from the local WWTP

Wood

The Province's 2008 report *An Information Guide on Pursuing Biomass Energy Opportunities and Technologies in British Columbia* estimated BC's sustainable bioenergy potential (not including the pine beetle resource) to be 35% plus, of the Province's total fossil energy demand – including all fossil energy for heating, industry and transport. Relative to other parts of the world BC has been slow in using modern technologies to use wood for energy purposes, but this is beginning to change. The report highlights wood to electricity and heat (small-scale, non-steam) systems as being the most efficient form of utilization in terms of displacement of other forms of energy.

Wood chip store at Revelstoke

One of the main barriers to implementation of urban biomass systems in BC is a public perception of biomass as having high particulate emissions; this perception is rooted in old polluting beehive burners. The perception is incorrect with modern efficient biomass systems if they burn clean wood. A recent independent report on a large biomass gasification system installed by the BC-based company Nexterra found that it had particulate emissions lower than a comparable natural gas system (gasification is a clean burning technology, but the installation in question also has an electrostatic precipitator). It is important that the source of wood be clean in order to have low emissions. Combustion systems (which are cheaper to install than gasification systems) do not have as good emission profiles, but they can still meet Provincial air emissions standards.

EMISSION IN lb/MMBTU				EMISSION IN lb/hr at USC			
	Average for 3 tests	Nexterra Contract Limits	EPA AP-42		Average of 3 tests at USC	USC Permit	Percentage of Permit
Opacity (%)	0	20	20	Opacity (%)	na	na	
PM (lb/MMBTU)	0.00221*	0.03	0.054	PM (lb/hr)	0.25	2.28	11
PM10 (lb/MMBTU)	0.0171	na	0.04	PM10 (lb/hr)	1.98	2.28	86
PM2.5 (lb/MMBTU)	0.00199**	na					
CO (lb/MMBTU)	0.0191	0.104	0.6	CO (lb/hr)	2.04	11.23	18
NOx (lb/MMBTU)	0.168	0.2	0.22	NOx (lb/hr)	19.46	21.6	90
VOC (lb/MMBTU)	0.0015	0.104	0.017	VOC (lb/hr)	0.155	11.23	14

* Same as natural gas boiler (EPA AP42)
**Calculated data. Not measured during USC's DHEC emissions test.

Air emissions testing at Nexterra's site at the University of South Carolina. Source: Nexterra

Wood pellets Source: CFuel

Wood pellets are small pellets made of compressed sawdust. The additional manufacturing input makes wood pellets more expensive than other forms of wood energy, but they are also considerably more energy dense and so can be transported much greater distances and still be both economic and retain a positive net energy balance. BC is a major global supplier of bioenergy in the form of wood pellets, supplying for example biomass district energy systems in Sweden. Although the vast forests of BC could theoretically be sustainably harvested to export wood pellets, wood pellet manufacturers have to date depended on a supply of cheap feedstock from mills to keep prices down, and as mills have closed and the supply of feedstock has decreased, the cost of pellets has increased. To date in BC wood pellet facilities have tended to be large. The next phase is likely to be smaller modular facilities.

Case Studies

Urban biomass district energy projects in BC include the prestigious Dockside Green neighbourhood in downtown Victoria, and Revelstoke town centre. The University of Northern BC campus in Prince George is in the process of installing a large hog fuel gasification system to supply 85% of the heat for the campus district energy loop. The UBC campus in Vancouver is also installing a biomass gasification system to heat campus buildings. Notable urban examples from the USA include: Seattle Steam, currently installing a large biomass boiler in the city centre opposite a 5-star hotel; and District Energy St. Paul, the largest biomass-fuelled district energy system in North America, heating 185 buildings plus 300 single-family homes (31.1 million square feet), and cooling 95 buildings.

Appendix 5 - Policy, bylaw and voluntary approaches to encouraging heating utilities and renewable heating systems

Bill 27 requires local governments to include GHG reduction targets in their Official Community Plan (OCP) by May 31, 2010, along with policies and actions proposed for achieving those targets. Planning and policy tools can be used to help local governments create the right conditions to support the development of heating utility and renewable heating projects, which can help meet OCP targets for GHG emission reductions. These tools are categorized in the following table and described in detail, below.

	Type		Planning and Development Phase		
Tool	Requirement	Incentive	Policy and Bylaw Development	Development Application Review	Permitting Process
Include supportive policies within the Official Community Plan		■	■		
Specify requirements within development permit area (DPA) guidelines	■		■		
Create a Local Service Area Bylaw	■		■		
Zoning Bylaw includes: • Zones for High Density and Mixed; and/or • Comprehensive Development Zones	■		■		
Revise Development Cost Charges Bylaw		■	■		
Amend the tax exemption bylaw		■	■		
Develop administrative bylaws that authorize waiving, reducing, or refunding of discretionary development processing fees		■		■	
Development cost charges are waived or reduced		■		■	
Voluntary requirements are negotiated as part of development permit, rezoning or OCP amendment applications		■		■	
Density bonusing considerations as part of development application		■			■
Expedited approvals		■			■
Reduced, waived, or refunded permit fees		■			■

Supportive Policies within the Official Community Plan

Supportive objectives and policies within OCPs provide important foundational elements to encourage the development of heating utilities and renewable heating systems in the community. They also raise awareness about the role for local government staff and developers in promoting these. Inclusion of such supportive policies in an OCP puts them on the agenda, and provides staff with an explicit mandate to explore energy opportunities in the community. Policies and actions on The City's own operations can provide leadership, demonstration and anchoring of broader projects in the community.

Development Permit Area (DPA) Guidelines

Bill 27 expanded local government authority to establish DPA requirements with respect to energy conservation and GHG reductions. Local governments may now establish DPAs for the purpose of promoting energy conservation and reducing GHG emissions, and within these areas, as a development permit condition specified in development permit guidelines, require specific features in the development, or machinery, equipment and systems external to buildings and other structures.

Local governments may be able to use these expanded powers to mandate particular types of renewable energy systems that can be located onsite, although this approach has not yet been explored by any local governments in BC. Although Bill 27 expanded the scope of DPA's as a tool for energy conservation, previously existing DPA powers for landscaping, siting and form have been used to promote passive solar heating in the City of Richmond and District of Saanich, and these types of requirements remain valid for energy planning today.

Local Service Area Bylaws

The *Community Charter* authorizes local governments to create a local area service and enables them to provide and charge for any service that council considers necessary or desirable, either directly or through another public authority, person or organization. Consequently, the City is able to provide local energy services, such as heating via a district energy system or through solar hot water systems for individual buildings, and charge for their use. A service area bylaw can be used to establish service areas for particular types of energy services (e.g. a hydronic district energy system) and to require buildings within the service area to connect to the energy source. A service area could encompass part or all of each of the City's areas. This approach was used by the Lonsdale Energy Corporation in the City of North Vancouver.

Zoning for High Density and Mixed Use

Promoting mixed-use, higher density development through zoning can establish the necessary conditions for alternative energy/heating supply utilities. Although developments with higher residential density and mixed uses do not on their own guarantee the financial and operational feasibility of district energy systems, they are necessary to provide a sufficient level of demand for heat.

Development Cost Charges

Local governments may now waive or reduce development cost charges (DCCs) for developments with low environmental impact or for a subdivision of small lots that is designed to result in low GHG emissions. As with previously allowed DCC exemptions, the requirements that must be met to receive a DCC reduction must be clearly stated in the DCC bylaw or regulation.

DCCs may be waived or reduced even if infrastructure cost reductions are not quantifiable. However, exemptions or reductions cannot be funded by charging higher DCCs on other projects, so a local government may still wish to associate any waivers or reductions with an avoided capital cost, to help justify the reduction. For example, a community designed to reduce automobile dependency may increase the longevity of local roads, avoiding maintenance costs or preventing the need to widen the road. Or, if a local government has determined that district energy infrastructure (such as underground pipes) must be constructed for a particular area in order to make it "district energy ready," this could be included in the capital plan and DCC bylaw, helping to offset costs to the local government of providing this infrastructure.

Tax exemption bylaw

The powers of tax exemption were strengthened in 2007, allowing local governments to use tax exemptions to encourage particular forms of revitalization, including environmental revitalization, primarily because long-term lower energy costs can help achieve local government revitalization objectives. In particular, the restriction of tax exemptions to areas designated as 'revitalization areas' has been removed. Tax exemptions can represent a significant financial benefit, and are an attractive incentive to the developer of a district energy system, particularly to help offset capital costs during the early stages of the project.

The Ministry of Community Development has prepared a guide on the use of revitalization tax exemptions. Local governments could also use the tax exemption power to promote green buildings or energy efficiency retrofits on existing buildings (e.g. properties that install solar panels or solar hot water heaters), or multi-building or neighbourhood-scale initiatives (e.g. heat pump or heat recovery system).

Voluntary Requirements at Development Application Stage

Consideration of the feasibility of a district energy system can become part of an agreement with a private developer if a zoning or OCP amendment, development permit, or the development of a comprehensive development zone is necessary to allow the proposed development. The City of Coquitlam used this approach for the Fraser Mills site.

Density Bonusing

The *Local Government Act* allows local governments to exchange density for amenities. This means that a developer may be allowed to build more units than what is normally permitted in the zone (via increased floor space ratio, site coverage or number of buildings per parcel) in exchange for the provision of amenities such as recreation centres, public squares, or pedestrian or bicycle paths. Typically these amenities have included parks, public areas, improvements to roads and sidewalks, public art, space for recreational or community services, and affordable housing, but this tool may be able to be used to promote a district energy system that serves as a community amenity. Density bonusing is only an incentive if both developer and local government agree that the site can reasonably accommodate more density, if both developer and local government agree upon type and value of the preferred amenity, and if the developer can anticipate a reasonable profit while providing the amenity.

Expedited Approvals and / or Reduced Permit Fees

Expedited approvals and reduced permit fees save developers time and money, and can provide an added incentive to consider district energy or renewable energy systems during development. The attractiveness of an expedited approval process for innovative projects should not be underestimated.

Further information on policy tools, as well as examples from other communities, can be found in *Energy Efficiency and Buildings: A Resource for BC's Local Governments* http://www.communityenergy.bc.ca/resources-introduction/energy-efficiency-buildings-a-resource-for-bcs-local-governments and in the Community Energy Association's *Renewable Energy Guide for Local Governments in BC -- Policy and Governance* module: www.communityenergy.bc.ca/resources/cea-publications-0

Appendix 6 - MOU between Okanagan College and City of Kelowna for WWTF effluent utilisation - Not included.