DISTRICT ENERGY PLAN

Comox Valley Regional District

Final Report

P851

November 5, 2025

RESHAPE STRATEGIES

Statement of Limitations

This report has been prepared by Reshape Infrastructure Strategies ("Reshape") and its partners for the exclusive use and benefit of Comox Valley Regional District ("Client"). This is a screening analysis, based on pre-design and representative cost and performance information. Strategies, performance and costs must be confirmed in the detailed design and vendor selection phases. This document represents the best professional judgment of Reshape and our partners, based on the information available at the time of its completion and as appropriate for the scope of work. Services were performed according to normal professional standards in a similar context and for a similar scope of work.

EXECUTIVE SUMMARY

District Energy Overview

District energy networks offer a cost-effective path to achieving net-zero emissions, particularly in densely populated urban areas. A key advantage of this infrastructure is its adaptability; once a heat network is established, it can draw heat from various sources. This flexibility means that these networks can be progressively decarbonized over time, much like how electricity grids have evolved.

These networks are also crucial for tapping into thermal renewable energy sources, such as heat pumps powered by renewables and other forms of recyclable heat. Furthermore, they encourage community participation, allowing both consumers and prosumers—individuals who can both consume and produce energy—to be involved in the development of sustainable local energy systems.

Modern district energy systems also bolster energy security by reducing a region's reliance on imported energy. This, in turn, stimulates local economies by creating jobs and generating tax revenue. When combined with energy storage, these networks can also help stabilize future electricity systems that have a high saturation of power from various sources.

The term "district energy" itself covers a broad spectrum of systems, which can vary significantly in size, the types of buildings they serve, and the climate they operate in. They also differ based on the heat sources they use and their operational temperatures and pressures.

Study Approach and Methodology

The study was designed to be a data-driven screening-level analysis of district energy (DE) opportunities within the Comox Valley Regional District (CVRD). The core methodology is built upon a geospatial framework, leveraging a regional building stock model (developed by Licker Geospatial) to systematically identify and prioritize viable DE projects.

Neighbourhoods were divided into DE and non-DE zones. A non-DE zone is one where building-scale approaches are the preferred pathway to decarbonize; alternatively, a DE zone is an area where it is likely that a district-scale approach is a lower lifecycle cost pathway to decarbonize the buildings in that area.

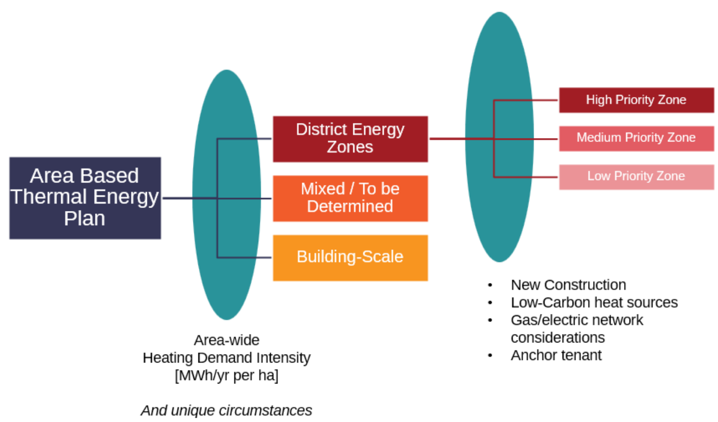

Figure 1: Illustrative Schematic of Study Approach

Regional Substation Analysis

Based on a review of data provided by BC Hydro, the distribution network serving the core municipalities in CVRD can serve 400 to 475 MVA of additional load within without the need to upgrade or install new transformer assets[1].

We anticipate that the CVRD will see approximately 300 MVA of incremental load growth by 2050 from new buildings, EV's, and the electrification of existing buildings. This is a 'high-bookend' estimate. Actual figures may be lower, based on real-world end-use load profiles, use of load management technology, and market proliferation of EV's and low-carbon buildings.

Based on this analysis, we do not anticipate that new load growth (including estimates for future building stock, electrification of existing buildings, and electrification of vehicles) will trigger the need for new substations with CVRD in the coming decades. BC Hydro will need to extend existing capacity by installing new feeders to serve power-constrained neighbourhoods. With the data provided by BC Hydro we were not able to pin point precise districts where new feeders will be required.

District Energy Opportunity Areas

The long list of DE opportunity areas was evaluated and prioritized based on the criteria in Section 3.4. The outcome of that exercise are shown on the map in Figure 14.

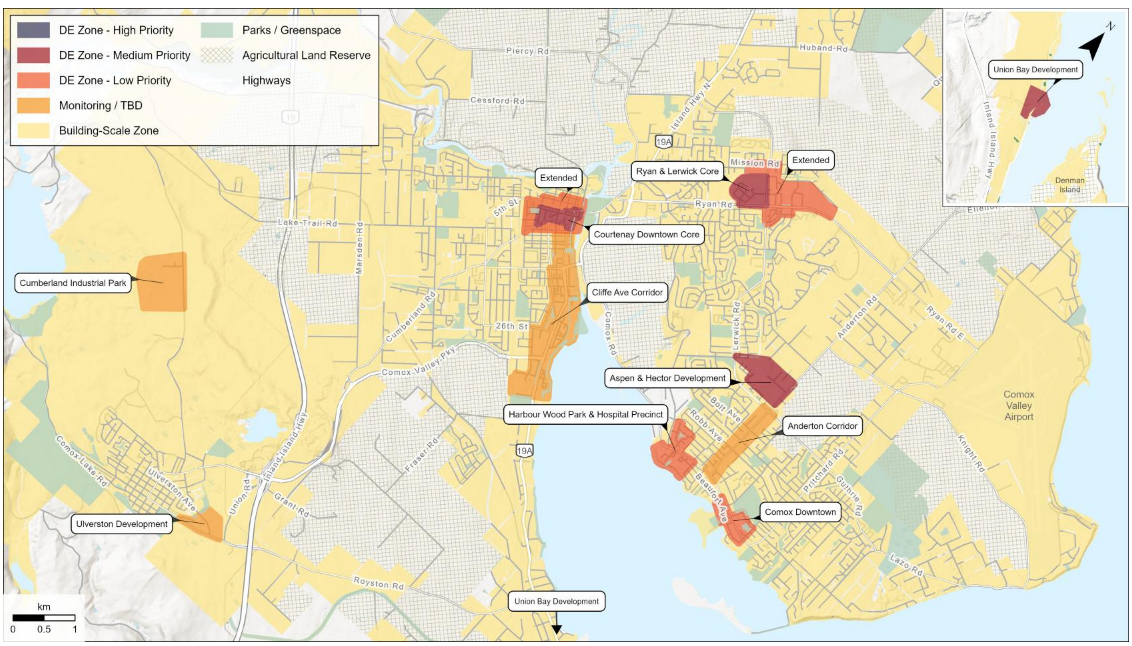

Figure 2: Area Based Thermal Energy Plan for Comox Valley Regional District

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[1] We have provided this as an aggregate figure (instead of a total broken down by substation). This reflects the fact that substation service areas can be adjusted to make up for lack of transformer capacity in neighbouring service areas. For example, the Puntledge Substation is likely to reach capacity based on existing and forecasted loads within the current service area; however additional service can be brought from Buckley Bay (which has plenty of excess capacity) to make up for this shortfall.

Next Steps

Our understanding of the Region's interest regarding District Energy Networks for new and existing neighbourhoods is based on the desire to enable certain outcomes for heating buildings in CVRD:

- Low-cost
- Low-carbon
- Low impact on BC Hydro grid

Based on this understanding and the findings of the study, should the CVRD be interested in pursuing district energy within the region the following actions would be recommended. We have also included recommendations for any Partner Municipalities that are interested in collaborating with CVRD on this file.

CVRD

- Provide commitment to connect Region-owned buildings to a future DE System
- Provide resources to lead grant applications where applicable
- Confirm development timelines and stakeholder interest in DE Zones

Municipalities

- Consider adopting the Zero Carbon Step Code for New Construction[2]
- Implement an alternate Step Code compliance pathway for DE-connected buildings (buildings are permitted to have higher energy use if energy supply is from a City-approved low-carbon source)
- Consider a Building Emissions Policy for Existing Buildings
- Ensure Buildings in DE Zones are Ready to Connect
- Leverage City-owned Land for DE equipment

Depending on the ownership model selected, CVRD may wish to initiate a DE Feasibility Study for some or all of the Medium Priority DE Zones. A site-specific Feasibility Study will provide more detailed techno-economic analysis of the specific DE system and its benefits as compared to building-level electrification as a pathway to decarbonization, providing the Region with a clearer picture of the economic viability of the project as well as the preliminary engineering work required for next steps. If CVRD advances a 100% publicly owned model this is a necessary step in DE implementation. If CVRD advances a Hybrid model, they may choose to wait until a partner is onside to initiate a study. The partner can bring their expertise, financial resources, and be more open to risk sharing at subsequent stages if they are involved in the Feasibility Study.

CVRD may want to pursue stakeholder consultation for the identified DE zones, as an initial filter before deciding to move forward with implementation. Potential stakeholders may include building owners and residents, partner Municipalities, BC Hydro, and private DE Utilities.

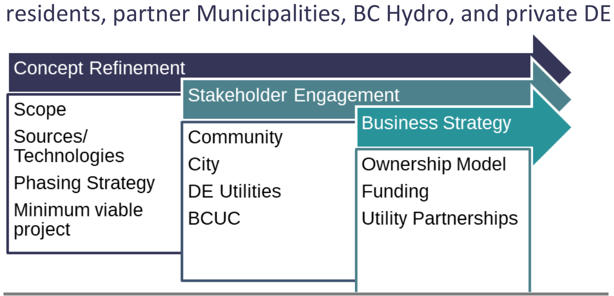

Figure 3: Framework for Next Steps and Implementation

[2] Courtenay council has passed a motion to adopt Step 3 of the Zero Carbon Step Code by the end of 2025 and Step 4 by 2028.

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1 INTRODUCTION

The Comox Valley Regional District is anticipating a significant amount of new development in the coming decades, with higher density built-forms expected in certain city centers and urban growth areas. Comox, Courtenay, and Cumberland have implemented green building standards aimed at minimizing the operational greenhouse gas (GHG) emissions form this new construction in order to meet climate objectives. Further, the Region has a number of buildings and facilities that they have a mandate to decarbonize.

District energy may provide a platform for this new construction, and existing buildings to fulfill green building requirements, and other climate objectives, while minimizing potential impacts on the power grid. **The scope of work of this study is to compare building-scale and neighbourhood-scale approaches to heating buildings in order to assess if there are advantages to neighbourhood-scale approaches, and if so identify areas of highest priority.**

If it is determined that a DE network is feasible for an area (or areas) of the Region, the outcomes of this study will be used to: define possible DE technical concepts and energy supply options, inform the next steps with respect to ownership and models, and begin conversations with third parties (E.g. developers, BC Hydro, potential customers, etc.).

The CVRD was initially interested in investigating District Energy as a means to address and reduce CVRD corporate (operational) GHG emissions. Following discussions with BC Hydro, it was understood that DE may also play a complementary role in managing the local power grid as the Region (and more broadly the Province) plans to decarbonize existing and new buildings. With these two interests in mind the study was expanded beyond public buildings to include all new and existing building in the Region.

Public GHG Emissions Targets

In 2019, the CVRD's corporate GHG emissions exceeded 1,600 tonnes of carbon dioxide equivalent (tCO_2e). More than 80% of corporate emissions in 2019 came from CVRD-owned buildings, with the large majority of emissions attributable to the two public Recreation Centers[3]. The CVRD has implemented a Corporate Energy & Emissions Plan (CEEP) to tackle rising emissions and move the CVRD closer to its GHG emission reduction targets – which includes a commitment to achieve net zero emissions by 2050. The Corporate Energy & Emissions Plan highlighted District Energy as a potential pathway to address emissions associated with new and existing buildings in the Region.

Table 1: CVRD Corporate GHG Emissions by Department, 2019

Category	GHG Emissions (tCO_2e)
Recreation	1,051 (65%)
Administration	292 (18%)
Wastewater	192 (12%)
Other	82 (5%)
Total	**1,617 (100%)**

[3] Comox Valley Regional District, Corporate Energy & Emissions Plan

The CVRD is a signatory of the BC Climate Action Charter. Charter signatories commit to becoming carbon neutral in corporate operations, as well as guiding communities to develop in a more complete, compact, and energy efficient manner.

One of the eight key goals of the CVRD Regional Growth Strategy is to minimize regional greenhouse gas emissions and plan for adaptation in the region. This goal is being carried out through several climate action initiatives, including the Comox Valley Sustainability Strategy, Comox Valley Rural Areas Community Climate Action Plan, CVRD Corporate Energy Plan, and the Transition 2050 Residential Retrofit Acceleration Strategy. The CVRD is also in the process of developing a Regional Climate Action Strategy which will focus on mitigation and adaptation measures to alleviate the pressures of climate change within the Comox Valley.

The Government of Canada and the Province of BC have both recently committed to achieving net zero emissions by 2050. To align with these higher-level targets, the CVRD has committed to reducing corporate emissions by 50% by 2030[4], and net zero by 2050.

1.1 Study Team

The Study Team is composed of Reshape as the project lead, KWL as the technical advisor for district energy concepts, and Licker Geospatial as the GIS Specialist. Table 2 summarizes the activities undertaken by each company in the execution of the project.

Funding for the study was provided by BC Hydro, who also collaborated with the study team to provide critical data on distribution system capacity in the Region, summarized in Section 4.

Table 2: Study Team Roles and Activities

Organization	Role	Activities
Reshape Infrastructure Strategies Ltd.	Project Lead	• Project Management • Lead Author • Power System Analysis • DE Prioritization and Evaluation • Ownership and Business Models • Final Recommendations
Licker Geospatial Consulting Co.	GIS Specialist	• Building Stock Model Development • GIS Support
Kerr Wood Liedal Associates Ltd. (KWL)	District Energy Technical Support	• Analysis of low-carbon heat supply alternatives • District Energy Technical Support

[4] Relative to the 2019 GHG emissions inventory

2 DISTRICT ENERGY OVERVIEW

2.1 What is District Energy?

DES consists of three key components: One or more energy centres (EC) to produce thermal energy; a distribution piping system (DPS) to connect ECs to individual buildings; and energy transfer stations (ETS) at each building to supply space heating, domestic hot water heating and/or cooling (Figure 4).

Energy Center (EC): A centralized hub containing the equipment the distributes and/or generates thermal energy services. The EC can be a standalone facility or co-located with a larger building with other uses.

Distribution Piping System (DPS): A network of pipes that distributed thermal energy between buildings. DPS are typically buried but can also run inside buildings (typically in below grade parkades)

Energy Transfer Station (ETS): The interface between the DPS and in-building thermal systems, that typically includes heat exchangers, metering, and controls equipment. A building may have more than one ETS if they are being provided with multiple thermal energy services (separate heating and cooling ETS, for example)

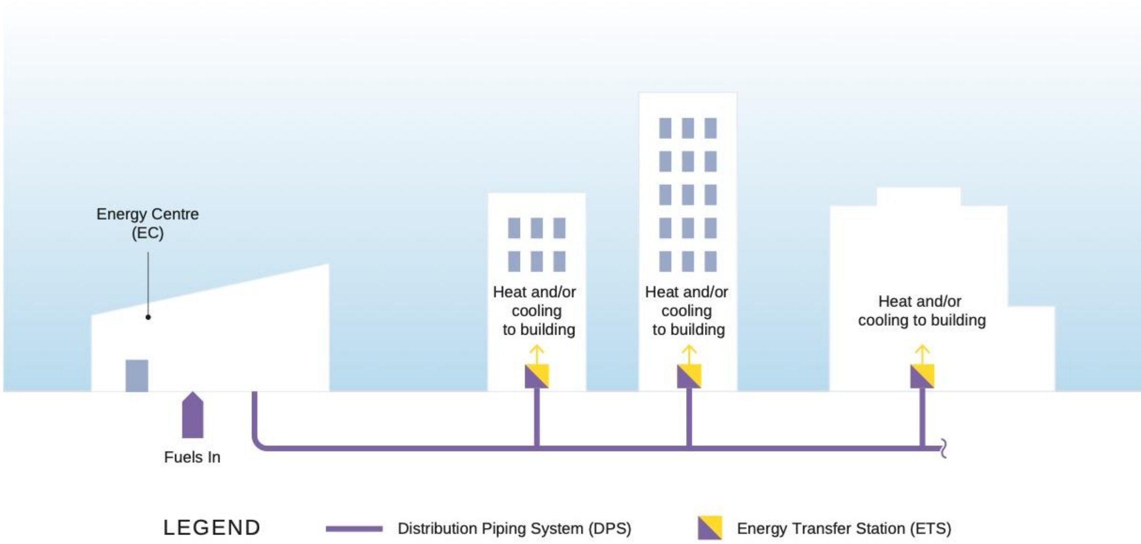

Figure 4: Schematic of District Energy components

Some District Energy networks include other elements such as Thermal Energy Storage (TES). TES can support a DE network in a number of ways including increasing run hours on capital intensive technologies, allowing the system to leverage time-of-use rates for power, and enhancing the resiliency of the network. TES can also support the broader energy system by helping to manage intermittent renewable power sources (tied to time-of-use rates). TES is typically orders of magnitude (i.e. 10-100+) times lower cost than electrical energy storage, and can be done with the need for exotic minerals

2.2 Drivers of District Energy

Historically, DE networks were established in dense urban areas because they offered a more efficient, cost-effective alternative to individual building systems, in a building footprint that was smaller footprint than the aggregate of all of the mechanical space that a DE system displaces in connected buildings.

DE was also instrumental in improving air quality in many cities by displacing coal, biomass, or fuel oil use in individual buildings. With the development of natural gas grids and rapid progress in gas boiler technology, some of the original value propositions of DE have waned, although older (legacy) DE systems continue to operate in many cities.

As cities have recognized the importance and need for climate action, there has been a renewed focus on GHG emissions from buildings and DE systems have regained a focus in the industry as platforms to catalyze low-carbon heating technologies at scale. One of the principal advantages of DE is that it can facilitate economies of scale and/or access to low-carbon energy resources that are not technically or financially feasible at the scale of a single building. Industrial equipment used in DE systems will often operate at a higher efficiency than commercial alternatives at the building-scale. Additionally, DE can unlock large sources of waste heat that no single user could fully utilize (e.g. data centres).

The move to low-carbon heating alternatives is adding strain to an already burdened power grid. With demands brought on by electrification of heating, transportation, and large power users (e.g. data centres), grid infrastructure (generation, distribution, & transmission) will need to increase significantly (2-3 times what took generations to build).[5]

District Energy can relieve the increasing strain on electrical generation and distribution systems by:

- enabling access to non-electric forms of low-carbon heat,
- centralizing electrical heating and cooling loads in energy centers so that they can be more easily managed through thermal storage, and
- during periods of extreme cold, electrified, low-carbon heating systems can be switched off and replaced by natural gas peaking boilers to manage the load on the electrical grid.

In the Comox Valley, several local conditions strengthen the business case for District Energy. The region is experiencing ongoing urban growth and densification in nodes such as downtown Courtenay, Comox Village, and emerging mixed-use developments near key transit corridors—creating the building density needed to support shared thermal networks. The community is also deeply committed to climate leadership, as reflected in CVRD and municipal greenhouse gas reduction targets and community energy plans, driving the shift away from fossil-based heating. The Comox Valley benefits from unique local low-carbon energy resources—including sewage heat recovery opportunities from existing wastewater infrastructure, potential industrial waste heat capture, and favourable groundwater/geo-exchange conditions—which may be only practical to harness at a district scale. At the same time, BC Hydro's grid faces increasing electrification pressures across the province; District Energy can help mitigate electrical capacity constraints in growth areas by reducing peak electric heating loads. Combined, these factors position District Energy as a potentially enabling platform to support compact, resilient, low-carbon growth in the Comox Valley while improving long-term energy affordability for residents and businesses.

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[5] While this is true at the provincial-scale, it is not necessarily the case that load growth and capacity burden is equally distributed in all regions. This is why a component of this Study was to analyze the regional distribution system capacity. This analysis is included in Section 4.

2.3 The Need for a Regional District Energy Plan

DE doesn't happen by coincidence; it takes deliberate planning and coordination with stakeholders to ensure that buildings do not default to easy choices that lead to sub-optimal outcomes.

The timeline for implementing DE is often long, so long-term coordinated planning is important. By the time a building has received a development permit, it is typically too late to connect it to DE platform.

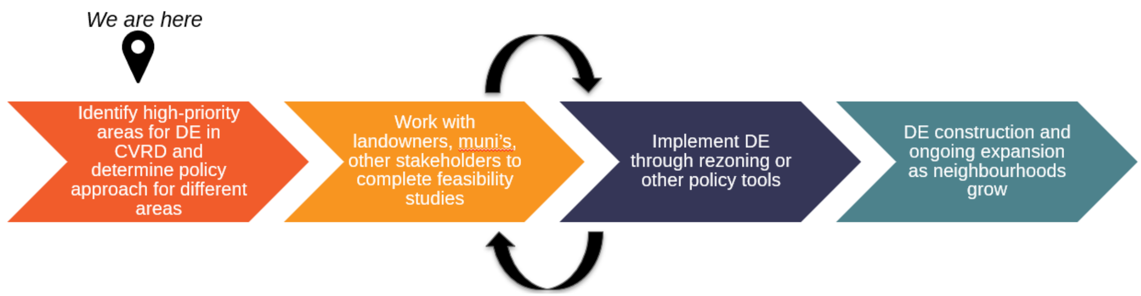

Figure 5: Process to develop and implement the CVRD DE Plan

CVRD has engaged Reshape in order to facilitate long-term energy infrastructure planning for the Region. This study will define area that are optimal for District Energy by first taking a look at the Region as a whole and determining where District Energy makes sense. These will be neighbourhoods where the anticipated heating demand is dense enough to support the additional capital cost of distribution piping and energy transfer stations needed for DE. However in these neighbourhoods, the outcome of this long-term planning outlook will be a lower-cost or more streamlined path to decarbonizing the buildings in those areas.

This study will identify the neighbourhoods and corridors that have the highest potential to support a District Energy system. Further feasibility studies and stakeholder engagement will be required to bring these projects to fruition. Should the CVRD or their member municipalities be interested in promoting district energy adoption in the region, the study will recommend possible roles and next steps for each local government.

3 STUDY APPROACH AND METHODOLOGY

The study was designed to be a data-driven screening-level analysis of district energy (DE) opportunities within the Comox Valley Regional District (CVRD). The core methodology is built upon a geospatial framework, leveraging a regional building stock model (developed by Licker Geospatial and informed by inputs from the regional municipalities) to systematically identify and prioritize viable DE projects.

Neighbourhoods were divided into DE and non-DE zones. A non-DE zone is one where building-scale approaches are the preferred pathway to decarbonize; alternatively, a DE zone is an area where it is likely that a district-scale approach is a lower lifecycle cost pathway to decarbonize the buildings in that area.

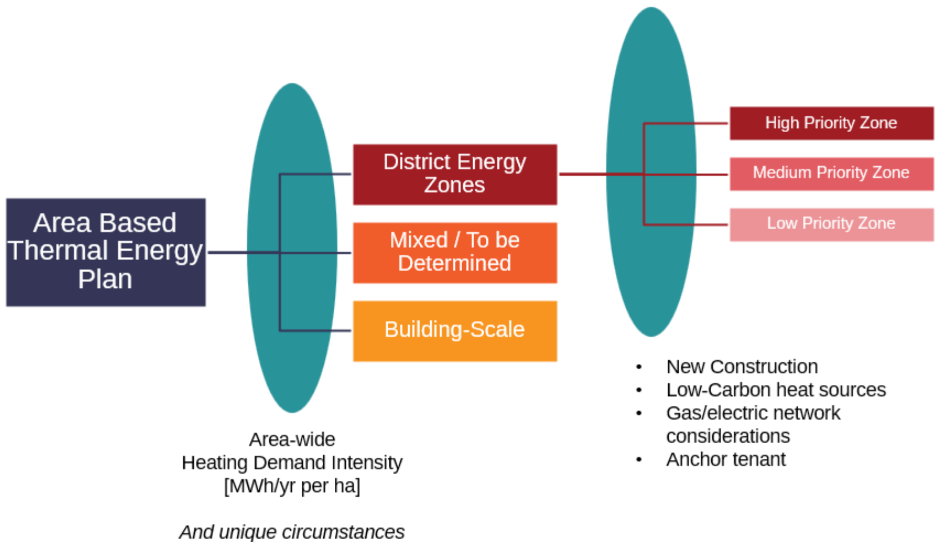

Figure 6: Illustrative Schematic of Study Approach

3.1 Building Stock Model

At a high level, the model considers anticipated housing demand and parcel-scale criteria to simulate the current building stock and a forecasted future for buildings at the parcel-scale for 2050. The model considers only Comox, Cumberland and Courtenay to support the purposes of the energy study[6]. Existing building stock data was retrieved from BC Assessment Building Information Reports, with post processing done by Licker Geospatial. Future floor area was forecasted based on a statistical model that incorporated known development sites (provided by the municipalities) as well as the redevelopment likelihood score. A detailed breakdown of the methodology used to develop the Building Stock Model is included Appendix A.

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[6] Electoral areas were not explicitly modelled in the GIS database, as these encompass areas of lower density with few likely opportunities for district energy. Several neighbourhoods in the EA's were still considered and screened as a part of this study (however they are not captured in the building stock model).

3.2 Building Heating Demand

Overlaid on top of the building stock model are heat demand intensity estimates (by year and occupancy type). The combination of these two inputs - the geospatial building stock model and the heating demand intensity values – provided the basis of the annual heating demand maps (see Figure 7 and Figure 8).

Heating demand for existing buildings was derived from the Community Energy & Emissions Inventory (CEEI) published by the Province of B.C. Values for new buildings were extrapolated from BC Energy Step Code requirements, as adopted in each Municipality.[7] The detailed inputs used in the study are included in Appendix C.

3.3 DE Zone Long List and Ranking

The primary driver for District Energy feasibility is high heat demand density. Presence of sufficient heat demand density (or forecasted heat demand density) is the metric that has the largest overall impact on the techno-economic viability of district energy.

Reshape filtered first for neighbourhoods with sufficient heat demand density in 2050 in order to develop a long list of potential DE opportunities areas. A heat demand density threshold was used in line with other screening level studies[8] (approximately ~200 MWh/ha) to populate the long list, which was then further evaluated and prioritized based on other metrics summarized in the following section.

Areas that did not meet this threshold were identified as 'Non-District Energy Zones', where a building-scale approach is likely to be the most economically viable pathway to decarbonization. These are areas where it is unlikely that the capital investment of a district energy network (including distribution piping, energy transfer stations, and centralized generation equipment) could be justified based on the projected revenues from the heat demand in the area. In these zones, installing building-scale low-carbon heating equipment (e.g. air-source heat pumps, ground-source heat pumps, electric heaters, etc.) would be the preferred pathway to decarbonize.

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[7] An adjustment factor was applied to thermal energy demand intensity (TEDI) requirements within the BC Energy Step code, to reflect the well documented performance gap between modelled and actual heating demand. Forecasted performance was assumed to be 15% above modelled values.

[8] See National Heat Study, District Heating and Cooling Spatial Analysis of Infrastructure Costs and Potential in Ireland

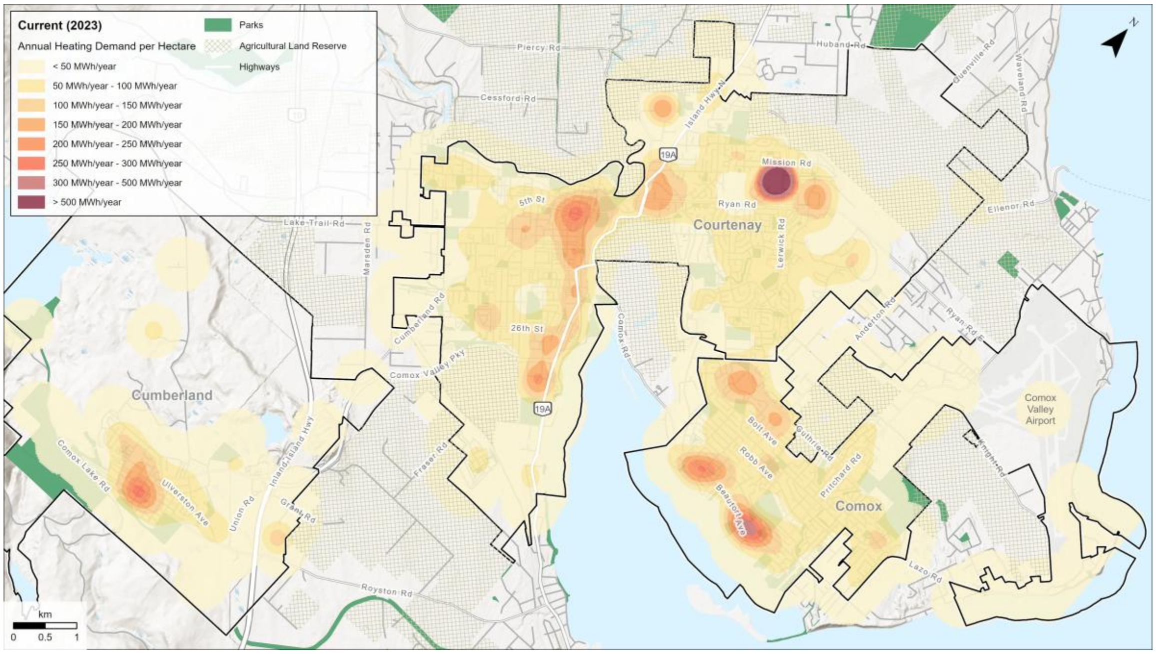

Figure 7: Current Estimated Annual Heating Demand, per Hectare

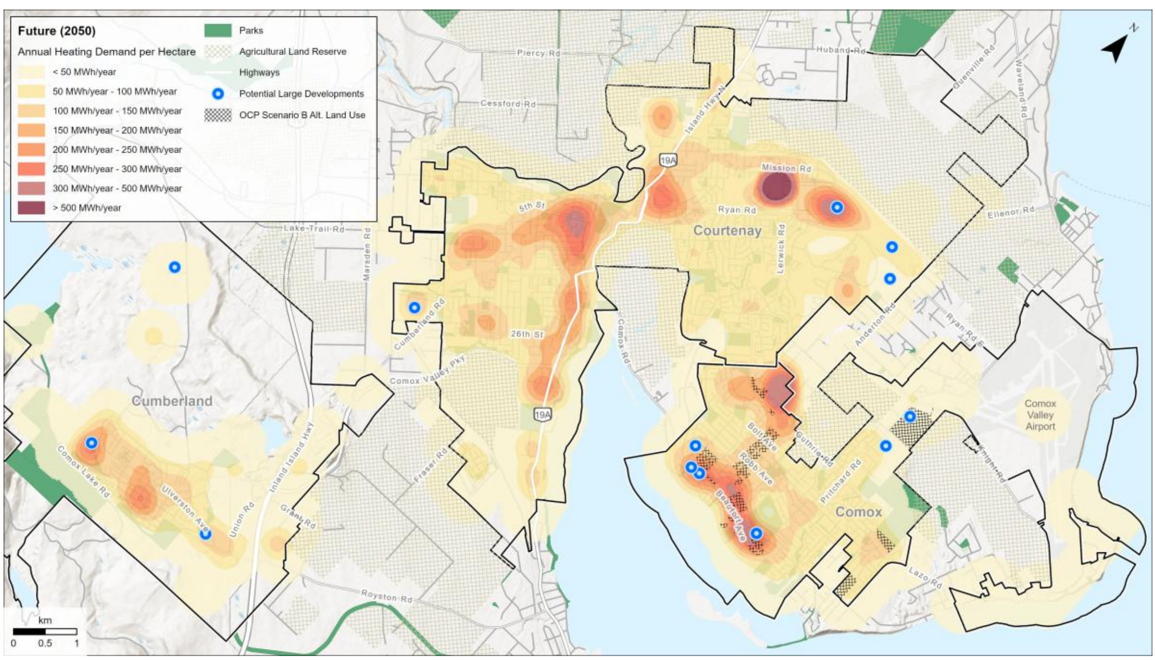

Figure 8: Forecasted (2050) Annual Heating Demand, per Hectare

3.4 Prioritization Criteria

Reshape developed the following evaluation criteria to prioritize the long list of DE opportunity areas (Table 5). This list and associated scoring and weighting was reviewed with CVRD staff in a workshop setting on March 12 2025, to confirm alignment and appropriate weighting.

The outcome of the scoring and prioritization are detailed in Appendix E and summarized in Section 5.

Table 3: DE Opportunities, Criteria and Weighting

Criteria	Description	Range	Weighting
Heat Demand Density	Determined based on heat density (MWh/ha) and schedule of anticipated development e.g. near-term (<5yrs), mid-term (5-10 yrs), long-term (10+ yrs)	0 to 3	High *(x5)*
Source of Low-Carbon Heat	May include geo-exchange, sewer heat, ice rink, ocean-heat, commercial refrigeration, industrial process heat, data center, etc.	0 to 3	High *(x3)*
Power Grid Congestion / Planned Upgrade	Is there a substation that is approaching capacity? Will a new feeder be needed to accommodate building-scale electrification?	0 to 3	High *(x3)*
CVRD/Public Anchor Customer	Are there public buildings in the area that can serve as anchor load	0 to 3	High *(x3)*
Limited Number of Developers/Owners	Areas with fewer stakeholders that will need to sign on as customer score higher = single campus/customer.	0 to 3	Med *(x2)*
Building Mechanical Systems	Do the potential customer buildings have mechanical systems that are compatible with a district energy system? Are mechanical systems nearing end-of-life and due for replacement?	0 to 3	Med *(x2*
Energy Center	Is there an obvious and/or no-cost site for energy center equipment (e.g. publicly-owned land)	0 to 3	Low *(x1)*
Infrastructure Coordination	Can a DE network be installed in parallel with other planned infrastructure renewal in the area (e.g. road construction, sewer upgrade etc.)?	0 to 3	Low *(x1)*

3.5 Low-Carbon Supply Alternatives

KWL was retained by Reshape Infrastructure Strategies to prepare a screening level analysis on available low-carbon energy supplies in the Comox Valley Regional District (CVRD). The technical memo is attached in full as Appendix B, generally focusing on the urbanized areas of Courtenay, Comox, Cumberland and surrounding communities. The findings of this analysis informed the evaluation of each of the DE opportunities identified.

Reshape began with a long-list of low-carbon heating technologies, summarized below in Table 4. Many low-carbon technologies are not applicable to district energy opportunities in CVRD for reasons of scale or availability. The long-list was screened down to four low-carbon technologies which were analyzed in detail by KWL – wastewater heat recovery, geothermal, solid waste, and clean water heat recovery. A summary of KWL's findings is included in the sections below. Notes on how the long-list was screened are included in Table 4.

Proximity to one of the low-carbon resources was a highly weighted criteria in the evaluation process (as shown on Table 3). The resource-specific sections below outline the availability of each of the four low-carbon heat sources. However the proximity to these resources is summarized in Section 5.2 Summary of DE Opportunity Evaluation.

Table 4: Longlist of Low-Carbon Heating Technologies

Type	Technology	Subcategory	Notes
Electric	Electric boiler		High strain on the power grid, should be considered for peak demand but not recommended as a baseload heating technology.
Electric	Heat Pumps	• Sewer Heat Recovery • Geo-exchange • Cooling Heat Recovery • Industrial Waste Heat • Ocean / River water	Availability of the resource is site specific. If available (at appropriate scale), these are typically the recommended resources for baseload heating.
Electric	Heat Pumps	• Air Source	General purpose alternative (availability of resource isn't determined by site), but typically less efficient than other HP alternatives.
Bio-energy	Biomass boiler	• Pellets • Chips • Engineered fuels	Biomass can be difficult to site in urban areas. Availability and transportation of long-term fuel supply must also be considered.
Green Gases	Boiler	• Renewable Natural Gas (RNG) • Hydrogen	Long-term availability and cost benchmark of RNG is uncertain. Should only be considered for peak/super-peak demand.

Type	Technology	Subcategory	Notes
	Combined Heat and Power Reciprocating Engine Fuel Cell Gas Turbine	• Renewable Natural Gas (RNG) • Hydrogen	Same as above
Other	Deep Geothermal[9]		CVRD does not have the scale / density to justify capital requirements
	Waste-to-Energy		No existing waste incinerator in the targeted communities
	Small Modular Reactors		Not applicable for CVRD
	Industrial Waste Heat	(direct use)	No sources identified

Wastewater Potential

CVRD and Village of Cumberland are both currently completing Phase 3 of their Liquid Waste Management Plans (LWMP). The Comox Valley Sewer Conveyance Project includes replacement and upgrading of several existing pump stations and major sewer pipes. The CVRD is also extending regional trunk sewerage service to several unserved communities outside Courtenay and Comox.

Wastewater energy available is based on the flow and potential drop in temperature. Assuming a minimum discharge temperature of 6 ºC, the maximum available heat in winter from the CVWPCC would be around 5-6 MW (see Figure 1) and up to 8 MW in the summer. More typically a heat recovery system would drop the wastewater temperature by 3-4 ºC, which would yield about 2.4 MW in summer and almost 4 MW in winter.

[9] Deep geothermal is the process of extracting thermal energy from hot rocks and fluids deep within the Earth's crust, typically at depths of up to several kilometers to provide heat and/or generate electricity. This is distinct from conventional geothermal (or 'geo-exchange') in which shallow boreholes (typically 500m to 800m) are used to inject and extract heat from the near-surface ground layer.

KWL also reviewed the City of Courtenay Wastewater System Master Plan, which included some flow monitoring data for the main trunk lines flowing into Courtenay Pump Station. This indicated average dry weather flow (ADWF) in the 40-50 L/s range for both trunk lines, which added up would be approximately two-thirds of the flow arriving at CVWPCC. Since this location is much closer to the regional town centre, there may be around 2 MW to 3 MW of recoverable heat to support a thermal network in this area.

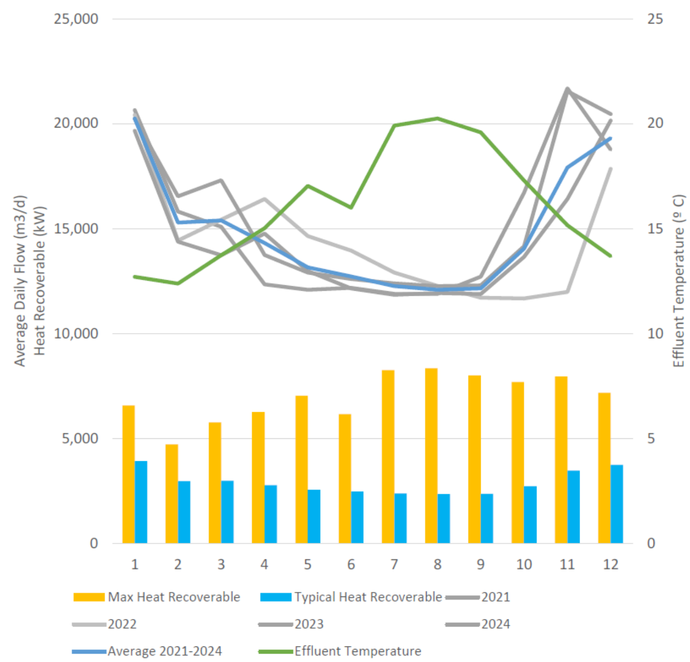

Figure 9: Wastewater Energy Available at CVPCC

The Village of Cumberland has much lower flow rates (~600 m3/d) as it is a small population compared to the CVRD wastewater system. The wastewater effluent from the treatment plant could support approximately 200 kW of load which is likely too small to be developed economically.

Based on these findings, the most viable location to recover wastewater heat would be from or near the Courtenay Pump Station, which has approximately 2 to 3 MW of recoverable heat and which is in relatively close proximity to the city center.

Solid Waste

There are no existing waste-to-energy facilities in the Region. According to the 2017 Waste Composition Report the combined regional service area received about 71 tonnes of clean wood waste, not enough to consider as a significant fuel source for a district energy system.

According to the 2023 CVWMC Annual Report approximately 2.2 million m3 of methane was collected, however we understand that CVRD is already in discussions with Fortis to upgrade and inject this into the existing gas-grid.

Geothermal

According to CanGEO, most of Vancouver Island including the Comox Valley is located in an area of very low deep geothermal potential, therefore it is not recommended to consider this form of geothermal as a potential source.

Alternatively ground-source heat pump (GSHP) systems. In general, GSHP systems perform best when there is a balance of heating and cooling. GSHP systems can be implemented in a variety of conditions, though typically a large open space such as a parking lot or playing field is ideal because the underground components can be excavated in the event of a fault or leak. Nonetheless many systems have been installed beneath buildings and there are technologies such as geopiles that are completely integrated with buildings.

Geothermal heating and cooling systems[10] offer exceptionally high seasonal efficiency compared to other low-carbon options because they use the stable temperatures underground to transfer heat rather than generate it. This results in lower operating costs and significant reductions in greenhouse gas emissions. They are also known for being low-maintenance with long equipment lifespans, since much of the system is protected underground and has few moving parts. With decades of proven performance in a wide range of climates, geothermal systems deliver reliable, comfortable heating and cooling year-round.

Water Resources

Seawater: Permitting requirements for using seawater are extensive, including both provincial and federal permits from multiple agencies. Due to these complexities seawater heat exchange projects tend to only be deployed for larger-scale applications or where there is a synergy with a co-located project (e.g. marina with resort development) where a foreshore lease / water lot can be 'piggybacked' upon.

Surface Water: Most surface water bodies of sufficient size to use for thermal energy are likely to be fishbearing. The most limiting factor could be use of surface water for cooling as the rejected heat could increase surface water temperature in summer months when temperatures are at their peak.

Groundwater: Groundwater-based heat pump systems (GWHPs) perform similarly to GSHPs, but tend to have complex maintenance requirements, especially for injection systems. Typically one or more extraction wells would require two to three times as many injection wells to balance the flows. Maintenance issues may relate to water quality, biological growth, pump inspection and maintenance and heat exchanger fouling.

In summary, water resources are somewhat abundant but practically challenging to implement as a source of thermal energy exchange.

[10] The Westhills Thermal Energy System (TES) located in Langford, B.C. is a geoexchange system with 212 vertically drilled wells, with water-to-water heat pumps and heat exchangers which are in a central energy plant. The Westhills TES also uses centralized natural gas boilers and a waste heat recovery system connected to the Westhills Arena, a nearby ice rink, owned by the City of Langford. The Westhills system is a useful local precedent for CVRD.

This is an 'ambient' system meaning the heat pumps are located in the buildings served by the TES. According to filings with BCUC the Westhills system has a capacity of approximately 3 MW heating (including peak/backup boilers) and 1.5 MW cooling, and in 2018 produced about 2,300 MWh of heat and 1,300 MWh of cooling to 425 connections.

4 REGIONAL SUBSTATION ANALYSIS

BC Hydro owns and operates the power grid serving buildings in the CVRD (See Figure 10). A primary driver for district energy systems in B.C. is to mitigate the future potential impact of low-carbon heating on the provincial grid. The analysis in this section provided the insight used to evaluate and prioritize DE opportunities on their potential to relieve grid constraints (a full list of prioritization criteria is included in Table 3).

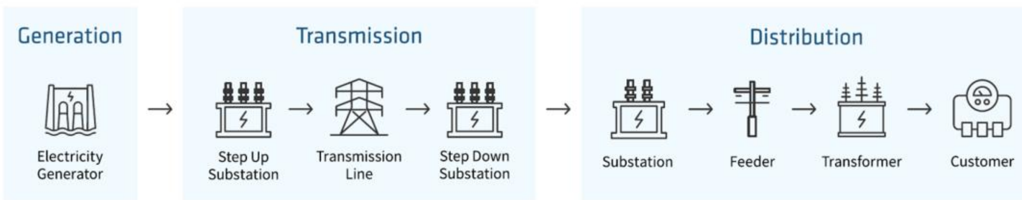

Figure 10: BC Hydro Grid Components, Schematic

The Comox Valley Regional District power system is part of a large, interconnected provincial transmission and distribution network that delivers electricity generated from mainly hydroelectric sources. The provincial grid is anchored by BC Hydro's major generation facilities in the Interior and northern regions of British Columbia, with power transmitted over high-voltage transmission lines to the southern and coastal load centres. On Vancouver Island, including the Comox Valley, electricity supply comes from both local generation sources and the provincial mainland via high-voltage submarine transmission cables running across the Georgia Strait. These submarine cables connect the island's transmission network to the mainland grid, ensuring redundancy and stability in supply.

Once on Vancouver Island, power is stepped down at regional substations to lower voltages suitable for local distribution. In the Comox Valley, BC Hydro operates transmission lines and substations—including the Comox, Puntledge, Oyster River, and Buckley Bay substations—that serve as key nodes in routing electricity to municipalities, rural communities, and industrial customers. These substations receive high-voltage power (typically 138 kV or 230 kV) and transform it to distribution voltages (25 kV), which are then delivered via overhead and underground distribution lines. From there, neighborhood transformers further reduce the voltage for residential and commercial use.

The Comox Valley load profile is shaped by a mix of urban, rural, and industrial demand. Residential consumption dominates in the City of Courtenay, Town of Comox, and surrounding communities, while light industrial and commercial loads add further demand. Seasonal variations in load are notable, with winter peaks driven by electric heating, and summer peaks moderated by the area's mild climate.

4.1 Existing Distribution System Assets and Capacity

In the Comox Valley Regional District (CVRD), the local distribution network is supported by four main substations that step voltage down from 138 kV to 25 kV: Comox, Buckley Bay, Oyster River, and Puntledge. These substations are key parts of the electrical system, converting high-voltage electricity from the provincial transmission grid into lower-voltage power that can be used by homes, businesses, and other facilities in Courtenay, Comox, and Cumberland.

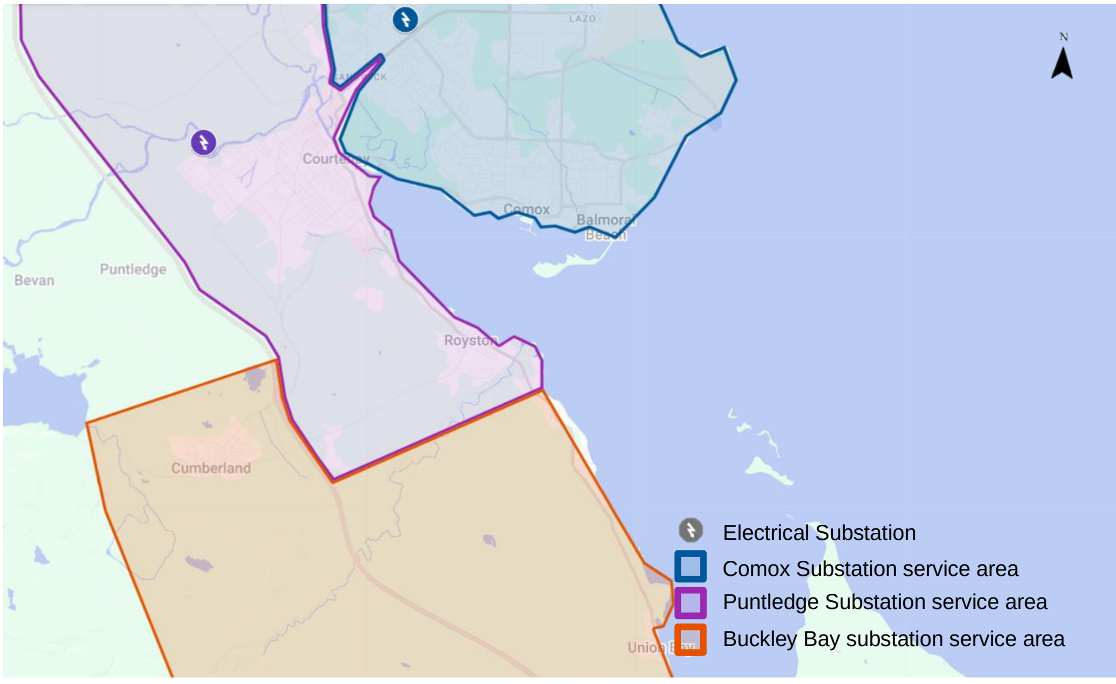

Figure 11: Approximate boundaries of service areas for substations in CVRD

Reshape solicited capacity information from Distribution Asset Planning group at BC Hydro. Current capacity data shows that the Comox Substation has between 15 and 50 MVA of available feeder capacity, Buckley Bay has 1 to 25 MVA, and Puntledge has between 20 and 30 MVA. Each substation also has space for a limited number of additional feeders (beyond those already installed) that can be utilized without triggering a wholesale substation upgrade. New feeders are installed in areas where new load growth cannot be served by existing line capacity. Each new feeder would provide an additional 13MVA of capacity.

The total additional capacity that can be provided by each substation through installation of new feeder lines is summarized in Table 5. BC Hydro was not able to provide capacity information at the feeder level[11].

In total, considering capacity within existing feeders as well as capacity that can be added in the form of new feeders, BC Hydro can serve 400 to 475 MVA of additional load within the service area of the three main CVRD substations, without the need to upgrade or install new transformer assets.

One of the reasons for this excess capacity is the new Buckley Bay Substation which was completed in 2016, a capital project driven by forecasted demand growth in the southern portion of the CVRD and capacity

[11] Reshape was advised that due to the dynamic nature of the distribution system (with the ability to shift loads from one feeder to another, and requests for new or upgraded service that are continually in process) it is difficult to accurately convey the available capacity for a single feeder in a distribution area. Instead, BC suggested that aggregate transformer capacity at the substation should be analyzed

constraints on existing feeders. The project cost a total of $44 million[12] over four years and significantly increased the total available transformer capacity in the Region.

Table 5: Capacity of substations serving CVRD, per BC Hydro Distribution Asset Planning group

Substation[13] (138kV-25kV)	Remaining Capacity of Existing Feeders (low/high)	Capacity that Can Be Added from New Feeders
Comox	15 MVA / 50 MVA	130 MVA
Buckley Bay	1 MVA / 25 MVA	200 MVA
Puntledge	20 MVA / 30 MVA	40 MVA

4.2 Projected Load Growth

The Comox Valley region will see substantial additional power demand in the coming decades from population growth in addition to decarbonization efforts and electrification of transportation. The magnitude of incremental power demand will determine the additional investment that will be required to reconfigure and grow the distribution network in response.

Reshape has developed an order-of-magnitude estimate of the anticipated load growth within the three main municipalities[14]. Our estimates consider additional load growth from new buildings[15], as well as the electrification of heating and vehicles. Full details of the analysis are included in Appendix D, with a summary provided on Figure 12.

Load growth figures are based on the outputs from the building-stock model developed by Licker-Geospatial, with input from Reshape on building energy performance.

We have applied diversity factors to estimate the anticipated grid-coincident peak demand. With respect to heating loads, our analysis assumes that all buildings (both new and existing) in the region will fully decarbonize by 2050 in-line with provincial climate targets.

We anticipate that the CVRD will see approximately 300 MVA of incremental load growth by 2050 from new buildings, EV's, and the electrification of existing buildings. This is an order-of-magnitude estimate based on conservative input assumptions (ie. high-bookend load growth scenario).

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[12] $32 million for the substation cost as well as an additional $11.5 million to the substation to the local electricity distribution system, per BC Hydro

[13] Although the Oyster River Substation is also located within the CVRD, it is not included in this analysis because it does not serve any high-density areas (ie. the three primary municipalities), where district energy is most feasible.

[14] The electoral areas were excluded to simplify the analysis, noting that new power demand will be mostly concentrated in urban areas

[15] Base building loads include non-heating end-uses, eg. lighting, plug loads, pumps, refrigeration etc

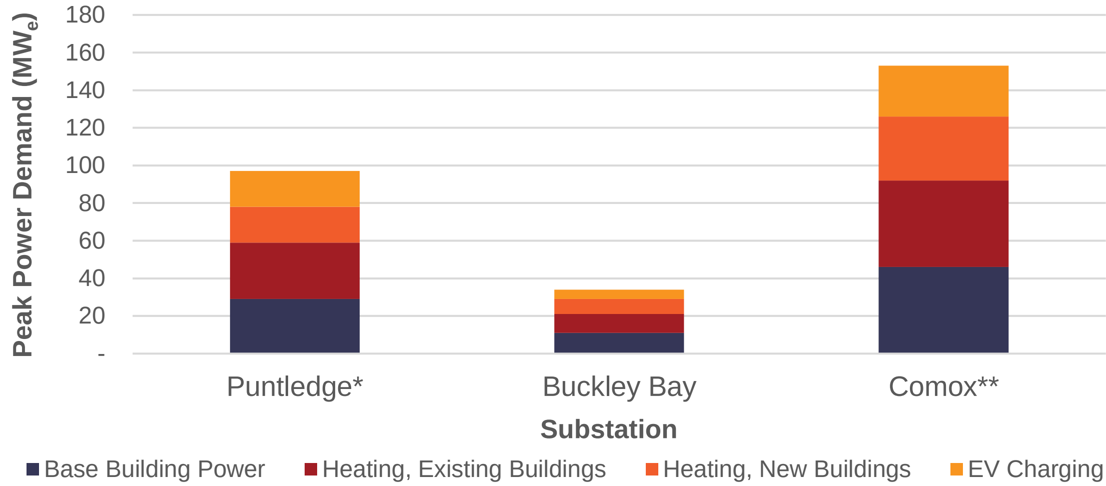

Figure 12: Forecasted Incremental Power Demand by 2050 (Order of Magnitude Estimate)

4.3 Cost of Grid Expansion

Reshape organized a meeting with BC Hydro's Distribution Asset Planning group on February 13th, 2025 to solicit input on the potential cost of new feeder lines within existing substations. Costs include electrical work at the substation, civil work to bury new feeder lines, as well as the materials cost of the feeder itself. New feeders can sustain approximately 13 MVA of capacity. The order-of-magnitude cost estimates provided by BC Hydro are shown on Table 6. BC Hydro also advised that the cost for a new substation (if required) would be on the order of $50 to $400 million, depending on size and location.

Table 6: Cost to Install New Feeders (13 MVA) Within Existing Substation (Order of Magnitude)

Item	Substation Work	Civil	Feeder Cost	**Total ($M)**
Cost ($M)	2	2	6	**10**

4.4 Conclusions from Regional Substation Analysis

Based on a review of data provided by BC Hydro, the distribution network serving the core municipalities in CVRD can serve 400 to 475 MVA of additional load without the need to upgrade or install new transformer assets[16].

We anticipate that the CVRD will see approximately 300 MVA of incremental load growth by 2050 from new buildings[17], EV's, and the electrification of existing buildings. This is a 'high-bookend' estimate. Actual figures may be lower, based on real-world end-use load profiles, use of load management technology, and market proliferation of EV's and low-carbon buildings. Detailed assumptions used for each of the end-use load projections are included in Appendix D.

Based on this analysis, we do not anticipate that new load growth will trigger the need for new substations with CVRD in the coming decades. BC Hydro will need to extend existing capacity by installing new feeders to serve power-constrained neighbourhoods. With the data provided by BC Hydro we were not able to pinpoint precise districts where new feeders will be required.

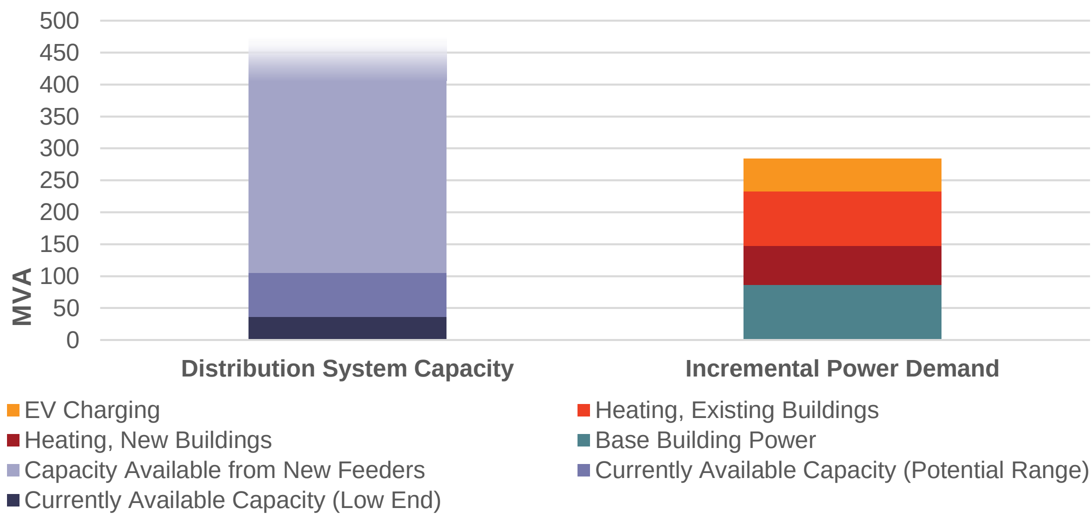

Figure 13: Forecasted Power Demand And Available Capacity (2050), Order of Magnitude Estimate

[16] We have provided this as an aggregate figure (instead of a total broken down by substation). This reflects the fact that substation service areas can be adjusted to make up for lack of transformer capacity in neighbouring service areas. For example, the Puntledge Substation is likely to reach capacity based on existing and forecasted loads within the current service area; however additional service can be brought from Buckley Bay (which has plenty of excess capacity) to make up for this shortfall.

[17] We note that most new buildings constructed between today and 2050 are likely to be fully electric to conform to the Zero Carbon Step Code. Courtenay council has passed a motion to adopt Step 3 of the Zero Carbon Step Code by the end of 2025 and Step 4 by 2028.

5 DISTRICT ENERGY OPPURTUNITY AREAS

5.1 CVRD Area Based Thermal Energy Plan

Neighbourhoods were divided into DE and non-DE zones, based on the heating demand density. A non-DE zone is one where building-scale approaches are the preferred pathway to decarbonize; alternatively, a DE zone is an area where it is likely that a district-scale approach is a lower lifecycle cost pathway to decarbonize the buildings in that area.

The long list of DE opportunity areas was evaluated and prioritized based on the criteria in Section 3.4. The outcome of that exercise are shown on the map in Figure 14.

It should be noted that the zone boundary areas are indicative only. Not all buildings in DE Zones need to be, or are likely to be, connected to a DE network (instead think of 'most' buildings in a given zone). Similarly, we do not suggest that there can be no DE networks in building-scale zones – there may be unique circumstances and small pockets of development that make sense for a district energy system. In general, the map shown on Figure 14 is a guideline for CVRD and municipal partners. Electoral areas within CVRD that are not shown on the Figure 14 should be considered building-scale zones.

A detailed description of DE and non DE zones along with a list of neighbourhoods is included on Table 7.

The full details of the scoring for each area is included in Appendix E,

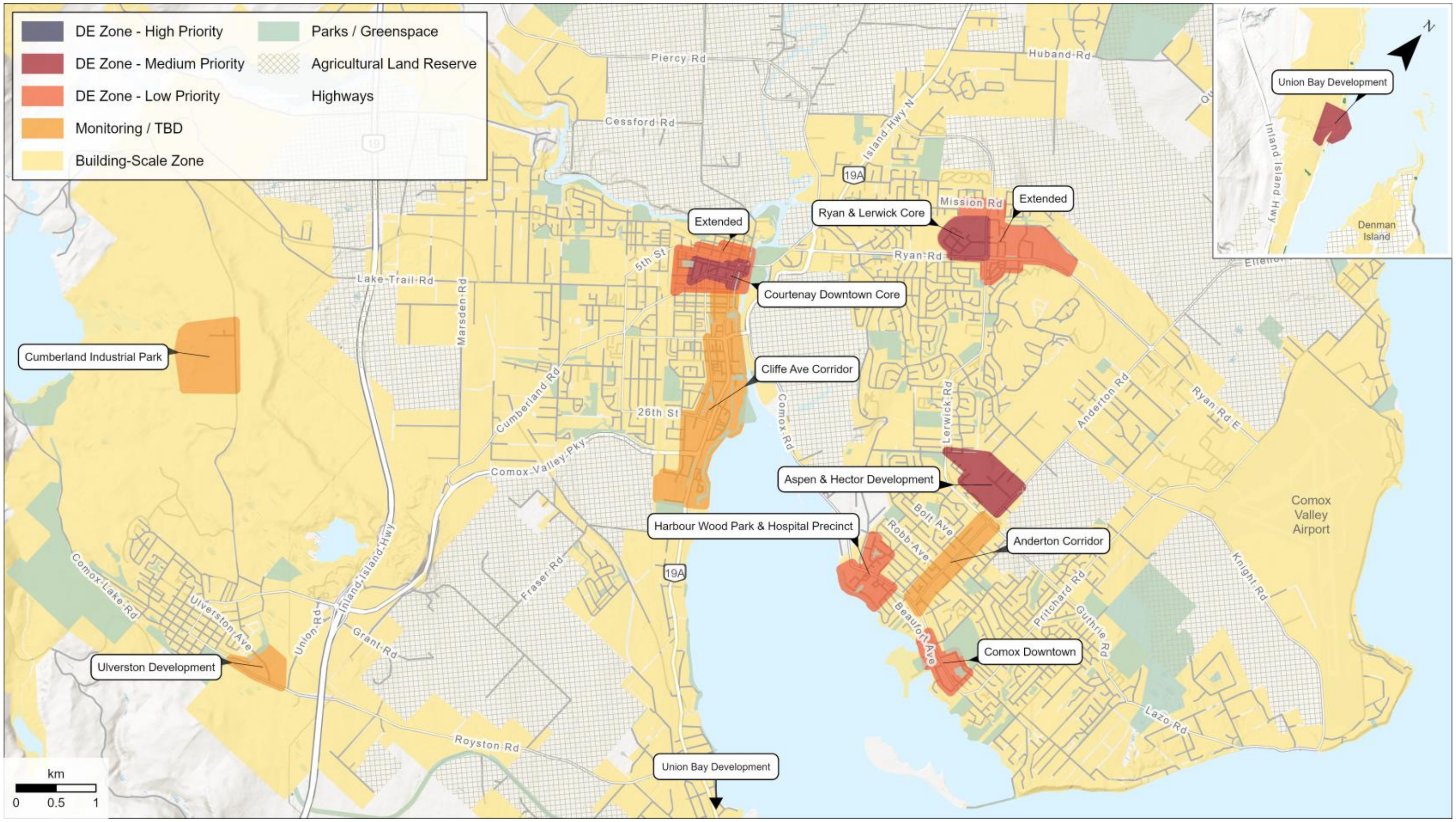

Figure 14: Area Based Thermal Energy Plan for Comox Valley Regional District

Table 7: Detailed Description of DE and Non DE Zones

Zoning	Detail	Description	Score	Neighbourhood
Non-DE Zones	**Building-Scale**	• Building-scale systems are very likely to be lower-life cycle cost for low-carbon heat relative to a district energy network	0 – 10	-
	Monitoring / TBD	• Currently there is not sufficient reason to pursue district energy in these neighbourhoods. • These nodes could be prospective DE zones if new development exceeds expectations, or if there is new opportunities identified that were not highlighted in this analysis.	10 – 20	Cliffe Ave Corridor Ulverston Development Cumberland Industrial Park Anderton Corridor
DE Zones	**Low Priority DE Zone**	• District energy network may be on-par with or lower lower-life cycle cost for low-carbon heat relative to a building-scale approach • Uncertainty around timing and magnitude of heat load required to support the business case for DE (e.g. new development may not occur for decades if at all)	20 – 30	Courtenay Downtown Extended Ryan Rd & Lerwick Rd Extended Harbour Wood Park & Hospital Precinct Comox Downtown
	Medium Priority DE Zone	• District energy network likely to be on-par with or lower lower-life cycle cost for low-carbon heat relative to a building-scale approach. • Some technical or feasibility challenges still exist (e.g. many buildings owners, supply resource uncertainty, etc.). Additional due diligence required.	30 – 45	Courtenay Downtown Core Ryan Rd & Lerwick Rd Core Union Bay Development Aspen & Hector Development
	High Priority DE Zone	• District energy network is very likely to be lower-life cycle cost for low-carbon heat relative to a building-scale approach	45+	-

5.2 Summary of DE Opportunity Evaluation

5.2.1 Courtenay Downtown (Medium Priority DE Zone)

Heat Demand Density: The Courtenay downtown neighbourhood was identified as a Growth Center within the OCP and the Complete Communities Report. The current heat demand within the core zone is 10,000 – 15,000 MWh/yr, expected to increase up to 20,000 MWh/yr by 2050.

Two key redevelopment sites (identified in the Downtown Courtenay Playbook) include the Riverfront District and the Thrifty's Redevelopment Site (which does include a major grocery retailer), each with an expected FAR of 2.0 to 2.5. It is our understanding that this redevelopment sites have completed construction or are currently under construction.

Public Buildings**:** Within the downtown area there are several Municipal, Regional, and Provincial buildings all located within a small geographic area. These include: CVRD Admin Office, Courtenay Fire Hall, Courtenay Courthouse, Vancouver Island Regional Library, and Courtenay City Hall

The CVRD Administration Office is ~5% of corporate emissions from CVRD buildings. This is an opportunity to address corporate emissions reductions for Courtenay and other Public Organizations.

Site for Energy Center: There are many surface-level open parking lots throughout the downtown that could act as a site for a future Energy Center (e.g. at CVRD office or coordinated into redevelopment sites)

Low-Carbon Heat Supply: The Courtenay Wastewater Pumping Station is located approximately 1.5km from the downtown, across the Courtenay River. KWL's initiate screening study estimates that there is 2 MW to 3 MW of recoverable heat at this pumping station. Other low-carbon heating sources in this zone might include geo-exchange or air-source heat pumps, as there is no space constraint constraints that might preclude these technologies.

Expansion Potential: The building stock model developed by Licker Geospatial indicated that there is expansion potential to a larger geographical area surrounding the downtown, including the Cliffe Ave Corridor, supported by the expected new higher density development in this area.

5.2.2 Ryan Rd & Lerwick Rd, Core (Medium Priority DE Zone)

A District Energy Feasibility Study was completed by FVB in 2012, followed by an ;Energy Sharing and Emissions Reduction Study' by Archineers Consulting in 2023. Both of these studies identified this zone as a prime candidate for a district energy system. A geo-exchange system was envisioned serving the Aquatic Center, Hospital, North Island College, and Queneesh Elementary School. The proposed system would inject heat from the hospital in the summer and serve winter loads for the remaining buildings (hospital heating load was not considered in the report, but remains an opportunity for optimization).

We note that neither of the previous reports analyzed the cost of the alternative, namely the lifecycle cost to decarbonize each of the identified buildings independently. We suggest that this is a necessary step to establish the motivation to pursue a district energy network at this site.

Some considerations that should be taken into account if a further study is initiated include:

- In-building conversion and compatibility costs
- Remaining service life of existing equipment

- Energy Center siting
- Distribution type (2-pipe / 4-pipe)
- Consideration for cooling service
- Consideration for future service of Hospital heating load (if not immediately)
- Consideration for future expansion opportunity to extended DE Zone (DPS and Energy Center)
- Screen for heat recovery from Comox Substation transformers

If an apples-to-apples techno-economic study indicates a networked solution as the preferred solution (over building-scale approaches), then the next step for CVRD would be to determine the intended ownership and governance model.

We note that CVRD is currently in detailed design for a whole-building decarbonization project at the Aquatic Center, which would likely preclude it as a customer for a district energy system in the near future. The feasibility of a district energy system in this zone, without the Aquatic Center as an anchor load is doubtful. The CVRD may want to maintain a DE-ready option within the detailed design phase of the project to maintain the optionality of connecting to a DE system if that is the direction that CVRD wants to pursue.

Expansion Potential: We note that there was a large potential new development highlighted by the City of Courtenay in the neighbourhood directly to the east of Ryan Rd and Lerwick Rd (see Figure 8). Any DE system in the Core zone should be designed with expanded service area in mind, including space allocation for additional generation capacity within the Energy Center, as well as capped connections to future DPS branches.

5.2.3 Aspen & Hector Development (Medium Priority DE Zone)

Heat Density**:** There are two major multi-phase developments currently planned and underway in the Aspen & Hector neighbourhood, making it one of the highest density proposed neighbourhoods in CVRD. Two adjacent development proposals include over 1,000 residential units on parcels that total approximately 10 hectare. This area is also Designated as a Settlement Expansion Area[18] (SEA) through the CVRD Regional Growth Strategy

Stakeholders: The developer of 941 Aspen Road & 2077 Hector Road (Highstreet Ventures) has a demonstrated track record of building low-carbon and zero-carbon developments. Highstreet has committed to building to Step 4 of the BC Energy Step Code. In our experience, developers that have corporate sustainability and emissions targets (above minimum code compliance) are more likely to engage with and be willing to participate / promote local District Energy networks. The

Greenfield Development: As a greenfield development there is an opportunity to coordinate infrastructure planning and construction (DPS and Energy Center). Further, a DE network would not need to rely on existing building (with potentially incompatible mechanical systems, or equipment that has been recently renewed) to connect. Buildings can be designed to be 'DE-Ready' (see Section 6.1) at a marginal incremental cost (relative to existing buildings)

Expansion Opportunity: The site is located at the north end of the Anderton Corridor zone, which has been identified as a potential (Monitoring / TBD) DE Zone. There may be an opportunity to extend service to some buildings within the Anderton Corridor zone.

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[18] The Ryan Rd & Lerwick Rd Core Zone includes areas within the City of Comox and Lazo North (Electoral Area B).

Low-Carbon Heat: The original Hudson Sewer Trunk design included provision for a waste-water lift station near Hector and Anderton Roads, that would be constructed in the future and was intended to serve properties south of Idiens Way, along Hector Road, McQuinn Drive, Acacia Road and Toronitz Road. The timing and density of development in this area has changed from the original design parameters and as a result the Hector Road pump station and forcemain are not currently planned for construction[19]. Without this lift station, the initial phases may flow into the Aspen Rd leg of the Hudson Trunk. CVRD staff are currently conducting additional analysis to finalize the wastewater servicing strategy for these developments. We recommend coordinating the wastewater design and construction with any planned DE project, as the sewer system may be a key low-carbon heat resource for the network.

Timing: The Highstreet sites (2077 Hector and 941 Aspen) will be developed in three phases, moving East to West, over 10+ years. The development timeline for 2123 Hector uncertain. Feasibility and coordinated planning for district energy system would need to happen as soon as possible to align with developer design and permitting timelines.

5.2.4 Union Bay Development (Medium Priority DE Zone)

The Union Bay Development is a master planned development proposed by Kensington Island Properties, to build up to 2,889 dwelling units over 8 Phases. The ultimate density of this development is uncertain based on the information provided to and reviewed by Reshape, as it is not clear what total land area will be occupied by these new residential and mixed-use buildings.

Future phases will add a higher education campus with student housing, a secondary/elementary school, a commercial park focused on the tech sector, as well as new neighbourhoods of multi-family and single-family homes, townhomes and estate homes.

Under the Regional Growth Strategy (RGS) and Rural Comox Valley Official Community Plan (OCP), the project area is designated as a Settlement Node. The viability of future development is uncertain based on the financial difficulties of the developer.

CVRD has a Master Development Agreement with the Developer (original 2010, updated 2017), which outlines community amenities / obligations and establishes standards and conditions to which infrastructure and development must adhere. The MDA does not have provisions for District Energy systems. However, use of "geothermal technology or other green technologies that minimize the consumption of fossil fuels"[20] is required in one of the Comprehensive Development Areas (CDA-3).

In Summer 2023 Fortis extended their gas line down Union Bay based on the developer's request and the development potential that exists there.

5.2.5 Harbour Wood Park & Hospital Precinct (Low-Priority DE Zone)

Heat Density: There are three large, anticipated developments currently in discussions with the municipality. However, uncertainty still exists with respect to development timeline and feasibility.

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[19] CVRD Staff Report, RE: Hudson Trunk Capacity Constraints, September 9 2024

[20] MDA pg. 31

Stakeholders: The North Island College is currently occupying some space within former St. Joseph's General Hospital[21]. Medical and Health care focused end-users (e.g. The Views – Senior Care Home) are typically aligned with District Energy development.

Low-Carbon Heat: The site is directly overtop of the path of the new Sewer Conveyance Project. This project is currently in construction, which means it may be too late to coordinate access during the construction process. However, the low-carbon heat source will still exist in the future.

The community park could act as site for an Energy Center and/or borehole field.

Optimizations: The neighbourhood is less than 750m from the Comox Downtown, which was also identified as a low-priority DE Zone. There may be an opportunity to connect or extend to the downtown area in the future.

5.2.6 Comox Downtown (Low Priority DE Zone)

Heat Density: The Comox Downtown area is forecasted to be the area of highest heating density by 2050, after Aspen & Hector node. We note that there is anticipated development and densification on the existing mall site.

The Comox OCP is currently under review, with a new OCP expected this year. In one of the scenarios being considered in the updated OCP the land-use boundaries of the downtown would be expanded, which would significantly increase the anticipated heating demand.

The Comox Downtown Enhancement Action Plan identified Residential Mixed-Use Intensification (up to 4-6 stories) of the downtown as a one of nine "Big Moves".

Low-Carbon Heat: The Sewer Pump Station on Jane Place will undergo major renewal to expand capacity as a part of the Sewer Conveyance Project.

5.2.7 Non-DE Zones (Monitoring / TBD)

Four zone were identified as 'Monitoring' within the evaluation. These neighbourhoods don't meet the threshold to be categorized as DE zones, however these nodes could be prospective DE zones if new development exceeds expectations, or if there are new opportunities identified that were not highlighted in this analysis. These zones include:

- Cliffe Ave Corridor
- Ulverston Development
- Cumberland Industrial Park
- Anderton Corridor

5.2.8 Other Notable Sites That Were Not Included on the DE Long List

Several other areas not listed within the DE Long List were brought forward during the course of the study for consideration but ultimately not included in the evaluation process. These areas are listed here for completeness as well as the primary reason for not carrying them further in the study.

[21] NIC News, "NIC opens new learning space at St. Joe's", September 20, 2019

- Saratoga Beach Development: Lack of density (latest application included mostly single detached dwellings)
- CFB Comox: Lack of density, limited new construction anticipated
- Comox Valley Sports Centre: Lack of density in the surrounding neighbourhood[22]
- Mount Washington Development: Remote site and challenging topography, development and timeline uncertainty
- Little River / King Coho Wastewater Facility: Lack of density and development potential

5.3 Discussion of Existing Buildings

The DE opportunity scan and prioritization included consideration for both existing buildings and new construction. We considered both categories of buildings in our future load forecasts equally, without giving preference to one or another. It should be noted that the DE market locally and internationally has shown that it is much easier (and therefore much more common) to initiate new DE systems anchored by high density new construction. Vancouver's NEU (serving the Olympic village), Creative Energy's Oakridge System, and North Vancouver's Lonsdale Energy Corporation are a few examples of this.

While it is possible to establish a new DES serving existing buildings alone, there are significant financial and technical challenges. These include:

- Diffuse ownership of buildings, as well as shared ownership structures (e.g., strata corporations in residential buildings).
- Lack of funding or financial incentive for connecting existing buildings to DE (particularly in the absence of GHG regulations on existing buildings).
- Incompatible building heating systems (e.g. electric baseboard heaters).
- Long remaining service life of existing equipment, and diverse timing of replacement schedules.
- Existing equipment (boilers/air handling units) located in penthouses, making tie-in difficult.
- Building heating systems/loads incompatible with DE (e.g., a low-temperature DES cannot serve building with steam boilers without major mechanical retrofits).

While existing buildings alone are not usually sufficient to support development of a new DE system (given lack of GHG regulations or strong connection incentives for existing buildings), it's still possible to connect existing buildings to existing or newly established DE systems that are anchored by new development, and it is technically possible to establish a new DE system serving existing buildings alone.

Many of the challenges to connecting existing buildings to DE can be overcome if the buildings are publicly owned.

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[22] We understand that CVRD is currently evaluating a project to recover heat from the Sports Center to supply to the adjacent secondary school. This appears to be a viable project; however, we chose not to include this area in our list as we don't see potential to expand this system beyond these facilities based on the existing and forecasted density of development.

5.4 Discussion of Cooling Systems and District Energy

The 2023 update to the BC Building Code includes a requirement that all *dwelling units* intended for continuous occupancy in the summer months must include at least *one room* equipped with a cooling system capable of maintaining a maximum temperature of 26 C during design conditions[23].

Although there are examples of district heating *and* cooling systems (particularly in the Greater Toronto Area), as well as low-temperature DES that act as a heat source and heat sink for heat pumps within connected buildings that provide both heating and cooling (such as the City of Richmond's Alexandra District Energy Utility), most of the municipally owned DES in the Lower Mainland of BC are medium temperature hot water systems that provide heating only.

New buildings connected to a heating-only DES will need to install on-site cooling systems to meet BC Building Code requirements; there are numerous ways of delivering cooling with on-site cooling systems paired with heating from DE.

Historically, the business case of district cooling has not been compelling in the BC Lower Mainland or on Vancouver Island because many multi-family buildings did not install cooling systems. Furthermore, the GHG emissions reductions associated with district cooling (relative to on-site cooling systems) are minimal in BC because cooling is almost always provided by electric chillers or heat pumps and is low carbon by virtue of the low-carbon electricity supply from BC Hydro.

With the new BC Building Code requirements for residential cooling, the business case for district cooling may be stronger, particularly in areas that include mixed uses (such as high density residential mixed with offices, hotels, retail districts and convention centres).

[23] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/construction-industry/building-codes-and-standards/bc-codes-2023-public-review-pcf/overheating.pdf

6 DISTRICT ENERGY POLICY OPTIONS

The low cost of gas-fired heat in existing buildings provides limited incentives to connect to DE, in the absence of high carbon taxes or regulations on emissions.

Climate policies can be either compulsory, (eg. direct regulation of emissions and carbon pricing), or non-compulsory policies (eg. incentives for emissions reductions, government subsidies, education and outreach, etc).

Compulsory policies can be further subdivided into direct (push*)* and indirect (pull) policies:

- Direct policies would encourage and facilitate the development of DE networks and low-carbon energy sources (immediately or in future);
- Indirect policies, in turn, would limit GHG emissions from new buildings (eg. through the zero carbon step code) and ideally also require GHG emission reductions from existing buildings, while simultaneously allowing or even encouraging DE solutions to achieve those outcomes.

These push and pull policies often work in tandem. Requiring GHG reductions from existing buildings or limiting GHG emissions from new buildings creates the pull for low-carbon energy. These policies also need to be designed in a way that permits DE solutions to satisfy the GHG limits or GHG reductions. This may include bridging mechanisms to address timing differences between individual building developments and larger infrastructure solutions. However, pull policies alone may not be adequate to achieve the benefits of DE given upfront costs, coordination challenges, timing issues and other co-benefits to communities that may not be factored into the decision making of individual developers or building owners. This is where more direct policies to push DE development can also play a role.

The biggest barrier to DE development is connection risk; DE utilities make business planning decisions to invest capital in generation and distribution infrastructure on the basis that some minimum threshold of customer demand will materialize over a given timeline. These decisions assume a future forecast of customers that will connect to the system on certain future dates. There is inherent risk in these assumptions. Will new buildings actually be constructed, and/or will they reach completion on the forecasted date? Will buildings ultimately connect to the DE system or will a better alternative present itself in the interim? Typically, there is no guarantee for many of these questions, which raises the project risk and deters investors from committing capital to the project in favour of safer investments.

This section provides a review of tools that may be leveraged to support DE development; a review of effective DE policies in other jurisdictions; and recommendations for how CVRD's existing tools and policies might be leveraged and improved to support the growth of DE nodes throughout the Region.

6.1 DE Enabling Policies Across Canada

An overview of DE policies from other jurisdictions is provided in Table 8. Although the list is not exhaustive, it illustrates that municipal ownership with a mandatory connection bylaw is a very common strategy for overcoming connection risk when establishing new DES.

Table 8: Summary of DE Related Policies in Other Jurisdictions

City (Province)	Mandatory Connection to Municipally Owned System	DE Requirement in Site Rezoning	City Buildings as Anchor Loads	City-wide Green Building Policy with GHGI	Economic Incentives for Connection	Informal / "Encouraged" in Development Application Approvals Process
City of Vancouver (BC)	✓	✓		✓		
City of Surrey (BC)	✓			✓		
City of North Vancouver (BC)	✓			✓		
City of Richmond (BC)	✓	✓		✓		
City of Edmonton (AB)	✓		✓			
City of Calgary (AB)			✓		✓	✓
City of Toronto (ON)			✓	✓		
City of Markham (ON)					✓	✓

Mandatory Connection Requirements

One of the simplest ways to reduce connection risk is through a mandatory connection policy. Denmark pioneered the concept of heat planning and mandatory connection as a tool to promote extensive development of DE. Under this framework, mandatory connection requirements are enacted in areas that have conducted an area-based heat plan that demonstrates DE as the lowest-cost option in a given area[24]. Consumers are also protected by a requirement for cost-based pricing, including a non-profit principle. Mandatory connection also applied to both new and existing buildings, although a lengthy grace period was often granted for existing buildings.

[24] This comparison is usually done on a long-term levelized cost basis, which may also account for the avoided costs of externalities, or other public benefits.

Mandatory connection can be limited to specific areas, specific types of connections or specific time periods. Outside these parameters, connections or renewals can be voluntary. For example, the City of Vancouver has a mandatory connection bylaw covering new construction and major renovations within a designated service area for its False Creek Neighborhood Energy Utility. Connections by existing buildings or buildings outside the service area remain voluntary. Mandatory connections may be used temporarily as a tool to support new system development by promoting an efficient layout and helping achieve adequate scale.

BC Municipalities have broad powers under the *Community Charter* to provide any service Council considers necessary or desirable and may, by bylaw, impose requirements in relation to municipal services.

It is unclear whether Regional Districts have similar powers, as there is no precedent in the Province in which a Regional District has imposed a mandatory connection agreement for a District Energy system. A cursory review of the Local Government Act did not reveal clear indications that Regional Districts have the authority to enact a mandatory connection bylaw (particularly within municipal boundaries). A definitive answer to this question would require a formal review of the LGA and Community Charter which is outside the scope of this study.

Connection Incentives

Strong connection incentives can also be used in lieu of mandatory connection requirements. These must be reasonably credible to support private investment, and private investors may also want assurance that such policies will continue for a sufficient period. These incentives can be financial or non-financial. For example, limits on gas connections or strong green building standards that allow compliance through DE connections can help de-risk new system development[25]. Expedited rezoning and development application approvals for buildings connecting to low-carbon DE can help incentivize connection.

Municipal Guarantees / Financing

Alternatively, investment risks could be backstopped through public sector guarantees or financed in part through a development levy or a tax lien attached to all of the properties in a service area. These approaches may be more acceptable to some stakeholders than mandatory connections, although they could also be more costly and less efficient than simply mandating connections. Under direct municipal ownership, some of the cross-subsidies and risk guarantees can simply be absorbed internally. In the case of shared or fully private ownership, subsidies or guarantees may be required to support investments by third parties.

DE Compatibility Guidelines

The fundamental requirements for DE connectivity are similar for many district energy systems. Most importantly, to serve the full heating load of a building (including space heating, make up air and domestic hot water), the building's space heating system must be hydronic (water-based). The following types of hydronic heating systems are compatible with most hot water DES:

- Fan coil heaters
- Fin type baseboard convectors / perimeter heaters
- Hydronic radiant floor heating
- Hybrid heat pumps (with a hot water coil for heating, the compressor runs for cooling only)
- Ventilation make-up air units with glycol heating coils

[25] The availability of these tools may be limited based on the authority of the jurisdiction

Another key requirement for DE compatibility is the provision of an Energy Transfer Station (ETS) room located at grade or in the first level of the parkade. The dimensions of the ETS room vary slightly depending on the size of the building but are generally smaller than a typical boiler room.

To minimize costs and DE piping within the building, the ETS room should be located on the perimeter of the building. In "DE Ready" buildings, the ETS room may house hot water boilers that will eventually be replaced by the DE connection.

Most DE utilities publish DE connection guidelines which outline in detail the specific requirements for buildings connecting to the DES, links to some examples are provided below. These guidelines are unique to each system but share many common requirements.
The City of Burnaby, City of North Vancouver (Bylaw 7575C), City of Surrey and City of Vancouver all have DE connection guidelines that outline the requirements for buildings to be compatible with DE.

6.2 Coordinating Framework for DE

An outcome of this study is the identification of neighbourhoods in the Region where DE is the preferred platform for supply of domestic hot water and space heating. Within these neighbourhoods (or "DE Zones"), the CVRD should work with partner Municipalities to include DE as part of the infrastructure planning process.

Within DE Zones, the following policies and processes are would further support DE development. Taken together these are considered to be an actionable *Coordinating Framework for District Energy* that the CVRD can lead while leveraging support from the private sector and partner municipalities:

- Conduct DE feasibility studies in DE nodes (by order of priority and timing of neighbourhood development). DE feasibility studies may be publicly funded or cost-shared with a private utility partner.
- All new buildings over a specific size threshold shall be designed to be "DE Ready" with hydronic (water) heating distribution systems and mechanical rooms located either at grade or in the parkade of buildings on the perimeter of the building. This will ensure that even if a DES is not established in time to serve a particular building, buildings can more easily be connected to DE in the future.
- Requirement for all new buildings over a specific size threshold to submit an Energy Modeling Report as part of the development application which will contain information that can be used to prepare or update DE feasibility studies and business cases.
- After and if a feasibility study indicates favourable conditions for DE in a node, the Region or Local Government leads a competitive process to select private sector utility partner to design, build, and operate the DES. Alternatively this can be completed before feasibility studies, in which case the private sector partner can collaborate on or lead the feasibility study. In this case it is more likely that CVRD would enter into a exclusivity agreement with the private sector partner to explore a suite of opportunities together (eg. the four medium-priority DE zones identified in the CVRD).

7 DISTRICT ENERGY OWNERSHIP MODELS

There is no one-size-fits-all ownership model for district energy (DE) systems. Models differ widely by region, technology, and market development stage. Ownership structures are shaped by local history, cultural preferences, and public policy. Additionally, ownership can change over time due to shifts in market maturity, system scale, technology, public priorities, and other factors. The presence and type of economic regulation in a jurisdiction can also shape or limit ownership models.

DE systems typically range from fully public to fully private (Table 9), with various hybrid models in between that feature different levels of shared ownership or governance.

Table 9: DE Ownership models, subtypes, and examples

Model Name	Asset Owner	Sub-type	Description	Example System (Parties)	Regulation
100% Public	*Direct public ownership or municipal corporation*	Self-perform	- All DBOFM by Local Government	**False Creek NEU** (City of Vancouver)	Automatic exemption from BCUC Regulation
		Contract Support	- Some DBOFM by Local Government - Some DBOFM by Partner	**Richmond City Center DEU** (Lulu Island Energy Corporation, Richmond)	Per recent ruling by BCUC, does not qualify for exemption (contracted operations)[26]
Hybrids (Public & Private)		Split Asset	- Specific assets owned by Local Government - Specific assets owned by Partner	**Burnaby Mountain DEU** (SFU & Corix)	Public portions of system (SFU plant and network) exempt, Private portions regulated by BCUC
	Special Purpose Vehicle	Joint Venture	- Assets jointly owned by Local Government and Partner - Investment shared between Local Gov. and Partner		Regulated by BCUC
100% Private	*Investor owned or customer owned*	Partnership	- Form of partnership can vary - May include shared aspects of some or all DBOFM	**Seṅáḵw DES** (Creative Energy / Squamish Nation)	
		Fully private	- All DBOFM by private entity	**Creative Energy DES** (Westbank & Instar AGF)	

[26] Under legal challenge by City of Richmond

With public ownership, local governments can establish greenhouse gas (GHG) targets for utilities and require connections to district energy (DE) systems, reducing competition from in-building energy systems lacking similar GHG goals. This is critical in the early stages of DE system development, when costs may exceed those of other low-carbon options in the short term, but DE systems offer greater potential for significant, cost-effective emissions reductions over time.

Under alternative ownership or governance models, local governments can influence GHG outcomes through partial ownership, concessions, or strategic partnerships. However, these approaches offer less direct control, especially without mandatory connection policies. Without such policies, local governments may need to rely on grants, subsidies, investment guarantees, or the sale of offsets from low-carbon investments to counter competition from conventional energy systems in the short term.

However the trade-off is that greater levels of public control (in the form of local government ownership) comes with higher level of public risk. This dynamic is outlined below on Table 10.

Table 10: DE Utility ownership models governance and municipal risk/control

Model Name	Sub-type	Governance	Level of Municipal Risk	Level of Municipal Control[27]
100% Public	Self-perform	City Council	High, City takes on all risk	Full control
	Contract Support	City Council & Partnership Agreement(s)	Some risk transfer to service provider	High level of control as defined in agreement
Hybrids	Split Asset	City Council & Energy Supply Agreement(s)	Limited to City owned assets	Full control over City owned assets
	Joint Venture	City Agreements with JV Entity, City Representation on Board	Lower than 100% Public models (depends on JV split)	Dependent on representation on Board
100% Private	Partnership	Partnership Agreement City Council, Investor's Board of Directors	Lower, defined in partnership and project agreements	Defined in partnership and project agreements
	Fully private	Investor's Board of Directors	Low	Indirect through bylaws / policies

[27] Over desired outcomes (e.g. GHGs), means (e.g. technology), financial (risk, return, financing) rates and policies

DE Regulation

In BC, utilities providing thermal energy (heating and cooling) are typically regulated by the BC Utilities Commission (BCUC). Two streams of regulation exist – Stream A and Stream B (Table 11). It is possible to initiate a system under Stream A and transition to Stream B at a later date, provided it meets the criteria for a Stream A utility.

Table 11: Streams for Thermal Energy Utilities in BC

Stream A	Stream B
Generally single site	Multi-site, multi-customer
Maximum capital of $15M	'Typical' DE
Light-handed regulation	Requires full regulatory process.
Utility contract, and BCUC form	Development costs can be recovered in rates

Municipally owned systems are exempt from BCUC regulations and instead are effectively regulated by required passed by City Council. This is how systems such as Vancouver's NEU and Surrey's City Energy set rates, emissions requirements, and long-term resource plans.

Since ownership determines the nature of regulatory requirements that a DE system will be subject to (and compliance requirements for Stream B systems can be onerous, adding significant time and cost to the initial development cycle), we have included some information on requirements for municipal and privately owned systems on Table 12.

Table 12: DE Regulatory Requirements for Municipal and Privately Owned Systems

	Municipal	BCUC	
		Stream A	Stream B
Ownership & Operations	Municipal[28]	Private	
Scope and Scale	N/A	-< $15M Single building or block	> $15M And/or crossing public rights of way
Nature of regulation	Municipalities serve as regulator Council and/or City-appointment expert review panels act in similar capacity to BCUC for private utilities	- Light-handed regulation (some reporting requirements) - Governed by bi-lateral contracts - BCUC only involved on complaints basis	Full Regulation (similar to gas and electric utilities)
Regulatory requirements	Refer to elements in table to the right	Follow Thermal Energy Systems (TES Guidelines)	See Stream B Table

BCUC Approvals for Stream B DE Systems

Prior to Construction

- Certificate of Public Convenience and Necessity (CPCN)
- Approval of any privilege, concession or franchise granted by a muni or public authority

Prior to Operation

- Rates
- Energy supply contracts

Ongoing

- Annual reporting requirements
- Rate changes
- Long-term resource plans
- New or revised energy supply contracts, system extensions
- Disposal, or amalgamation of utility property outside the normal course of business
- Sale, purchase, or transfer of shares or rights resulting in a reviewable interest (a direct or indirect control of more than 20% of a public utility)
- Issue of any securities (shares, bonds, notes or other obligations) with a term over 1 year
- New or revised privileges, concessions or franchises granted by a muni or public authority

[28] Municipally owned systems that do their own operations (Vancouver, Surrey) qualify for municipal exemption to regulation. Municipally owned systems that contract operations (Richmond) are required to apply for municipal exemption to regulation.

8 NEXT STEPS FOR DISTRICT ENERGY IN COMOX VALLEY

This study has found that most areas within the Region are best served by a building-scale approach to decarbonization. There is some potential to develop District Energy networks in select nodes within the core municipalities. In particular, there were four Medium Priority DE Zones identified (note that there were no High Priority DE Zones identified in the Region). Medium Priority DE Zones are neighbourhoods where a District Energy network is likely to be on-par with or lower lower-life cycle cost for low-carbon heat relative to a building-scale approach. Some technical or feasibility challenges may still exist within these areas, requiring additional due diligence (e.g. many buildings owners, supply resource uncertainty, etc.).

If the CVRD selects to develop or further support a District Energy strategy, and depending on the ownership model selected, CVRD may wish to initiate a DE Feasibility Study for some or all of the Medium Priority DE Zones. If CVRD advances a 100% publicly owned model this is a necessary step in DE implementation.

If CVRD advances a Hybrid ownership model, they may choose to wait until a partner is onside to initiate a study. The partner can bring their expertise, financial resources, and be more open to risk sharing at subsequent stages if they are involved in the Feasibility Study

Multiple sources of funding for exist for feasibility studies, including:

- BC Hydro Industrial electrification programs
- Federation of Canadian Municipalities (FCM) programs under the Green Municipal Fund

These study funding programs can be precursors to capital grant applications.

Within a technical feasibility study, the following parameters should be defined:

- Services (heating only or heating and cooling)
- Defined service areas
- Network type
- Energy sources/technologies
- How is the system phased?

CVRD may want to pursue stakeholder consultation for the higher priority DE zones, as an initial filter before deciding to move forward with implementation. Potential stakeholders may include building owners and residents, partner Municipalities, BC Hydro, and private DE Utilities.

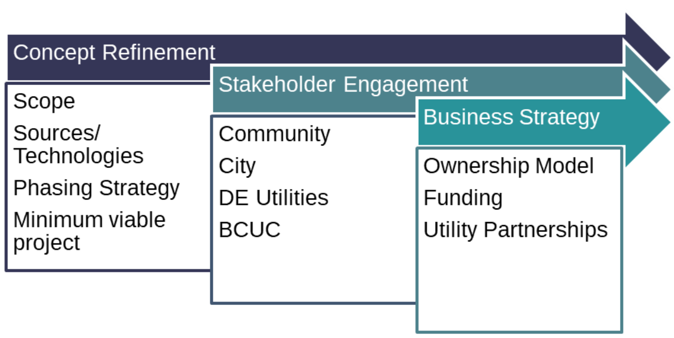

Figure 15: Framework for Next Steps and Implementation

8.1 Next Steps for Medium-Priority DE Zones

Aspen & Hector

Since the site rezoning of the two major development sites at the Aspen & Hector node have been approved by City Council and the land is owned by private developers, the Region's opportunity to require low-carbon development or mandatory DE connection as a condition of the site rezoning or land sale is limited. However, the developer may still be convinced of the value of connecting to or developing a District Energy platform if the system can provide value to the developer, such as reducing the space required for heating and cooling equipment within individual buildings and "future proofing" their assets against potential GHG regulation or renewed carbon tax.

The **next steps** for advancing the DE opportunity in the Aspen & Hector zone are:

- Meet with the developers (High Street Ventures & Broadstreet Properties) to confirm development timelines and introduce the concept of DE and the value proposition for developers.
- Complete a DE feasibility study for the Aspen & Hector node. The cost may be shared with the development team. The study should include:
    - Consideration of utilizing waste-heat from the planned Hector sewer lift station
    - Opportunity to coordinate infrastructure planning and construction (DPS and Energy Center)
    - Ownership-neutral lifecycle cost comparison between district-scale and building-scale thermal systems

Union Bay

CVRD has a Master Development Agreement with the Developer (original 2010, updated 2017), which outlines community amenities and obligations, and establishes standards and conditions to which infrastructure and development must adhere.

The MDA does not have provisions for District Energy systems. However, use of "geothermal technology or other green technologies that minimize the consumption of fossil fuels" is required in one of the Comprehensive Development Areas (CDA-3)

In Summer 2023 Fortis extended their gas line down Union Bay based on the developer's request and the development potential that exists there.

The **next steps** for advancing the DE opportunity in the Union Bay zone are:

- Continue to monitor the latest state of the project in light of property developer's ongoing financial struggles
- Engage with the existing and/or new property developer to introduce and gauge interest in developing a District Energy system
- Consider whether District Energy can be incorporated into the existing MDA, or into a new MDA with a new owner and developer

Ryan & Lerwick

A District Energy Feasibility Study was completed by FVB in 2012, and a subsequent study "Energy Sharing and Emissions Reduction Study" was completed by Archineers Consulting in 2023. A Geo-exchange system was envisioned serving the Aquatic Center, Hospital, North Island College, and Queneesh Elementary School. The proposed system would inject heat from the hospital in the summer and serve winter loads for the remaining buildings (hospital heating load not considered in the report)

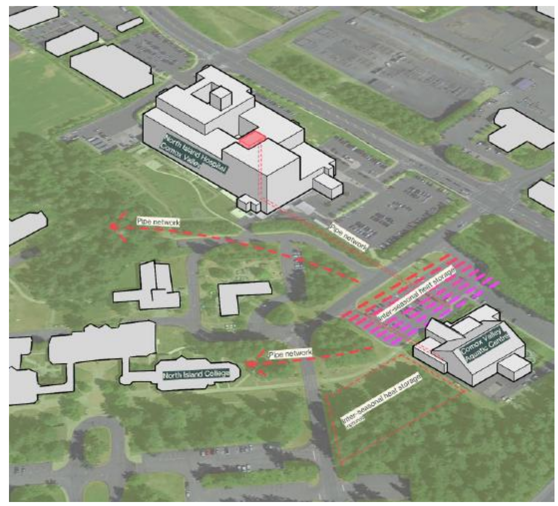

Figure 16: Energy Sharing and Emissions Reduction Study, HCME & Archineers Consulting, 2023

The **next steps** for advancing the DE opportunity in the Ryan & Lerwick zone are:

- Engage with the Hospital and NIC to re-introduce the concept of a district energy system. Discuss:
  - Renewal plans for existing mechanical equipment
  - Location of energy center
  - Ownership options, forecasted emissions performance
- Conduct a financial analysis to establish the lifecycle cost of the proposed DE system in comparison to building-scale alternatives for all parties
- While the stakeholder engagement and financial analysis is underway (4 – 6 months), maintain optionality for DE within the current mechanical design of the Aquatic Center retrofit project.
- If the techno-economic analysis points to a networked solution, consider the intended ownership / governance model (what amount of risk and control does the Region want to retain).

Courtenay Downtown

Figure 17: Image from the Downtown Courtenay Playbook, 2016

The downtown is an identified growth area with key redevelopment sites that may include a large grocery retailer. Within the downtown there are several public buildings that can act as anchor loads, and many available sites for an Energy Center (publicly owned and otherwise. There also exists an opportunity for expansion to the extended downtown area and Cliffe Ave corridor.

The anticipated heating density is still relatively modest when compared to other established District Energy systems, and there is not an obvious or easily accessible source of low-carbon heat.

The **next steps** for advancing the DE opportunity in the Courtenay Downtown zone are:

- Engage with the City of Courtenay to pursue a joint feasibility study. The study should present the ownership-neutral lifecycle cost comparison between district-scale and building-scale thermal systems for new and existing buildings within the service area, achieving near-zero carbon performance.
- Gather commitments from publicly owned buildings within the service area to connect to a future DE system

8.2 Next Steps for CVRD and Partner Municipalities

Our understanding of the Region's interest regarding District Energy Networks is to achieve optimal outcomes for new and existing neighbourhoods within the Comox Valley. The initial motivation for this study was the idea that there may be neighbourhoods where District Energy can offer better long-term outcomes relative to a building-scale approach, including:

- Low-cost heating supply
- Low-carbon heating supply
- Low impact on BC Hydro grid

If CVRD chooses to move forward in developing or supporting District Energy systems to achieve these outcomes, there are several actions that the Region can take within the organization to promote this strategy. We have also included notes for any Partner Municipalities that are interested in collaborating with CVRD on this file.

CVRD

- Provide commitment to connect Region-owned buildings to a future DE System
- Provide resources to lead grant applications where applicable
- Confirm development timelines and stakeholder interest in DE Zones

Municipalities

- Consider adopting the Zero Carbon Step Code for New Construction[29]
- Implement an alternate Step Code compliance pathway for DE-connected buildings (buildings are permitted to have higher energy use if energy supply is from a City-approved low-carbon source[30])
- Consider a Building Emissions Policy for Existing Buildings
- Ensure Buildings in DE Zones are Ready to Connect
- Leverage City-owned Land for DE equipment

[29] Courtenay council has passed a motion to adopt Step 3 of the Zero Carbon Step Code by the end of 2025 and Step 4 by 2028.

[30] For example, see Vancouver Building By-Law (VBBL) 10.2.2.5

9 REPORT SUBMISSION

RESHAPE INFRASTRUCTURE STRATEGIES

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Revision History

Revision #	Date	Status	Revision Description	Author
01	08-20-2025	Draft Report	Draft For Client Review and Comment	CR
02	11-05-2025	Final Report	Final Report for Client Review	CR

Filename: RPT-P851-CVRD District Energy Plan-Draft Report

LIST OF APPENDICES

APPENDIX A
Licker Geospatial Technical Memo

Model Overview

The following memo describes the data sources and methodology used to produce the current and forecasted floor area (see Results section), which supports the Comox Valley Regional District's District Energy Study in collaboration with Reshape. This modelling was produced in the Spring of 2025.

At a high level, the model considers anticipated housing demand and parcel-scale criteria to simulate a forecasted future for buildings at the parcel-scale for 2050. The model considers only Comox, Cumberland and Courtenay to support the purposes of the energy study. The sections found in the memo provide the methodology by which this forecast is produced, including the following:

- Data Sources
- Baseline (current state)
- Forecasting
    - Development Pipeline
    - Redevelopment Likelihood
    - Bill 44
    - Residential forecast
    - Non-Residential forecast
- Results - Floor Area

Data Sources

Multiple datasets from diverse sources were used for this work. The following table lists the dataset and its source as well as its use in the modelling.

Table 1. Datasets utilized for residential and non-residential parcel-scale modelling.

Dataset	Source	Uses
Parcel fabric	ParcelMapBC, 2024	Unit of analysis (all parcel-scale modelling)
Current building floor area	BC Assessment Building Information Report, current to Sept 2023	Baseline (current state) Secondary suites analysis Redevelopment likelihood
Future housing projections	CVRD Housing Needs Assessment (2024)	Residential forecast
Future employment space	Engagement	Non-residential forecast
ADU projections	BC Assessment and Census	Residential forecast
Land Use	Comox OCP Update - Scenario A Cumberland OCP Update Courtenay OCP (adopted 2022)	Residential forecast Non-residential forecast
In-Stream Developments	Engagement	Residential forecast Non-residential forecast
Anticipated Developments	Engagement	Discussion purposes only

Baseline (Current State)

The methodology for estimating baseline floor area is as follows:

1. The Building Information Report from BC Assessment is processed such that each parcel is attributed with its building type (using actual use code, occupancy or manual class code), its year of construction, land and building assessment information, dwelling units, and floor area, depicted in square feet.
2. For this project, buildings were categorized as residential or non-residential.
3. Single family homes, suited single family homes and duplexes contain an estimation for basement size (foundation area) from BC Assessment. This was excluded from reporting for residential floor area as requested by Reshape.
4. The total floor area for each municipality is reported in the table below.

Table 2. Estimated floor area for each jurisdiction by building type from BC Assessment (2023)

	Total Floor Area by Type, 2023 (m2)		
Building Type	**Comox**	**Courtenay**	**Cumberland**
Single Detached (SFD)	588,203	989,206	167,660
Suited Single Detached (SFD-S)	100,756	260,059	6,046
Apartment (APT)	125,408	401,060	27,311
Ground Oriented Multi-Family (GO)	36,475	63,189	34,444
Total Residential	**850,841**	**1,713,514**	**235,462**
Commercial	113,234	408,225	23,740
Institutional	34,879	378,347	55,036
Industrial	92,724	276,908	16,702
Total Non-Residential	**240,837**	**1,063,480**	**95,478**

Forecasting

The methodology for estimating future floor area for the year 2050 is broken down in the sections below. The first section, the "pipeline", accounts for in-stream developments provided directly from municipal staff or from their respective websites and may be residential or non-residential. Please note there are developments that were not included to estimate future floor area and are rather considered as anticipated developments. Methodology for projecting remaining development required to meet housing demand and consequently future floor area are further described for residential and non-residential buildings in the sections below.

Pipeline

Table 3 below lists the developments included in the modelling from either active development permits or active building permits. Developments were received either from municipal staff or from municipal websites.

Table 3. Developments incorporated into the floor area forecast by jurisdiction.

Jurisdiction	Development	Units / Type
Cumberland	Maple Street Subdivision	17 single detached, 8 suites
	Ulverstone Ave & Second St	21 apartment
	Royston Rd & Union Rd	56 single detached, 33 suites
	Coal Valley Estates	592 ground oriented MF 99 apartment 84 single detached, 40 suites
Comox	1966 Guthrie	206 apartment
	1946+1950 Comox Ave	161 apartment, 69 ground oriented MF
	2077 Hector Ave & 941 Asped Rd	450 apartment, 300 ground oriented MF
	2123 Hector Ave	162 apartment, 108 ground oriented MF
	215 Port Augusta	52 apartment
	941 Aspen Rd	360 apartment, 160 ground oriented MF
Courtenay	Silver Stone	42 ground oriented MF, 2 suited single detached
	1900 Ryan Rd	80 single detached, 20 suite
	498 Old Island Hwy	100 apartment
	397 5th St	39 apartment
	407 4th St	39 apartment
	574 Cumberland Rd	33 apartment
	1360 Arden Rd	79 ground oriented MF, 19 suites
	3420 Buckstone Rd	34 ground oriented MF
	4657 N Island Hwy	12 ground oriented MF
	925 Braidwood Rd	160 apartment
	2355 Mansfield Dr	30 apartment
	2270 Cliff Ave & Mansfield Dr	140 apartment
	1077 Piercy Ave	24 apartment
	1590 Piercy Ave	9 ground oriented MF

Redevelopment Likelihood

To determine which parcels would be redeveloped in the modelling to yield a new building, parcels across each jurisdiction are ranked by their likelihood to develop. The modelled relative likelihood for a parcel to develop (redevelopment score) is a function of the following parameters:

- Building value to land value - where a lot with a lower ratio may be underutilized economically;
- Floor space ratio - where a lot with a lower ratio may be underutilized functionally;
- Year built - where an older building is more likely to redevelop than a newer building; and
- Vacancy - if a lot is currently vacant, it has a high likelihood of developing (assuming no constraints to development)

The redevelopment score produced through this method was compared to the score produced through the methodology shown in the Complete Communities report for Courtenay. The results were very similar in that the ranked order of development produced between both methods was effectively the same.

Bill 44

Relevant upzoning has been established by jurisdictions following the Provincial legislation related to small-scale multi-unit housing (SSMUH). As the modelling utilizes land use, which is inclusive of these required changes, no additional modelling was done for Bill 44. Multiplex or townhouse forms are effectively allowed in all land uses, with the exception of the Residential Detached designation in Comox and Residential Large Lots designation in Cumberland, which accounts for very few parcels.

Residential

Housing Demand

Housing demand for each jurisdiction was derived from the Comox Valley Regional District Housing Needs Report prepared in August of 2024. Table 6-3 (p. 39) of the report provides anticipated housing demand by geography, including Cumberland, Courtenay and Comox for 2026 and 2041. Given that 2023 is also known from the BC Assessment inventory, the 2050 housing demand was extrapolated linearly. Resulting housing targets for 2050 by geography are shown in the table below. Demand reported in Table 6-3 (p.39) of the Housing Needs Report is understood to be absolute in each year; in other words, the demand in 2041 is not additional to the demand in 2026 but rather inclusive of it such that, for example, in Comox there should be 1,036 units built by 2026 and an additional 2,322 units built by 2041, for a total of 3,358 new units between 2023 and 2041. Extrapolation to 2050 follows the same approach.

Table 4. Net and absolute housing unit demand by jurisdiction.

Jurisdiction	Current Housing Units, 2023	Anticipated Demand from 2023-2026 (Total Units)	Anticipated Demand from 2023-2041 (Total Units)	Extrapolated Demand from 2023-2050 (Total Units)
Comox	6,791	+1,036 (7,827)	+3,358 (10,149)	+4,991 (11,782)
Courtenay	14,315	+2,471 (16,786)	+8,350 (22,665)	+12,421 (26,736)
Cumberland	2,157	+358 (2,515)	+1,350 (3,507)	+2,012 (4,169)

Secondary Suites

Some of the anticipated housing demand will come from secondary suites. Secondary suites may be built into new single family homes at time of construction or may be added to existing single family homes through conversion. Analysis of census data and BC Assessment data provided the probability for a newly built single-detached home to include a secondary suite in the modelling. The same analysis produced an annual conversion rate for existing single family homes to suited single family homes. This conversion rate (see table 5) was multiplied by the existing single family home stock in each jurisdiction to determine the likely housing demand that would be satisfied through the addition of secondary suites.

Table 5. Secondary suite modelling assumptions for new single family dwellings that will include suites, and for existing single family dwellings that will convert to suited single family.

Jurisdiction	Estimated new construction SFD built with a secondary suite	Annual conversion rate of existing SFD to suited SFD	Existing single detached homes (2023)	Housing demand to be met by conversion of secondary suites
Comox	20%	0.02%	4,151	22
Courtenay	12%	0.02%	6,980	38
Cumberland	48%	0.80%	1,134	245

Residential Land Use

When a parcel is selected for development, the land use designation of the parcel determines the allowed forms and maximum densities that can be built. Densities for all land uses in the District are in maximum units per hectare or have a maximum number of units per lot. The number of units that can be built on the parcel is calculated from the parcel area. For large greenfield developments (vacant) where the parcel is 1 ha or greater, the parcel area is reduced by 30% in calculating units to accommodate non-developable space allocations for roads and other infrastructure. While the model does not consider the economic market, it is assumed that the most dense form allowed by the land use and parcel size would be built for maximum profitability. Please note that parcels that fall within the agricultural land reserve (ALR), parks, heritage sites, and parcels with recently built buildings (< 10 years old) are not considered for future development. The following table lists the residential land uses modelled, their source, allowed forms, and densities.

Table 6. Residential land use assumptions by jurisdiction, where density is expressed either by units per hectare (UPH) or by units permissible by lot.

Jurisdiction and Source	Land Use Designation	Forms and Densities
Comox OCP Update Engagement 2025 Proposed Land Use - Scenario A	Downtown Comox	APT - 65 UPH
	Mixed Use	APT - 65 UPH
	Residential Detached	2 units / lot Suites allowed
	Residential: Townhouses & Ground Oriented Infill	GO - 22 UPH SFD - 22 UPH Suites allowed
	Residential: Low Rise Apartments, Townhouses	APT - 45 UPH GO - 45 UPH
Cumberland OCP Update Engagement 2025 Proposed Land Use	Multi Family	APT - 30 UPH GO - 30 UPH
	Residential Infill	GO - 25 UPH SFD - 25 UPH Suites allowed
	Mixed Use	APT - 25 UPH GO - 25 UPH SFD - 25 UPH Suites allowed
	Commercial Mixed Use	APT - 45 UPH
	Downtown Commercial Adjacent Residential	APT - 45 UPH
	Residential Large Lots	2 units / lot Suites allowed
Courtenay OCP Land Use, Map B-1, 2024	Downtown	APT - 111 UPH
	Multi-Residential	APT - 111 UPH GO - 74 UPH
	Neighbourhood Centre	APT - 111 UPH GO - 74 UPH
	Town Centre	APT - 111 UPH
	Urban Corridor	APT - 111 UPH
	Urban Residential Neighbourhood	GO - 24 UPH SFD - 24 UPH Suites allowed

Non-Residential

Non-residential floor area was forecasted using a combined approach of local-serving employment space and employment space as anticipated through engagement. Local-serving employment space was added to all apartment developments in the modelling where the land use allowed mixed-use buildings as ground-floor retail or office space (specific uses are not attributed and were labelled only as non-residential). The table below lists the non-residential developments included through engagement.

Table 7. Non-residential development pipeline.

Jurisdiction	Development	Density	Source
Courtenay	Light industrial along Christie Pky	0.25 FSR	Permit tracker
Cumberland	Bevan Industrial	0.25 FSR (based on proximal lots)	Engagement and website
Cumberland	Renovation/reconstruction of existing civic buildings	0.45 FSR (based on existing)	Engagement
Comox	Storage and office space in business park area	0.45 FSR (60% coverage)	Engagement

Results - Floor Area

Table 8. Total residential and non-residential floor area (in square metres) by geography for Courtenay, Comox, and Cumberland.

Jurisdiction	Building Type	Total Floor Area (m2)		
		2023	2050	Delta
Courtenay	Residential (excl. basements)	1,713,514	2,917,294	1,203,780
	Non-Residential	1,063,480	1,262,072	198,592
Cumberland	Residential (excl. basements)	235,462	461,918	226,457
	Non-Residential	95,478	148,900	53,422
Comox	Residential (excl. basements)	850,841	1,306,521	455,680
	Non-Residential	240,837	319,550	78,713

APPENDIX B
KWL Technical Memo

KERR WOOD LEIDAL
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Technical Memorandum

DATE: October 23, 2025

TO: Connor Read, P.Eng.

FROM: Mike Homenuke, P.Eng.

RE: **COMOX VALLEY REGIONAL DISTRICT LOW CARBON ENERGY STUDY**
Review of Potential Low-Carbon Thermal Energy Resource Options
Our File 3291.036-300

1. Introduction

KWL was retained by Reshape Infrastructure Strategies to prepare a brief report on available low-carbon energy supplies in the Comox Valley Regional District (CVRD). This report generally focuses on the urbanized areas of Courtenay, Comox, Cumberland and surrounding communities, however many of the options discussed would be applicable to the populated rural and semi-rural areas.

2. Low Carbon Energy Supplies

KWL has not conducted an exhaustive evaluation of low-carbon energy options that could potentially be available in the CVRD, but there are several ‘families’ of low-carbon options that were evaluated for this study:

- Wastewater System – the sewer collection systems and treatment facilities can be used to exchange heat with thermal networks.
- Solid Waste System – some portions of solid waste can be diverted and upcycled as fuel products or methane collected from landfill gas can be used for energy.
- Waste Heat – large industrial and commercial facilities may produce waste heat from processes and cooling systems.
- Geothermal – energy can be exchanged with the earth using heat pumps.
- Water Resources – water in the natural environment can sometimes be used for heat exchange if negative impacts can be avoided or tolerated.

This study is a preliminary review based on available data at the time of writing. None of the concepts discussed below have been reviewed for feasibility, and this study presents an initial inventory of potential thermal energy resources for the CVRD.

3. Wastewater

The CVRD owns and operates conveyance and treatment of wastewater for the communities of Courtenay, Comox, K’ómoks First Nation and CFB Comox (19 Wing) on Vancouver Island. The Village of Cumberland also has its own wastewater collection and treatment system.

Five wastewater pumping stations discharge wastewater to one of two forcemains that convey wastewater to the Comox Valley Water Pollution Control Centre (CVWPCC), which provides secondary wastewater treatment before discharging to the Salish Sea.

CVRD and Village of Cumberland are both currently completing Phase 3 of their Liquid Waste Management Plans (LWMP). The Comox Valley Sewer Conveyance Project replacement and upgrading of several existing pump stations and pipes, as well as extending regional trunk sewerage service to several unserviced communities outside Courtenay and Comox.

The CVWPCC is located in Comox and receives all the collected wastewater from Courtenay, Comox and several unincorporated serviced areas in the CVRD, a total of roughly 45,000 residents along with businesses and industries.

CVRD provided wastewater effluent daily flow and temperature data for 2021 to 2024 as presented in Figure 1. The CVWPCC shows as having much higher winter season flows than summer. Average dry weather flow (ADWF) is the preferred metric for assessing heat capacity. The estimated ADWF for winter from 2021-2024 was about 17,000 m^3/d and summer 12,700 m^3/d. Average monthly effluent temperature ranged from 12-13 ºC in winter to approximately 20 ºC in the summer.

Wastewater energy available is based on the flow and potential drop in temperature. Assuming a minimum discharge temperature of 6 ºC, the maximum available heat in winter from the CVWPCC would be around 5-6 MW (see Figure 1) and up to 8 MW in the summer. More typically a heat recovery system would drop the wastewater temperature by 3-4 ºC, which would yield about 2.4 MW in summer and almost 4 MW in winter.

The Village of Cumberland has much lower flow rates (~600 m^3/d) as it is a small population compared to the CVRD wastewater system. The wastewater effluent from the treatment plant could support approximately 200 kW of load which is likely too small to be developed economically.

The CVWPCC produces biosolids that are trucked to the CVRD's composting facility and co-processed with other streams to produce "Skyrocket" a Class A compost product. This means no biogas or other fuels would be produced without major changes to processes and systems.

KWL also review the City of Courtenay Wastewater System Master Plan, which included some flow monitoring data for the main trunk lines flowing into Courtenay Pump Station. This indicated ADWF in the 40-50 L/s range for both trunk lines, which added up would be approximately two-thirds of the flow arriving at CVWPCC. Since this location is much closer to the regional town centre, there may be around 2 MW to 3 MW of recoverable heat to support a thermal network in this area.

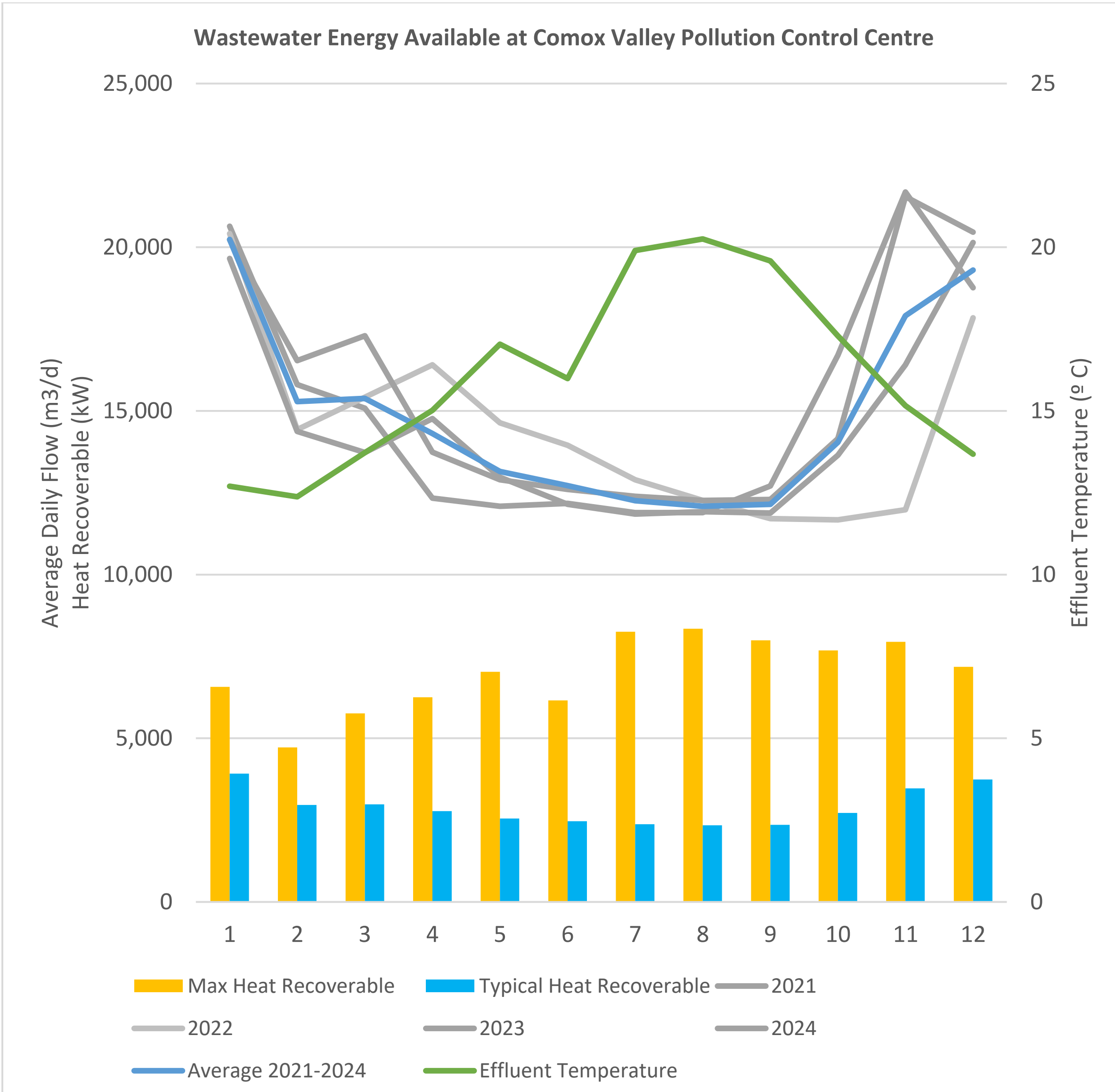

Figure 1: Wastewater Energy Resources at CVWPCC

4. Solid Waste

Solid waste streams can provide sources of fuel for thermal networks. Mixed municipal solid waste (MSW) is commonly converted to heat and power in many regions throughout the world. "Waste to Energy" or "Energy from Waste" (WTE or EfW) also serves to reduce the mass of waste needing landfilling or other final disposal. In the context of CVRD it is highly improbable that WTE would be considered for many reasons ranging from economics to public health concerns, but principally that mixed MSW used in WTE is not a low-carbon fuel if a new facility is created when none existed previously. There are sub-streams of MSW that could be more readily used for thermal energy needs that would potentially qualify as low-carbon because they originate from biogenic sources.

Comox Strathcona Waste Management provides solid waste management services to the CVRD and Strathcona Regional District and is a function of the CVRD. The Comox Valley Waste Management Centre (CVWMC) hosts an engineered landfill and the composting facility. According to the 2017 Waste Composition Report the combined regional service area received about 71 tonnes of clean wood waste and roughly 6,550 tonnes of food and yard waste. These streams would typically be considered low-carbon.

As noted in the Wastewater section, CVRD has a composting facility that consumes the available food and yard waste, and potentially some of the clean wood. With a heating value of roughly 19 MJ/kg (GJ/tonne) only about 1,000 GJ (270 MWh) of heat could be produced annually from the clean wood stream, which is not sufficient to support a low-carbon energy system beyond a relatively small building. As small-scale biomass systems generally require a highly uniform fuel grade, unprocessed waste wood is unlikely to be a suitable fuel source.

Landfill gas is produced, collected and flared at the CVWMC. According to the 2023 CVWMC Annual Report approximately 2.2 million m3 of methane was collected. Assuming a heating value of 38 MJ/m3 the total annual heating value of the methane would be about 83,000 GJ, or an average of about 2.65 MW (input).

On this basis KWL concludes that the available MSW in the CVRD is not a significant or suitable source of fuel as a direct input to thermal networks but there may be potential to beneficially use the recovered landfill gas that is currently flared to the atmosphere.

5. Industrial / Urban Waste Heat

KWL completed a cursory scan of potential industrial facilities that could produce enough waste heat to consider capture, however, there do not appear to be any such facilities in the Comox Valley. Other urban sources of waste heat could include ice rinks, cold storage warehousing, large grocery stores and buildings with large cooling loads. In Courtenay/Comox the following facilities were identified:

- Comox Valley Recreation Centre – two ice sheets, already has implemented some heat recovery for use in heating the swimming pool
- Glacier Gardens Arena – located adjacent to CFB Comox
- Comox Valley Curling Centre
- Comox Valley Regional Hospital
- Larger grocery stores included Costco, Thrifty Foods, Quality Foods

Other sources of urban waste heat may be present. KWL notes that CVRD has already studied potential for use of waste heat from the Recreation Centre ice plant.

6. Geothermal

There are several styles of geothermal systems ranging from deep geothermal often associated with electrical power production from large geothermal reservoirs to small-scale low temperature ground-source heat pump (GSHP) systems that would be more applicable to buildings and thermal networks.

According to CanGEO, most of Vancouver Island including the Comox Valley is located in an area of very low deep geothermal potential, therefore it is not recommended to consider this form of geothermal as a potential source.

GSHP systems can be implemented on an individual or neighbourhood/district scale, and feasibility for implementation generally depends on the underlying ground conditions and balance of thermal loads. GSHP systems come in vertical and horizontal configurations, as well as open and closed loop systems. Open-loop systems are discussed in the Water Resources section below. Closed-loop systems involve installing underground pipes in vertical wells or horizontal arrays, which circulate a thermal fluid (typically a glycol-water solution) through the ground and enable heat exchange. GSHPs are able to do both heating and cooling. In general, GSHP systems perform best when there is a balance of heating and cooling.

GSHP systems can be implemented in a variety of conditions, though typically a large open space such as a parking lot or playing field is ideal because the underground components can be excavated in the event of a fault or leak. Nonetheless many systems have been installed beneath buildings and there are technologies such as geopiles that are completely integrated with buildings.

There were two instances of small-scale, low density GSHP-based utilities registered with the BC Utilities Commission (BCUC). Westhills is a development in Langford that has a district energy network with a centralized geothermal field and Casa del Mila Oro in Osoyoos is a resort development with multiple strata buildings on geothermal systems. There are several other geothermal utilities operating on high density parcels throughout Metro Vancouver, and many private GSHP systems throughout BC.

Alexandra District Energy Utility – Richmond, BC

The largest and probably most well-known geothermal-based DE utility in BC is Alexandra District Energy Utility (ADEU) in Richmond, BC. This serves multiple apartment buildings and some commercial buildings totalling over 100,000 m^2 floor area and has approximately 600 vertical boreholes.

Capital and operating costs for ADEU to date were not available for this study. This utility would be at the largest end of the scale that could be considered in CVRD due to the higher density involved, however if there are plans to construct several multi-unit residential buildings near to one another this type of system might be a potential candidate.

Westhills Development - Langford, BC

The Westhills Thermal Energy System (TES) is a geoexchange system with 212 vertically drilled wells, with water-to-water heat pumps and heat exchangers which are in a central energy plant. The Westhills TES also uses centralized natural gas boilers and a waste heat recovery system connected to the Westhills Arena, a nearby ice rink, owned by the City of Langford. The central plant is connected to a network of pipes that distribute the energy throughout the Westhills community. This is an “ambient” system meaning the heat pumps are located in the buildings served by the TES.

The Westhills TES is a regulated public utility with service areas falling into both Stream A and Stream B. According to filings with BCUC the Westhills system has a capacity of approximately 3 MW heating (including peak/backup boilers) and 1.5 MW cooling, and in 2018 produced about 2,300 MWh of heat and

1,300 MWh of cooling to 425 connections. The system was constructed between 2014 and 2016 and cost approximately $11 million. The estimated annual operating cost was roughly $0.5 million.

Casa del Mila Oro – Osoyoos, BC

This site is a resort complex located near Osoyoos Lake with approximately 58,000 sq. ft. (~5,500 m2) of residential townhome and condominium floor space plus an outdoor pool. According to BCUC filings the GSHP system cost about $355,000 to install (install date not known). The operating cost of the system including financing was reported at about $60,000 per year but also appears to have required significant repairs.

While not stated directly in the filings the system appears to be a groundwater-based open-loop system, which tend to be much lower in cost than closed-loop systems.

Eversource Geothermal Pilot – Framingham, MA (USA)

Reshape requested a review of networked geothermal systems such as Eversource in Massachusetts. There is limited publicly-available information about this specific utility, the pilot project reportedly involves 36 homes with distributed wells. This approach allows for the system to be expanded incrementally and avoids the need for large centralized open areas to host a wellfield. This project is recommended for the CVRD to monitor as the semi-rural portions of the region would likely have properties with sufficient space to host several boreholes while the frontage distance between the homes would not be excessive such that the piping cost would make the project infeasible. Existing heat pump incentive programs may be sufficient to cover building-side retrofits.

Based on these case examples, KWL concludes that geothermal is likely to be a viable source of low-carbon energy in the CVRD, but it is not clear whether scalability beyond site-level projects would be feasible. In all of the case examples above, the heat pumps were located in the customer buildings or suites, and distribution would be considered 'ambient'.

As noted above, GSHP systems can be somewhat versatile in their applications. They tend to be capital-intensive with the benefit of low operating costs and high energy efficiency especially when cooling is involved. Unless a project is located in an environmentally-sensitive area or artesian aquifer where drilling activities would present unacceptable risks it would be difficult to preclude its consideration as a low-carbon energy option.

7. Water Resources

Water resources refer to bodies of water available in the natural environment. Use of water resources for thermal energy purposes is somewhat uncommon but examples using seawater, surface water and groundwater can be found in many places.

The common theme amongst all the water resource options are that environmental permitting and regulations will almost certainly apply to any project, particularly if there is a known or potential fish presence in the water body of interest.

Seawater

CVRD's eastern edge is defined by the Salish Sea shoreline. Projects with foreshore access needing larger heating and cooling demands may consider seawater as a possible source of heat exchange.

Seawater in southern coastal BC remains relatively cool (<10 ºC) below the low tide line year-round, with perhaps the exception of embayed areas such as estuaries and lagoons. This means extracting heat may require larger flow rates due to a limited temperature drop being available, especially in winter, however 'free' cooling may be available year-round.

Permitting requirements for using seawater are extensive, including both provincial and federal permits from multiple agencies, including but not necessarily limited to:

- Department of Fisheries and Oceans (Federal)
- Navigation Canada (Federal)
- Department of Defense (Federal – if adjacent to CFB Comox or other restricted areas)
- Local Port Authority / Harbour Master (Federal, if applicable)
- Ministry of Water, Land and Resource Stewardship (Provincial)
- Ministry of Environment and Parks (Provincial)

Due to these complexities seawater heat exchange projects tend to only be deployed for larger-scale applications or where there is a synergy with a co-located project (e.g. marina with resort development) where a foreshore lease / water lot can be 'piggybacked' upon.

Seawater thermal energy projects would typically involve some kind of foreshore structure to house pumping equipment and submerged intake and discharge structures either floating or below the low water mark. Intakes must be designed to not impinge marine animals and require constant maintenance due to biological growth. All heat exchange surfaces must be resistant to corrosion from seawater.

Surface Water

There are many surface water bodies in the CVRD, from large lakes such as Comox Lake to minor streams. Most surface water bodies of sufficient size to use for thermal energy are likely to be fish-bearing. The most limiting factor could be use of surface water for cooling as the rejected heat could increase surface water temperature in summer months when temperatures are at their peak.

Water use licensing is regulated by the provincial government, but DFO may still require a project review. Notably, DFO operates a major hatchery on the Puntledge River adjacent to BC Hydro's Puntledge Generating Station. The Puntledge Generating Station generates power from water diverted from Comox Lake via a penstock to a point downstream in the Puntledge River. Because this water is already diverted there could be a possibility to utilize it for heat exchange.

The other major facility diverting water in the region is the Comox Valley Water Treatment Plant. KWL generally does not recommend using municipal drinking water for heat exchange because in winter the heat extracted has to be partly made up downstream by hot water heaters, and heat rejected in the summer increases the temperature which can increase chlorine demand and bacterial regrowth risk. Since the treatment plant is relatively remote from any settlements or buildings it is unlikely to be used as a thermal energy source.

Groundwater

Groundwater use is regulated by the provincial government, and a permit is required for any projects exceeding 74 L/s. This is sufficient flow to support about 1-2 MW of heat exchange, but the extracted water would need to be discharged to a suitable location or re-injected into the aquifer.

Aquifers underly most of the populated areas of the CVRD and there are thousands of existing wells. Regional mapping suggests most groundwater resources are considered as being moderate to high vulnerability due to withdrawal rates and/or potential for contamination.

Groundwater-based heat pump systems (GWHPs) perform similarly to GSHPs, but tend to have complex maintenance requirements, especially for injection systems. Typically, one or more extraction wells would require two to three times as many injection wells to balance the flows. Maintenance issues may relate to water quality, biological growth, pump inspection and maintenance and heat exchanger fouling.

Overall Water Resources Findings

In summary, water resources are somewhat abundant but practically challenging to implement as a source of thermal energy exchange. KWL generally recommends considering co-location of heat exchange systems with existing or planned water resource projects to minimize additional regulatory processes and avoid duplication of infrastructure (e.g. intakes). All water resource systems require specific management and maintenance practices to avoid impacts on the environment, while also dealing with biological activity that reduces operability.

8. Summary & Recommendations

The foregoing presents a cursory review of potential sources of low-carbon thermal energy resources within the CVRD. Key findings include:

- Wastewater and solid waste systems are in the control of CVRD and have sufficient energy resources to warrant further consideration if demand is available.
  - Approximately 2 MW to 3 MW of raw wastewater heat exchange may be possible at Courtenay Pump Station on Comox Road.
  - Approximately 3 MW to 4 MW of effluent heat exchange may be available at CVWPCC.
  - Approximately 2.5-3 MW of landfill gas energy equivalent could be recovered from the CVWMC landfill.
- There are limited sources of urban or industrial waste heat to recover. Property owners could consider on-site heat recovery given limited quantities and potential for community sharing.
- Ground-source heat pump systems can be deployed in most locations, but feasibility depends on site conditions and energy demand.
- Water resources including seawater, surface fresh water and groundwater are all available throughout the CVRD but are generally challenging to utilize to due environmental permitting requirements and operating/maintenance costs. These sources are generally not recommended unless there are co-located facilities that simplify the implementation and/or reduce costs.

The above findings would need to be reviewed against potential demand for these resources. Assessment of energy demand is being completed by others, therefore the potential for development of these resources has not been determined.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by:

____

Mike Homenuke, P.Eng. ENV SP
Principal

MEH

Encl.:

Statement of Limitations

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Revision History

Revision #	Date	Status	Revision Description	Author
0	October 23, 2025	Final	Final Report	MEH

Enclosure A – Wastewater Data Analysis

Figure 3.1: Comox Road Flodar Dry Weather Flow Calibration Hydrograph

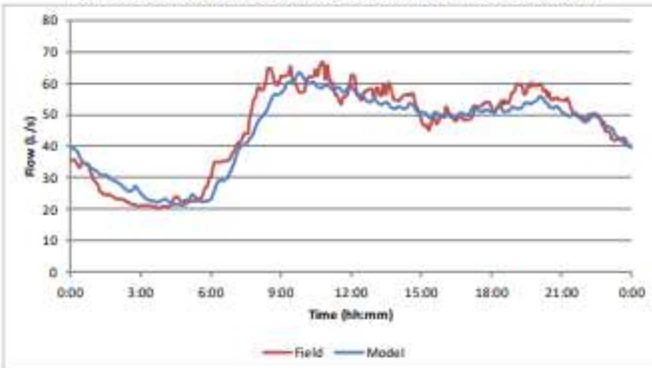
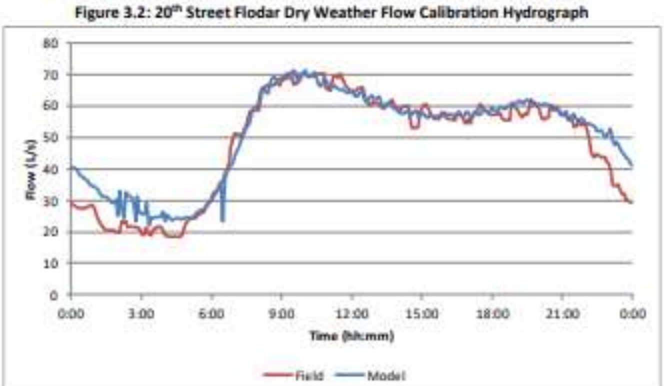
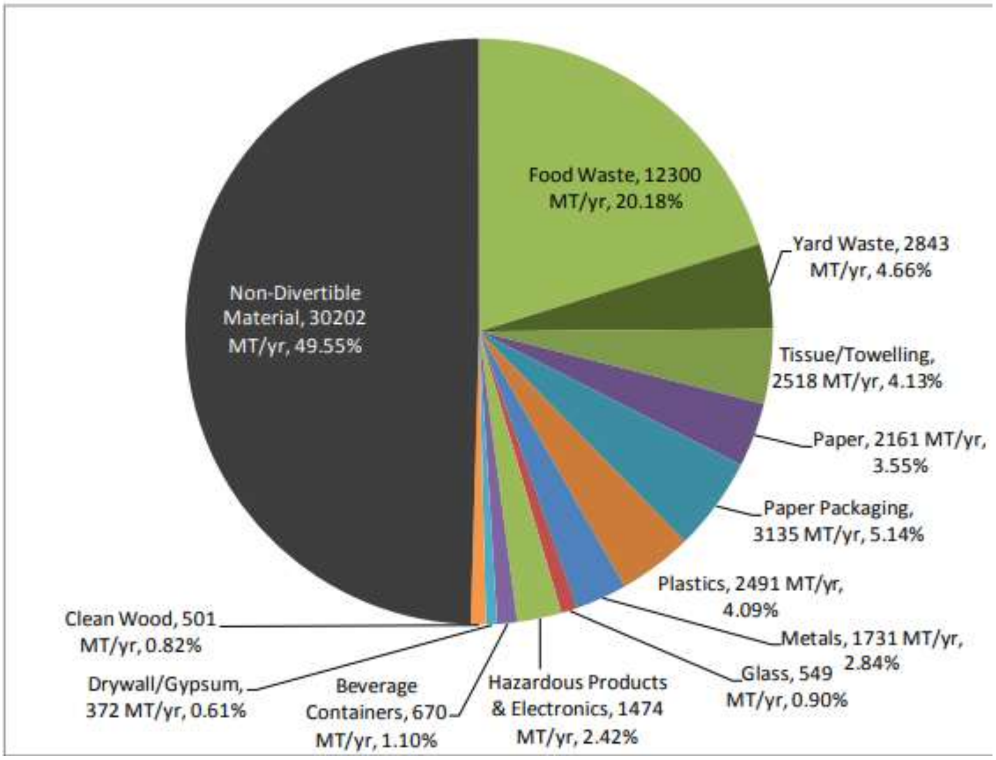


Figure 3.2: 20th Street Flodar Dry Weather Flow Calibration Hydrograph



Enclosure B – Solid Waste Data Analysis



APPENDIX C
Heating Demand Intensity Values, Detailed Inputs

Table: Existing Heating Demand, CVRD Existing Buildings, (Estimate)

		Annual Heating, Combustion	Peak Demand (W/m2)
Comox	Residential	65	40
	Non-Residential	90	50
Courtenay	Residential	50	30
	Non-Residential	65	40
Cumberland	Residential	55	40
	Non-Residential	170	100
-	Hospital (General)	250	80

Table: Forecasted Heating Demand, CVRD Municipalities

	Permit Date:	Before 2027		2027 - 2032		After 2032	
	Occupancy Date (2-Year Lag):	Before 2029		2029 - 2034		After 2034	
		Annual Heating (kWh/m2/yr)	Peak Demand (W/m2)	Annual Heating (kWh/m2/yr)	Peak Demand (W/m2)	Annual Heating (kWh/m2/yr)	Peak Demand (W/m2)
Comox	Single Family Home	76	50	65	40	53	30
	Multifamily Residential	82	50	70	40	55	30
	Non-Residential	40	30	28	20	28	20
Courtenay	Single Family Home	65	40	53	30	53	30
	Multifamily Residential	70	30	55	30	55	30
	Non-Residential	28	20	28	20	28	20
Cumberland	Single Family Home	76	50	65	40	53	30
	Multifamily Residential	82	50	70	40	55	30
	Non-Residential	40	30	28	20	28	20

APPENDIX D
Regional Substation Analysis, Detailed Inputs

Received from Licker Geo 04.28.2025

Table: Existing and Future Building GFA and Peak Heating Demand from GIS Model

			GFA (m2)			Peak Heating Demand (kWth)			
			Existing	Future	Delta	Current - Total	Future - Total	Future (Existing Buildings)	Future (New Buildings)
			GFA m2, 2023	GFA m2, 2050	net new m2	Total Peak Heating Demand kW, 2023	Total Peak Heating Demand kW, 2050	Buildings built Pre-2024, kW	Buildings built Post-2024, kW
Puntledge Substation Service Area	Courtenay	Residential	839,127	1,465,456	626,329	25,174	46,361	19,146	27,215
		Non-Residential	750,483	871,485	121,002	29,961	31,431	28,071	3,360
Buckley Bay Substation Service Area	Cumberland	Residential	235,462	461,918	226,457	9,418	19,179	8,289	10,891
		Non-Residential	95,478	148,900	53,422	9,529	9,979	8,306	1,673
Comox Substation Service Area	Comox	Residential	850,841	1,306,521	455,680	34,034	53,246	30,149	23,096
		Non-Residential	240,837	319,550	78,713	12,018	13,614	11,297	2,317
	Courtenay	Residential	874,387	1,451,838	577,451	26,232	46,148	18,230	27,918
		Non-Residential	312,997	390,587	77,590	14,778	16,193	14,510	1,682
	Comox Sub. Total	Residential	1,725,229	2,758,359	1,033,131	60,265	99,394	48,379	51,014
		Non-Residential	553,834	710,137	156,303	26,796	29,806	25,807	3,999
Total	All	All	**4,199,612**	**6,416,256**	**2,216,644**	**161,144**	**236,151**	**137,998**	**98,153**

Table: EV Charging Peak Power Demand Scenarios

		Puntledge	Buckley Bay	Comox
Forecasted Population, 2050		25,449	6,660	35,561
Estimated Total Vehicles		19,087	4,995	26,671
% of Vehicles that are EV's		100%	100%	100%
EV Charging Power Demand, Low	MW	14	4	20
EV Charging Power Demand, Base	MW	19	5	27
EV Charging Power Demand, High	MW	23	6	32

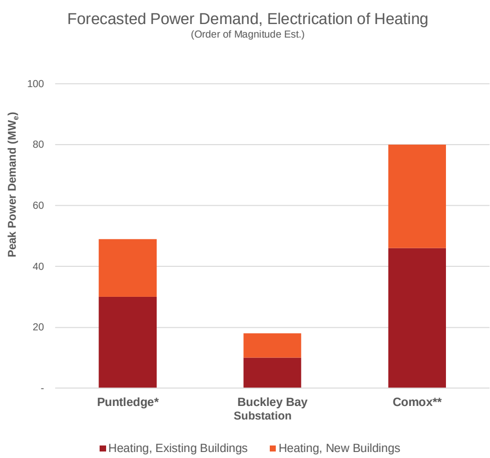
Demand per Plug in EV (kW) - based on fleet outputs from DOE EVI-F			Registered Vehicles	
Low	Base	High		
0.75	1	1.2	0.75	*BC Average*

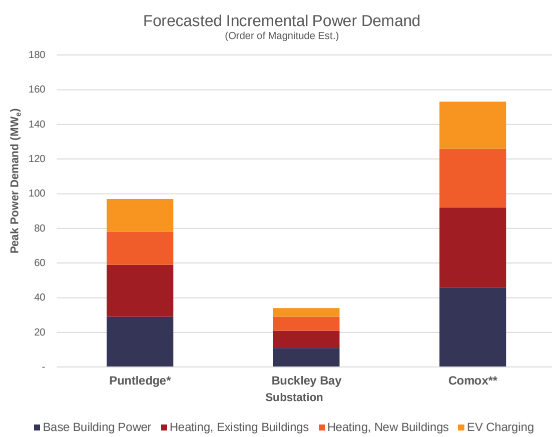
Table: Calculation of Peak Power Demand For New and Existing Buildings (2050, Fully Electrified Heating using blended average seasonal COP assuming heat from building-scale ASHP's)

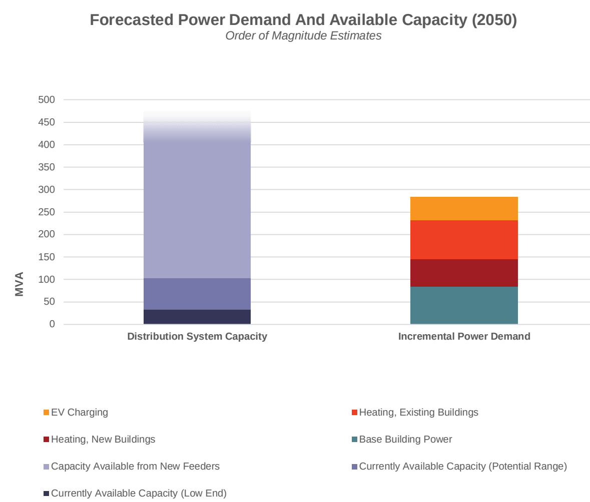
		Puntledge	Buckley Bay	Comox			ALL
		Courtenay	Cumberland	Comox	Courtenay	CMX Total	All Total
Net New Floor Area (m2)	Residenti	626,329	226,457	455,680	577,451	1,033,131	1,885,917
	Non-Resi	121,002	53,422	78,713	77,590	156,303	330,727
	Total	747,331	279,879	534,393	655,041	1,189,434	2,216,644
Base Building Electric Peak Demand, New Buildings, Residential		22,548	8,152	16,404	20,788	37,193	67,893
Base Building Electric Peak Demand, New Buildings, Non-Residential		6,534	2,885	4,251	4,190	8,440	17,859
Base Building Electric Peak Demand, New Buildings, Total		29,082	11,037	20,655	24,978	45,633	85,752
Peak Heating Demand, Existing Buildings (kWth)		47,217	16,595	41,446	32,740	74,186	137,998
Peak Heating Demand, New Buildings (kWth)		30,575	12,564	25,413	29,600	55,014	98,153
Peak Heating Demand, Existing & New Buildings (kWth)		77,792	29,159	66,859	62,341	129,200	236,151
Undiversified Peak Power Demand for Heating, Existing Buildings (kWe)		39,348	13,829	34,538	27,284	61,822	114,998
Undiversified Peak Power Demand for Heating, New Buildings (kWe)		25,479	10,470	21,178	24,667	45,845	81,794
Undiversified Peak Power Demand for Heating, New & Existing Buildings (kWe)		64,827	24,299	55,716	51,951	107,667	196,793
Diversified Peak Power Demand for Heating, Existing Buildings (kWe)		29,511	10,372	25,904	20,463	46,366	86,249
Diversified Peak Power Demand for Heating, New Buildings (kWe)		19,110	7,852	15,883	18,500	34,384	61,346
Diversified Peak Power Demand for Heating, New & Existing Buildings (kWe)		48,620	18,224	41,787	38,963	80,750	147,594

Building Scale COP	Diversity & Grid Peak-Coincidence Factor		Base Building Electric Peak Demand (W/m2)	
	Heating	Base Building Power	Residential	Non-Residential
1.2	75%	60%	60	90

	Puntledge*	Buckley Bay	Comox**	Total
Substation Capacity (Low Bookend)	20	1	15	36
Substation Capacity (High Bookend)	30	25	50	105
Base Building Power	29	11	46	86
Heating, Existing Buildings	30	10	46	86
Heating, New Buildings	19	8	34	61
EV Charging	19	5	27	51
Total	**97**	**34**	**153**	**284**







*does not include impact of Royston or other populated areas served by Puntledge Substation outside of Courtenay municipal boundaries

*does not include impact of CFB Comox or other populated areas served by Comox Substation outside of Comox & Courtenay municipal boundaries

APPENDIX E
District Energy Zone Evaluation Matrix

DE OPPORTUNITIES
CRITERIA AND WEIGHTING

RESHAPE STRATEGIES

Criteria	Description	Range	Weighting
Heat Demand Density	Determined based on heat density (MWh/ha) and schedule of anticipated development e.g. near-term (<5yrs), mid-term (5-10 yrs), long-term (10+ yrs)	0 to 3	High *(x5)*
Source of Low-Carbon Heat	May include geo-exchange, sewer heat, ice rink, ocean-heat, commercial refrigeration, industrial process heat, data center, etc.	0 to 3	High *(x3)*
Power Grid Congestion / Planned Upgrade	Is there a substation that is approaching capacity? Will a new feeder be needed to accommodate building-scale electrification?	0 to 3	High *(x3)*
CVRD/Public Anchor Customer	Are there public buildings in the area that can serve as anchor load	0 to 3	High *(x3)*
Limited Number of Developers/Owners	Areas with fewer stakeholders that will need to sign on as customer score higher = single campus/customer.	0 to 3	Med *(x2)*
Building Mechanical Systems	Do the potential customer buildings have mechanical systems that are compatible with a district energy system? Are mechanical systems nearing end-of-life and due for replacement?	0 to 3	Med *(x2*
Energy Center	Is there an obvious and/or no-cost site for energy center equipment (e.g. publicly-owned land)	0 to 3	Low *(x1)*
Infrastructure Coordination	Can a DE network be installed in parallel with other planned infrastructure renewal in the area (e.g. road construction, sewer upgrade etc.)?	0 to 3	Low *(x1)*

ASSESSMENT AND RANKING DETAILS

Tag	Name	Essential Criteria: Heat Demand Density	Essential Criteria: Source of Low-Carbon Heat	Essential Criteria: Power Grid Congestion / Planned Upgrade	Essential Criteria: CVRD/Public Anchor Customer	Distinguishing Criteria: Limited Number of Developers/Owners	Distinguishing Criteria: Building Mechanical Systems	Optimizations: Energy Centre Site	Optimizations: Infrastructure Coordination	**Evaluation Score**
	Weights	*5*	*3*	*3*	*3*	*2*	*2*	*1*	*1*	-
1A	Courtenay Downtown Core	2	2	0	3	2	0	3	1	**33**
1B	Courtenay Downtown Extended	1	2	0	3	1	0	2	1	**25**
2	Cliffe Ave Corridor	1.5	1	0	0	0	0	2	0	**13**
3A	Ryan Rd & Lerwick Rd Core	2.5	3	0	3	2	1	3	0	**40**
3B	Ryan Rd & Lerwick Rd Extended	2	2	0	2	1	1	0	0	**26**
4	Harbour Wood Park & Hospital Precinct	2	3	0	0	2	1	3	0	**28**
5	Ulverston Development	1	1	0	0	2	2	2	1	**19**
6	Cumberland Industrial Park	0.5	1	1	1	2	1	1	1	**20**
7	Anderton Corridor	2	1.0	0	1	0	0	2	1	**19**
8	Union Bay Development	2	3	1	0	3	2	2	3	**37**
9	Comox Downtown	2.	2	0	2	0	0	0	1	**23**
10	Aspen & Hector Neighbourhood	3	1	0	0	3	2	3	3	**32**
	Perfect Score	3	3	3	3	3	3	3	3	**60**

ASSESSMENT AND RANKING DETAILS

Tag	Name	Evaluation Score	Ranking
1-A	Courtenay Downtown Core	33	Medium
1-B	Courtenay Downtown Extended	25	Low
2	Cliffe Ave Corridor	13	Monitoring / TBD
3-A	Ryan Rd & Lerwick Rd Core	40	Medium
3-B	Ryan Rd & Lerwick Rd Extended	26	Low
4	Harbour Wood Park & Hospital Precinct	28	Low
5	Ulverston Development	19	Monitoring / TBD
6	Cumberland Industrial Park	20	Monitoring / TBD
7	Anderton Corridor	19	Monitoring / TBD
8	Union Bay Development	37	Medium
9	Comox Downtown	23	Low
10	Aspen & Hector Neighbourhood	32	Medium