Reducing Greenhouse Gas Emissions in the Public Sector: An Evaluative Framework for District Energy Projects in British Columbia

(598 Policy Report)

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December 12, 2010

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Abstract

The reduction of greenhouse gas emissions (GHG) is a key policy objective of the BC Government. The Government is demonstrating leadership by requiring all public sector organizations (PSOs) to become carbon neutral by 2010. District energy (DE) is a valuable mechanism that can help PSOs reduce GHG emissions and avoid the purchase of carbon offsets. The Public Sector Energy Conservation Agreement (PSECA) is one initiative that can help PSOs implement DE projects. This study outlines the steps taken to develop selection criteria for the public funding allocated through PSECA for DE systems. The method included a preliminary literature survey to inform an interview process directed at identifying stakeholder interests. A number of key themes were identified that informed the development of selection criteria: fuel type, project location and scale, aspects of triple bottom line accounting, partnership scenarios, and other best practices. The final results were delivered on time and according to the pre-determined schedule set by stakeholders. Important observations identified during the process included the difficulty of aligning decision-making processes with the political and fiscal realities within which funding initiatives (such as PSECA) are implemented and the challenge that process changes can pose to the achievement of desirable outcomes.

Acknowledgements

The authors would like to acknowledge the support and contributions of persons without whom this study would not have otherwise been completed. Particular thanks are extended to Ms. Colleen Sparks, Director, Carbon Neutral Government and Climate Action Outreach at the Climate Action Secretariat, for initiating the study, and Dr. Tom Pederson, Executive Director of the Pacific Institute for Climate Solutions, for providing generous research funding. The authors would also like to especially thank Dr. Rod Dobell, Professor Emeritus of Public Policy in the University of Victoria's School of Public Administration, for his steadfast guidance, constructive comments, and ongoing encouragement over the course of the research process.

Executive Summary

Background

The reduction of greenhouse gas (GHG) emissions is a key policy interest of the Government of British Columbia (BC). The BC government has demonstrated leadership on this front by legislating all public sector organizations (PSOs) to become carbon neutral in their operations by 2010. The Public Sector Energy Conservation Agreement (PSECA) is one mechanism that has been established to assist PSOs with reaching mandated GHG reductions targets.

PSECA was signed in 2007 and remains in effect from 2008 to 2020. The initiative is influenced by key policy objectives that further interests of energy security, energy conservation, and GHG emissions reductions. These policy drivers align closely with three very significant strategic policy instruments: the *Greenhouse Gas Reduction Targets Act (2007),* BC Energy Plan (2007), and *BC Clean Energy Act (2010).* Together, these instruments give PSECA its impetus to pursue aggressive conservation targets, require regular energy audits and reporting, and encourage innovative energy technologies.

As of 2008, the government committed $75 million to be spread over 3 consecutive rounds of funding. The current round of funding specifically allocates $12 million to assist with the implementation of district energy (DE) systems. These systems typically incorporate three elements: a central energy plant, an underground distribution system, and a cluster of buildings. Although the scale of DE systems is contingent on adequate building and energy density, they are determined to be a valuable mechanism in reducing GHG emissions. The Province is well poised to incorporate these systems into its stock of building infrastructure.

The oversight and implementation of PSECA falls to the direction of a working group comprised of representatives from several key government ministries and other strategic partners. Members currently include the BC Climate Action Secretariat and BC Hydro. The PSECA working group leverages diverse and specialized knowledge from its members and partners. That expertise and knowledge is used to guide project selection and inform funding decisions.

As with other funding initiatives, PSECA exists in a policy climate where its implementation is subject to a number of political, fiscal, and operational constraints. Given a relatively short funding window, the PSECA working group endorsed a systematic approach that would expedite and facilitate defensible decision-making within extraordinary tight deadlines. Yet, such an approach must also facilitate transparency and accountability. This study is undertaken in response to these needs.

Purpose

The purpose of this study is to assist the BC Government with furthering its objectives of reducing GHG emissions in the public sector. The key deliverable is the development of explicit selection criteria to assist the PSECA working group with assessing DE applications made in response to the third round of PSECA funding. The scope of this study is therefore limited to the development of an evaluation framework to be presented to the PSECA working group to inform DE project selection. This framework will also be useful to the government when assessing future DE projects.

Summary of Method

This study was premised on a conceptual framework that integrates three knowledge steams: PSECA policy drivers, working group knowledge, and established process requirements. The research method began with a preliminary literature survey to inform an intensive in-depth interview process, which was directed at eliciting specialized and detailed knowledge from working group members and a number of other elite respondents. That information was then used to inform the development of an evaluation framework that included a mechanism for weighting individual selection criteria (to reflect the primacy of each criterion) and the use of a numerical ranking scheme to document decision-making.

The literature survey component of the research method was undertaken with the objective of reviewing relevant subject literature in order to identify central themes and considerations to include in the interview instrument. Efforts were made to consolidate information acquired from the interviewees such that the resultant selection criteria represented the aggregated view of all respondents. The resultant selection criteria were arranged so that they aligned with one of five central themes: fuel type, location and scale, triple bottom line (TBL) elements, partnerships, and other best practices. The use of a weighting mechanism was developed in efforts to minimize the inherent bias and to ensure equitable consideration for the views of all respondents.

Results

Despite the challenge of aggregating perspectives of the respondents, the results obtained from this study reflect the interests of the PSECA working group and other immediate stakeholders. Where possible, linkages have been established between what respondents reported and what was documented in the preliminary literature survey that informed the enquiry. In all cases, the acquired survey information is tied to a derived criterion.

The results of this study cumulated in the identification of 18 specific criteria, each of which corresponds to one of the five central themes informing the interview instrument that guided the interview process: fuel type, location and scale, triple bottom line (TBL) elements, partnerships, and other best practices. The criteria are included in a scoring guide, which was developed for the purpose of assigning a numerical rank to each criterion. These criteria are also informed by an accompanying weighting mechanism. The full list of criteria is presented in Table 1.

The scoring guide, depicted in Table 1, makes use of a standard three-point scale, with a score of 3 assigned for full alignment with a criterion and a score of 1 assigned for partial alignment with that criterion. The accompanying weighting mechanism was informed by respondents and developed by the research team. As such the weighting given to each respective criterion accurately reflects the depth of qualitative information acquired and distilled as an outcome of the interview process.

Table 1. Criteria Scoring Guide Showing Explicit Criteria and Associated Weighting Mechanism

No.	Criteria	Scoring Guide	Score	Weighted Score
1	**Net GHG emissions reduction over BAU case (based on fuel switching, backup, and peak load cycles)**	Over 80% = 3, 50% - 80% - 2, 20% -50% = 1, 0%-20% = 0		0.00
2	**Security of fuel source supply (reliability/sustainability/affordability)**	Low risk = 3, Medium Risk = 2, High Risk = 1, Very High Risk = 0		0.00
3	**Local sourcing of fuel supply (primary and secondary)**	Same Community = 3, Region = 2, Province = 1, Elsewhere = 0		0.00
4	**Reliance on natural gas as fuel source (e.g., primary /secondary, backup, and peak loading)**	Back-up only = 3, Secondary =2, Peak Load = 1, Primary = 0		0.00
5	**Ability to accommodate both current and future demand, whether service provision is isolated or community wide**	High Ability = 3, Medium Ability = 2, Low Ability = 1, No Ability = 0		0.00
6	**Connects multiple buildings and/or customers**	More than 20 buildings = 3, 10 - 20 Buildings = 2, 5 - 10 Buildings = 1, 0-5 Buildings = 0		0.00
7	**Services PSO's or other community organizations for which DE system would otherwise not be viable**	Services more than 2 PSO's = 3, Services 2 PSO's = 2, Services 1 PSO = 1		0.00
8	**Partners with community local government, or industry**	Partners with Community and Local Government = 3, Partners with Industry *or* local government = 1, No Partnership = 0		0.00
9	**Assigns GHG emissions reductions benefit claims through MOU (energy audit)**	MoU in place with GHG reduction allocated to PSO = 3 , MoU in Place with GHG divided between partners = 2, MoU in place with GHG allocated to partner = 1, No MoU in place = 0		0.00
10	**Engages stakeholders actively through consultation/engagement framework**	Stakeholder consultation plan in alignment with Government standards is in place = 3, Stakeholder consultation plan is in place = 2, Stakeholder informing plan is in place = 1, No stakeholder engagement/consultation plan = 0		0.00
11	**Aligns with overall community sustainability goals**	Aligns with all community sustainability goals = 3, Aligns with some community sustainability goals = 1, Conflicts with community sustainability goals = 0		0.00
12	**Offers value-added elements**	Offers significant value added elements = 3, Offers few value added elements = 1, Offers no value added elements = 0		0.00
13	**Provides GHG emissions reduction evaluation plan**	Provides a GHG emissions evaluation plan = 3, Does not provide a GHG emissions evaluation plan		0.00
14	**Demonstrates compliance with environmental management protocols**	EM protocols adhering to international standards is in place = 3, EM protocols not adhering to international standards is in place = 1, No EM protocols in place = 0		0.00
15	**Leverages funding from other sources**	Leverages funding from multiple sources that facilitates partnership = 3, Leverages funding from multiple sources = 2, Leverages funding from one other source = 1, Does not leverage other funding sources = 0		0.00
16	**Supports development of local/community capacity for DE**	Provides training and information sharing to facilitate local capacity for DE = 3, Provides public education component = 1, Does not provide help develop local/community capacity for DE = 0		
17	**Demonstrates replicability**	Uses technology replicable in other communities in BC = 3, Does not use technologies replicable in other communities in BC = 0		
18	**System design maximizes efficiencies and minimizes redundancies (both plant and infrastructure)**	System design is highly efficient (according to professional assessment) = 3, System design is moderately efficient = 2, System design has a low efficiency rating = 1, System design uses technology that is not efficient.		
		Total Score	0	

Lessons Learned and Discussion

The method developed for this study has been determined to be consistent with the research design and purpose. Results were delivered expediently and within the timeframe originally specified by the client. Yet, several important observations were made during the criteria development process. These observations include limitations and oversights identified during the interview process, limits on stakeholder engagement, and a number of operational constraints inherent in the PESCA process.

These observations highlight the tension that exists between making timely funding decisions and the need to demonstrate accountability and transparency. In addition, with increasing demand for mechanisms that assist PSOs with reducing their GHG emissions, as per the legislated carbon neutrality requirements prescribed by the GGRTA, public scrutiny of the funding programs (such as PSECA) will likely increase. As a result, flexible decision-making processes may require rigorous and documented project selection.

Due to PSECA process changes, unforeseen at the time of writing, it remains uncertain as to how the criteria delivered as the product of this study influenced the final selection of DE projects. Inevitably, such matters lay beyond the scope of this investigation. However, regardless of whether the current policy context enables the evaluation framework developed here to be used to inform the current round of PSECA funding, with ten years remaining in the PSECA agreement, the results of this study remain available for refinement and future use where other circumstances may dictate.

List of Acronyms

ALMD – BC Ministry of Advanced Education and Labour Market Development
ASD – Alternative Service Delivery
BAU – Business as Usual
BC – British Columbia
BCEP – BC Energy Plan GHG – Greenhouse Gas Emissions
BCUC – British Columbia Utilities Commission
CAS – BC Climate Action Secretariat
CDEA – Canadian District Energy Association
CEA – (BC) Clean Energy Act
CEA – Community Energy Association
CEM – Council of Energy Ministers
CHP – Combined Heat and Power
CITZ – BC Ministry of Citizen's Services
CO_2 – Carbon Dioxide
CPS – Capital Planning Secretariat
DE – District Energy PSECA – Public Sector Energy Conservation Agreement
DH – District Heating
GAAP – Generally Accepted Accounting Principles
GGRTA – Greenhouse Gas Reduction Targets Act
GRE – Government Reporting Entity
HVAC – Heating Ventilation Air Conditioning
ICE – Innovative Clean Energy Fund
IDEA – International District Energy Association PSO – Public Sector Organization
IEA – International Energy Agency ISO – International Standards Organization
MCD – BC Ministry of Community Development
MEMPR – BC Ministry of Energy, Mines, and Petroleum Resources
MOU – Memorandum of Understanding
NRCan – Natural Resources Canada
OCP – Official Community Plan
P3 – Public Private Partnership
RGS – Regional Growth Strategy
TB – Treasury Board
TBL (or 3BL) – Triple Bottom Line

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Introduction

Climate change is an issue that demands concerted action on the international front. Although the international community has taken action on this issue through the establishment of treaties and protocols, such as the United Nations Framework Convention on Climate Change and the Kyoto Protocol, the outcome of the recent United Nations Climate Change Conference (Copenhagen Summit) in 2009 [1] demonstrates that a definitive collective response continues to be lacking. What has become readily apparent, however, is that the international community's efforts to address climate change first requires effective leadership on the domestic front.

British Columbia (BC) has demonstrated its leadership in combating climate change by initiating a number of strategies to curb greenhouse gas (GHG) emissions in the province. The current government's "Climate Action Plan," [2] highlights many of them. Of particular significance is the government's ambitious goal to reduce GHG emissions in the province to 33% below 2007 levels by the year 2020. In order to help reach that target and demonstrate leadership, the Province enacted legislation that commits the public sector to carbon neutrality by 2010.[3]

To help achieve the goal of a carbon neutral public sector, the Public Sector Energy Conservation Agreement (PSECA) was initiated (BC Climate Action Secretariat, 2010b). Currently, the BC public sector comprises several thousand buildings, which range from social housing and office buildings to hospitals, schools, and universities. For various reasons, many of these public organizations incur significant energy demand. One way the Province can improve energy conservation and efficiency in the public sector is by upgrading and retrofitting public sector buildings and energy infrastructure. The development of district energy (DE) systems offers the Province a means to do so.

DE systems typically comprise three key elements: a centralized energy plant (or series of plants), a distribution network that relies on an underground piping, and a cluster of buildings that demand the energy supplied. Where DE systems have been defined in the subject literature the following description touches on these elements:

> District energy (DE) comprises systems that service multi-building heating and cooling needs, and may include cogeneration systems that produce both heat and electricity. The thermal energy generated by DE systems is distributed to buildings through underground piping that carries either hot water or low pressure steam (Rosen, Le, & Dincer, 2005, p. 148).

As this description suggests, DE systems offer energy planners and system operators with an effective mechanism to service the diverse energy needs of multiple energy consumers.

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[1] The outcome of the Copenhagen Summit was deemed a failure by BBC news, for more information see: http://news.bbc.co.uk/2/hi/8426835.stm

[2] Information on BC's Climate Action Plan can be found at http://www.livesmartbc.ca/government/plan.html

[3] For the Province of BC, achieving carbon neutrality involves a four step process: reducing carbon emissions, measuring the remaining emissions, purchasing offsets to arrive at net zero emissions, and reporting results (for more information see footnote 4 or consult : BC Climate Action Secretariat, 2009).

A number of DE systems are currently in operation throughout BC, in both rural and urban areas (Canadian District Energy Association , 2009). These systems have proven to be energy efficient and capable of satisfying community energy needs. Many DE systems are community-based, often servicing dense urban cores, but they can also be effective in rural areas that have sufficient energy use density (Community Energy Association, 2010). In addition to providing energy conservation and emissions reductions benefits, DE systems enable fuel flexibility and bolster system reliability. System benefits are also compounded by the energy security and price stability offered. As a whole, these characteristics align well with the objectives of PSECA.

Public sector entities play a significant role in communities throughout the province. Initiatives that encourage the development of DE projects will not only further the Province's energy conservation goals but also those of the extended community. Because DE systems are known to work well in various geographic settings and dovetail well with community energy planning strategies, they offer attractive solutions for servicing commercial, institutional, residential, and industrial energy needs (Community Energy Association, 2007). In addition to providing environmental benefits, DE systems have also resulted in economic and social benefits (Government of British Columbia, 2010d). Encouraging the development of DE systems in BC through initiatives such as PSECA can therefore expand opportunities, and the BC public sector is well poised to incorporate DE systems into its building stock.

Purpose

The purpose of this study is to assist the BC government in pursuing its objectives of reducing GHG emissions in the public sector. The primary deliverable of the research is the development of criteria and an evaluation framework to be used to assess the quality of district energy funding applications submitted in response to the third round of PSECA funding. The scope of the study is limited to the development of an overall evaluation framework, a list of criteria and a ranking system, to be presented to the PSECA working group to assist with DE project selection.

To help facilitate this purpose, the role of the research team is twofold: first, to serve as facilitators by assisting the working group with the development of project selection criteria, and second, to interview key stakeholders and other persons with the objective of obtaining specialized information. The results of this study will be useful to the BC Government when assessing future DE projects. The development of a project evaluation framework will not only enable defensible decision-making, allowing potential projects to be assessed on their individual strengths, but also strengthen process accountability and transparency requirements through numerically ranked project selection.

The study is the culmination of various process requirements, an informative literature scan, and an in-depth interview process. The study incorporates six sections and proceeds accordingly: the first section provides relevant background information on PSECA and touches on program rationale, key policy drivers, and operational constraints. The second section describes the conceptual framework, which is then followed by a third section that outlines the research method. The fourth section documents the results and links interview outcomes to the subject literature and respective criteria. The fifth section comprises the discussion and lessons learned. The sixth section concludes by offering final remarks.

Background

PSECA has its origins in the current government's second term mandate, in which policy action on global warming and climate change was made a priority. In its 2007 speech from the Throne, the government announced its policy on climate change, expressing its commitment to making the government carbon neutral in its operations by 2010 (Government of British Columbia, 2007a). That commitment was reinforced at the 2007 Union of British Columbia Municipalities (UBCM) convention (Office of the Premier, 2007). Shortly afterwards, and coinciding with the ratification of GHG reductions legislation, the emissions reductions targets became entrenched for the entire BC public sector (BC Ministry of Environment, 2010).

In order to demonstrate effective leadership on climate action, the Province and BC Hydro committed to establishing a working partnership and signed PSECA in 2007. The agreement, in effect from 2008 through to 2020, rests on three fundamental pillars: the pursuit of aggressive conservation targets; the enhancement of energy assessments and energy audits; and the encouragement of innovative energy technologies (Public Sector Energy Conservation Agreement, 2007). In pursuing these objectives, PSECA has made investments in public sector building upgrades and retrofits that conserve energy, support energy self sufficiency, and incorporate alternative energy solutions. The existing stock of public sector buildings comprises more than 6500 individual facilities, which include Crown corporations, social housing, hospitals, schools, colleges, and universities (Public Sector Energy Conservation Agreement, 2007).

Key Policy Objectives

PSECA is informed by policy objectives that hinge on energy security, energy conservation, and GHG emissions reductions. Generally, these policy objectives align with international efforts to address global warming and climate change. More specifically, these policy objectives reflect the government's efforts to demonstrate informed leadership on climate change through the implementation of three strategic policy instruments: the *Greenhouse Gas Reduction Targets Act (2007), BC Energy Plan (2007),* and BC *Clean Energy Act (2010)* (enacted at the time of writing), all of which are discernible in the language and objectives of PSECA. Each of these policy instruments is discussed below.

Greenhouse Gas Reduction Targets Act (GGRTA). In 2007, the Province of British Columbia implemented legislation that committed the Province to achieving aggressive greenhouse gas (GHG) emissions reductions. The GGRTA was given royal assent in 2007 and enacted in 2008. The legislation binds the Province to becoming carbon neutral in its operations by 2010 (Greenhouse Gas Reduction Targets Act, 2007).

The GGRTA requires the Province to reduce provincial GHG emissions to 33 percent below 2007 levels by the year 2020, with interim targets established for 2012 and 2015. The Act also imposes a longer-term emissions reduction target of 80 percent below 2007 levels by 2050. And, under the auspices of public accountability and transparency, the Province is required to report its progress on reaching these targets at two-year intervals (Greenhouse Gas Reduction Targets Act, 2007).

The GGRTA explicitly binds the public sector to carbon neutrality. [4] That requirement extends to every public sector organization (PSO) throughout the province. As determined by the Act, the public sector not only includes provincial government ministries and Crown corporations, but also institutions such as health authorities, schools, colleges, universities, and BC social housing. As part of the requirement to report on their progress in reaching the prescribed targets, PSOs are expected to submit plans that outline strategies used to reduce GHG emissions, including the purchase of carbon offsets (Greenhouse Gas Reduction Targets Act, 2007).

BC Energy Plan (BCEP). The second policy instrument informing PSECA is the BCEP. The BCEP was established in 2007 and advances 55 policy actions that support the Province's competitive advantage in the area of clean and renewable electricity. [5] To help address BC's future energy needs and promote energy conservation, the Plan articulates strategies that encourage energy security and the use of clean and renewable energy sources. The Plan encourages the adoption of innovative technologies and solutions (Government of British Columbia, 2007b).

Where the focus is on strengthening BC's energy security, BCEP commits the Province to achieving electrical self-sufficiency by 2016. The Plan stipulates that at least 90 percent of the Province's electrical power generation be acquired from clean or renewable sources of electricity. In promoting energy conservation and energy efficiency, BCEP requires that BC Hydro secure 50 percent of its incremental resource needs through conservation measures by the year 2020. The Plan also incorporates aggressive net zero GHG emissions reductions goals aimed at ensuring environmental leadership and conservation. (Government of British Columbia, 2007b).

BCEP also advances the Province's investment in technological innovation and resource development through the establishment of two new programs. First, the Innovative Clean Energy Fund allocates $25 million to promote the development of clean and renewable energy technologies in the energy, transportation, and oil and gas sectors. Second, the BC Bio-energy Strategy leverages the Province's abundant renewable energy resources, particularly those in the biomass sector, to promote sustainable energy use in BC (Government of British Columbia, 2007b)

Clean Energy Act (CEA). Passed in June, 2010, the CEA is an instrument that, although enacted after the implementation of PSECA, reinforces the policy drivers that gave the initiative its impetus. CEA is therefore horizontally relevant to PSECA. In promoting energy security, advocating GHG reductions, and capitalizing on BC's clean and alternative energy potential, the

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[4] Carbon neutrality in the language of the GGRTA does not explicitly mean zero GHG emissions, but rather 'net zero' emissions, which affords more flexibility in reaching specified targets. To satisfy GGRTA requirements PSOs must: establish baseline GHG emissions for every year and report their total GHG emissions for that year; undertake efforts to implement strategies and reduce GHG emissions as much as possible; and purchase carbon offsets (financial investments in certified carbon neutral technologies/ projects) to achieve net zero emissions by a prescribed date to satisfy GHG target requirements (see GGRTA).

[5] For information on how Province of BC defines clean and renewable energy see Appendix B

Act pursues objectives similar to the GGRTA and BCEP. The CEA proposes a number of energy related strategies to achieve 16 specific objectives (Government of British Columbia, 2010a). The CEA supports the BCEP target of energy self-sufficiency by introducing a new regulatory framework that embraces long-term integrated resource and energy planning. The Act also advocates for the development and implementation of new strategies that encourage energy conservation and investment in clean and renewable energy generation. More notably, the plan augments BC Hydro's commitment to accommodate incremental power demand by increasing the acquisition target from 50 to 66 percent (Government of British Columbia, 2010a).

In regards to GHG emissions reductions, the CEA reassesses the BCEP requirement that 90 percent of electrical energy be secured from clean and renewable energy sources by increasing that proportion to 93 percent. The Act also encourages the development and implementation of programs and strategies geared towards the high efficiency production of heat and hot water. This latter emphasis has particular relevance for PSECA, as it relates directly to the development of DE systems (Government of British Columbia, 2010a).

The CEA also capitalizes on BC's clean energy potential by establishing a framework that allows BC Hydro to expedite its acquisition of clean energy by leveraging the capacity of the province's independent clean and renewable power producers. Furthermore, the Act introduces the second phase of a bio-energy call, which is directed at the procurement of electrical energy produced from biomass (wood-waste). The Act will also help stabilize energy pricing in the province by allowing the BC Utilities Commission (BCUC) to establish appropriate pricing schedules for clean energy (Government of British Columbia, 2010a).

Program Funding and Stakeholders

It is anticipated that PSECA will provide approximately $200 million in project funding over the twelve year lifespan of the initiative (Government of British Columbia, 2007c). As of 2008, the Province committed $75 million to be distributed over three consecutive rounds of funding (Government of British Columbia, 2008). To date, the first two rounds of funding have resulted in a number of projects that have either been completed or are nearing completion. As a result of these investments, the Province has documented annual energy cost savings of approximately $7 million, electrical energy conservation of approximately 40 GWh, and GHG emissions reductions of over 18,000 metric tonnes (BC Climate Action Secretariat, 2010a).

Funding for the third round of PSECA (2010/2011 fiscal period) has been set at $25 million and calls for proposals (at the time of writing) are now underway. In the current round, funding has been allocated to four priority areas: $2 million for solar hot water projects; $6 million for HVAC system upgrades in K-12 schools; $5 million for portfolio-wide projects that meet minimum thresholds for GHG reductions; and $12 million for projects that incorporate district energy heating systems. Subject to the development of selection criteria, it is expected that funding for qualifying projects will be allocated on a first-come first-served basis (BC Climate Action Secretariat, 2010b)

In the previous funding rounds, eligible projects may have also qualified for additional funding incentives through programs sponsored by BC Hydro and other partners. Depending on qualification status, supplemental funding may also be available for proponents that receive third-round funding. Furthermore, there is now the possibility that proponents may also be eligible to receive supplemental incentive funding from Terasen Gas Incorporated, a BC gas utility recently secured as a PSECA partner (BC Climate Action Secretariat, 2010b).

The oversight and implementation of PSECA has been assigned to a working group, comprised of representatives from key government ministries and other strategic partners. PSECA working group members include representatives from the Climate Action Secretariat (CAS), Ministry of Energy, Mines, and Petroleum Resources (MEMPR), and the Ministry of Citizens' Services (CITZ). The program's strategic partners include BC Hydro and Solar BC, and, only recently, Terasen Gas—having signed an agreement with the Province in June, 2010 (BC Climate Action Secretariat, 2010b). As a single entity, the PSECA working group leverages diverse and specialized knowledge, encompassing a range of expertise.

Other immediate stakeholders in PSECA include PSOs, Treasury Board (TB), Ministry of Advanced Education and Labour Market Development (ALMD), and Capital Planning Secretariat (CPS) (Public Sector Energy Conservation Agreement, 2007). Peripheral stakeholders involved in the initiative include the Ministry of Community Development (MCD), local governments, infrastructure developers, and respective regulatory bodies such as the British Columbia Utilities Commission (BCUC). Other stakeholders impacted by PSECA include government agencies offering infrastructure grants and other funding to PSECA applicants.

Program Constraints

As is the case with many other programs and initiatives funded by the Provincial government, PSECA is subject to a number of operational, political, and fiscal constraints. Among other purposes, these constraints exist to ensure spending decisions align with established reporting and accountability mechanisms. An important operational requirement is that ownership of provincially funded capital assets must reside with the Province. This constraint emerges from the BC government procurement rules for capital assets, which are applicable to all organizations deemed to comprise the government reporting entity (GRE).

A second program constraint results from limits on project investment and a political requirement that funding be allocated to both rural and urban sectors. Given the high capital costs typically associated with implementing DE systems, the $12 million allocated by the PSECA DE component places a practical limit on the number of projects that can be selected: to optimize funding potential, project selection is capped at no more than four (BC Climate Action Secretariat, 2010b). The selection process is made more difficult because of the requirement that projects be geographically represented in accordance with the prescribed urban/rural stipulation.

The third constraint imposed by PSECA relates to the government's budget cycle. As governments typically operate on regimented fiscal cycles, access to PSECA funding is limited to defined windows of opportunity. In considering the immediate fiscal context (fiscal period 2010/2011), for example, the call for applications was announced in mid-June. Projects were expected to be selected and reviewed during September, and proponents to incur relevant project costs by March 31, 2011 (BC Climate Action Secretariat, 2010b). Cumulatively, these fiscal constraints limit prospective projects to those in the implementation phase and with a first-mover advantage —essentially accommodating projects that are already underway or are about to begin the construction phase within the funding window prescribed by PSECA.

The Present Context

PSECA applications are currently being considered for the 2010/11 fiscal period. In early May, 2010, members of the PSECA working group convened to discuss the third round of PSECA funding. The primary focus of that discussion concerned the funding of DE systems and the need for an evaluation framework that would include relevant selection criteria and assist project evaluators in assessing DE projects. At the time of writing, all DE project proposals are subject to pre-determined high-level criteria as per PSECA guidelines (BC Climate Action Secretariat, 2010b) that stipulate that proponents must satisfy the following:

a) projects result in good value for money;
b) proposals are technically viable;
c) proponents demonstrate that they possess the requisite experience and resources to undertake and complete the project; and
d) projects exhibit high potential for demonstration value.

Although these high-level criteria exist to provide PSECA applicants with general eligibility guidelines, a number of political and operational considerations place specific constraints on PESCA's implementation. For instance, in the current round of funding, the working group faced a situation where the program budget had to be reviewed with department financial analysts as early as June of 2010. With less than six weeks provided to furnish the requisite documentation to move forward with program spending, a systematic approach needed to be developed that would expedite and facilitate defensible decision-making within extraordinarily tight deadlines.

To accommodate imposed time constraints and ensure desirable outcomes, early consultation with the working group members led to the development of a Project Charter and the subsequent development of a process schematic that identified key milestones and deliverables. In order to hasten the development of DE criteria, the working group endorsed the plan for an interview process that might enable consensus to be reached sooner than if deliberating on the matter at length as a whole. This study emerged in response to that reasoning.

The current context subjects PSECA to a number of other factors that, while considered beyond the scope of this study, have significant implications for the initiative nonetheless. First, the current policy climate is one rooted in concerns for accountability, transparency, and defensible decision-making. PSECA spending is not only subject to Treasury Board (TB) oversight, but also falls under the purview of program auditing, and by extension public scrutiny. It might be argued that, as the volume of applications increases over the initiative's lifetime, a robust system is needed whereby the allocation of funding is documented in such a way that the selection of projects becomes easily defensible. The development of an evaluation framework that includes explicit weighted criteria should facilitate accountability and provide a solid basis for documentation of reasons for decisions.

A second factor concerns the requirement that, beginning in 2010, PSO's must meet GHG emissions reductions targets as established by the GGRTA. Simply put, PSOs must either reduce GHG emissions in their respective operations to prescribed levels or purchase carbon offsets as an alternative (see notes 3 and 4 above). PSOs that have not yet implemented strategies to reach zero emissions will incur the direct costs of purchasing carbon offsets until the discrepancy is reconciled. It is anticipated, therefore, that the number of PSECA funding applications will likely increase in the near future, which means an effective mechanism must be available to screen applicants.

A third factor to consider is one in which policy decisions are increasingly being informed by multiple stakeholders. As noted above, the implementation of PSECA involved the participation of a number of stakeholders from various ministries, crown corporations, and (more recently) the private sector. As members of the PSECA working group have come to recognize, eliciting the views of multiple stakeholders requires a process that effectively reconciles the interests of all parties concerned. As the case may demonstrate, PSECA may have the potential to serve as a model for other government initiatives that require the participation of multiple stakeholders.

A fourth factor to consider is one in which the challenge of reducing GHG emissions has also resulted in the exploration of new territory where political decision-making is shaped by the advent of new technologies. As specialized knowledge and expertise inherently reside with firms in the private sector, decision-making and policy development now consider solutions that involve reaching out to the private sector. In the current political landscape, new models of governance and alternative service delivery (ASD) often rely on establishing public-private-partnerships (otherwise, P3s) that offer new avenues for informing and implementing energy policy. The PSECA DE component is at the fore of incorporating innovative technologies and straddles the threshold of that frontier.

Conceptual Framework

This study is premised on the conceptual framework depicted in Figure 1. The development of the criteria and evaluation framework proposed here involves the integration of three knowledge steams: PSECA policy drivers, working group knowledge, and established process requirements. An appropriate synthesis of this explicit information and knowledge, along with additional information from the subject literature, will be essential in developing the interview instrument and guiding the interview process. The objective of this study is to develop a proposed evaluation framework, which includes a mechanism for weighting individual selection criteria, and hence the possibility of a numerical ranking scheme.

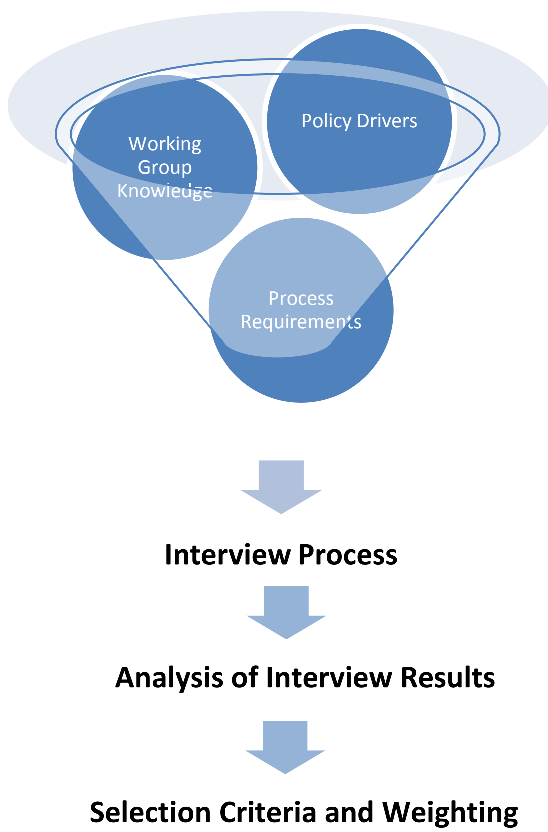

Figure 1. Conceptual framework depicting policy drivers, working group knowledge, and process requirements as key channels feeding into the development of PSECA selection criteria and resulting weighting mechanism via the interview process and information analysis.

Method

The key objective of the interview process was to ensure that all working group members were provided with an equal opportunity to inform the selection of criteria used to select projects and guide funding decisions made under the PSECA DE component. The research team strived to ensure that the study was also accomplished within the mutually agreed upon time frame. Study objectives were motivated by the answer to a specific research question: What criteria will help to ensure that PSECA funding is allocated to DE projects that are most in alignment with policy and working group member objectives? The outcome of the study was the development of an evaluation framework that included explicit weighted criteria to assist with project evaluation, candidate selection, and funding allocation.

The study's research method was designed to address the overarching challenge of reconciling expert knowledge and information with differing working group member perspectives in striking a fair balance and ensuring the equitable selection of DE projects. The initial stages of the research process involved consultation with the PSECA working group to discuss the research method and establish key milestones and deliverables. It was essential to establish a mutually agreed upon process at the outset to make certain that working group members remained committed to their respective obligations. Early discussions also afforded working group members an opportunity to plan ahead and confirm their on-going participation in the research process. A Project Charter was then developed to delegate tasks and document key milestones and project deliverables (See Appendix G).

It was determined by the research team and the PSECA working group that one-on-one personal interviews would be the preferred mechanism to engage working group members. The use of an interview process was endorsed to expedite the information gathering process and to reduce possible conflicts that may have otherwise arisen due to the differing mandates of the respective organizations involved. Information acquired over the course of the interview process was recorded, synthesized, and summarized in an executive summary, which, along with the initial draft criteria, was then submitted to the PSECA working group for review and discussion.

Once the criteria were established, working group members were then asked to provide their personal preferences in ranking each criterion that would be used to assess projects submitted to PSECA administrators for funding consideration. The criteria were then tabulated, summed, averaged, and weighted in a scoring matrix that would be used to score the project submissions received. The primary deliverable for this study, thus, incorporated a weighted criteria scoring matrix that would be submitted to the PSECA project director for evaluating eligible projects through a third-party project selection team.

Prior to embarking upon the interview process, the research team agreed to conduct a preliminary literature survey to assure interview questioning would be framed in accordance with primary concerns raised in the literature. It was expected that questions informed in this fashion would prove useful in focusing the interviews and canvassing respondents for information. As for subject matter, the literature survey was directed at obtaining information from existing policies and legislation, sample DE case studies, academic literature, and other funding programs. It was agreed in advance that, although it would not be comprehensive, the literature survey would be of sufficient scope and depth.

As a result of the literature survey (the complete literature survey is included in Appendix A), several key themes were identified, which led to the subsequent development of the sample interview categories. Prior to initiating contact with interviewees, and engaging in the interview process in earnest, the sample interview categories were presented to the PSECA working group and reviewed as part of an informal pre-testing and feedback process. The group's feedback was then used to inform draft questions in the interview instrument.

A research ethics review application, including a proposed research protocol and statement of informed consent, was also developed and approved by the University of Victoria Human Research Ethics Board. Prior to commencing the interviews, a participant consent form was sent to all participants, informing them of the interview process and investigator obligations under the University of Victoria research ethics protocol (see Appendix H). The statement of consent also stressed voluntary participation and assured privacy and anonymity.

Other information disclosed in the consent form addressed interview requirements, such as duration of the interview, the interview format, and the nature of questions to be asked. Participants were also informed that they retained the privilege to terminate interviews at their discretion. No compensation was given, as all interviewees were determined to participate in the process in a professional capacity and/or on behalf their respective employers.

The interview process consisted of one-on-one in-depth interviews with representatives from the organizations comprising the PSECA working group: BC Hydro, the Climate Action Secretariat, Shared Services BC, and the Ministry of Energy and Mines and Petroleum Resources. Other knowledge holders, whose contact information was provided by members of the working group, were also approached and invited to participate in the interview process. As per the research ethics protocol (noted above) and the interview participation agreement, these respondents remained anonymous. A key element in the process was the development of a consistent interview instrument (see Appendix I), which was used to guide the interviews.

Interviewees were encouraged to speak from the position and perspective of their respective organizations. Participants were also asked to provide additional feedback, where they determined it would be beneficial. Interviews followed in a semi-structured discussion format and had duration of approximately one hour. All interviews were conducted jointly by a two-person research team: where one investigator asked questions, the responses were recorded by the other. All interview data were catalogued, synthesized, and subsequently arranged by themes and summarized in an executive summary, which was provided to the PSECA working group for its review prior to the development of the initial draft criteria.

Following the submission of the executive summary, additional discussions were scheduled and— based upon the collective responses of the interview respondents— the first draft of selection criteria was developed by the research team. The responses, organized into five key themes for further analysis, comprised: location and scale, fuel type, triple bottom line (TBL) accounting, partnership, and other best practices (see Table1, in the discussion section, for the complete list of selection criteria).

Following the submission of the draft selection criteria to the working group, the research team then developed a weighting mechanism. It was determined that several criteria merited greater consideration due to their alignment with key policy objectives such as the over-arching goal of GHG emission reductions. The weighting mechanism attempted to capture that significance. The research team recognized that the weighting mechanism would inject some inherent bias, but by giving the views of all working group members equal consideration, it was agreed that the negative effects of that bias could be minimized.

In weighting the selection criteria, the research team aggregated the perspectives of each respondent and created a scoring matrix that enabled the relative importance of each criterion to be determined on the basis of its overall score. Each participant was given a week to fill out and return the matrix provided to them— scoring each criterion on a spectrum from 1-5 (Likert-type rank scale), with the score of 5 assigned the highest level of importance. Respondents were also provided with the option of assigning a score of 0 to any criterion determined to be irrelevant to the study's purpose.

Using frequency distribution type analysis, the results were summed, averaged, and divided by the aggregated average scores of all criteria to arrive at a weighted multiplier for each individual criterion (criterion average/average of criteria averages). The multiplier was then included in a scoring guide delivered to the project director to assist with project assessment. The criteria, scoring guide, and accompanying weighting mechanism (multiplier) served as the final deliverable to the client (for a sample of the scoring guide consult Table 1.).

Results

As noted in the methodology section, this study incorporated a semi-structured interview format that involved in-depth discussion with key working group members. This section documents the outcome of that interview process as it relates to the development of relevant selection criteria. Where possible, linkages have been established between what respondents reported and what was stated in the subject literature that informed the enquiry (Appendix A provides the complete literature review). In all cases, survey information has been tied to the derived criterion. The results are presented below in accordance with the following sequence: fuel type, GHG emissions reductions, project type, project scale, project location, ownership/partnership, triple bottom line (TBL) accounting, and other best practices.

Fuel type

The energy policy literature advances a number of clean energy fuel options, including biomass, and natural gas as being available for use in DE systems (see, Bahadorani et al., 2009; Difs et al., 2010; Ghafghazi et al., 2009; International District Energy Association [IDEA] 2005; International Energy Association [IEA], 2000; Natural Resources Canada [NRCan], 2008; BC Ministry of Community Development [MCD], 2009; Rentizelas et al., 2009; Rosen, 1994). The literature also raises a number of concerns surrounding fuel type choices. Some considerations impacting fuel type selection have been determined to include physical geography (Gilmour & Warren, 2008), resource endowment (Community Energy Association [CEA], 2007), sustainable local fuel supply, and adequate storage facilities (Alanne & Saari, 2006).

Where the discussion focused on energy sources and fuel type, and when asked to comment on the preferred fuel type, no overwhelming consensus emerged amongst interview respondents. Several respondents acknowledged that fuel type would likely be defined by the specific context that frames a proposed system. An overwhelming majority of interviewees did, however, agree that prospective DE systems should incorporate the use of clean and renewable energy sources, and over three-quarters of respondents cited the prevalence of existing biomass fuelled systems. Where the interview process probed deeper into the issue, the information acquired from respondents informed the development of four criteria: net GHG emissions reductions, fuel supply security, local fuel sourcing, and the use of natural gas.

Criterion 1: Net GHG emissions reduction over BAU case (based on fuel switching, backup, and peak-load cycles).

The DE subject literature cites measurable GHG emission reductions as an important benefit of DE systems (Canadian District Energy Association [CDEA], 2009; CEA, 2007; Council of Energy Ministers [CEM], 2009; Difs et al., 2010; IDEA, 2005; International Energy Agency [IEA], 2000). However, despite evidence of GHG reductions surpassing levels reported for the BAU case, results have not been reported in a consistent fashion. The IEA (2002), for example, noted a 3 to 4 percent annual reduction in global fuel-sourced carbon dioxide (CO_2) emissions attributed to investments in DH/CHP systems. In a study conducted by Rogner (1993), an overall annual reduction of 30 percent of in CO_2 levels was cited. Rosen and Le (1994) adopted different metrics to report cumulative emissions reductions of as much as 277,000 kt of CO_2 over a 20 year period. Although the achievement of CO2 reductions is readily apparent, the benefits are typically shaped by the specific context in which DE systems are established.

When presented with the issue of desirable GHG reduction levels, respondents did not agree on what level of GHG reductions should be established as the minimum threshold against which prospective DE projects should be assessed. And, although one of the key policy objectives of PSECA is the reduction of GHG emissions, several respondents indicated that emissions reductions should be significantly lower than that of the business as usual case (BAU), or those instances in which systems are known to rely on conventional technologies. In terms of reporting actual threshold figures, approximately one quarter of respondents noted that GHG emissions should match the 33 percent by 2020 target established by the Province (Government of British Columbia, 2007a).

Criteria 2 and 3: Security of fuel source supply (reliability/sustainability/affordability); and local sourcing of fuel supply (primary and secondary).

Although presented here as two discrete elements, the subject literature has considered fuel security and local sourcing as closely intertwined and mutually supportive. A number of commentators in the energy policy literature have touched on the relevance DE systems have for energy security (see for example, CEA, 2007; CDEA, 2009, CEM, 2009; IDEA, 2005). Much of what was reported by respondents has been documented in the DE literature. In their analysis of the Danish energy system, for instance, Möller and Lund (2010) explored the issue of volatile oil prices and concluded that DE systems are capable of mitigating energy concerns. Other experts (Alanne & Saari, 2006; Rosen, 1994) have acknowledged the importance of local fuel sourcing and fuel storage. Jeffries, K [personal communication, May, 2010] identified long-term fuel sourcing, local access and competitive pricing as factors impinging on the economic viability of DE systems.

Where the issue of fuel security was put to respondents, one-half of respondents indicated that proponents must clearly document the security of their primary fuel supply (again, emphasizing local sourcing) and establish a workable contingency plan to ensure on-going system operation, in the event that primary fuel stocks are no longer available. Where the issue was one of protection against market shocks, stable pricing, and affordability, over one-half of respondents stressed a preference for hybrid type systems (DE systems that incorporate mixed fuel stocks), which were acknowledged as being useful in mitigating against market fluctuations and contributing to overall system reliability. One respondent explicitly cited a need to address compatibility issues in cases where existing DE systems undergo conversion to other energy sources.

As energy security is a rather expansive topic, contingent on several factors (CEA, 2007), the local sourcing and access criterion drew a significant response amongst respondents. More specifically, where the issue concerned sustainable fuel access and energy security, all respondents noted it was crucial for all prospective DE projects demonstrate long-term viability in securing access to local fuel stocks or, where applicable, the local sourcing of waste heat. Yet, as has been pointed out in the literature (IEA, 2002), a small number of respondents recognized that local sourcing may have direct implications for long-term sustainability. This resonates with the view expressed by Thiffault (2008), who in considering the emerging trend towards biomass fuel sources, stressed that the lack of adequate policy and guidelines surrounding the harvesting of biomass impedes sustainability practices.

Criterion 4: Reliance on natural gas as fuel source (e.g., primary /secondary, backup, and peak loading).

Natural gas has been cited by several experts as playing an integral role fuelling DE systems (see Gilmour &Warren, 2008; Roger, 1993, Rosen, 1994). The reliance on fossil fuels, for example, has been by documented by the CDEA (2009), which also found natural gas to be the predominant fuel source throughout Canada, and Ghafghazi et al. (2009), who established that 80 percent of DE operations in Canada currently rely on fossil fuels. And, although natural gas has been documented as serving as a temporary primary fuel source (CEA, 2007), the fuel has also been recognized as playing an important role in providing peak-power and back-up support as a secondary fuel supply (Church, 2007a; Ghafghazi et al., 2009).

The role of natural gas in DE systems was discussed with respondents, and there was consistency between what was cited in the DE literature (Gilmour & Warren, 2008) and what respondents had reported. The majority of respondents identified that natural gas is used widely in DE systems currently in operation throughout the province. The majority of respondents also reported natural gas should be expected to be used in a temporary capacity. Yet, while several respondents specifically acknowledged that DE systems should only rely on natural gas as a primary fuel source at start-up, a small minority drew attention to the requirement that all projects should be assessed on the use of natural gas at full build-out (in terms of peak-power and base loading).

Location and Scale

Where the issue concerns the DE system development, two considerations that have been raised in the subject literature include location and scale. From an energy efficiency perspective, a fundamental principle of DE systems has been argued to be the close proximity of energy suppliers to energy demanders (CDEA, 2009; Gilmour & Warren, 2008; Morofsky, 1977). However, one key factor that impacts system viabilty has been determined to be the degree of urbanization (Gilmour & Warren, 2008; IDEA, 2005; Rogner, 1993). Although this may suggest that DE systems work best in urban environments, the CEA (2010) has pointed out that rural environments may offer village centres or clusters of buildings (which might include a school, recreation center, or hospital) that could support smaller scale DE systems. Where the issue of scale has been discussed in the literature, DE systems should be designed to consider factors that include future energy demand, increasing energy densities, and diverse energy use profiles (CEA, 2007; Church, 2007b).

The location and scale of a DE system has also been documented in the DE literature as being impacted by the type of DE system being proposed. Generally speaking, and depending on their function, DE systems are known to vary from providing combined heat and power (CHP) to providing only district heat (DH) (see Appendix A for a detailed discussion on this topic). In all cases, the size of the service load has been determined to be a crucial factor in establishing plant capacity and network size (Church, 2007b). Nonetheless, when respondents were asked which type of system would be most desirable for PSECA purposes, no consensus was established on whether project funding should consider either DH or CHP systems only. Over a third of respondents, however, expressed a preference for the development of DH systems, citing system practicality and the availability of clean and renewable energy sources. With this in mind, criteria resulting from the discussion concerning location and scale are presented below.

Criterion 1: Ability to accommodate both current and future demand, whether service provision is isolated or community wide.

As noted above, the energy policy literature has established that DE systems are viable in both the rural and urban contexts (CEA, 2010; CDEA, 2009; CEM, 2009). The PSECA requirement to consider projects in both settings is therefore well supported. Where system location has been discussed in the literature, it has been emphasized that DE systems be situated in close proximity to consumers and consumption nodes (Alanne & Saari, 2006). Yet, it has also been determined by many DE system experts that system viability is contingent on securing access to adequate energy load densities (Jeffries, K [personal communication, May, 2010]; IEA, 2002; Reidhav & Werner, 2008).

In recognizing examples already underway in BC, all respondents acknowledged that DE systems are viable in both the urban and rural contexts. In considering system viability, most respondents agreed that prospective DE systems should demonstrate adequate energy density and service loading. And, in contemplating future energy needs, approximately one-quarter of respondents indicated that PSECA funding could be directed towards expanding existing DE systems, to meet the additional demand that may exist in both rural and urban settings. In terms of cost effectiveness measures, however, some respondents reported that investments in new systems could lead to cost saving advantages over retrofitting existing systems.

Criterion 2: Connects multiple buildings and/or customers.

The subject literature advances a number of arguments relating to DE system advantages. For example, DE systems are considered attractive because they offer flexibility with project design and scaling, satisfying the various energy needs of buildings that range from only a few to many (CEA, 2007; Church, 2007a; IDEA, 2005; Rosen & Le, 1994). Similarly, DE systems have been cited as offering system versatility, in that they may incorporate a series of mini-plants, which has been found to accommodate modular service expansion and increasing energy demand (Jeffries, K [personal communication, May 2010] ; CEA, 2007; Ghafghazi et al., 2009; Gilmour & Warren, 2008). Where the issue is heat losses in system networks, the literature has documented losses to be between 5 and 8 percent of input energy (Church, 2007b; IEA, 1996). However, advances in piping technology (IEA, 1996) and adherence to effective building clustering (CEA, 2007) have been shown to mitigate such losses.

Where respondents were asked to comment on project scale, most indicated a preference for projects that provide energy services to multiple customers or organizations—suggesting adequate energy density and consumer profile diversity. Phased development was raised by a small number of respondents. It was also noted by some that community-based systems —which could involve servicing local governments, businesses, and residences—would prove desirable. It was determined therefore that projects with potential to accommodate future growth and system expansion be encouraged. One respondent had identified piping distances and potential heat losses as factors to consider. Nonetheless, as most cases were determined to be context specific, interviewees expressed no clear preference on a definitive project size.

Partnership

As reported in the policy literature, the goal of reducing GHG emissions has been placed on many entities through specific legislated instruments. Examples include: PSO's, under the GGRTA (Greenhouse Gas Reduction Targets Act, 2007); local governments, under the BC Climate Action Charter (The BC Climate Action Charter, 2007); and firms in the industrial sector, under recently enacted cap and trade legislation (Greehouse Gas Reduction [Cap and Trade] Act, 2008). Yet, as noted by respondents, there has been shared interest in DE systems and securing the related benefits. It has been suggested that the encouragement of joint ventures between entities in various sectors strengthens communication, which has been argued by some observers in the field to facilitate greater understanding of the role that DE systems play in reducing community-wide GHG emissions (CEA, 2007; Gilmour & Warren, 2008).

Criterion 1: Partners with community local government, or industry

From an operational perspective, the literature has indicated that partnering with local governments would provide a more diverse customer base for DE projects, which would create a more stable base-load for the system to operate efficiently (CEA, 2010). Partnering with industry has also been shown to match energy suppliers with energy demanders (CEA, 2007; Gilmour & Warren, 2008). Many respondents indicated the importance of partnering with local governments and industry, citing operational and policy reasons. While recognizing each case is unique in itself, some respondents reported that many communities are well positioned to leverage future development opportunities to encourage growth and diversity, all of which were cited as contributing to long-term security for service demand.

Partnerships have also been recognized in the literature as being e helpful in aligning specific project objectives with broader community goals relating to environmental sustainability, economic development, and community growth (CEA, 2010). The CEA (2010), for example, has indicated that partnership facilitates capacity-building between communities. From a policy perspective, many respondents agreed that partnerships support community development (also noted in the literature: see CEA, 2010). This resonates with the program objectives of PSECA, which has viewed the development DE systems as a capacity-building mechanism on the energy conservation and sustainability front (BC Climate Action Secretariat, 2010b).

Criterion 2: Services PSO's or other community organizations for which DE system would otherwise not be viable.

Under the GGRTA, all PSO's are required to be carbon neutral by 2010 (Greenhouse Gas Reduction Targets Act, 2007). This requirement extends to organizations, such as school districts, for which the implementation of DE is not always practical—given concerns of scale and location (refer to the section on location and scale above). Many respondents agreed that partnerships between larger precincts, here taken to include universities and hospitals, would enable district heating to be extended to other public sector institutions for which the development of such systems would not otherwise be economically or technically feasible. In addition, partnership with smaller public sector entities has been determined to disseminate information about DE benefits to PSOs throughout the province.

Criterion 3: Assigns GHG emissions reductions benefit claims through MOU (energy audit).

Another issue concerning partnerships that surfaced during the interview process was that a clear memorandum of understanding (MOU) should be established to identify the allocation of GHG emission reductions credits. This concern has been determined to be couched in the need to ensure GHG accounting integrity. To date, the literature on carbon accounting is sparse, as the topic falls within an emerging field that has not yet been fully explored. Nonetheless, the allocation of GHG emissions reduction credits raises another concern that emerges from the existence of overlapping GHG emissions reduction goals, a result of requirements noted in the three legislative instruments identified directly above (at the beginning of this section). Thus, it will be crucial to determine the credit allocations granted to the respective parties in advance. On this issue, respondents recommended that projects that exhibit an accurate framework for assigning GHG emissions reduction credits should score more favourably.

Triple Bottom Line (TBL) Elements

The public policy literature advocates the practice of adopting a broader perspective and assessing policy issues in terms of economic, social, and environmental impacts (Mackay, 2009). Of those that spoke on TBL issues directly (less than one-quarter of respondents), the consensus was that eligible proponents should demonstrate that they have considered various options and planned their respective projects in accordance with TBL principles. These respondents noted that projects should be economically viable, environmentally sustainable, and socially supportive of broader community objectives. Interviewees that explicitly advocated for TBL analysis noted that, although the primary policy driver underlying PSECA targets GHG emissions reductions, the allocation of public funds demands other criteria to ensure full value-for-money.

Criterion 1: Engage stakeholders actively through a consultation/engagement framework.

A fundamental premise of TBL accounting that has been identified in the literature concerns the evaluation of project impacts on stakeholders (Mitchell, Curtis, & Davidson, 2008; Norman & MacDonald, 2004). One response that was consistent with this view, and expressed amongst respondents that advocated for a TBL approach, was that proponents demonstrate effective stakeholder engagement strategies in eliciting feedback and monitoring results. Indeed, stakeholder engagement would appear to resonate well with the aspects of TBL accounting these respondents identified.

The policy literature also cites various examples of situations where organizations purport to engage in TBL accounting as part of their business practice. For instance, the business strategies of corporations such as AT&T and the Walmart chain have been identified as using stakeholder engagement strategies (AT&T, 2009; Greenbiz, 2010). There are also examples of cases in which public sector entities in BC have adopted a TBL approach and an accompanying stakeholder engagement strategy: the BC Energy Plan (2007) (see: BC Ministry of Energy, Mines, and Petroleum Resources, 2010), the BC Ministry of Agriculture and Lands Service Plan (2010) (see: BC Ministry of Agriculture and Lands, 2010), and BC Hydro Triple Bottom Line Report (2002) (see: BC Hydro, 2002).

Criterion 2: Aligns with overall community sustainability goals.

A criterion that arises out of, and which is also connected to, stakeholder engagement is the requirement for DE project plans to align with overall community sustainability goals. Most interview respondents indicated that proposed projects should be in alignment with the sustainability contexts within which they operate. These contexts are typically framed by community sustainability goals, Official Community Plans (OCP’s), Regional Growth Strategies (RGS’s), and other strategies concerned with sustainability and GHG emissions reductions. By requiring local governments and regional districts to set community wide targets for GHG emissions reductions as part of their OCP’s and RGS’s (BC Ministry of Community Development, 2008), these strategies effectively parallel the policy context within which PSECA has been implemented.

Correspondingly, since an overwhelming majority of local governments have committed to achieve carbon neutrality by 2012 (BC Ministry of Community Development, n.d.), DE systems may play an important role in helping these communities to achieve such ambitious goals. Several commentators (Respini, 2000; Elkington, 1998; Mitchell, Curtis & Davidson, 2008) have highlighted how alignment with community sustainability goals is furthered by observing TBL accounting. Arguably, a TBL framework offers increased awareness of the larger context within which these organizations operate and may contribute to effective long- term decision-making.

Criterion 3: Offers value added elements.

According to the literature, many DE projects currently in operation throughout BC have identified TBL philosophy as a key focus and development principle. For example, in a 2004 request for proposal released by the City of Victoria, and relating to the development of its Dockside Lands, prospective proponents were required to submit a TBL accounting framework along with their development proposals (City of Victoria, 2004). Attention to value-added components such as public education, First Nations employment and skills development, and provision of community amenities supported the bid that resulted in the current Dockside Green development (Dockside Green, 2010). This is consistent with the view that emerged among interviewees: respondents reported that PSECA projects should result in tangible spin-off benefits to the community at large. Respondents also cited the incorporation of value-added elements that included education opportunities, knowledge transfer, and employment opportunities

Criterion 4: Supports the development of local community capacity for DE.

The focus on capacity building is in alignment with PSECA objectives, one of which is to increase awareness of DE systems as a useful mechanism in reducing the GHG emissions associated with space heating and domestic hot water consumption (BC Climate Action Secretariat, 2010b). Capacity building is also consistent with the objectives of other policy initiatives: such as the BC Energy Plan, which cites community benefits as a central component of any TBL accounting approach (Government of British Columbia, 2010b). Furthermore, the focus on a green economy, through initiatives such as the Innovative Clean Energy (ICE) Fund demonstrate that the BC Government views the support of local capacity for clean and renewable energy as a central component of larger community sustainability efforts (Government of British Columbia, 2010d).

Concerns raised by respondents, and noted here, included the need for the PSECA selection committee to evaluate projects on the degree to which they build additional capacity in small communities—which, was determined to also include exportable knowledge. Some respondents noted that PSECA funding could go so far as to help rural districts to gain momentum with the implementation of their climate action plans. One respondent reported that applying criteria through a TBL lens may enable rural projects to become more competitive with their urban counterparts because other important factors are considered in the overall project assessment.

Criterion 5: Provides GHG emissions reduction plan as part of an overarching sustainability plan.

By entrenching GHG emissions reductions targets in overarching sustainability action plans that also incorporate TBL practices—such as community engagement, local governments are well-situated to promote community awareness of how DE systems further GHG emissions reductions (regardless of the level that may be reached). This premise is in close alignment with the PSECA objective of showcasing green technologies as effective mechanisms in reducing GHG emissions (BC Climate Action Secretariat, 2010b). Several respondents reported that proponents should, at a minimum, have strategies in place for establishing and documenting the achievement of sustainability targets. It was also suggested that project proponents be recognized for undertaking self-initiated efforts to retrofit buildings to make them more energy efficient.

It was proposed by some respondents that prospective projects be recognized for supporting sustainability action plans that address energy efficiency and GHG emissions reductions. As noted above, there was no consensus reached among respondents concerning GHG reduction levels. Part of the reason for this reasoning may be attributed to the view amongst some respondents that each project would face unique challenges, which was considered to result in disparate GHG emissions reductions. Therefore, respondents determined it would be impractical to compare projects exclusively on GHG emissions reduction levels.

Criterion 6: Demonstrates compliance with environmental management protocols.

The environmental management literature documents various protocols (see, for example, International Standards Organization, 2004). It was duly noted by respondents that, where applicable, proposed projects must comply with existing requirements for environmental management protocols. While, it is determined that the size and scale of the project will define whether the project requires an environmental assessment, in light of other criteria—such as community engagement and alignment with community sustainability goals—it was established that it would also be a good practice for proponents to articulate overarching environmental management protocols. Respondents suggested that projects adhere to established environmental management systems such as ISO 14001, which requires the identification of environmental impacts, the development of strategies to reduce those impacts, and the establishment of targets to demonstrate progress on achieving results (International Standards Organization, 2004).

Other Best Practices

Over the course of the interviews process, respondents were encouraged to provide additional comments and identify other best practices that they determined would inform the criteria development process. A number of additional points were raised; the more salient points are summarized below:

Criterion 1: Leverages funding from other sources.

Several respondents raised the concern that, where possible, PSECA proponents should leverage funding from other sources. Respondents noted that PSECA funding might go further if it were combined with funding secured from other sources (a review of other available government funding sources is available in Appendix D). Respondents also noted that pooled funding would likely enhance project scale, enabling projects to provide greater value. It was also proposed that some projects may not be otherwise feasible without securing PSECA funding. Respondents suggested that proponents should be assessed on whether they have leveraged other funding and whether PSECA funding would move the project forward into implementation. It was suggested that both cases would represent situations in which qualifying projects would score higher on the relevant assessment criteria.

Criterion 2: Demonstrates Replicability.

Respondents indicated that projects should be able to demonstrate the potential for replicability in other regions of the province. As noted above, one of the objectives of PSECA is to encourage the use of alternative (innovative) energy sources and technologies (BC Climate Action Secretariat, 2010b). Yet, respondents indicated that, while the specific technology used depends primarily on the context within which a specific DE project is implemented, it would be advantageous to fund the use of technologies that are proven to be efficient and reliable, while also demonstrating viability in either the urban or rural BC context.

Scoring Guide

In addition to the criteria outlined above, a scoring guide was developed and provided to the working group to be used by PSECA project evaluators in assessing eligible projects. A sample of the scoring guide is provided in Table 1. The scoring guide incorporates a standard three-point ranking scale, with a score of 3 points assigned for full alignment with a criterion and 1 point assigned for partial alignment with that criterion. This scoring guide, in combination with the accompanying weighting mechanism— which was informed by respondents and developed by the research team—is considered to have captured the aggregate perspectives of respondents. The scoring guide has therefore been determined to accurately represent the qualitative information gathered and distilled as an outcome of the interview process.

Table 1. Criteria Scoring Guide Showing Explicit Criteria and Associated Weighting Mechanism

No.	Criteria	Scoring Guide	Score	Weighted Score
1	**Net GHG emissions reduction over BAU case (based on fuel switching, backup, and peak load cycles)**	Over 80% = 3, 50% - 80% - 2, 20% -50% = 1, 0%-20% = 0		0.00
2	**Security of fuel source supply (reliability/sustainability/affordability)**	Low risk = 3, Medium Risk = 2, High Risk = 1, Very High Risk = 0		0.00
3	**Local sourcing of fuel supply (primary and secondary)**	Same Community = 3, Region = 2, Province = 1, Elsewhere = 0		0.00
4	**Reliance on natural gas as fuel source (e.g., primary /secondary, backup, and peak loading)**	Back-up only = 3, Secondary =2, Peak Load = 1, Primary = 0		0.00
5	**Ability to accommodate both current and future demand, whether service provision is isolated or community wide**	High Ability = 3, Medium Ability = 2, Low Ability = 1, No Ability = 0		0.00
6	**Connects multiple buildings and/or customers**	More than 20 buildings = 3, 10 - 20 Buildings = 2, 5 - 10 Buildings = 1, 0-5 Buildings = 0		0.00
7	**Services PSO's or other community organizations for which DE system would otherwise not be viable**	Services more than 2 PSO's = 3, Services 2 PSO's = 2, Services 1 PSO = 1		0.00
8	**Partners with community local government, or industry**	Partners with Community and Local Government = 3, Partners with Industry *or* local government = 1, No Partnership = 0		0.00
9	**Assigns GHG emissions reductions benefit claims through MOU (energy audit)**	MoU in place with GHG reduction allocated to PSO = 3 , MoU in Place with GHG divided between partners = 2, MoU in place with GHG allocated to partner = 1, No MoU in place = 0		0.00
10	**Engages stakeholders actively through consultation/engagement framework**	Stakeholder consultation plan in alignment with Government standards is in place = 3, Stakeholder consultation plan is in place = 2, Stakeholder informing plan is in place = 1, No stakeholder engagement/consultation plan = 0		0.00
11	**Aligns with overall community sustainability goals**	Aligns with all community sustainability goals = 3, Aligns with some community sustainability goals = 1, Conflicts with community sustainability goals = 0		0.00
12	**Offers value-added elements**	Offers significant value added elements = 3, Offers few value added elements = 1, Offers no value added elements = 0		0.00
13	**Provides GHG emissions reduction evaluation plan**	Provides a GHG emissions evaluation plan = 3, Does not provide a GHG emissions evaluation plan		0.00
14	**Demonstrates compliance with environmental management protocols**	EM protocols adhering to international standards is in place = 3, EM protocols not adhering to international standards is in place = 1, No EM protocols in place = 0		0.00
15	**Leverages funding from other sources**	Leverages funding from multiple sources that facilitates partnership = 3, Leverages funding from multiple sources = 2, Leverages funding from one other source = 1, Does not leverage other funding sources = 0		0.00
16	**Supports development of local/community capacity for DE**	Provides training and information sharing to facilitate local capacity for DE = 3, Provides public education component = 1, Does not provide help develop local/community capacity for DE = 0		
17	**Demonstrates replicability**	Uses technology replicable in other communities in BC = 3, Does not use technologies replicable in other communities in BC = 0		
18	**System design maximizes efficiencies and minimizes redundancies (both plant and infrastructure)**	System design is highly efficient (according to professional assessment) = 3, System design is moderately efficient = 2, System design has a low efficiency rating = 1, System design uses technology that is not efficient.		
		Total Score	0	

Lessons Learned

Overall, the results of this study show that the research design and method developed and used were consistent with the study's purpose. It is anticipated that the criteria and evaluation framework emerging from this study will be effective in meeting the client's immediate needs. Nonetheless, in taking a retrospective view of the research process documented in this study, several observations have surfaced. These observations include limitations and oversights identified during the interview process, limits on stakeholder engagement, and a number of operational constraints imposed by PESCA. Each of these observations merits additional comment and is discussed further in the paragraphs below.

First, interviewing individual working group members was determined to be useful in overcoming problems that may arise as a result of group dynamics— such as excessive participant bias. Much of the information received from working group members reflected a significant difference in opinion over the primacy of key policy drivers. For example, where some respondents believed that GHG emissions reductions should be the primary evaluation criterion, other respondents considered GHG emission reductions to be of lesser importance than that of energy security. Furthermore, where some working group members stated that it was important to adhere to TBL practices in the selection process, others did not emphasize the need for a definitive three- pronged balanced approach. Regardless, the interview method undertaken for this study offered the research team the means to determine, and reconcile, varying perspectives amongst interview respondents. It must be also emphasized, however, that the existence of differences of opinion that may have their origin in the 'silo' structure of governance observed in the BC government bureaucracy, resulting in an inevitable deterrent to effective cross-jurisdictional decision making and program management.

Second, although one-on-one interviews proved to be an effective mechanism for the collection and assimilation of respondent information, it must be pointed out that participants also faced time constraints, which may have impeded their ability to participate fully in the criteria development process. However, in an effort to make the process more amenable to respondents, the research team created an interview schedule that accommodated the needs of interviewees and which otherwise reduced the need for key working group members to convene and deliberate as a whole. Yet, it was also the case that all scheduling conflicts could not be easily avoided: some interviewees were not able to allocate a full hour to the interview process, and the depth of useful information suffered as a result.

Third, as noted above, limits on stakeholder engagement were also problematic during the interview process. Although the working group's commitment was secured at the outset with a project charter, the accountabilities established in that charter suffered, perhaps due to unanticipated process and oversight changes that occurred while the study was underway. These factors led to a situation where the full participation of the working group stagnated. It was difficult therefore to finalize the selection criteria as part of a larger group exercise, as originally planned. Thus, the deliberation process became muted. This serves as a valuable reminder of the need to maintain close communications with working group members when engaging in a mutually agreed upon process.

Prescribed limits on stakeholder engagement also led to a situation where interviews with external experts and stakeholders were not fully taken advantage of. Although some external experts were consulted, it was not possible to interview other key informants, given the urgency time constraints placed on product delivery. Had it been possible to interview specialists from key partner organizations, such as BC Hydro and Terasen Gas Inc., and plant operators, such as personnel from Dockside Green and the District of North Vancouver DE systems, the criteria development process may have benefited.

Fourth, the development stages of the various potential DE projects themselves may also have impacted the value of moving forward with the implementation of a criteria development process at this stage of PSECA. Due to the constraints of the government fiscal cycle, and the need for speedy deliverables imposed on the initiative, it could be argued that fewer than the expected numbers of applications would be received within the prescribed funding window. As noted above, PSECA funding is only to be allocated to first-mover projects (i.e. those beyond design and feasibility study phases and ready to move forward with construction): this requirement limits the number of potential projects. Indeed, it might be argued that construction-ready projects must have already secured the requisite funding to proceed to that phase. Arguably, PSECA funding would thus serve to be merely supplemental, and not necessarily play a critical role in contributing to project viability or moving the development forward.

Fifth, the constraints imposed by the government fiscal cycle also prohibits alignment with other funding programs, a limitation which is prohibitive for those DE projects more conducive to partnerships (see Appendices E and F for an overview of some DE projects). The regimented fiscal cycle would also likely result in the elimination of possible projects that typically take longer to develop than can be accommodated by the BC government capital asset procurement constraints imposed on GREs.

Cumulatively, these constraints present the possibility that PSECA program funding may not be used as effectively as possible; and that first-mover type projects are rewarded at the expense of projects that may otherwise prove to be more innovative, or offer greater GHG emission reductions. The observations made here also suggest that funding programs similar to PSECA may not be the most effective instruments to encourage the development of DE projects. In addition, since DE projects are a useful energy solution for larger institutions and typically involve significant capital costs, it could be argued that innovative partnership models might be a viable option for large-scale projects; indeed, this would arguably reduce public expenditure and risk associated with such projects.

Discussion and Concluding Remarks

The primary purpose of this study is to assist the BC Government with furthering its objective of reducing GHG emissions in the public sector. Underpinning that purpose was the development of explicit selection criteria that would equitably address the concerns of all PSECA working group members, while also ensuring that PSECA funding would be directed to those projects best able to achieve the key policy objectives of energy conservation and GHG emissions reductions. By adopting an interview process that elicited individual responses, as well as facilitating collective discussion and feedback, the research method was designed to give all respondents a mechanism to provide frank and honest answers. There were, however, some changes to the criteria development process that occurred mid-stream and which ultimately affected the end results.

Approximately midway through the criteria development process, the PSECA DE project experienced a change in direction with its implementation. The change significantly affected the trajectory of the criteria development process and the need for an expedient deliverable. This change arose in large part because of staffing changes. However, as noted in the background section, impacts also resulted from the current policy climate within which PSECA was implemented. These factors led to a significant decrease in respondent (PSECA working group) engagement with the criteria development process, which ultimately affected the validity of the final criteria and weightings. Furthermore, although they reflect the professional perspectives of the PSECA working group members, the final results were informed only by those who chose to participate in the process on an ongoing basis.

The observations above highlight the tension that can arise between the need to move quickly with decision-making on the allocation of public funds and the need to demonstrate accountability and transparency. Because of the carbon neutrality requirements prescribed under the GGRTA, it is very likely that the future will bring increased demand for mechanisms that assist PSOs with GHG emissions reductions, and public scrutiny of the decision-making processes informing government led funding programs (such as PSECA) will likely grow. Indeed, the option of a flexible decision-making process, such as that employed in the current policy climate, may turn out to be less defensible without rigorously documenting project selection.

Despite the unforeseen process changes that were beyond the immediate control of the research team, the method developed for this study proved to be useful and the results were delivered expediently and within the timeframe originally specified by the client. The selection criteria proposed here were developed and weighted in a way to mitigate working group bias while also allowing for the numerical ranking of potential projects. The evaluation framework itself encompassed a number of discrete criteria that systematically address various policy requirements. In short, the overall results resonate with not only the objectives of PSECA, but also the collective interest of the PSECA working group.

Looking forward, it is anticipated that the results of this study will remain available for future use where the further development of DE systems may play a fundamental role in BC’s energy conservation efforts. Ultimately, the development of DE systems for PSOs remains an emerging field of study. With ten more years remaining in the agreement for implementing clean energy solutions, considerable time remains for the DE system development. Nevertheless, where further analysis and research is expected to proceed, a number of questions arose over the course of this study that, if they were to be explored further, might complement the objectives of the PSECA DE:

- Would it be useful to incorporate additional criteria into the evaluation framework?
- Would consultation with additional stakeholders and experts improve the process?
- How might the selection criteria be provided to potential proponents in advance of the actual application period?
- What other funding models might be used to encourage the development of DE projects in BC?

In offering concluding remarks, at the time of writing, it remains uncertain as to whether the explicit selection criteria and evaluation framework provided to the PSECA working group influenced the final selection process: intrinsically, such matters remain beyond the scope of this study. Yet, in the search for more effective resource allocation, the method and results developed and presented here offer a potentially useful starting point that remains open to further evaluation and enrichment. Public sector organizations in BC have now moved beyond the threshold of implementing strategies to reach prescribed GHG targets, and now need to move toward continuous reduction in the costs of doing so. The time is ripe for establishing effective mechanisms that optimize systems and achieve value-for-money in public expenditures.

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Appendix A: Literature Survey

This literature survey was conducted for the purpose of informing the PSECA district energy (DE) component criteria selection process and the development of an evaluative framework. While it is not intended to be comprehensive, the review is intended to survey the relevant literature to identify salient subject matter, primary themes, and key considerations as they relate to the development of DE systems. As a result, the literature review is structured according to several themes: BC's current energy-use profile, a description of DE systems, DE benefits, support of PSECA policy drivers, important system considerations, triple bottom line (TBL) accounting, and partnership/ownership considerations. It has been determined that the results of this interview will be useful in designing a preliminary interview instrument and supporting the PSECA interview process.

BC's Energy-use Profile

The subject literature has established that 90 percent of BC's electrical power is currently produced in hydroelectric facilities that generate clean power (Community Energy Association [CEA], 2008; Government of British Columbia, 2009). It may seem counterintuitive, therefore, to reason that DE systems could play a significant role in furthering the energy conservation and greenhouse gas (GHG) emissions reductions agenda in BC. Yet, the DE literature suggests otherwise. The Community Energy Association (CEA), for example, has determined that space and water heating in BC's residential and commercial (taken here to include institutions) sectors results in considerable energy use and GHG emissions (CEA, 2007). An investigation of BC's energy use profile in these sectors may shed light on how DE systems may complement the government's energy conservation objectives.

An estimation of BC's energy use may be established by comparing the energy use profiles of the province's commercial and residential sectors with estimates for the Canadian aggregate. When looking at total energy consumption in these sectors, energy use statistics have shown that BC deviates little from the national profile (Natural Resources Canada, 2009). Table C1 in Appendix C, for example, highlights energy use and emissions information for the year 2007. Estimated secondary energy use in Canada's commercial and residential sectors is shown to have amounted to approximately 16 and 13 percent of total secondary use, respectively; and GHG emissions for these sectors have been shown to result similar percentages.

In considering the BC context, Table C1 (see Appendix C) shows that energy use in the province's commercial and residential sectors amounted to approximately 10 and 14 percent of total energy use for each respective sector. The proportion of total GHG emissions in these sectors, however, has been documented as being noticeably less: 8 and 9 percent for each respective sector. It could be argued that the difference is attributed to BC's endowment of clean hydroelectric power. Nevertheless, Table C1 shows energy consumption in BC's commercial and residential sectors has been significant and that it has also deviated little from the Canadian aggregate.

Deeper understanding of energy consumption and emissions in BC's commercial and residential sectors is made possible when secondary energy use totals are matched to specific fuel types. Table C2 (see Appendix C) has disaggregated total energy use in BC's commercial and residential sectors into constituent energy sources. As shown in Table C2, the predominant energy sources in these sectors consisted of electricity and natural gas. The table also shows that natural gas and electricity use accounted for approximately 45 percent of the total energy used in the commercial sector. For the residential sector, Table C2 clearly shows natural gas satisfied slightly more energy demand than electricity (49 compared to 42 percent, respectively). In looking at emissions, however, Table C2 shows that natural gas consumption resulted in the majority of total GHG emissions in both sectors (upwards of 75 percent). This information suggests natural gas accounted for a disproportionate portion of GHG emissions.

The energy use profiles in BC's commercial and residential sectors may be analyzed even further when the various energy sources are distilled into final end use. Table C3 (see Appendix C) shows the relative proportion of various energy sources documented as being used for space heating, space cooling, and water heating. Natural gas has been predominant: Table C3 shows natural gas to have had accounted for over 70 percent of the total energy consumed for space and water heating in the commercial sector. A similar profile is shown for the residential sector, where natural gas has been documented as satisfying approximately 80 percent of water heating demand and 57 percent of space heating requirements.

As shown in Table C3, space cooling needs in both sectors has been met mainly through electrical energy consumption (over 84 percent). However, as the portion of energy used for space cooling has been shown as representing only a small fraction of total energy use, its significance may be debated. Regardless, the foremost conclusion that might be drawn from this analysis is that natural gas has been responsible for the majority of emissions in space and water heating. In terms of energy conservation and emissions then, it could be argued that improvements can be made.

Where the proportion of total GHG emissions is concerned, Table C4 shows space heating in the commercial was estimated to account for over 50 percent of total emissions. For the residential sector the table shows the emissions from space heating were significantly greater, at 65 percent of total sector emissions. These estimates suggest that the majority of emissions for space and water heating for 2007 were attributed to natural gas consumption. In considering energy conservation and emissions then, it might be argued that more can be done to reduce the level of GHG emissions in the commercial and residential sectors.

Describing DE systems

As with other industrialized countries, electrical power in Canada has been documented as being produced in large centralized plants, located at long distances from end-users who rely on the energy (DEKB.co.uk, n.d.). The literature has also shown that, in order to mitigate logistical problems, large centralized power facilities are typically located near fuel sources to minimize transportation distances and to take advantage of natural geographic features, such as rivers and lakes (DEKB.co.uk, n.d.). Although, the literature has shown that large centralized facilities result in economies of scale, some experts have argued that these facilities result in inefficiencies that include waste heat dissipation, line losses, and other impediments encountered with transmitting energy (Alanne & Saari, 2006; Canadian District Energy Association [CDEA], 2009; ABB, 2007).

DE systems have been described in the literature as small scale, often versatile, facilities capable of producing energy closer to where consumers demand it. (DEKB.co.uk, n.d.; Alanne & Saari, 2006). In contrast to large centralized systems, DE systems have been described as being located in dense urban environments where they provide electrical and/or thermal energy to businesses, institutions, and multi-unit residences (CEA, 2007). Some DE systems have been documented as incorporating a series of mini-plants, which facilitates modular service expansion (Jeffries, K [personal communication, May 2010]; CEA, 2007; Ghafghazi, Sowlati, Sokhansanj, & Melin, 2009; Gilmour & Warren, 2008). In addition, unlike their larger counterparts, DE systems have been identified as producing electricity by using small internal combustion engines, micro-turbines, and small steam engine technologies (BC Ministry of Community Development [MCD], 2009; PolySMART, 2009).

The literature on DE systems is vast and could easily fill volumes. Yet, a cursory scan of the DE literature would likely return many similar descriptions of what is considered to comprise a DE system (see for example: CDEA, 2009; Church, 2007a; CEA, 2007: Ghafghazi et al., 2009; Gilmour; 2007; Gilmour & Warren, 2008; Jeffries, K [personal communication, May 2010]; Rosen & Le, 1994). Many descriptions identify three specific traits: the existence of a centralized energy plant, the provision of thermal energy to multiple consumers, and the use of underground piping in the distribution network. The description provided by the International District Energy Association (IDEA) is but one example:

> The fundamental idea of district energy is simple but powerful: connect multiple heating and cooling energy users (buildings) through and underground piping network to environmentally responsible energy sources (central plants), such as combined heat and power (CHP), industrial waste heat and renewable energy sources such as biomass, geothermal, and natural sources of heating and cooling (IDEA, 2005, p. 1).

The description quoted here offers a broad perspective, alluding to the versatility DE systems. This description not only highlights heating and cooling functionality of DE systems but also touches on other notable aspects, such as their flexibility to draw on various fuel sources to produce heat and electricity. Specifically, where the production of heat and electricity occurs in the same plant, DE systems have been described in the literature as cogeneration facilities, otherwise combined heat and power (CHP) systems (CDEA, 2009; Gilmour, 2007, Gilmour & Warren, 2008; Gochenour, 2001; Rosen, Le, & Dincer, 2005). Yet, DE systems have also been documented as recovering waste and using it for cooling purposes. Systems that combine heating, cooling, and power functions have been labeled in the literature as tri-generation facilities, or CHCP systems (PolySMART, 2009; Rentizelas, Tolis, & Tatsiopoulos, 2009; Trigeneration Technologies, n.d).

Regardless of whether DE systems are developed as CHP or CHCP systems, they have been found to impact energy conservation, energy security, and reduced energy costs. Some commentators (CDEA, 2009; IDEA, 2005) have determined that rising fuel costs and greater recognition of the value of recovered heat has resulted improved system efficiency. Many DE advocates have argued that, by recovering waste heat, CHP systems not only conserve energy but also provide significant efficiency gains over conventional power plants. The literature t has been established that where conventional systems operate at energy efficiencies of 30 to 40 percent (e.g. rejecting as much as 60 percent of energy to the environment as waste heat) CHP systems offer efficiencies in excess of 80 percent (IDEA, 2005; International Energy Agency [IEA], 2000; ABB, 2007; Rosen, 1990; Rosen,1994; Rosen, Le, & Dincer, 2005).

Some DE observers have purported that CHCP systems offer the greatest benefits, citing operational efficiencies of as much as 90 percent (Trigeneration Technologies, n.d.; IEA, 2000). Other commentators (PolySMART, 2009) have argued that DE technology is desirable because the same waste heat recovered for space heating can also be used to for air-conditioning and space cooling. CHCP technology has been determined to be more efficient because power plants can be used to accommodate year-round demand for thermal energy (PolySMART, 2009). Where this technology has been cited as being practical for use in southern latitudes, Rentizelas et al., (2009) concluded that CHCP may also result in measurable benefits for many northern countries.

Despite the focus on the efficiencies available with CHP and CCHP systems, there has also been extensive attention directed towards energy systems designed to recapture waste heat to meet only heating demand (CEA, 2007; IEA, 2002; MCD, 2009). The recovery of waste heat has been identified in the literature as a central premise underlying the concept of integrated resource recovery (IRR), an approach that focuses on waste heat as a valuable energy resource (MCD, 2009). IRR has been characterized in the literature as capturing and transferring waste heat from various low temperature sources that include municipal waste water systems, industrial processes, and wet/dry organic waste (MCD, 2009).

DE Benefits

DE systems have been cited in the literature as providing energy planners, policy makers, system owners, and plant operators with a number of benefits. The IDEA (2005), for example, cited several benefits of DE systems: improved energy efficiency, strengthened environmental protection, greater fuel flexibility, simplified maintenance and operation practices, better system reliability, greater customer convenience, decreased life-cycle costs, lower capital costs for building infrastructure. While the list is not exhaustive, many of these benefits have been noted by other sources in the subject literature.

Other organizations in the literature have also confirmed some of the benefits described above. The IEA (2002) has identified energy efficiency, emissions reductions, fuel flexibility, and scale economies as notable DE characteristics. Morofsky (1977) cited economies of scale, fuel efficiency, improved operation and maintenance, and lower life cycle costs. Alanne and Saari (2006) noted fuel flexibility and innovative technology as favourable benefits. Reduced environmental impacts, improved system reliability, greater fuel security, and scale economies were among benefits reported by the CDEA (2009). Gilmour and Warren (2008) distilled DE benefits into three categories: community, environment, and business, which together encompass a spectrum of benefits such a fuel security, system reliability, reduced capital costs (for buildings), and economic competiveness. On this reading of the literature, it is evident that these benefits are consistent with the policy drivers of the PSECA initiative.

Support of Policy Drivers

To a large extent, the pursuit of DE systems has been driven by concerns of energy conservation, GHG emissions reductions, and energy security. Where the issue concerns energy conservation, DE systems have been cited in the literature as improving overall energy efficiency (Church, 2007a; Rosen, 1994; IEA, 2000; IDEA, 2005). In comparing DE technologies to conventional systems, Rosen and Le (1994) found DE systems to result in significant reductions in energy consumption. In a techno-economic evaluation of DE systems in Ontario, (Rogner, 1993) linked improved resource efficiencies to the recovery of heat otherwise rejected in energy production. Rogner also argued that CHP systems could result in 30 percent fuel savings, when compared to conventional on-site gas-fired heating systems in individual buildings. In their analysis of energy systems and various heating options on the Danish building stock, Lund, Möller, Mathiesen and Dyrelund (2010) concluded that DE system efficiencies led to a substantial reduction in total fuel demand.

Where the issue is GHG emissions reductions, the subject literature has cited energy efficiency and GHG reductions as among the tangible benefits of DE implementation. Many DE advocates, (see, for example: IDEA, 2005; CDEA, 2009; Council of Energy Ministers[CEM], 2009; CEA, 2007; Difs, Wetterlund, Trygg, & Söderström, 2010) have identified energy efficiency and GHG emissions reductions as key benefits. In its policy paper on DE systems, the IEA (2002) attributed a 3 to 4 percent annual reduction in global fuel-sourced carbon dioxide (CO_2) emissions to investments in DH/CHP systems.

Other observers have noted GHG emissions reduction benefits as well. For instance Rogner (1993) found DE systems to result in significantly lower emissions than conventional systems, having cited reductions of up to 90 percent for sulphur dioxide (SO_2) and nitrous oxides (NO_X), and an overall reduction of 30 percent of in CO_2 levels. Rosen and Le (1994) modeled several DE scenarios over a 20 year period , which led them to report cumulative emissions reductions of as much as 277,000 kt for CO_2, 1,500 kt for SO_2, and 600 kt for NO_X. And, in their analysis, Gilmour and Warren (2008) argued that, if all residential and commercial buildings were connected to DE systems, Canada’s total CO_2 emissions could be reduced by as much as 9 percent.

The subject literature has also cited a number of reasons as to why DE systems have achieved significant emissions reductions. Several sources, (Rosen et al., 2005; MCD, 2009; Gilmour & Warren, 2008; Gaia Energies, n.d.; Gilmour & Warren, 2008; IDEA, 2005), have concluded that, in centralizing energy production in a single plant, DE systems effectively consolidate individual heating requirements, enabling them to satisfy aggregate energy demand. As the case may be, these support an economy of scale argument that has been premised on overall gains in technical efficiency.

Other arguments identified in the DE subject literature have focused on the use of clean and renewable energy (Rosen et al., 2005; Lund et al., 2010; Möller & Lund, 2010). Lund et al (2010) and Möller & Lund (2010) acknowledged that alternative fuel sources are capable of offsetting the production of energy that would have otherwise have been produced by sources that emit additional GHG emissions (such as fossil fuels). In approaching the subject from a thermodynamic engineering perspective , Rogner (1993) and Rosen (1994) found that emissions reductions to have resulted from CHP energy production, noting that such systems offer efficiencies to be in excess of those resulting from production of heat and electricity in separate facilities.

A number of sources in the energy policy literature have touched on the relevance DE systems have for energy security (CEA, 2007; CDEA, 2009; CEM, 2009; IDEA, 2005). In his analysis, Jeffries, K [personal communication, May 2010] identified long-term fuel sourcing, local access, and competitive pricing as factors impinging on fuel security. Gilmour and Warren (2008) determined that Canada's future energy needs will increase at an incremental rate, a situation they argued could be mitigated by leveraging the fuel efficiency and reliability available in DE systems. In their analysis of the Danish energy system, Möller and Lund (2010) explored the issue of volatile oil prices and diminishing natural gas supplies and noted the role DE systems can play in alleviating energy security concerns. Furthermore, in their assessment of energy security strategies, Alanne and Saari (2006) drew attention to the potential of local fuel utilization, adequate fuel storage, and the use of DE systems to bolster energy system resilience.

Important System Considerations

System location. Any analysis of the DE subject literature directed at identifying and summarizing the key factors to consider in the development of DE systems would likely to prove a challenging exercise. Indeed, the subject literature has commented on considerations extensively. A practical starting place, perhaps, might be had with the view expressed by Morofsky (1977):

> The future implementation of district energy systems in Canada is intertwined with the type, location and size of new electrical generating capacity; future requirements for improved building energy use; urban environmental concerns; national urban objectives, especially as they may redirect projected growth to smaller cities or to new communities; and, of course, fossil fuel [or for that matter, any fuel] costs and availability (p 18).

The statement above not only speaks to policy drivers but also other important factors determined to inform the adoption of DE systems. As key policy drivers have already been discussed above , the following discussion concerns other factors that have been discussed in the literature.

One consideration that has been raised is the issue of system location. As noted above, the general impetus for the adoption of DE systems in Canada has been documented as being driven by higher fuel prices and increased demand, which—when coupled with the emergence of alternative fuels and technological improvements—shifted the focus from the development of large power plants to smaller local facilities situated closer to energy consumers (Gilmour &Warren, 2008; Morofsky, 1977; CDEA, 2009; Nijjar, Fung, Hughes, & Taherian, 2009). Indeed, as Alanne and Saari (2006) have concluded, a key attraction of DE systems is their close proximity to energy consumers and consumption nodes. Other commentators have stressed the importance of proximity to service loads, as the viability of DE systems has been argued to depend on energy load density (Jeffries, K [personal communication, May 2010]; IEA, 2002; Reidhav & Werner, 2008). Other sources (Gilmour & Warren, 2008; IDEA, 2005; Rogner, 1993) have argued that the success of DE systems is also determined by the degree of urban development.

Although the DE literature has identified urban settings as more compatible with district energy, [6] it has not been as readily apparent whether the same holds true for plant proposed for rural settings. However, in its endorsement of integrated community energy solutions (ICES), the CEM(2009) emphasized that energy solutions "can be scaled to meet the needs of all types of communities, ranging from rural and small remote towns to medium-sized municipalities and large cities" (p. 1). ICES has been actively promoted by the CEM(2009) as a cross-sector solution that encompasses both energy supply and distribution – by extension this could be argued to include DE systems. Moreover, DE systems have been cited in literature as having been successfully implemented in smaller communities. [7] Evidence of this has also been documented by the CDEA (2009) in its inventory of DE systems underway in Canada.

Other factors associated with location have been cited as being important in the DE literature as well. For instance, some DE observers (Alanne & Saari, 2006; Jeffries, K [personal communication, May 2010]; Rosen, 1994) have argued that local energy conversion hinges on local fuel sourcing and local fuel storage. The CEA (2007) has identified several location specific factors that impact the success of DE systems: the potential future development, the demand for year-round heat, the existence of a energy demand anchor (large energy users), and the ability to retrofit existing buildings. Church (2007b) and MCD (2009) reiterated these last two points, citing the need for a host anchor and the difficulty of connecting existing buildings because of the high capital costs associated with heating system conversion.

System scale. Another consideration identified in the subject literature is system scale. DE commentators (CDEA, 2009; Möller & Lund, 2010) have identified three elements to consider when assessing the size of DE systems: plant capacity (heat demand density), distribution network length, and the number of connected buildings. On the first element, the CDEA (2009) found the median plant capacity in Canada to be approximately 15 MW, [8] but also acknowledged that increasing densification requires system expansion. Alanne and Saari (2006) determined system modularity to be an important factor in sizing DE systems. Moreover, in his assessment of sizing plant capacity, Church (2007b) highlighted peak load requirement, annual energy consumption, and individual energy-use profiles as contributing factors.

In regards to the second element, distribution network length, the literature has identified piping distance (CEA, 2007) and potential heat losses (Nijjar et. al, 2009; Jeffries, K [personal communication, May 2010]; Church, 2007b) as key factors that merit consideration. When

[6] For example, Rogner (1993) analyzed the application of district energy in urban and sub-urban environments in Ontario and found sub-urban residential urban sprawl type developments to result in energy densities to low to justify the costs of DE service distribution. The IDEA (2005) indicated that, in North America, DE systems are often situated in dense urban environments and business districts, serving clusters of buildings and supporting the energy needs of universities, hospitals, and military bases. And the CEA (2007) made the case that the best areas for DE heating are high density development zones as opposed to single-family residential developments.

[7] Detailed information on the examples of the DE systems in Revelstoke and Okotoks is available in Appendix E.

[8] The literature shows there is a range of systems in existence. Production capacity depends on system purpose. In considering the BC context, for example, the Revelstoke Community Energy Corporation (RCEC) relies on a 1.5 MW base load boiler and 1.75 MW peak boiler for energy output. The Lonsdale Energy Corporation uses a series of mini-plant with a total production capacity of 6MW. It is also important to note, however, that neither system generates electricity. The system proposed for Quesnel does generate power, and is expected to produce 5.5 MW of heat and 1.7 MW of electricity. For additional information consult Appendices F and G.

considering piping length, no consensus seems to have been reached in the literature on optimal distribution length. For example, in a census of Canadian district energy systems, Gilmour (2007) found that distribution networks varied significantly between older systems (averaging 10 km) and newer systems (averaging 4.0 km). The CDEA (2009) also found large variations in network length. In surveying the length of district heating networks in BC's universities, distribution network piping ranged from 600m, at Simon Fraser University, to 15,000m, at the University of British Columbia (CDEA, 2009). The IEA (1996), however, has confirmed network distribution lengths of 20 km are attainable, but identified supply temperature, pipe diameter, and pressure regulation as contingent factors.

In addressing heat losses, the literature has documented heat loss in piping networks to be in the range on 5 to 8 percent (Church, 2007b; IEA, 1996). Morofsky, (1977) attributed heat losses to factors such as variations in heat transfer mediums, flow rates, and pipe construction methods. Several sources(CEA, 2007; IDEA, 2005; Gilmour & Warren, 2008; Rogner, 1993) pointed out that DE systems have used hot water, steam, and chilled water as thermal energy transfer mediums. The literature has documented older steam-based systems to be less efficient than modern hot water heating systems because of high pressures, high temperatures, and poorly insulated piping (Gochenour, 2001). Steam systems have be found to result in heat losses of as much as 20 percent of system input temperature (Gochenour, 2001).

As the case may be, however, some observers (CDEA, 2009; Church, 2007b; Gilmour & Warren, 2008) in the DE literature have noted that the trend today is towards systems and infrastructure that rely on lower pressure and supply temperature. Jeffries, K [personal communication, May 2010] has commented that transmitting heat through lower temperature mediums has resulted in reduced heat loss, which is mirrored by increased fuel efficiency. The literature has also indicated that recent advances in piping technology, such as low temperature plastic piping and burial methods, have led to reduced heat losses in system piping infrastructure (IEA, 1996). Additional benefits have been reported with the use of single-loop low temperature distribution systems (Gochenour, 2001; Church, 2007b).

Factors such as building size, building clustering, and building density have raised other points of discussion in the DE literature. As has been established in note 6 above, DE systems work well in precincts or districts where buildings are clustered. The IDEA (2005) and Jeffries, K [personal communication, May 2010], found the number of buildings serviced by DE system infrastructure to range from 3 or 4, in the preliminary stages of system development, to as many as 1,800, at full build-out. [9] Despite of the number of buildings connected, the CEA (2007) has concluded that the distance between buildings to be a limiting factor: shorter distances of 200 to 300m between buildings have been considered practical; and, distances of 1 to 2 km between energy plants and system anchors (the predominant energy users) have determined to be ideal for minimizing heat losses.

System fuel type. The policy drivers identified in the background section above advocate the use of clean and renewable energy sources. [10] Many observers in the energy policy literature have argued that DE systems are capable of incorporating innovative technologies that complement

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[9] Gochenour (2001) has pointed out that the DE system in New York relies on 5 central plants, incorporates over a 100 miles of piping, and is recognized as the world's largest DE system.

[10] For information on what constitutes the BC definition on clean and renewable energy refer to Appendix B.

fuel switching and operational flexibility. These operational benefits have been reported in the subject literature as offering advantages over conventional stand-alone fossil fuel systems (Jeffries, K [personal communication, May 2010]; see also Alanne & Saari, 2006; CEA, 2007; DEKB.co.uk, n.d.; IDEA, 2005; IEA, 2000; Lund et al., 2010; Möller & Lund, 2010; Thyholt & Hestnes, 2008).

As noted in the literature, it is has been the case that many DE systems currently in operation continue to rely on fossil fuel inputs as primary energy sources (Gilmour &Warren, 2008; Roger, 1993, Rosen, 1994). However, on closer reading of the subject literature, it has been determined that planners, designers, operators, and others may draw on a suite of fuel options and system technologies. Among the options that have received high acclaim by DE experts are combined heat and power (Rentizelas et al. 2009), deep lake water cooling (IDEA, 2005), geothermal (Bahadorani, Naterer, & Nokleby, 2009), biomass/biogas combustion (Natural Resources Canada[NRCan], 2008), municipal solid waste combustion (IEA, 2000), integrated resource recovery (MCD, 2009) ; Solar energy (Ghafghazi et al., 2009), gasification (Difs et al.,2010), and ground-air-water source heat pumps (CEA, 2007).

In considering the range of clean and renewable fuel alternatives, the subject literature has also articulated a mechanism by which the choices energy planners face are made more discernable, if not simplified. The IDEA (n.d.) and Church (2007b) have established a hierarchy that stratifies fuel source options according to energy availability, energy quality, and energy processing. The first level concerns resource recovery from industrial and municipal operations. This approach aligns well with the integrated resource recovery (IRR) model advanced by MCD (2009). The second level advocates methods that convert waste into energy and includes municipal solid waste incineration and landfill gas combustion (CEA, 2007). The third level incorporates renewable energy sources such as biomass, which includes mill residues, forestry debris, and processed pellets (NRCan, 2008). The fourth level encompasses CHP technologies and the recovery of high-grade heat energy as has been discussed by Rosen (1994). The final level in the hierarchy advocates efficient fossil fuel use, typically achieved by agglomerating individual energy needs in a centralized energy system (CDEA, 2009).

Prior to proceeding with a discussion on alternative fuel types, it may be useful to elaborate more on the role fossil fuels play in DE systems. The reliance on fossil fuels for use in existing DE systems has been documented by the CDEA (2009). In compiling its survey information, the CDEA (2009) disclosed that natural gas continues to be the predominant primary fuel source in DE systems currently in operation throughout Canada. Ghafghazi et al. (2009) reached the same conclusion, noting that, in Canada, 80 percent of established DE systems continue rely on fossil fuels in some capacity. The Lonsdale Energy Corporation (see Appendix E) is one example of a DE system that relies exclusively on natural gas.

In considering the BC context, McKenna and Smith (2009), acknowledged that natural gas-fired CHP is among the system technologies cited by BC Hydro as creating value and furthering BC's energy needs. McKenna and Smith (2009) have also advanced the argument that natural gas technology may offer greater operating efficiencies and fewer GHG emissions when compared to other system technologies that rely on coal or diesel fuel. The CEA (2007) identified natural gas as a primary fuel source, acknowledging the fuel's use in a temporary capacity. Other observers (Church, 2007a; Ghafghazi et al., 2009) have noted the importance of natural gas in providing peak-power and back-up support as a secondary fuel source for DE systems.

As has been noted above, a number of renewable fuel sources and technologies have been documented in the literature as being useful in DE systems. The CEA (2007), for example, has identified cogeneration (CHP) and the combustion of wood waste (biomass) as among the most common energy sources used for district heating. Other energy sources, determined by the CEA (2007) to be particularly relevant in the BC context, include: recovered waste heat, solar energy, energy extracted from ground, air, or water sources, and biomass/biogas. In their estimation, Gilmour and Warren (2008) have argued that access to renewable energy sources such as biomass and waste heat makes DE a compelling energy solution.

The same view has been shared by several local authorities on the subject (Travers [personal communication, June 2010]; see also CEA, 2010; MCD, 2009), which have indentified alternative fuel technologies as harnessing both low grade and high grade heat sources. Other sources (Jeffries, K [personal communication, May 2010]; CEA, 2007) have noted the added value of integrating these various energy options into hybrid systems that conveniently accommodate fuel switching. As might be inferred from the brief analysis offered here, a number of solutions are available to planners faced with assessing fuel choices.

Biomass. One fuel source that has been given extensive attention in the DE literature is biomass. Biomass has been described in the subject literature as fuel sources that originate from forestry residues and industrial processing in the forestry and agricultural sectors (European Bioenergy Network [EUBIONET], 2003). The fuel often includes wet and dry organic waste such as wood chips, saw dust, log bark, municipal solid waste, manure, straw, peat, and wood pellets (CEA, 2007; Jeffries, K [personal communication, May 2010]; MCD, 2009; NRCan, 2008; Thyholt & Hestnes, 2007). The CDEA (2007) has adopted a broad definition, determining biomass to be "any organic matter that can be burned for energy" (p. 47).

The BC definitions for clean energy (see Appendix B) has documented two biomass energy streams: the first, biogas energy, is determined to include all gaseous products resulting from breakdown of organic waste material; the second, biomass energy, is considered to encompass any thermal energy produced from the direct combustion of dry organic material (typically wood and wood debris). In terms of specific energy conversion processes, NRCan (2008) has identified four biomass conversion methods: direct combustion, biochemical alteration, anaerobic digestion and gasification, and pyrolization (to produce oils and value-added products).

In terms of the immediate BC context, biomass has been advocated by some experts as an important and emerging fuel source in throughout the province, the argument here being that large amounts of wood waste are readily available due to an intensive forestry sector (CDEA, 2009; CEA, 2010). In addition, as has been emphasized by some observers (see Gilmour & Warren, 2008; CEA, 2010), DE is more viable in regions where access to local sources of renewable fuels such as biomass is well established. NRCan (2005) has established fuel accessibility to be more crucial where the operation of biomass fed DE systems demands long-term and cost-effective access to feed stock.

Where the issue concerns efficiency and emissions levels, the European Bioenergy Networks has cited Copenhagen's hybrid biomass system as an example of one of the most efficient CHP plants in the world—purporting 94 percent operating efficiency and overall GHG emissions reductions of 10 percent, when compared to conventional systems (EUBIONET, 2003). Other experts have also commented on the efficiency gains and emissions reductions argued to result from biomass systems (see Nijjar et. al, 2009; Difs et al., 2010; Gochenour, 2001; NRCan, 2005).

Although it might be inferred from the above comments that biomass plants are highly efficient, the literature has documented that there remains some concern with particulate emissions (CEA, 2007; Hager, 2010; Thyholt & Hestnes, 2007). It has been accepted by some in the literature that particulate emissions result in a negative externality (CEA, 2010). Yet, it has also been emphasized that biomass-fired systems typically incorporate improved emissions and control technologies, which ensure compliance with rigorous government standards (Jeffries, K [personal communication, May 2010]; CEA, 2010). Nonetheless, in the ongoing debate surrounding GHG emissions, the fundamental argument for biomass systems has been grounded on the premise of carbon neutrality: the sustainable harvesting of biomass is purported to result in no net increases in GHG emissions (EUBIONET, 2003; NRCan, 2005; Thyholt & Hestnes, 2008).

Triple Bottom Line (TBL) Accounting

On investigation of the public policy literature the concept of triple bottom line (otherwise TBL or 3BL) has been associated with stakeholder engagement and strategic policy planning. As has been cited by Elkington (1998), the term ‘Triple Bottom Line’ has origins in the corporate social responsibility literature and has been documented as emerging during the mid-1990s, when the management think-tank AccountAbility first adopted the use of the term in its work. It has also been disclosed that the TBL concept stems from the premise that the overall fulfillment of corporate obligations to stakeholders should be evaluated in the same way that financial performance has been measured for over a century (Norman & MacDonald, 2004). Observers have also determined that TBL proponents believe that social (and environmental) performance can be measured in objective ways and that firms should adopt such measures to improve their social (and environmental) performance (Norman & MacDonald, 2004).

The subject literature has also established that some corporations have recognized the value of TBL accounting for corporate success. Respini (2000) has considered TBL to be important management tool that enables organizations to leverage early warning signals, thus allowing them to react quickly to stakeholder concerns. It has been concluded that large corporate entities such as AT&T and Walmart embrace TBL accounting as a mechanism for strengthening long-term viability, having direct implications for stock prices and profits (AT&T, 2009; Greenbiz, 2010). As noted by some experts, however, a tension exists as a trade-off between short- term profits and long-term viability. Some experts have argued that, if social and environmental outcomes are not considered, long-term viability of a corporation is subject to adverse factors such as decreased social capital, increased in environmental penalties, and other sanctions that could adversely affect the profit margins (Respini, 2000; Norman & MacDonald, 2004; Elkington, 1998).

As has been articulated in the subject literature, TBL has not gone without criticism. One fundamental central criticism of TBL is that social and environmental indicators are not as easily measurable as economic indicators. Pava (2007) has argued, for example, that TBL may align with the principles of big business and corporations, but the practice fails to recognize the complexities of environmental sustainability and other factors that impact social well-being (Pava, 2007). Norman and McDonald (2004) have also approached the subject from an adversarial stance, arguing that that TBL is laden with rhetoric in which firms obligations to social and environmental responsibility become diluted and otherwise distorted.

Where the debate on TBL has been noted, others in the subject literature have expressed that the underlying motivation for TBL is not necessarily and accountability mechanism where corporations are required to document progress on social and environmental indicators, but a more organic process whereby TBL philosophy is incorporated into operational and organizational cultures. Mitchell, Curtis, and Davidson (2008) have argued that it should be possible to look beyond the tangibles documented in TBL reports and assessments with the goal of evaluating impacts on interested parties and stakeholders.

Other observers have approached the subject from the perspective of ethics, arguing that stakeholder participation in reporting, and attention to sustainability issues, is fundamental in developing organizational ethics (Scott, 2003; Meppem, 1998; Buckingham-Hatfield, 1999). Huffington (2002) has concluded that a key premise of TBL is not one that requires the accurate measurement of a corporation's performance on specific social and environmental indicators, but rather one in which corporation's consciously shift their focus from conventional financial accounting regimes, which typically consider only profit, to an ethics protocol that also considers the social and environmental impacts that may result from business undertakings. Norman and McDonald (2004) have purported that, in evaluating a business' success is never as simple as looking at the financial bottom line.

Another major criticism of TBL has origins in debate surrounding the validity of social and environmental indicators. Some commentators in the literature have asserted that social and environmental indicators are subjective by nature, and simply a matter of conjecture (Norman & MacDonald, 2004) . Norman and MacDonald, however, concluded that it is important for an organization to adopt ethical principles in their business dealings, and that they should engage stakeholders on social, environmental, and economic interests (Norman & MacDonald, 2004). Concern has also been expressed that, where it is held that social and environmental outcomes can be subjectively measured, bias may lead to 'green washing,' or an instance whereby organizations ostensibly practice social and environmental responsibility when in fact the opposite is true (Norman & MacDonald, 2004).

In shifting the discussion from the debate surrounding TBL to its use in the public realm, the paragraphs below focus on how TBL has been applied in the BC context. To be clear, the BC government has been cited in the subject literature as relying on TBL evaluation frameworks to assess many of its initiatives and programs. This is evident in the BC Energy Plan, which explicitly states the following:

> [This plan] adopts a triple bottom line approach to competitiveness, with an attractive investment climate, environmentally sustainable development of B.C.'s abundant resources, and by benefiting communities and First Nations (BC Ministry of Energy, Mines, and Petroleum Resources, 2010).

Another example of how the BC government has adopted TBL framework is the 2010/2011 Agriculture and Lands Service Plan, where it has been specifically noted that the Ministry has adopted a perspective that includes economic, environmental and social objectives (BC Ministry of Agriculture and Lands, 2010). It has also been documented in the literature that, as early as

1999, BC Hydro began incorporating TBL practices into its business operations and reporting regimes (BC Hydro, 2002). In addition, as another example, Shared Service Accommodation and Real Estate Services (ARES), which oversees the government's real estate services, also engages TBL, having recently developed guidelines that bring sustainability issues to the fore in decision-making (Mackay, 2009).

It might be inferred from the literature that, in supporting sustainable communities, DE accommodates TBL considerations. Many of the DE projects currently in operation throughout BC have identified TBL philosophy as a key development principle and focus. For example, in a 2004 request for proposal (RFP) released by the City of Victoria, and relating to the development of its Dockside Lands, a TBL accounting framework was required to be submitted along with prospective development proposals (City of Victoria, 2004). Because of effective community engagement and attention to sustainability concerns, the resulting Dockside Green project relied on TBL accounting framework to evaluate DE system performance (Dockside Green, 2010). In addition, the Lonsdale Energy Corporation (LEC) DE system in North Vancouver BC has also demonstrated the capacity to report on economic benefits (reduced energy costs) and environmental benefits (reduced GHG emissions) (Lonsdale Corporation, 2009).

Despite evidence that shows TBL accounting to result in tangible benefits, arguments have been made in the subject literature that DE systems result in economic, environmental, and social ramifications. For example, the recent gasification development in Kamloops, BC serves as an example where a proven technology, argued to result in environmental and economic benefits, has also led to social challenges because of inadequate consultation and disclosure with the extended community (Kamloops Daily News, 2010). The DE proposal for Kamloops was identified as lacking effective consultation, a contributing factor leading to unsuccessful project implementation (Kamloops Daily News, 2010). Indeed, the case of Kamloops has been documented as a project mired in organized public protest (Mason, 2010; Save Kamloops, 2010). Accordingly then, where the importance of public consultation is concerned, Kamloops serves as an important precedent for pursuing TBL practices.

Regardless of the ongoing subject debate in the literature, TBL accounting has continued to remain a central component in BC government policy. As noted above, a precedent has been established in BC whereby TBL accounting should be a requisite part of project selection criteria. Whether a project has clearly articulated adherence to an established and documented TBL framework, the argument could be advanced that prospective projects should, at a minimum, demonstrate economic viability, alignment with community-wide social and economic objectives, and demonstrate environmental responsibility. Although it may be reasonable to conclude that—because PSECA is motivated by energy conservation emissions reductions objectives—prospective DE projects must be evaluated on energy use and emissions, it should be the case that all projects are subjected to metrics that assess an array of economic, social, and environmental factors.

TBL accounting characteristics appear to depend on specifics such as the type and the location of the project being evaluated. It would be reasonable to conclude that each project is accompanied by unique economic influences, social objectives, and environmental factors which are shaped by the specific contexts of the communities within which projects are implemented. Thus, it will be important to discuss aspects of TBL with PSECA stakeholders in order to ensure the final criteria comprehensively address all relevant aspects of project accounting.

Partnership and Ownership

Partnership has been viewed by many in the subject literature to be an important component of developing a district energy project. Several sources have mentioned the importance of partnership in community development (Clark, 2006; Ahlbrandt, 1986). The CEA (2007) has indicated that partnership facilitates knowledge transfer between communities. As noted above, one of the program aims of PSECA is to build capacity in communities on the energy conservation front by through the development of DE systems (BC Climate Action Secretariat, 2010b).

As reported in the policy literature, the goal of reducing GHG emissions is a burden that weighs heavy on many entities, including: PSO's, local governments, and firms in industrial and institutional sectors (BC Climate Action Secretariat, 2010b; BC Climate Action Secretariat, 2007; Government of British Columbia, 2003). These sources have also suggested there has been common interest in pursuit of DE systems and related benefits. Specifically, it has been suggested that, by encouraging partnerships, communication between various sectors of the community is strengthened, which then facilitates greater understanding about the role DE systems are believed to play in reducing GHG emissions. And, as established by some observers, partnerships increase the viability of DE by matching energy suppliers with energy demanders and offering a diverse and stable base loads (CDEA , 2009; CEA, 2007).

Partnership has also been determined to help ensure DE projects are developed in alignment with community objectives that often include consideration environmental sustainability and economic development, and community growth (Church, 2008). Church has also argued that partnerships enable capital to be pooled in such a way that the financial burden associated with DE systems may be shared amongst a number of entities, who may otherwise lack the resources to implement a DE system on their own.

One of the inherent challenges of effective partnerships has been documented in the literature to be the allocation of risk (PartnershipsBC, 2006; Church,2008). For capital intensive projects such as infrastructure, it has been established that the PSO involved in a partnership scenario will always retain a certain level of risk (PartnershipsBC, 2006). It has also been established that the level of risk is determined by the functional status of the PSO: for example, in considering heating and cooling system volatility, the level of risk varies significantly between organizations that provide health care services, education services, transportation services, or other public services (PartnershipsBC, 2006).

From another view, PartnershipsBC (2006) has also established that PSO's incur certain financial risk in efforts to mitigate against disasters, unforeseen maintenance and operational costs, or failed partnerships (PartnershipsBC, 2006). In order to address the allocation of risk, it has been emphasized that, under government procurement rules for capital assets and generally accepted accounting principles (GAAP), the public sector retain full ownership of the infrastructure for which it assumes the allocated risk (Canadian Institute of Chartered Accountants, 2010). This has been documented in the subject literature as resulting in challenges for DE projects that receive funding from a number of sources, as ownership typically rests with a single entity. While the private sector may not typically invest in infrastructure that will be owned by government, it may be beneficial for a private sector utility to secure large public sector entities (e.g. hospitals or universities) as stable energy use anchors for DE projects (CEA, 2007; Good, J [personal interview, September 13, 2010]).

If clear lines of public ownership can be established for all capital projects for which the government has been allocated risk, then it might be argued that a public- private- partnership model could be viable in spreading development risk (Good, J [personal interview, September 13, 2010]). For PSECA, the establishment of public-private-partnerships (otherwise P3's) has been determined to make sense where funding is used for projects that benefit the public good, but which are otherwise not commercially viable. As has been the case in BC, DE projects are likely to be operated by private utilities; therefore it makes sense to transfer associated startup risks to the private partner since they benefit financially from the investment (Good, J [personal interview, September 13, 2010]).

It has been documented that one of the underlying purposes of the PSECA program is to demonstrate showcase projects that use clean energy technologies in BC (BC Climate Action Secretariat, 2010b). By supporting DE projects for PSOs, PSECA has been argued to increase the visibility of DE in BC communities, encourage the establishment of working partnerships, and strengthen the likelihood of DE systems being used in the future (BC Climate Action Secretariat, 2010b).

Evidence has supported the observation that the transfer of specialized knowledge is inherent in many DE systems in BC, due to the unique nature of the project. For example, the Lonsdale Energy Corporation system in North Vancouver BC, which is wholly owned by the City and operated by a private utility, would enable to a much greater understanding of the benefits of DE for communities throughout the province (Lonsdale Corporation, 2009). Other DE projects, such as the Dockside Green system in Victoria, BC, provide educational benefits to the community at large, while also providing esoteric knowledge into potential operational and implementation challenges of DE systems (Dockside Green Energy LLP., 2008).

The Revelstoke Community Energy Corporation (RCEC) is another example of a partnership between the private and public sectors, and also serves to demonstrate how DE projects can showcase specific technologies. The case of Revelstoke has served as an example of a case in which forest resource-based communities have partnered with industrial processing facilities (Government of Canada, 2009). The case of Revelstoke also demonstrates another important benefit of partnership. By partnering with local industry, the city was able to address a local wood-waste problem, while also leveraging an inexpensive form of renewable energy (Government of Canada, 2009).

Other examples have been cited in the literature as cases where benefits have resulted from forming partnerships. These include the Williams Lake Co-generation plant, the biomass-fuelled plant at the University of Northern British Columbia, and similar biomass projects currently proposed for the cities of Prince George and Quesnel, BC (Capital Power Corporation, 2008; Nexterra, 2009; City of Prince George, 2010; Terasen Gas, 2010).

Yet, other communities have also expressed interest in reducing the GHG emissions associated with their corporate operations. Local governments who have signed on to the BC Climate Action Charter have committed to be carbon neutral by 2012 (BC Climate Action Secretariat, 2007). Similar to the case for PSOs, this means they will either have to reduce their corporate emissions, or purchase offsets to reach net zero emissions (BC Climate Action Secretariat, 2007). Thus, local governments have an interest in furthering the development of DE projects. In addition, many firms in the industrial sector will be required to report on annual emissions, as a result of the recently proposed cap and trade system (BC Climate Action Secretariat, 2007). It might be argued therefore that industrial firms will acquire an interest in either reducing emissions, or earning carbon credits and trading them with other organizations desiring to offset GHG emissions (BC Climate Action Secretariat, 2007).

Partnership could also be argued to result in benefits that can increase the feasibility and efficiency of DE projects. It may be also be surmised that partnerships enable projects to be developed in alignment with shared goals, while also increasing the likelihood that smaller organizations, such as schools and businesses, may benefit from the services DE systems offer as well. Arguably, partnership should be considered a fundamental component of DE selection criteria for DE for project evaluators. Nonetheless, it is important to identify the operational limitations of partnership in pursuing such strategies as project development mechanism between the public and private sectors (Good, J [personal interview, September 13, 2010]).

Appendix B: British Columbia's Clean or Renewable Electricity Definitions

Electricity generated in British Columbia may be reported as Clean or Renewable Electricity if:

1. The facility is in compliance with all applicable Federal and Provincial environmental regulations;

AND

2. The facility satisfies one of the following requirements:

   a. The electricity is generated in a facility that uses a Clean or Renewable Electricity Resource
   or Technology as defined in this document.

   b. The electricity is generated in a facility that fulfills one of the following requirements:

      - It can be demonstrated that the facility meets the certification criteria for "electricity - renewable low-impact" as defined by Environment Canada's Environmental Choice^{Tm} Program; or

      - The facility maintains Environmental Choice^{Tm} Program certification.

   c. Electricity is generated using a process, resource, or technology that is not recognized as Clean or Renewable in this document, but receives recognition from the minister of Energy, mines and Petroleum Resources as Clean or Renewable Electricity.

BRITISH COLUMBIA'S CLEAN OR RENEWABLE ELECTRICIY RESOURCES

Resources and technological applications that may qualify as a source for Clean or Renewable Electricity production are listed below:

BIOGAS ENERGY - means electricity generated from a system that captures biogas for combustion or conversion to electricity. Biogas means the gaseous products (primarily methane and carbon dioxide) produced from organic waste material. Facilities producing biogas include landfill sites, sewage treatment plants, and anaerobic digestion organic waste processing facilities.

BIOMASS ENERGY - means electricity generated from the combustion or gasification of organic materials. Biomass includes, but is not limited to:

- Clean wood biomass, meaning
  - wood residue within the meaning of the *Forest Act*,

  - wood debris from logging, construction, or demolition operations,
  - organic residues from pulp and paper production processes, and
  - timber, within the meaning of the *Forest Act* infested by the mountain pine beetle;

- Liquid fuels derived from biomass including bio-oil, ethanol, methanol, and bio-diesel;
- dedicated energy crops; and
- Clean organically sourced material separated from municipal solid waste (MSW) and processed to serve as a combustion fuel.

Clean biomass does not include organic material that has been treated with inorganic substances such as paints, coal-tar creosote, pentachlorophenol or chromated copper arsenate, to change, protect, or supplement the physical properties of the materials.

If a facility co-fires fuels, or uses a mix of fuels that includes fossil fuels, only the proportion of the total electric output that can be attributed to the use of a clean or renewable fuel source qualifies as clean or renewable electricity. The proportion of the total electric output that qualifies as clean or renewable electricity must be calculated based on the proportion that clean or renewable energy constitutes of the total energy input used by the renewable energy system to generate electricity, or if practicable, separate metering.

ENERGY RECOVERY GENERATION (ERG) - means electricity produced from the recovery of waste energy from an industrial process that would otherwise have been vented or emitted into the atmosphere. ERG represents a net environmental improvement relative to existing energy production because it uses the waste of other processes to generate electricity. Therefore, all output from an ERG facility is considered Clean or Renewable Electricity.

GEOTHERMAL ENERGY - means electricity produced using the natural heat of the earth and all substances that derive an added value from it, including steam, water and water vapour heated by the natural heat of the earth and all substances dissolved in the steam, water or water vapour obtained from a well. This does not include hydrocarbons or water that has a temperature less than 80°C at the point where it reaches the surface.

HYDROCARBON ENERGY - means electricity produced from a facility combusting or converting fossil fuel using a closed-loop process whereby all greenhouse gas emissions from the operation of the facility are either deemed to be zero, negligible, or subject to long-term sequestration from the immediate receiving environment. Such a system requires approval of the minister of Energy, mines and Petroleum Resources for classification as Clean or Renewable Electricity.

HYDRO ENERGY - means electricity generated from a system or technology that converts either the potential or kinetic energy of water.

HYDROGEN - usually recognized as an energy carrier, hydrogen can also be used as a primary fuel source for internal combustion engines. Hydrogen produced from either a clean or renewable resource, or captured as a waste by-product of an industrial process, and then converted into electricity, is considered Clean or Renewable.

MUNICIPAL SOLID WASTE (MSW) - incineration of MSW to produce energy has both positive and negative environmental impacts. The release of carbon dioxide and other emissions is a negative impact, but reducing the amount of materials in landfills has benefits. Therefore, the combustion of MSW for electricity generation may be considered Clean or Renewable Electricity. a MSW incineration system requires approval of the minister of Energy, mines and Petroleum Resources for classification as Clean or Renewable Electricity.

MSW can also be converted to synthetic gas, which in turn is used to generate electricity. The electricity produced using such a process may be considered Clean or Renewable Electricity. a MSW-synthetic gas-generation system requires the approval of the minister of Energy, mines and Petroleum Resources for classification as Clean or Renewable Electricity.

SOLAR ENERGY - means electricity generated by converting the radiant light or heat energy of the sun through the use of photovoltaic and concentrating solar thermal technologies.

TIDAL ENERGY - means electricity produced by harnessing the natural rise and fall of the tides in the ocean.

WAVE ENERGY - means electricity produced by harnessing the natural rise and fall of waves in the ocean.

WIND ENERGY - means electricity produced from a system of airfoils or blades that spin a drive shaft to capture the kinetic energy of the wind.

OTHER POTENTIAL CLEAN OR RENEWABLE ELECTRICITY SOURCES - can include a project where the proponent or electricity distributor can demonstrate to the satisfaction of the minister of Energy, mines and Petroleum Resources that a project or application of technology otherwise excluded by this guideline, or not qualifying for certification under the Environmental Choice Tm Program, should be recognized as producing Clean or Renewable Electricity.

Source: Retrieved from: BC Ministry of Energy Mines and Petroleum Resources web site: http://www.empr.gov.bc.ca/EAED/AEPB/Documents/CleanEnergyJune.pdf

Appendix C: Energy and Emissions Profiles for Commercial and Residential Sectors

Table C1. National and Regional Annual Secondary Energy use and Emissions by Energy Sector for 2007

	Energy Consumption and Emissions [a]	Residential	Commercial/ Institutional	Industrial	Transport	Agricultural	Total
Canada	Energy use (PJ)	1,447.2 (16.31%)	1,141.6 (12.87%)	3,471.6 (39.13)	2,595.2 (29.26%)	215.0 (2.42%)	8870.6 (100%)
	GHG emissions (Mt of CO_2e)	41.2 (10.64%)	35.1 (9.07%)	118.5 (30.61%)	179.3 (46.3%)	13.0 (3.36%)	387.1 (100%)
BC and Territories	Energy use (PJ)	163.0 (14.0%)	120.9 (10.38%)	497.4 (42.7%)	369.6 (31.73%)	14.0 (1.20%)	1164.9 (100%)
	GHG emissions (Mt of CO_2e)	4.3 (9.4%)	3.5 (7.66%)	11.3 (24.72%)	25.7 (56.23%)	0.9 (1.97%)	45.7 (100%)

Source: Extrapolated from Natural Resources Canada (2009). Comprehensive energy use database (1990-2007. Retrieved from Office of Energy Efficiency web site: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0

[a] Although these figures include energy used from all sources (electricity, natural gas, oil products, and other fuels) GHG emissions figures **exclude** emissions resulting from electricity production.

Table C2. Annual Secondary Energy use by Sector and Energy Source for British Columbia and Territories for 2007

	Energy Source	Residential	Commercial / Institutional	Industrial [a]
Energy Use (PJ)	Electricity	68.7 (42.1)	55.4 (45.9)	117.9 (24.8)
	Natural Gas	80.6 (49.4)	53.5 (44.3)	119.0 (25.0)
	Heating Oil	2.4 (1.5)	- -	- -
	Light Fuel Oil [c]	- -	6.5 (5.4)	34.8 (7.3)
	Heavy Fuel Oil	- -	3.0 (2.4)	1.5 (0.3)
	Coal	- -	- -	16.8 (3.5)
	Steam	- -	0.0 (0.0)	- -
	Wood [d]	10.0 (6.1)	- -	183.2 (38.5)
	Other [e]	1.3 (0.8)	2.5 (2.1)	2.2 (0.5)
	Total	163.0 (99.9)	120.9 (100.1)	475.4 (99.9)
GHG Emissions (Mt of CO_2e)[b]	Electricity [f]	-	-	- -
	Natural Gas	4.0 (96.7)	2.7 (75.0)	5.9 (59.0)
	Heating Oil	0.1 (1.6)	-	- -
	Light Fuel Oil [c]	- -	0.5 (13.89)	2.5 (25.0)
	Heavy Fuel Oil	- -	0.2 (5.55)	0.1 (1.0)
	Coal	- -	-	1.4 (14.0)
	Steam	- -	0.0 (0.0)	- -
	Wood [d]	0.0 (0.1)	-	0.1 (1.0)
	Other [e]	0.1 (1.6)	0.2 (5.55)	0.0 (0.0)
	Total	4.2 (100)	3.6 (99.99)	10 (100)

Source: Natural Resources Canada. (2009). Comprehensive energy use database (1990-2007). Retrieved from Office of Energy Efficiency web site: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0

Note. Table extrapolated from available data - figures in parenthesis represent percentages (totals may not add up to 100 due to rounding).

[a] For industrial sector, totals **do not** include: Coke, Coke Oven Gas, LPG and gas plant NPG, Still Gas and Petroleum Coke.

[b] Data on GHG emissions excludes GHG emissions resulting from the production electricity

[c] "Light Fuel Oil" includes kerosene and diesel fuel

[d] For industrial sector "wood" includes wood waste and pulping

[e] For residential and commercial/institutional sectors, "Other" includes coal and propane

[f] GHG emissions totals **exclude** emissions resulting from electricity production

Table C3. Residential and Commercial Sector Annual Secondary Energy Use and GHG Emissions by Energy Source and End-use for British Columbia and Territories for 2007

		Energy Source	Water Heating	Space Heating	Space Cooling [a]
Residential Sector	Energy Use (PJ)	Electricity	6.1 (17.6)	26.3 (28.9)	0.6 (100)
		Natural Gas	27.9 (80.2)	51.8 (56.9)	- -
		Heating Oil	0.2 (0.6)	2.2 (2.4)	- -
		Wood	0.5 (1.4)	9.6 (10.5)	- -
		Other	0.1 (0.3)	1.2 (1.4)	- -
		Total	34.8 (100.1)	91.1 (100.1)	0.6 (100)
	GHG Emissions (Mt of CO_2e)	Electricity [d]	- -	- -	- -
		Natural Gas	2.6 (89.7)	1.4 (100)	- -
		Heating Oil	0.2 (6.9)	0.0 (0.0)	- -
		Wood	0.0 (0.0)	0.0 (0.0)	- -
		Other	0.1 (3.4)	0.0 (0.0)	- -
		Total	2.9 (100)	1.4 (100)	- -
Commercial /Institutional Sector	Energy Use (PJ)	Electricity	0.7 (6.9)	8.5 (13.5)	2.5 (94.1)
		Natural Gas	7.8 (76.5)	45.0 (71.4)	0.2 (5.9)
		Light Fuel Oil [b]	1.0 (9.8)	5.4 (8.6)	- -
		Heavy Fuel Oil	0.4 (3.9)	2.4 (3.8)	- -
		Steam	0.0 (0.0)	0.0 (0.0)	- -
		Other [c]	0.3 (2.9)	1.7 (2.7)	- -
		Total	10.2 (100)	63 (100)	2.7 (100)
	GHG Emissions (Mt of CO_2e)	Electricity [d]	- -	- -	- -
		Natural Gas	0.4 (80.0)	2.2 (75.9)	0.0 -
		Light Fuel Oil [b]	0.1 (20.0)	0.4 (13.8)	- -
		Heavy Fuel Oil	0.0 (0.0)	0.2 (6.9)	- -
		Steam	0.0 (0.0)	0.0 (0.0)	- -
		Other [c]	0.0 (0.0)	0.1 (3.4)	- -
		Total	0.5 (100)	2.9 (100)	0.0 -

Source: Natural Resources Canada. (2009). Comprehensive energy use database (1990- 2007). Retrieved from Office of Energy Efficiency web site:
http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0

Note. Figures in parenthesis represent percentages (totals may not add up to 100 due to rounding)
[a] Space cooling uses only electricity
[b] Includes diesel and kerosene
[c] Includes coal and propane
[d] GHG emissions figures **exclude** GHG emissions resulting from the production of electricity

Table C4. Residential and Commercial Sector Annual Energy use and GHG Emissions by End Use for 2007

Residential Sector				
Profile Category	**Water Heating**	**Space Heating**	**Space Cooling [a]**	**Total Sector**
Energy Use (PJ)	34.7 (21.3)	91.1 (55.9)	0.6 (0.37)	163.0 (100)
GHG Emissions (Mt of CO_2e) [b]	1.4 (32.6)	2.8 (65.1)	0.0 (0.0)	4.3 (100)
Commercial Sector				
Profile Category	**Water Heating**	**Space Heating**	**Space Cooling [a]**	**Total Sector**
Energy Use (PJ)	10.2 (8.4)	63.0 (52.1)	2.6 (2.2)	120.9 (100)
GHG Emissions (Mt of CO_2e) [b]	0.5 (4.3)	2.9 (82.9)	0.0 (0.0)	3.5 (100)

Source: Natural Resources Canada. (2009). Comprehensive energy use database (1990- 2007). Retrieved from Office of Energy Efficiency web site:
http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0

[a] Space cooling uses only electricity
[b] GHG emissions figures **exclude** GHG emissions resulting from the production of electricity

Appendix D: Comparison of Eligibility and Selection Criteria for Various Programs

	Building Canada Fund (BCF) - Communities Component (MCD) [1]	ecoEnergy for Renewable Power Program (NRCan) [2]	Innovative Clean Energy Fund (ICE) (STED) [3]	Green Municipal Fund - Call for Applications: Energy (FCM) [4]	Canada-BC Municipal Rural Infrastructure Fund (MRIF) (MCD) [5]	PSECA- District Energy Component (CAS) [6]	Remote Community Implementation (RCI) Program (MEMPR) [7]
Applicants	• Must be local governments or non-government organizations/ private sector entities whose applications are supported/sponsored by resolution of a local government council	• May include businesses, institutions, or organizations that produce and sell electricity in Canada	• Local governments and First Nations, PSOs, NGOs, registered non-profit organizations, registered private sector companies, and consortiums	• Must be either a municipal government or a municipal utility/corporation wholly owned by a municipal government	• Must be local governments (or their authorized representatives) or NGOs whose applications are endorsed by resolution of a local government council	• Must be public sector organizations (PSOs) or entities otherwise listed in the Government Reporting Entity (GRE) framework	• Limited to "remote" communities, which include civic and First Nations communities not connected to the grid
Eligible Projects	• Must focus on the construction, renewal, or expansion of infrastructure and must be undertaken and implemented in communities with populations less than 100,000	• May involve either the construction of a new or the refurbishment or expansion of an existing low-impact renewable generating facility	• Must further Government priorities, which include producing clean and renewable energy; improving energy transfer/distribution; and improving energy use by consumers	• May involve either energy efficient retrofitting or new construction; and the building must be owned by an eligible applicant	• Must be determined a priority by the local government and focus on the construction, renewal, or expansion of community infrastructure	• Must focus exclusively on transformative - district energy systems, which may or may not include the generation of saleable electricity	• Must relate to the provision of clean energy community – scale alternative power and heating infrastructure or demand side management upgrades
Funding Limits	• Combined federal and provincial funding is limited to 66% of costs, and maximum funding from either source is limited to 50% of project cost	• Subject to stacking limit for any ecoEnergy funding contribution in excess of $100,000; total assistance from all government sources may not exceed 75% of capital costs	• Preference given to projects that leverage other funding; ICE funding is limited to 33% of total project costs; combined total funding from provincial and federal government sources is not to exceed 75% of total project costs	• May receive funding for up to 80% of eligible project costs to a maximum loan of $4 million and grant of $400,000; value of grant must not exceed 10% of loan amount	• Combined funding from federal and provincial sources must not exceed 50% of eligible project costs, and local governments must commit to funding the balance of those costs.	• Projects that have committed funding from other sources are preferred; no stacking limit is imposed by PSECA funding	• Preferred projects will have secured additional funding from other sources
Eligibility Criteria	• Must demonstrate the capacity to operate and maintain infrastructure over the long-term • Must fall within an eligible funding category/s and meet the specific objectives and criteria of applicable category/s	• All biomass and hydro projects must maintain EcoLogo[M] certification to receive funding • Must satisfy net eligible production levels using renewable resources and the power must be sold in Canada	• Must demonstrate the necessary technical, managerial, and financial capacity to undertake and complete the project. • Must be technically feasible and ensure the successful development and use of clean energy technology	• Must display sound project management, undertake quality public engagement, and secure municipal council commitment. • Must provide feasibility studies that depict projected energy use and conservation levels	• Must exhibit long-term sustainability, sound asset management, operational validity and environmental sensitivity • Must demonstrate need for federal and provincial financial support for project implementation, enhancement, or acceleration	• Must display necessary technical, financial, and managerial competencies and resources to undertake and complete the project • Must be technically sound and exhibit strong demonstration value and replicability potential	• Must exhibit adequate managerial, human and financial resources and solid project and risk management competency • Must display robust technical and operational feasibility

Eligibility Criteria	• Must be supported by credible, feasible, and comprehensive business cases • Where applicable, applicants must provide risk management plans • Must meet all applicable legislative or regulatory requirements, e.g. First Nations consultation and environmental assessments Projects are selected on the degree to which they meet environmental, economic, and quality of life objectives • Projects are assessed on the degree to which they align with provincial, regional, and municipal development and sustainability plans • Tendering and contract award process must be fair and transparent • Projects are subject to mandatory and additional leveraging criteria as established by the BCF Policy Leveraging Framework • Where applicable, projects are subject to category specific criteria , e.g. flood mitigation criteria • Completion deadline of no later than March 31, 2016	• All biomass combustion system projects must be certified by Environment Canada and report GHG and air emissions reductions after one year of operations • All components of a new facility, or those added to an existing facility, must be new equipment • All low-impact renewable generating facilities must use renewable energy sources • With the specific exception of wind power, all qualifying projects must generate a total rated capacity of 1MW or greater • Projects are assessed against pre-determined capacity limit factors for each technology used in production • All Projects subject to Class 43.1/ Class 43.2 definitions of Canada's *Income Tax Regulations* when determining eligible capital costs • Must be commissioned and operating at full capacity within specified periods	• Must have secured balance of project funding is secured from other sources • Must provide thorough and detailed project management, risk management, and mitigation plans • Proponents must demonstrate that they have undertaken necessary stakeholder engagement and secured the necessary permits • Must satisfy any number of BC's technology commercialization priorities, e.g. commercialization of clean or renewable energy • Must demonstrate significant replicability and exportability potential • Payments tied to project milestones and paid upon completion; may be paid one milestone in advance	• For building retrofits, projects must demonstrate 30% reduction in energy consumption over current levels (benchmark) • To qualify for grants, projects must demonstrate their alignment with, and support of, municipal sustainability plans • Applications are scrutinized to establish their potential to provide economic, environmental, and social benefits within the context of sustainable development. • Loans and grants are offered to projects that serve as the best examples of municipal leadership in sustainability and result in high net environmental impact • Projects are examined to determine whether they incorporate innovation, demonstrate replicability, and facilitate knowledge sharing • For new building construction, projects must demonstrate a reduction of 40% and satisfy the equivalent of LEED silver for building design • To qualify for retrofits, proponents must provide benchmark energy conservation figures for energy use	• Project tender must not have been awarded nor construction started • Must provide details on how proposed projects advance the local government's development and financial plans • Must be endorsed by a resolution of the applicable local council or regional board where the infrastructure is located. • Must fall within one of the applicable project categories and be consistent with the objectives of that category. • Must contribute to economic, environmental, and social objectives • Where applicable, projects must exhibit best practices, innovative approaches, and economically feasible technology • Must secure the necessary permits from appropriate approval authorities. • Must comply with applicable federal and provincial environmental legislation • Must be completed by March 31, 2010	• Must demonstrate good value for money. • Must have secured the necessary permits and meet the standards established by all applicable regulatory regimes • Must demonstrate compliance with the relevant federal and provincial environmental assessment protocols • Must support the development of local capacity and align with local/regional sustainability plans • Must further BC's economic, environmental, and social objectives. • Must demonstrate effective stakeholder engagement practices. • Must demonstrate GHG emissions reductions over BAU benchmark or achieve reductions as specified in business case technical reports • Must ensure security of fuel supply and local sourcing of primary fuel stock • Must be construction-ready	• Must align with Community Energy Plans and/or other sustainability plans • Projects are assessed on their ability to contribute to and enhance community vitality and economic, environmental, and social sustainability objectives • Projects are evaluated on whether they contribute to capacity building through shared knowledge • Must result in the significant displacement of fossil fuel use; some projects must lead to the elimination of fossil fuel. • All projects are assessed on their capacity to reach specified GHG emissions reductions targets • Must be either construction- ready or in final stages of implementation.

Annotated List of Sources

[1] *Canada-British Columbia Building Canada Fund (BCF) - Communities Component*

Source: http://www.buildingcanada-chantierscanada.gc.ca/regions/bc/bc-bcf-fcc-eng.html

Infrastructure Canada funding supports initiatives that strengthen the economy, protect the environment, and enhance communities. Under the BCF, funding is allocated to provinces on a per capita basis. The Communities Component portion of the fund targets communities with populations less than 100,000.

In BC, BCF Communities Component commits $136 million of funding, which is matched by the Province and local governments (totaling $408 million). An additional $64.64 million of funding has been secured through Canada's Economic Action Plan. The funding is available until 2014 and is directed towards projects related to safe drinking water, disaster mitigation, Brownfield redevelopment, and local roads and bridges. Projects selected for funding will be subject to a competitive process.

[2] *ecoEnergy for Renewable Power Program*

Source: http://www.ecoaction.gc.ca/ecoenergy-ecoenergie/power-electricite/index-eng.cfm

Natural Resources Canada's ecoENERGY for Renewable Power program invests $1.48 billion in projects to increase Canada's supply of clean electricity from renewable sources such as wind, biomass, low-impact hydro, geothermal, solar photovoltaic and ocean energy. The program will encourage the production of new electricity from renewable energy sources to power about one million homes.

The program is targets businesses, municipalities, institutions, and organizations and provides incentives of one cent per kilowatt-hour for up to 10 years to eligible low-impact, renewable electricity projects constructed over four years, from April 1, 2007 to March 31, 2011.

[3] *Innovative Clean Energy Fund (ICE)*

Source: http://www.tted.gov.bc.ca/ICEFund/About/Pages/default.aspx

The Innovative Clean Energy Fund (ICE) provides $25 million each year to help fund renewable energy projects in BC. ICE is supported by funds collected through a 0.4% levy on sales of electricity, natural gas, oil, propane, and other products determined to be energy products as prescribed by regulation. Transportation fuels are exempt from the levy.

Project funding is geared towards the development of new sources of clean energy and technologies and to help support local economies in communities throughout BC. Projects should not only showcase innovative technologies that help solve BC's energy problems but also have international marketability. As a requirement, funding is only available to projects the use "pre-commercial" or "commercial" energy technologies not currently used in BC.

[4] *Green Municipal Fund (GMF) - Call for Applications: Energy*

Source: http://www.sustainablecommunities.fcm.ca/gmf/gmf-2009-call-for-applications/energy-2009-call-for-application.asp

The GMF is sponsored by the Federation of Canadian Municipalities (FCM), and focuses on providing municipalities with low interest loans and grants for energy efficient retrofits and new building projects. Eligible applicants are able to request up to $4 million in loans and up to $400,000 in grants for each project undertaken. The process is not competitive, and applications are evaluated as they are received. More than one application may be made, each being assessed on its merits.

[5] *Canada-BC Municipal Rural Infrastructure Fund (CBCMRIF)*

Source: http://www.th.gov.bc.ca/CBMRIF/

MRIF is a federal and provincial partnership initiative in which each government will each contribute one-third of program funding to invest in local infrastructure projects, with local governments providing the balance. The goal of the program is to assist rural communities with securing their infrastructure needs.

For BC, an original funding pool of $102 million was increased by $47 million. With matching local government contributions, total project funding amounts to $220 million. The fund allocates 80% to communities under 250,000 people. The program sets aside 60 % of funding for "green projects;" with the balance going to other eligible projects.

[6] *Public Sector Energy Conservation Agreement (PSECA) - District Energy Component*

Source: http://www.env.gov.bc.ca/cas/mitigation/pseca.html

PSECA was established in 2007 to help public sector organizations (PSOs) achieve GHG emissions reductions, conserve energy, and to support BC's goal of becoming carbon neutral by 2010. The BC Government has committed $75 million over three years to further those objectives. An additional $25 million is allocated to specifically fund solar, HVAC, and district energy projects. Funding is allocated on a competitive basis and first-come-first-serve basis and restricted to PSOs in the Government Reporting Entity (GRE).

[7] *Remote Community Implementation (RCI) Program*

Source: http://www.fraserbasin.bc.ca/programs/caee_rci.html

The RCI is an initiative managed by the Fraser Basin Council under the Community Action on Energy and Emissions (CAEE) program. The program's purpose is to provide assistance to remote communities for clean energy and energy efficiency projects. The program supports projects that reduce greenhouse gas emissions, dependence on fossil fuels, and energy costs.

Program funding is available to only civic and First Nations remote communities. Funds complement other available funding programs and are restricted to capital costs. Up to $45,000 is available for "minor" projects, and "major" projects are eligible to receive between $100,000 and $300,000 (4 to 6 projects are to be funded over three years).

Appendix E: Selected DE Case Studies (Revelstoke, North Vancouver, and Okotoks)

Revelstoke Community Energy Corporation (RCEC), Revelstoke BC:

Plant information:

- 1.5 MW production capacity biomass boiler with propane backup (1.75 MW) for district heating
- Partnership between City of Revelstoke and Downie Sawmills (20 year agreement)
- Owner- City of Revelstoke
- Operator- Downie Street Sawmills
- Fuel- 85% wood waste, 15% propane
- Distribution system- 1.6 km of pipe (hot water)
- Cost- $5.6M
- Funding sources- government loans, equity holding, credit-union loan, reserve shares

Benefits:

- Reduced reliance on non-renewable fossil fuels and energy security
- GHG reductions of 3,700 tonnes
- Reduced used of silo boiler (90% reduction in particulate emissions)
- Stable heat supply and pricing for customers
- Lower energy costs
- Increased profit for mill through alternative waste disposal and reduced heating costs
- Showcase for other forest resource sector communities

Considerations:

- Provincial safety regulation require 24 hour staffing to monitor high pressure steam systems
- Reliance on secondary fuel supply and backup systems increase with uncertainty surrounding renewable fuel supply
- Early stakeholder engagement and consultation facilitates buy-in and community support
- Prefeasibility studies help establish plant size, determine servicing needs, and anticipate growth

Lonsdale Energy Corporation (LEC), North Vancouver BC:

Plant information:

- 6MW production capacity utilizing mini-plants- each plant with capacity of 800-900 kW
- Hot water system capable of 15MW through expansion
- Owner/Regulator- City of North Vancouver
- Municipal Utility- Lonsdale Energy Corporation
- Operator- Corix Utilities (under contract)
- Fuel- Natural gas-fired boilers
- Distribution system- steel piping (hot water) serving residential and commercial
- Initial cost - $8M
- Funding sources-
    - $2M-City of North Vancouver
    - $2M- Corix Utilities
    - $4M -GMF funding ($2M=grant)

Benefits:

- Heating security through discrete mini-plants
- Compact footprint- easily accommodates scarce land
- Fuel flexibility- boilers adaptable to alternative fuels
- Reduced emissions over conventional heating practices- 64% reduction in nitrous oxide, 21% reduction in carbon dioxide
- High efficiency boilers- 95% capture for heat energy
- Hot water system is amenable to various heating fuels
- Serves diverse thermal needs- currently 3 million ft^2 floor space

Considerations:

- Demonstrates the viability of municipal utility service- provides alternatives
- Provincial tax regimes place municipal utility services at a disadvantage vis-á-vis larger provincial utilities
- Municipal energy plans and sustainability plans facilitate the development of DE systems by recognizing areas of mixed use development, future growth and service demand
- Systems capable of adjusting to incremental growth may offset the risk of over-sizing systems designed to over-estimated demand projections

Drake Landing Community Utility (DLCU), Okotoks, Alberta:

General Description:

- Adopts a governance model based on public-private partnership: Drake Landing Company Utility (DLCU)
    - non-profit organization consisting of 4 partners:
        - Town of Okotoks
        - ATCO Gas
        - United Communities (project developer)
        - Sterling Homes (contractor/builder)

System details:

- Serves residential heating and hot water needs, supplies 52 homes (78,000 ft^2)
- Uses sustainable fuel sources by harnessing solar energy and incorporating geothermal storage
- Accommodates 90 percent of individual space heating needs while also meeting 60 percent of domestic hot water needs
- System relies on thermal collectors, heat exchanger technology, and hot water storage, and natural gas boilers to provide thermal energy via DE network
- Plant capacity documented to be capable of providing 4.5 MW (heating)
- Solar energy production potential of 1.5 MW
- Peak and back-up support provided by natural gas-fired boilers

Project funding:

- Funding partners include Natural Resources Canada (NRCan), ATCO Group, and Science Application International Corporation(SAIC)- partnered with developer and construction firm
    - $7 million in initial start-up capital
    - $2 million from federal government
    - $2.9 million from Federation of Canadian Municipalities (FCM)
    - $625,000 from government of Alberta

Documented benefits:

- Environmental
    - all homes meet Canadian R-2000 building standards
    - aligns with and models the community's sustainable development plan
    - All homes determined to use 60 to 70 percent less natural gas than business as usual (BAU) case
    - Energy savings and emissions reductions:
        - energy savings of 3.0 GJ per year

        - GHG emissions reductions of 152 tonnes per year
        - natural gas use offset of 82,000 m^3 per year

- Economic
    - Use of alternative fuel (solar and geothermal) offers long-term price stability
    - Low pressure/ low temperature system results in reduced piping costs
- Social
    - Project serves as a showcase models for developing capacity in other communities

Source: Retrieved from Canadian District Energy Association web site: http://cdea.ca/resources/best-practices/

Appendix F: Selected DE Case Studies (Quesnel)

Quesnel Community Energy System (QCES), Quesnel, BC:

General Information:

- Public-private partnership model of governance :
    - City of Quesnel
    - Terasen Gas Inc.
    - West Fraser Timber Co. Ltd.
    - BC Hydro
- Regulatory oversight:
    - British Columbia Utilities Commission (BCUC)

System Information:

- Combined heat and power (CHP) system utilizing waste heat and biomass residues
- Expansion of existing district heating system
- Generation of 1.7 MW of electricity (sold to BC Hydro via purchase agreement)
- Production of 5.5 MW of heat
- Services industrial , commercial, municipal , and residential sectors
- Utilizes estimated 9,000 tonnes of wood waste (mill residues) annually
- Capable of reaching 90 percent energy efficiency in system operation

Project Partners and Funding:

- Total capital costs $14 M
    - $4.13 M from Innovative Clean Energy (ICE) Fund (project funding)
    - $200,000 BC Bioenergy Network (forgivable loan)
    - $150,000 Western Economic Diversification Canada (seed funding)
    - $54,000 Green Municipal Fund (GMF) (feasibility studies)
    - $40,000 BC Hydro (feasibility studies)

Documented Benefits:

- Economic
    - Potential to encourage/enhance local economic development (low temperature heat available for processing)
    - Incorporates existing facilities into system expansion (cost savings)
    - Source of non-tax based revenue for the City of Quesnel
    - Provides West Fraser with additional revenue stream (offset losses from pine beetle infestation)
    - Creation of temporary (84) and permanent (4) jobs when operational
    - Retains wealth in the community

- Environmental:
    - Relies on biomass and waste heat recapture (carbon neutral energy sources offsets fossil fuel use)
    - Results in 6,000 tonnes per year GHG reductions
    - Enables City of Quesnel to meet its Climate Action Charter GHG targets commitment
    - Generates 14.2 GWh per year of clean electricity
    - Conserves natural gas for future uses

- Social:
    - Serves as a showcase project and demonstrates new technologies
    - Builds community self reliance and resilience
    - Provides educational value to community

Source: Retrieved from Terasen Gas Incorporated web site:
http://www.terasen.com/EnergyServices/News/QuesnelCommunityEnergySystem.htm#backgrounder

Appendix G: PSECA Project Charter

PSECA District Energy Funding Allocation: Project Charter

1. Project summary

The BC Government is committed to reaching GHG emissions reduction targets, as legislated by the *Greenhouse Gas Reduction Targets Act (GGRTA).* Public Sector Organizations (PSO's) have been legislated to be carbon neutral by the end of 2010. This means that PSO's must find innovative ways to reduce their emissions. District energy projects provide PSO's with a viable means for reducing carbon emissions associated with heating and power. They can also serve an important role in reducing the emissions of the community as a whole.

There are many stakeholders involved in the decision- making process surrounding funding allocations to district energy projects. In addition to specific government ministries, stakeholders include the Climate Action Secretariat, BC Hydro, Terasen Gas, and PSO's. The purpose of the project will be to work with stakeholders to identify specific needs and objectives and to provide recommendations on how to most effectively develop DE projects (as they relate to PSO's) so that they meet with Treasury Board (TB) approval.

This project will consist of a literature review to ensure that decisions around public funding for district energy projects for PSO's are informed by best practices and lessons learned from other jurisdictions. In addition, interviews will be conducted with key persons to better establish the context in which District Energy projects will be developed, while ensuring that criteria for funding allocation is in alignment with stakeholder interests and expectations.

2. Project goals, business outcomes, and objectives

No.	Goals	Objectives	Business Outcomes
1.	More effective allocation of current PSECA funding to achieve maximum GHG emissions reductions in perpetuity, through the development of District Energy projects for Public Sector Organizations	• Characteristics of Funding Criteria are well-defined and rigorous • Funding Criteria will consider social, economic, and environmental goals of the project sponsors • Criteria will allow for allocation of funding by September of 2010	• Criteria for the allocation of PSECA funding that clearly defines the economic drivers, GHG emissions reduction drivers, and policy/legislative drivers • Recommendations to Treasury Board and Minister of State for the criteria to guide funding allocation decisions • Recommendations to Treasury Board and the Minister of State regarding PSECA projects to receive the remaining PSECA funding for the 2010/2011 fiscal year.

2.	A means to inform future funding decisions surrounding the allocation of project funding to district energy projects in other sectors, to ensure greatest GHG reduction potential	• Increased alignment of funding for District Energy projects with a rigorous criteria informed by mutually agreed upon standards (i.e., by the sponsors of this project).	• Policy Research Report outlining academic, policy, and scientific thinking behind effective use of public funding for district energy funding allocation. • Briefing note and presentation summarizing policy research paper.

3. Project Scope and Tasks

This project will look at district energy projects from a Public Sector Organization focus. The associated criteria for PSECA funding allocations will be based upon the direct needs/interests of public sector organizations and informed by PSECA working group and stakeholders.

The project will be considered complete once a decision has been made regarding the remaining PSECA funding for District Energy projects for 2010/1011 and implementation is underway. All documentation will be reserved for future reference.

Tasks	Responsibility
1. Preliminary Literature Review	Dar Purewall
2. Provide contact information for key information sources to Dar Purewall	Project Team
3. Advanced literature review, first person interviews and group discussions	Mark Haines and Dar Purewall
4. Send advanced notice to funding partners/proponents indicating upcoming call for projects (engage proponents as early as possible to ensure adequate advanced notice and transparency)	MEMPR/Hydro
5. Development of recommended criteria and associated documentation to support recommendations	Mark Haines and Dar Purewall
6. Develop official criteria for project selection and distribute to funding partners	Project Team
6. Development of briefing note for the Minister of State and overview PowerPoint deck.	Mark Haines
7. Project selection finalization	Project Team
8. Treasury Board submission	Mark Haines and Dar Purewall
9. Implementation plan	CAS/Hydro/MEMPR (Specific roles to be defined)

10. Communication plan	CAS/Hydro/MEMPR (Specific roles to be defined)

Activity beyond scope of research at hand:

1. Research for other aspects of PSECA funding
2. Research on District Energy project application beyond the scope of the needs of Public Sector Organizations Activities

4. Milestones

Project Milestone	Description	Expected Date
1. Preliminary Literature Review	A review on District Energy application, best practices, policy drivers, and legislative drivers will be conducted in April	End of April
2. Send out advance notice of upcoming call for projects. Complete Interviews, and Focus Group Discussions	Proponents will be contacted early to alert them of upcoming call for projects. Interviews will be conducted with key information holders and key stakeholders. These will be conducted in early May following completion of preliminary research.	May 1st – 15th
3. Advanced Literature Review	Advanced lit review will conducted over the course of May	May 1st – May 30th
4. Criteria Recommendations Development	Criteria will be developed based upon best practices, pre-feasibility studies (underway or taken), and research compiled over the course of the study. Criteria will be sent to key stakeholders for review and comment. Finalized criteria to inform project selection will be confirmed by June 15th.	May 15th – June 15th
5. Project Selection	In consultation with key stakeholders, recommended district energy projects will be selected for the PSECA funding.	June 15th – June 30th
6. Present to Treasury Board and Minister of State	Project recommendations and selection criteria for will be presented to Treasury Board and the Minister of State for Climate Action and other applicable decision makers/ committees for confirmation for a fall announcement.	July 5th – July 10th
7. Public Announcement of Funding Allocation and Criteria	Present selected projects as well as funding criteria publicly at a fall event such as UBCM	September 2010

5. Constraints

The following table lists the conditional factors the project must respect:

No.	Category	Constraints
1.	Budget	Funding for this project will consist of part-time remuneration for Dar Purewall, David McPhie, and Mark Haines, as well as other in kind support from BC Hydro, EMPR, and CITZ.
2.	Security	Information received and discussed for the development of the criteria will be considered confidential until distributed to funding partners for call for project proposals.
3.	Timeline	All deliverables must be achieved to the schedule above for a September announcement date for PSECA funding.
4.	Timeline	Due to the aggressive timeline, all requests for comment will require a response within 4 business days.
5.	Travel	This project may be subject to limited travel budget. Where possible, other means of communication will be used for conducting interviews and facilitating group discussions (e.g. LiveMeeting and teleconference)

6. Assumptions

The following assumptions have been made about this project:

No.	Assumption
1.	This project will retain support from key sponsor organizations (BC Hydro, CAS, MEMPR, and Citizens' Services) until its completion.
2.	Support will be maintained at a political level for the allocation of remaining PSECA funding to District Energy projects.
3.	Support will be maintained for the involvement of the researchers in this project as a part of their normal work responsibilities.
4.	Subject to negotiated changes, the timeline for deliverables will be maintained.

Appendix H: Research Participant Consent Form

University of Victoria | Human and Social Development

School of Public Administration

Research Participant Consent Form

Reducing GHG Emissions: An Evaluative Framework for District Energy Systems in BC's Public Sector

You are invited to participate in a study entitled *Reducing GHG Emissions: An Evaluative Framework for District Energy Systems in BC's Public Sector* that is being conducted by Mark Haines and Dar Purewall.

Mark Haines and Dar Purewall are graduate students in the School of Public Administration at the University of Victoria and you may contact either of them if you have further questions by contacting Mark Haines at 250-387-2759 [email: Mark.Haines@gov.bc.ca] or Dar Purewall at 250- 953-4882 [email: Dar.Purewall@gov.bc.ca].

As graduate students, we are required to conduct research as part of the requirements for a degree in Masters of Public Administration. Our research is being conducted under the supervision of Rod Dobell. You may contact him at 250-472-5172.

Purpose and Objectives

The Purpose of this research project is to further the Province of BC's goals of reducing greenhouse gas (GHG) emissions in the public sector by:

1) providing recommendations to the Climate Action Secretariat on criteria for selecting "district energy" projects to receive PSECA funding;
2) establishing a evaluation framework for prioritizing funding allocation for proposed district energy projects in BC;
3) documenting the characteristics of sound District Energy projects in the British Columbia context; and,
4) presenting findings to inform the Minister of State for Climate Action.

Importance of this Research

The BC Government is committed to reaching GHG emissions reduction targets, as legislated by the *Greenhouse Gas Reduction Targets Act (GGRTA).* Public Sector Organizations (PSO's) have been legislated to become carbon neutral by the end of 2010. This means that PSO's must find ways to reduce their emissions.

District energy projects provide PSO's with a viable means for reducing their carbon emissions associated with electricity and heating. Because they incorporate infrastructure development, they can also serve an important role in reducing the emissions of the community as a whole.

This research is important because it will help inform the BC Government about how and where to invest in future district energy projects. This information will also assist Local Governments and Public Sector Organizations by communicating best practices surrounding similar projects.

Participant Selection

You are being asked to participate in this study either because the PSECA working group has advised us that you possess information or knowledge that may be valuable to this investigation or because other persons we have been in contact with have recommended that we consult with you for similar reasons.

Process

If you agree to voluntarily participate in this research, your participation will involve investing approximately one hour's time in answering questions in either a face-to-face interview (preferred) or a telephone interview environment.

The interview process would take place at a time and location of convenient to you. As the information sought may be confidential, a meeting room should be arranged – whether we come to meet you, or you come to meet us (i.e., at the university or at the offices of our research client).

Prior to obtaining your consent, we will answer any questions you have about the interview process. Depending on the interview format, your consent will be obtained either written or verbally. In either case, a copy of this consent form will be left with (or sent to) you for review and a copy will be kept for our records.

Due to the nature of our research question, we have adopted a semi-structured interview process that relies on a number of open-ended questions. Our hope is that these questions will invite you to provide information that is rich and detailed, while remaining within the scope of investigation.

We anticipate that we may need to contact you at a future date, so that you might provide additional information or simply clarify things. We also understand that your time is valuable, so should the occasion arise, we will be contacting you by telephone. Should you prefer to meet in person, we would certainly accommodate the request. In any case, further discussion/ interview would require your verbal consent.

Inconvenience

Participation in this study may cause some inconvenience to you, including scheduling or time/ logistical constraints [e.g. booking meeting rooms] associated with interviews and possible follow up discussion. If web software is used to video conference, there may be some inconvenience in downloading the client software or learning to navigate the user interface.

Risks

There are no known or anticipated risks to you by participating in this research.

Benefits

The potential benefits of your participation in this research include:

1) contributing to the discourse on climate action in the policy context;
2) assisting like-minded government, academic and corporate partners in gaining more knowledge through applied practice;
3) informing the actions and decisions of Local Governments and First Nations around green infrastructure solutions; and
4) enhancing the social, economic, and environmental well-being of individuals and communities.

Voluntary Participation

Your participation in this research must be completely voluntary. You may decline to answer any question or refuse to provide any information you wish. If you do decide to participate, you may withdraw anytime without any consequences or need for explanation. If you do withdraw from the study the information you provided us will not be used unless you specifically consent that it may be used to inform the research at hand.

On-going Consent

To make sure that you continue to consent to participate in this research, we will approach you before each interview, or follow up discussion, to confirm your status as a participant by asking you whether you still agree to the terms as prescribed by this agreement [original consent] and will note you response for our records.

Anonymity

In terms of protecting your anonymity we are compelled to advise you that, due to the nature of the investigation, the working relationships among PSECA stakeholders, and possible associations among informants, that your anonymity will be subject to limits. Although we cannot guarantee that you remain anonymous, we will strive to protect your privacy by doing the following:

- Your consent form will be held in a secure place to protect your identity.
- You will not be referred to by name or title in our notes, and any information you provide us will be referenced only to your organization.
- Your identity, or title, will not be disclosed in the final research report, nor will it be published at any time in relation to that report.
- Should you choose to withdraw from the study, you retain the right to refuse us the use of your information.

Confidentiality

Your confidentiality and the confidentiality of the data will be protected throughout the research process and storage of data. As researchers, we will ensure the following:

- The information you provide us will be documented and used only with your express consent, and, apart from the researchers, no other person(s) will have access to your information.
- Your interview will be conducted entirely in isolation from that of any other person except where joint participation is consented and mutually agreed upon (e.g., where interviewees may represent the views of the same department, unit, or firm).
- Your information will be held in a secure environment, and electronic information will be stored on password-protected personal computers and a secure government server.
- Your name will not be referenced in any publication of our final report (including revisions, or presentations), which will be provided to you at your request.

Dissemination of Results

It is anticipated that the results of this study will be shared with others in the following way:

- In accordance with academic protocol, our findings will be presented in a defense before a review committee comprised of representatives from the University of Victoria School of Public Administration.
- Our research findings will be also be included in a final report prepared specifically for our client: the Climate Action Secretariat branch of the BC Ministry of Environment.
- A revised copy of the final report will be made available for other public sector entities including local governments.
- Findings from our research will also be used to inform a briefing note prepared for the Minister of State for Climate Action.
- Our findings will not be used for commercial purposes.

Disposal of Data

Data from the research undertaken here will be held for a period not exceeding twelve months, following the publication of our final report (expected date: mid September 2010). Following that, all information (including digital data) will be held (archived) in secure storage at a BC government facility. All written notes will be shredded; and all data stored in digital format on personal devices will be destroyed (if contained on compact disc) or permanently erased (if stored on portable memory devices or personal computer hard-drives).

Contacts

Should you require further information in regards to this research project, please contact us directly by using the information provided at the **beginning** of this form. If, for any reason, you wish to contact our research supervisor, please use the information below:

Research Supervisor: Rod Dobell (Professor)
Department/ Faculty: School of Public Administration / Human and Social Development
Phone: 250-472-5172
Email: rdobell@uvic.ca

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca).

Your signature below indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researchers.

________________________________ __________________________________ __________________

Name of Participant *Signature* *Date*

A copy of this consent will be left with you, and a copy will be taken by the researcher

Appendix I: Research Study Interview Instrument

PSECA District Energy Research Project: Interview Questions (May 2010)

DATE:______________________________ RESPONDENT_____________________________________

Earlier you received an email with a consent form attached. If you have any questions or concerns about that form feel free to raise them in the interview.

At any time, if you are uncomfortable with answering an interview question, or feel that you are not best qualified to answer the question, please just let us know and we can move on. You are not obliged to answer any question.

All information gathered will be used for both the purpose of developing criteria for the selection of PSECA District Energy projects, as well as for the development of a public policy paper that analyzes best practices for District Energy for Public Sector Organizations in British Columbia.

Your identity will be kept confidential.

Important PSECA considerations:

Keep in mind the dual focus of our research when answering questions. A component of this research will be used to inform District Energy initiatives for PSO's in BC in years to come. However, in the short term, we will be looking at District Energy within the constraints of the PSECA program. These constraints will be determined through investigation.

If you feel you are unable to fully answer a question, please feel free to suggest another person/s that may be able to add more information to the discussion. Also, please inform us at any time if there are additional persons outside of the core working group who should be contacted during the course of our research.

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*The Public Sector Energy Conservation Agreement (PSECA) between BC Hydro and the Province funds building **retrofits** to achieve a significant reduction in provincial energy consumption and greenhouse gas emissions. Through PSECA, B.C. is targeting a 20 percent reduction in **public sector** electricity consumption by 2020 – or enough electricity savings to power more than 34,000 homes. (Ministry of Citizen's Services website)*

Part 1.) Project Type:

1) Given the objective of reducing GHG emissions, which of the following types of DE projects would be most practical for PESCA funding?
   – District Heating
   – District Electricity
   – Co-generation
   – Tri-generation

2) What things are most important to consider when deciding project location and scale? (e.g. project siting, development size, future development, and rate of development)

3) With regards to the above, how much consideration should be given in cases where competition for PSECA funding places some PSO's at an advantage or disadvantage relative to others (e.g. Schools vs. Hospitals vs. Universities)?

Part 2.) Fuel Type:

1) In light of the considerations provided below, what fuel types would be most preferred when selecting DE project candidates? Alternatively, which fuel type would least desirable?

   Considerations:

   – Single fuel systems vs. hybrid systems (using mixed stock)
   – Availability of fuel supply (local, renewable, sustainable)
   – Emissions, particulates levels
   – Energy (heating) efficiency
   – Delivery (mode and distance) and storage

2) If natural gas is proposed as a fuel source, what should be the minimum threshold level (below the BAU case) to fund projects that rely on that fuel?

3) What emission reductions target should be considered as part of DE criteria? In addition, what framework should be used to establish benchmarks and make comparisons?

4) If partnerships with industry or other sectors is proposed to access waste heat (e.g. an IRR system), what technical or operational constraints should be considered when assessing DE projects that rely on that resource?

Part 3.) DE Best Practices:

1) What complementary "green" policies, frameworks, or strategies, if any, should be in place when determining whether a DE project qualifies for public funding (e.g. sustainability action plan, GHG emissions reduction plan, community energy plan, etc)?

2) Recognizing that it is important for PSECA funded DE projects to serve as "showcase" models, what are some of the key practices that would be helpful for others to learn from and emulate?

Possible examples:

- Replicable technology
- planning best practices
- System of performance measurement and reporting
- Capacity building
- Network building for the collaborative exchange of information and knowledge
- Part of a modular DE system or demonstrated potential for expansion

Part 4.) Financing Options:

(PART 4. DROPPED FROM INTERVEIW FORMAT)

1) What types of funding models are most agreeable for DE projects?
   - Is an application for PSECA funding contingent on other funding being in place (secured) prior to the approval process?
   - Is there a "stacking limit"?
   - What type of funding is acceptable? e.g. BC Hydro Sustainable Communities (DE) Program funding; Innovative Clean Energy Fund.

2) Given limited PSECA funding, how many DE projects should be considered?

3) What are considered to be eligible funding costs (consulting/legal fees, capital equipment, operating costs, implementation costs)?

Part 5.) Ownership:

1) How do partnerships impact project eligibility?

2) If eligible, what types of partnership would be most preferred for a PSECA funded DE project?

3) If working with partners- what mechanisms (agreements, stakeholder consultation, best practices, etc) should be in place to support decision-making, transparency, or regulation?

4) Recognizing the limits set by existing precedents (government ownership requirement), what types of other ownership models would be attractive to pursue (e.g. direct ownership, subsidiary, private sector, or P3)?

There may be additional details (themes, questions, or best practices) that we have not been addressed here and which you believe should be considered as part of the selection criteria. Please provide any suggestions.

In addition, is there anything you suggest we should explore further with other interviewees?

Thank you for your participation. We would be happy to share a preliminary synthesis of our research prior to the end of May.

(END)

Appendix J: Raw Weighting Scores

Criteria no.	IP 1	IP 2	IP 3	IP 4	IP 5	IP 6	Average	Weight
1	5	5	5	5	5	5	5.00	1.5152
2	5	5	3	4	5	5	4.50	1.3636
3	3	4	2	1	3	3	2.67	0.8081
4	3	2	4	5	3	3	3.33	1.0101
5	5	3	2	5	3	3	3.50	1.0606
6	3	4	3	4	3	3	3.33	1.0101
7	3	2	3	3	3	3	2.83	0.8586
8	4	3	5	3	2	2	3.17	0.9596
9	4	3	1	0	5	5	3.00	0.9091
10	4	1	3	4	3	3	3.00	0.9091
11	4	2	1	0	1	1	1.50	0.4545
12	4	2	1	5	4	4	3.33	1.0101
13	5	2	5	5	2	2	3.50	1.0606
14	4	3	5	4	3	3	3.67	1.1111
15	4	3	5	3	5	5	4.17	1.2626
16	3	3	5	0	4	4	3.17	0.9596
17	4	3	4	3	2	2	3.00	0.9091
18	5	3	5	5	2	2	3.67	1.1111
19	5	2	2	4	1	1	2.50	0.7576
20	5	3	4	5	1	1	3.17	0.9596
						Average Score:	**3.30**	