

A Renewable Energy Requirement for B.C.

Final Report

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- The City of Campbell River



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Contents

Executive Summary	1
What is a Renewable Energy Requirement?	1
The proposed RER for BC.....	1
Supporting the implementation of the RER.....	5
Recommendations for next steps for adoption of the RER.....	5
1. Introduction	6
1.1 Purpose.....	6
1.2 What is a Renewable Energy Requirement?	7
1.3 Impact of RER in Merton, U.K.....	7
1.4 Why a RER?.....	8
1.5 The RER and energy efficiency	8
1.6 Collaborating Organizations.....	10
2. Legislative Approach	12
2.1 Context.....	12
2.2 Criteria.....	12
2.3 Overall jurisdiction on buildings between local and provincial governments.....	13
2.4 Options for legislative approach.....	14
2.5 Preferred Regulatory Option	18
2.6 Process for governments (local and provincial) to enact the preferred approach	21
3. Costs and Savings Associated with the RER.....	22
3.1 Cost and savings summary.....	22
3.2 Energy Costs.....	25
3.3 The B.C. building industry — construction costs	27
3.4 Cost and benefits of compliance — residential sector.....	28
3.5 Cost and benefits of compliance - commercial sector	33
3.6 Conclusion.....	44
4. Potential GHG Savings	47

4.1	Dawson Creek.....	47
4.2	Campbell River.....	49
5.	Overview of the RER Options.....	51
5.1	Technical Aspects of the RER.....	51
5.2	Establishing the scope of the RER.....	55
5.3	Compliance and assessment.....	56
5.4	Timing for RER.....	58
6.	The Proposed RER.....	59
6.1	Definitions.....	59
6.2	Compliance flexibility.....	60
6.3	Energy efficiency.....	60
6.4	Inclusions.....	60
6.5	Exemptions.....	60
6.6	Eligible technologies.....	60
6.7	Net metering.....	Error! Bookmark not defined.
6.8	Compliance.....	61
6.9	Enforcement.....	62
6.10	Timing of RER.....	62
6.11	Review of the RER.....	62
7.	Implementation of the Recommended RER.....	63
7.1	Implications for various parties.....	63
7.2	Barriers and Solutions.....	63
7.3	Supportive resources and materials.....	66
8.	Engagement Process.....	67
8.1	Summary of Local Government Engagement.....	67
8.2	Summary of provincial government Engagement.....	68
9.	Recommendations.....	70
9.1	Recommendations for adoption of RER.....	70
9.2	Next steps for adoption.....	70
10.	References.....	71
	Appendix A – Meeting Summaries.....	73
	Summary of meetings with Campbell River and Dawson Creek.....	73
	Summary of meetings with Provincial Government staff.....	77

List of Tables

Table ES1 Range of Internal Rate of Returns (IRRs) for the three residential building types and four renewable technologies considered..... **Error! Bookmark not defined.**

Table ES2 Range of Internal Rate of Returns (IRRs) for the four commercial building types and four renewable technologies considered..... **Error! Bookmark not defined.**

Table 1 - Comparison of Regulatory Options20

Table 2: Forecast electricity prices25

Table 3: Forecast natural gas prices26

Table 4: B.C. Construction Costs27

Table 5: Energy Costs, Commercial27

Table 6: Distribution of household energy use28

Table 7: Single family duplex, natural gas heat, results table.30

Table 8: Single family duplex, electric heat, results table.31

Table 9: Row house duplex, electric heat, results table.31

Table 10: Commercial sector, distribution of energy use33

Table 11: MURB, renewable energy analysis.....36

Table 12: School, Renewable Energy Analysis38

Table 13: Hospital, renewable energy analysis40

Table 14: Large commercial, renewable energy analysis42

Table 15 Range of internal rate of return (IRRs) for the three residential building types and four renewable technologies considered.....44

Table 16 Range of internal rate of return (IRRs) for the four commercial building types and four renewable technologies considered.....45

Table 15: Residential buildings for RER modeling, Dawson Creek.....47

Table 16: Commercial buildings for RER modeling, Dawson Creek48

Table 17: Buildings and floorspace influenced by RER, Dawson Creek48

Table 18: GHG savings from RER, Dawson Creek48

Table 19: Residential buildings for RER modeling, Campbell River.....49

Table 20: Commercial buildings for RER modeling, Campbell River49

Table 21: Buildings and floor space influenced by RER, Campbell River49

Table 22: GHG savings from RER, Campbell River50

Table 23 – Performance vs. Prescriptive Approach.....53

Executive Summary

What is a Renewable Energy Requirement?

Just as buildings must meet minimum energy efficiency or safety requirements, many jurisdictions also require buildings to meet minimum renewable energy requirements.

With a renewable energy requirement (RER), new buildings, as well as buildings that are undergoing major renovations, would be required to meet a portion of their energy needs — for both power and heat — using on-site or community-based clean and sustainable sources.

Requirements such as these are in use around the world – from small rural communities to major urban centres. For example:

- In Merton, UK, new buildings, as well as buildings undertaking major renovations, must demonstrate that 10 per cent or more of the building’s anticipated energy needs will be provided by renewable energy sources.
- In Barcelona, Spain, solar water heaters must be included on new buildings, and must be sized to meet a minimum of 60 per cent of domestic hot water requirements, and 20 per cent for industrial processes.

In general, a RER can lead to the following benefits:

- Reduced GHG emissions and energy use in communities throughout B.C.;
- Progress towards net-zero energy/emissions homes, buildings and communities;
- Potential to encourage further energy efficiency;
- Economic growth and job creation; and
- Adaptation to climate change (e.g. greater energy security).

The proposed RER for BC

Through a collaborative process involving developers, local governments, real estate agents, NGOs, and community members, Pembina is recommending the following RER for B.C.

All new residential and commercial buildings must meet 10 per cent of their estimated annual energy consumption with eligible on-site or community-based renewable energy. Compliance is mandatory in jurisdictions where the requirement has been adopted.

Should the regulation be performance-based or prescriptive?

The performance-based approach is favoured, because:

- It is more likely to be adopted by local governments;
- It provides necessary flexibility for developers and the building industry;
- It enables easier administration by implementing governments at local and provincial levels; and
- The prescriptive path adds complexity that may require differentiation between regions as resources and cost-efficiency vary.

One identified challenge of the performance-based approach was the need by developers for some initial guidance on how to meet the RER. Pembina is therefore proposing that the RER should be accompanied by a guide that provides guidance to developers.

What percentage of renewable energy should be required?

To determine a target for B.C., 10 per cent was used as a starting bar. The 10 per cent level was found to result in a decrease in GHG emissions (over “business as usual”), and be feasible to implement. It was also determined that most market-ready technologies would be able to generate at least 10 per cent of the average building’s energy needs.

How should we adopt a RER in B.C.?

An opt-in requirement as part of the *Local Government Act* is the preferred approach for a RER in B.C. in the near term. This approach provides clear jurisdiction as well as the ability for communities to choose whether they want to join the requirement when it is first introduced, or possibly join later.

The recently implemented Solar Hot Water (SHW) Ready regulation provides an example of how provincial and local governments can work together to enact an opt-in regulation for renewable energy.

In the fall of 2010, the Province of B.C. proposed an opt-in requirement that would enable local governments to mandate that all new single-family dwellings within their communities be SHW ready. Local governments were provided with the option to state their desire to implement this requirement in their communities. On June 14th, 2011, the province announced the new Solar Hot Water Ready regulation and the 36 communities that had chosen to adopt it.

How should compliance be ensured?

Since compliance and enforcement will be required at the local government level, the options here must be relevant at that level and easily integrated into existing processes. The proposed compliance and enforcement procedure is therefore:

- At the building design stage, local governments can withhold development permits until such time that developers have demonstrated a plan for compliance with the RER.
- At the building occupancy stage, local governments can withhold occupancy permits if compliance with the RER is not met.

Treatment of energy efficiency

Three main pathways to encourage the development of energy efficiency and renewable energy in tandem towards a net-zero goal have been identified:

1. Set the RER as a per cent of the total energy used by a building.
2. Set the RER as a per cent of total energy used by a building, but vary the RER percentage based on energy performance.
3. Use energy performance to set requirements and allow a mix of renewable energy and energy efficiency to meet them.

This project focused on path 1 above. Evaluating the preferred option of these three was beyond the scope of this project.

As per pathway 1, increased energy efficiency is not a specific requirement of the proposed RER. However, builders and developers are encouraged to recognize that measures taken to lower energy requirements can be cost effective as they can reduce projected building energy consumption, and (subsequently) the amount of energy required for compliance with the RER. Builders and developers are strongly encouraged to maximize energy efficiency during the building design phase.

Cost and feasibility assessment of meeting the RER

Meeting the proposed 10% RER is possible given the technologies on the market today. This analysis looked at certain technologies, building types and regions, but was not a comprehensive overview of all possible compliance paths.

The main conclusions are summarized in the tables showing relative cost-effectiveness below.

- Cost effectiveness varies. Because of their affordability, the technologies with the best business cases are solar air heating (for commercial buildings), and pellet stove (for residential buildings), with Internal Rates of Return (IRRs) over 10%.

- Solar PV for commercial buildings, and solar hot water (SDHW) and ground source heat pumps (GSHP) for electrically heated residential buildings are in the next IRR range, with IRR between -3% and 3%. Given the many assumptions required for this analysis, and the uncertainty associated with these, we deem that these technologies could be profitable, in the right context.

Other factors beyond cost-effectiveness are also to be considered to assess worthiness of a project, including increased self reliance, air quality, protection from increase in energy costs, leadership, and a desire to reduce one’s contribution to climate change.

Tables 1 and 2 summarize the ranges of IRRs for the various technologies and building types. They use the following scale:

- **** 10% or more
- *** 3% to 10%
- ** -3% to 3%
- * -12% to -3%

Table ES1 Range of (IRRs) for the three residential building types

	Row House Electric Heat	Single Family/Duplex Electric Heat	Single Family/Duplex Gas Heat
Pellet Stove	****	****	N/A ¹
Ground Source Heat Pump	**	**	*
Solar Domestic Hot Water	**	**	*
Solar PV	*	*	*

Table ES2 Range of (IRRs) for the four commercial building types

	Hospital	Large Commercial	MURB	School
Solar Air Heating²	****	****	****	****
Ground Source Heat Pump^{3,4}	* to ****	* to ****	* to ****	* to ****
Solar PV	**	**	**	**
Solar Hot Water Heating⁵	*	not modeled	*	not modeled

¹ Because forecasted pellets prices are higher than forecasted natural gas prices for the mainland, there are no cost savings associated with these systems and the IRR cannot be calculated.

² These are assumed to displace natural gas as the energy source for space or water heating.

³ These are assumed to displace natural gas as the energy source for space or water heating.

⁴ The wide range of IRRs values for ground-source heat pumps (GSHP) in commercial building is due to the fact that the cost of these system varies highly for commercial buildings depending on the type of system and its size. Cash flows for a low, average, and high cost system were estimated.

⁵ These are assumed to displace natural gas as the energy source for space or water heating.

Supporting the implementation of the RER

Some key barriers that may affect the successful implementation of a RER for local governments, developers, contractors, real estate agents and the public were identified.

Key steps that will be necessary to enable the successful implementation of a RER include:

- Incentives and grants to help support the initial implementation of various renewable energy technologies;
- Educational, communication and marketing materials for local governments, developers, contractors, real estate agents and the public. It is critical that clear technical documents are developed for local governments, developers and contractors to ensure that the information is available to those parties implementing the RER. Communication, education, and marketing materials are also critical to provide to those entities who may be buying or selling the homes and buildings; and
- Education and training for local government staff, such as building inspectors, developers and contractors to ensure that those entities understand how to comply with the RER, and that they are aware of the tools and resources available.

Recommendations for next steps for adoption of the RER

The next steps for adopting the RER in B.C. include the following:

- Build support and awareness for the RER among additional local governments, developers, renewable energy industry and real estate agents;
- Provide briefings to relevant B.C. provincial government ministries on the findings of the project;
- Identify and undertake any areas of further research that are needed to answer any outstanding questions and move the RER forward;
- Develop supporting resources for local governments and developers to accompany the implementation of the RER;
- Develop higher energy efficiency standards in conjunction with the RER to ensure maximum effectiveness in its implementation; and
- Adopt the RER as soon as possible, taking these necessary steps into account.

1. Introduction

1.1 Purpose

The purpose of this report is to assess the feasibility of implementing a Renewable Energy Requirement (RER) in B.C.

Through a collaborative process involving developers, local governments, real estate agents, NGOs, and community members, this project has aimed to accomplish the following objectives:

- Create the framework for a RER that could be implemented in B.C. at the provincial level;
- Propose options for the adoption of the RER in B.C.;
- Consider the implications for the implementation of a RER for local governments; and
- Understand the costs and benefits associated with the implementation of a RER.

To this end, this report is divided into the following sections:

1. **Introduction** – provides a brief explanation of RERs
2. **Legislative Approach** – describes and recommends an approach to implement an RER in B.C.
3. **Costs and Savings Associated with the RER** – provides the results of an analysis on the costs and savings of various renewable energy technologies in various building types across four regions in B.C.
4. **Potential GHG Savings** - Summarizes potential GHG savings for Dawson Creek and Campbell River
5. **Overview of RER Options** – provides discussion on each of the components of the RER
6. **The Proposed RER** – synthesizes the discussion of section 4 into a recommendation for the components of the RER
7. **Implementation of the Proposed RER** – describes how the RER could be implemented in B.C.
8. **Engagement Process** – describes the engagement process used to provide input in to the proposed RER
9. **Recommendations** – provides recommendations based on the findings of the report
10. **Appendix** – provides summaries of the feedback received in community workshops and meetings with the provincial government

1.2 What is a Renewable Energy Requirement?

Just as buildings must meet minimum energy efficiency or safety requirements, many jurisdictions also require buildings to meet minimum renewable energy requirements.

With a renewable energy requirement (RER), new buildings, as well as buildings that are undergoing major renovations, would be required to meet a portion of their energy needs — for both power and heat — using on-site or community-based clean and sustainable sources.

RERs can be met by integrating renewable technologies in a building's design. For example, solar water heaters can meet 50 per cent or more of the hot water energy requirements of a new home and pellet boilers or geexchange systems can help heat new commercial buildings. District energy systems, such as waste-heat captured from a local mill or a geexchange system, can provide space heat for new commercial developments or space heat and cooling in a new residential building, respectively.

Requirements such as these are in use around the world – from small rural communities to major urban centres. For example:

- In Merton, UK, new buildings, as well as buildings undertaking major renovations, must demonstrate that 10 per cent or more of the building's anticipated energy needs will be provided by renewable energy sources.
- In Barcelona, Spain, solar water heaters must be included on new buildings, and must be sized to meet a minimum of 60 per cent of domestic hot water requirements, and 20 per cent for industrial processes.

1.3 Impact of RER in Merton, U.K.

Merton provides a good example that British Columbia can draw lessons from when considering how RERs can support B.C.'s energy goals. In general, Merton found that their RER has integrated well into their regulatory environment, with the following specific observations:

- A 10 per cent reduction energy reduction requirement resulted in a 26 per cent reduction in greenhouse gas (GHG) emissions;
- Lower costs than anticipated;
- No impact on the pace and scale of overall development;
- Relatively small impact on administrative workload;
- Significant growth in the renewable technology economy; and

- Increased energy efficiency investments.⁶

1.4 Why a RER?

In order to meet net-zero energy goals and GHG reduction targets, both energy efficiency and renewable energy are required.

In general, a RER can lead to the following benefits:

- Reduced GHG emissions and energy use in communities throughout B.C.;
- Progress toward]s net-zero energy/emissions homes, buildings and communities;
- Potential to encourage further energy efficiency; and
- Economic growth and job creation.⁷
- Adaptation to climate change (eg. greater energy security)

1.5 The RER and energy efficiency

A RER is most effective at reducing energy use when high standards of energy efficiency for new buildings are in place. The first priority must be to build energy efficient homes before considering RERs. Adding renewable energy to an inefficient home does not result in the use of less energy, rather it results in the continued waste of energy, whether it comes from a renewable source or not.

1.5.1 Energy efficiency and renewable energy regulation in B.C.

B.C. is ramping up energy efficiency for new homes. In the past, Building Code updates happened with respect to health and safety but in 2007 the province added the Energy Efficiency Building Strategy to that list, setting ambitious targets for residential, commercial and institutional buildings. In 2008, a ministerial order updated the 2006 Building Code with respect to energy and water efficiency, which Part 9 residential buildings to meet a set of prescriptive requirements or achieve EnerGuide 77, Part 9 non-residential buildings to meet a set of insulation requirements, and Part 3 residential and commercial buildings to meet ASHRAE 90.1 2004.

⁶ Zirnheld, H. and M. Horne. 2010. On-site Renewable Energy Requirements for Buildings. <http://greenbuildingleaders.ca/publications>

⁷ Zirnheld, H. and M. Horne. 2010. On-site Renewable Energy Requirements for Buildings. <http://greenbuildingleaders.ca/publications>

In 2012, these codes are expected to become more stringent. Anticipated next steps include raising the Part 9 residential requirements to EnerGuide 80 and Part 3 changes are anticipated to require meeting ASHRAE 90.1 2010 or NECB 2011.

In 2011 The Province of BC also introduced a new regulation providing an option for local governments to require solar hot water ready construction for new single-family homes.

The RER will need to be situated in the context of these anticipated updates to the Building Code.

1.5.2 Integrating renewable energy and energy efficiency

Three main pathways to encourage the development of energy efficiency and renewable energy in tandem towards a net-zero goal have been identified:

1. Set the RER as a per cent of the total energy used by a building.⁸

This option indirectly supports energy efficiency. By articulating the RER as a requirement to meet a certain percentage of the total energy needs of a building with renewable energy, it is advantageous to decrease the total energy needs of the building before calculating the amount that renewables will contribute. This encourages building design and construction that reduces energy consumption beyond the Building Code so that less investment is needed to meet the RER. This path is used in Merton, U.K.⁹

2. Set the RER as a per cent of total energy used by a building, but vary the RER percentage based on energy performance.

This option directly supports energy efficiency by explicitly outlining the compliance paths that will result in a decrease in the percentage of renewable energy required if certain energy efficiency standards are met.

The Ontario township of East Gwillimbury's proposed regulation uses this approach, recognizing that investments in additional energy efficiency and conservation are often more cost effective than investing in renewable energy. Builders and developers are therefore allowed to meet up to 50 per cent of a building's renewable energy requirement with investments that go beyond the current minimum energy efficiency requirements in a municipality. Effectively, builders can reduce a building's renewable energy requirement from 10 to five per cent of overall energy demand, by cutting back on the building's overall energy demand. East Gwillimbury already has in place requirements for residential developments to meet EnergyStar (equivalent to EnerGuide 80), and commercial development to meet 25 per cent below the MNECB.

⁸ This research also examines a prescriptive approach to an RER (i.e. requiring a certain technology), but this option is not discussed in this section as it does not set up conditions that encourage energy efficiency. It is however considered in section 3.

⁹ The combined impact of Merton's policy has been a 26 per cent reduction in GHG emissions - even though the policy only requires a 10 per cent reduction.

3. Use energy performance to set requirements and allow a mix of renewable energy and energy efficiency to meet them.

Energy efficiency and renewable energy targets can be met by setting a total energy performance requirement that goes beyond the Building Code. The performance requirement can be met using either energy efficiency or renewable energy, or their combination, depending on the most effective financial and technological solution in each circumstance. It is possible that under this option developers will use 100 per cent energy efficiency and zero renewable energy to meet the requirement. If the energy performance requirement is set to zero purchased energy from the grid, it would mean that the building is using on-site renewable sources to meet its energy needs that cannot be reduced further through energy efficiency.

Directive 2010/31/EU of the European Parliament and of the Council of May 9, 2010 on the energy performance of buildings uses this approach. This Directive requires Member States to set minimum energy performance requirements and to ensure that by December 31, 2020 all new buildings are nearly zero-energy buildings (as defined by each Member State in kWh/m²/yr).

This project focused on path 1 above. Evaluating the preferred option of these three was beyond the scope of this project.

1.6 Collaborating Organizations

The Pembina Institute has worked closely with the following organizations in order to complete this project. The role each of these organizations played in the project is described briefly below¹⁰:

BC Hydro

- Strategic guidance and feedback throughout project process.

Solar BC/BC Sustainable Energy Association (BCSEA)

- Strategic guidance and feedback throughout project process.

City of Dawson Creek

- Staff and council and broader development community, and
- provided key input on RER design.

¹⁰ BC Building Code (Christine Webb and John Nicol – attended Meeting #1 only, due to other work commitments), BC Ministry of Energy and Mines (Geoff Turner, Janice Larson), BC Ministry of Environment (Ted Sheldon, Scott Cutler), BC Ministry of Community, Sport and Cultural Development (Heike Schmidt), Solar BC/BCSEA(Nitya Harris), BC Hydro (Toby Lau, Katherine Rossokha, Hamideh Abolghasemi Riseh). Local workshops attended by municipal staff and council (Dawson Creek, and Campbell River).

City of Campbell River

- Staff and council and broader development community, and
- provided key input on RER design

Provincial government “Round Table”

- An informal collection of staff from the following ministries:
 - Ministry of Energy and Mines, including:
 - Buildings and Safety Branch, and
 - Electricity and Alternative Energy Division;
 - Climate Action Secretariat, and
 - Ministry of Community, Sport and Cultural Development.
- Each provided input at key points in the development of the RER.

2. Legislative Approach

2.1 Context

This section outlines potential legislative approaches that could be considered by both local and provincial governments for the adoption of a RER in B.C. Each approach is then evaluated according to the five criteria described below and the preferred approach is identified.

2.2 Criteria

Five criteria were consulted when considering the preferred approach for the RER.

1. *Inclusion of significant number of homes and buildings* — The objectives for the RER includes moving the building sector in B.C. on a path of reducing electricity and fossil fuel consumption, aiming toward a net-zero energy construction design in B.C. A similar and related objective is GHG emission reductions that are in line with provincial and local government goals as well as the scientific basis for climate protection.¹¹ Both these objectives require that most homes and buildings throughout the province will be included in the RER.
2. *Clear jurisdiction* — Do the bodies implementing the action have authority to do so? This authority should be provided through legislation and/or tested by courts (if language in legislation is subject to debate). If jurisdiction is ambiguous, governments and builders will be reluctant to move ahead with implementing the requirement. It is therefore crucial that the RER is enacted through a process where the enacting party has clear jurisdiction.
3. *Ability for communities to take early action* — Can a community implement the RER prior to acceptance by all communities in the province? Some B.C.

¹¹ For the science-based targets for GHG emissions for Canada, see for example M. Bramley. 2005. *The Case for Deep Reductions: Canada's Role in Preventing Dangerous Climate Change*. The Pembina Institute. http://pubs.pembina.org/reports/Case_Deep_R_E.pdf

communities have already stated their interest in moving ahead with a RER. Thus it is important to provide leading communities with the ability to implement the requirement in the near term. Other communities may face extra barriers to implementing a RER during the same timeframe and may prefer a longer one. Flexibility in timing, and possibly for implementation itself, allows communities to support a RER within their own timeframe.

4. *Consistent approach* — This criterion refers to consistency in the design of RER, such as the renewable technologies that qualify, the types of homes and buildings covered by RER, and the minimum fraction of renewable energy. Ensuring that communities take a consistent approach to RER will be important not only to provide clear expectations for developers and builders, but also to ensure that high standards are being set across the province. A consistent approach also facilitates more cost-effective development of incentives, education, training and other support for implementing the requirement across communities.
5. *Ease of Administration* — This refers to the effort required by the local staff and provincial governments to implement and enforce. With limited resources available to enact new policies, local and provincial governments prefer an approach that is simple to enact and administer. Approaches that require approval or policy changes from multiple parties (e.g. local and provincial governments) are considered less desirable.

2.3 Overall jurisdiction on buildings between local and provincial governments

Currently, the provincial government has the jurisdiction to include a RER while local governments have limited options available.

The broad authority for the provincial government to set renewable energy standards (i.e. how buildings use energy) is found in the *Local Government Act* through the powers of:

- Adopting by reference, with the changes the minister considers necessary, all or part of any building code or standards for the construction, alteration, repair or demolition of buildings;
- Regulating buildings generally for matters not included in the building code;
- Exempting certain persons, buildings, classes of buildings, materials or areas either generally or for certain periods of time from the building code or regulations, and making other regulations for the persons, buildings, classes of buildings, materials or areas exempted; and

- Providing for the administration of the building code and other regulations.¹²

Local governments may enact bylaws that regulate buildings; however, they cannot deviate from the standards established in the provincial Building Code. In particular,

[a]ny bylaw dealing with building regulation must be approved by the Minister, enacted under a regulation, or enabled by agreement between a local government and a provincial Ministry. Local governments have no independent jurisdiction in relation to buildings because, according to section 9 of the *Community Charter*, they must receive some approval or further definition by the provincial government.¹³

Thus the provincial government must make the necessary amendments to mandate, or authorize local governments to mandate, the use of RERs. Note that the provincial government has not yet included renewable energy in the provincial building code or the *Local Government Act*. The solar hot water ready requirement would be the first step to include renewable energy in provincial standards for buildings.

2.4 Options for legislative approach

2.4.1 Existing options available to local governments

Local governments have limited tools to encourage renewable energy in homes and buildings in their communities through existing jurisdiction. A legal review of the existing tools concluded that these options are limited to voluntary approaches or an option with unclear jurisdiction (eg. development permit areas). Local governments can use three main approaches:

1. **Voluntary** — Local governments have a variety of tools available to influence home or building developers to install renewable energy technologies. These tools rely on developers voluntarily taking action. The tools that local governments can use to encourage, but not require, renewable energy in homes and buildings include:

- Re-zoning Policy;
- Amenity Bonuses (eg. Density Bonus);
- Phased Development Agreements;

¹² *Local Government Act*, s.692(1)(c), (d), (e) and (f). Interpretation of authority provided in D. Curran 2010. *Jurisdiction Options for Energy Efficiency and Renewable Energy in Buildings*. <http://greenbuildingleaders.ca/docs/gbl-discussionpaper-withcover.pdf>

¹³ Curran, Deborah. 2010. *Jurisdiction Options for Energy Efficiency and Renewable Energy in Buildings*. <http://greenbuildingleaders.ca/docs/gbl-discussionpaper-withcover.pdf>

- Fiscal tools (Property Taxes or Local Area Service Charges, Development Cost Charges,); and
- Other incentives (eg. expedited permitting, building permit fee rebates, revitalization tax exemptions)¹⁴

2. **Mandatory: Development Permit Area** — Development permit area (DPA) requirements are an option that local governments can use to require renewable energy technologies on building site. DPAs can be used by local governments to mandate the installation of renewable energy infrastructure on the outside of homes and buildings in designated development areas. However, local governments cannot demand installation of interior systems to hook-up to the renewable energy system on the outside of the building, since provincial jurisdiction covers standards within buildings.
3. **Mandatory: Service Area Bylaw** — If a local government owns a district energy system, via Service Area Bylaw, that local government may be able to mandate the connection of buildings to that system.¹⁵ The district energy system would need to meet the minimum fraction of renewable energy generation for such a by-law to qualify as a RER.
4. **Mandatory: Concurrent authority** — Concurrent authority generally applies to proposed bylaws in areas where the provincial government and the local governments have shared interest in regulating activities, with building regulation being an area where concurrent authority is required. Under the Community Charter, local governments may propose bylaws that differ from the technical standards or application of the B.C. Building Code. These bylaws must be submitted to the Building and Safety Standards Branch for approval by the Minister.

Thus a local government could apply to the Provincial Government for approval of a proposed bylaw to enact a RER, through concurrent authority. This option allows individual local governments to begin implementation early. However, since the approach relies on local governments taking action individually, the number of local governments that implement the RER may be limited and could result in an insufficient number of homes and buildings being included across

¹⁴ These options are not discussed further in this paper, but more information is available in the paper *Jurisdiction Options for Energy Efficiency and Renewable Energy in Buildings* at the Green Building Leaders website. Curran, Deborah. 2010. *Jurisdiction Options for Energy Efficiency and Renewable Energy in Buildings*. <http://greenbuildingleaders.ca/docs/gbl-discussionpaper-withcover.pdf>

¹⁵ The City of North Vancouver enacted a Hydronic Heat Energy Service By-law, which created a district heating service area for Lower Lonsdale and requires developers in the district to provide infrastructure to connect to the district energy system. The BC government provided a summary of this approach, with a warning that “Note, however, that this bylaw is precedent-setting and has not yet been tested by the courts. Formal legal advice would be necessary before proceeding with a similar bylaw” <http://www.toolkit.bc.ca/success-stories/district-heating-north-vancouver>.

the province. This option also adds a greater administrative burden to local governments since they would each need to apply for concurrent authority. The provincial government may be concerned that each local government would enact different versions of a renewable energy requirement and would also be faced with the resource challenge of responding to multiple requests for concurrent authority.

Finally we note that “The lack of additional jurisdiction [for local governments] provided in the Building and Other Bylaws Regulation, as well as the additional requirements to seek approval of building bylaws, means that most local governments will not use this authority to enhance building performance because of the uncertainty of, and the potential delay in waiting for, provincial approval. This authority has been in place since 2003 and no local government has asked for or received approval from the provincial government to alter Building Code standards in the area of energy efficiency.¹⁶”

2.4.2 Options available if provincial government amends the current legislation

Requirements for renewable energy are not currently included in provincial building code, the *Local Government Act* or any other existing legislation. However, the provincial government has demonstrated interest in encouraging renewable energy for buildings through the development of the Solar Hot Water (SHW) ready requirement (see text box on p.16).

The provincial government has several options for enacting a RER in B.C. Both options are connected with changes to the *Local Government Act*, *Community Charter* and/or their Regulations (such as the BC Building Code).

The *Local Government Act*, R.S.B.C. 1996, c. 323, section 692, creates the ability for the Minister to create both the B.C. Building Code (*British Columbia Building Code Regulation*, B.C. Reg. 216/2006) and ‘other’ building regulations. Section 692(1), reads: “The minister may make regulations as follows: ... (d) regulating building generally for matters not included in the building code.”

¹⁶ Since 2004 local governments have submitted 11 bylaw requests dealing with fire sprinklers, adaptable housing and Letters of Assurance. Working groups on adaptable housing and Letters of Assurance have resulted in Building Code changes, with fire sprinklers being an unresolved issue. Christine Webb, Building and Safety Policy Branch, Ministry of Housing and Social Development. Personal communication January 13, 2009. Quote from D. Curran 2010.

Solar Hot Water Regulation

The Solar Hot Water (SHW) Ready regulation (101/2011) provides an example of how provincial and local governments can work together to enact new regulations for renewable energy.

In the fall of 2010, the Province of B.C. proposed an opt-in requirement that would enable local governments to mandate that all new single-family dwellings within their communities be SHW ready. Local governments were provided with the option to state their desire to implement this requirement. On June 21st, 2011, the regulation came into effect.¹⁷

The SHW ready provisions are currently not a formal addition to the building code. Instead, they are being introduced through a new regulation under section 692(1)(d) of the *Local Government Act*¹⁸ (*Provincial Building Codes and Regulations*) that applies to 36 local governments¹⁹ that agreed to implement the requirement. Though participation in the SHW readiness regulation was voluntary, SHW readiness in new single-family dwelling is now mandatory for those local governments.

The options for the provincial government to amend existing legislation are:

1. **Amend the BC Building Code regulation under the *Local Government Act* by adding the RER.** Adding the RER to the building code would provide clear authority for implementation. The process could follow the steps undertaken to include energy efficiency in the building code, that is, the provincial government would design the requirement and include it in the building code. One drawback to this approach is that the level of performance improvements and timing of these amendments has been slower than desired by some local governments. Note this change could also be achieved through creating a new regulation or amending *Buildings and Other Structures Bylaws Regulation* under the *Community Charter* for a RER across the province.

¹⁷ BC government online newsroom. June 14, 2011. *Greening the Building Code - Communities adopt solar power*. <http://www.newsroom.gov.bc.ca/2011/06/greening-the-building-code-communities-adopt-solar-power.html>

¹⁸ *Local Government Act*, s. 692(1) — The minister may make regulations as follows: (d) regulating building generally for matters not included in the building code.

¹⁹ For the purposes of this project, local governments will be defined broadly to include municipalities and regional districts.

2. **Create a new Regulation or amend *Buildings and Other Structures Bylaws Regulation* under the *Community Charter* to provide an option for local governments to voluntarily sign up for the RER enacted by the provincial government.** This would be an opt-in regulation similar to the recent Solar Hot Water (SHW) Ready regulation. As with the SHW ready requirement (see text box), local governments could choose to adopt this opt-in standard as set by the provincial government. This option uses existing local government procedure and jurisdiction, making it administratively simple. It also provides the ability for individual local governments to adopt the RER prior to a full-scale provincial application that is needed for amendments to the building code. The flexibility of this option is also a drawback in that it relies on having a sufficient number of local governments willing to participate. Ultimately this could mean that it may not reach enough homes and buildings to effectively reduce electricity and fossil fuel consumption.
3. **Create a new Regulation or amend *Buildings and Other Structures Bylaws Regulation* under the *Community Charter* that would mandate a RER in all local governments, with an option for individual local governments to be excluded.** This is a slight variation on the optional approach described above, leading to an “opt-out” rather than “opt-in” requirement.
4. **Amend the *Community Charter* and *Local government Act* or the *Buildings and Other Structures Bylaws Regulation* under the *Community Charter*, to provide authority to all local governments to enact by-laws for RER.** This would limit the administrative barrier faced by individual local governments but would not address the concern of multiple versions of the RER across different communities. This option would then depend on individual local governments to enact RER bylaws.

2.5 Preferred Regulatory Option

An opt-in requirement as part of the *Local Government Act* is the preferred approach for a RER in B.C. in the near term. As can be seen in Table 3, this approach provides clear jurisdiction as well as the ability for communities to choose whether they want to join the requirement when it is first introduced, or possibly join later.

The main drawback to the opt-in requirement is that fewer homes and buildings will be covered by the requirement than if the requirement was enacted through the provincial building code. In order to reach a large number of homes and buildings and provide clear jurisdiction for implementation, an amendment to the provincial

building code is the ultimate goal. However, as mentioned above, some B.C. communities are interested in seeing the implementation of a RER on a faster timeframe than what is likely from provincial building code amendment that would apply to the full province. An opt-in requirement is also likely to be administratively easier for the provincial government than an opt-out for the first implementation of the RER. For subsequent rounds of implementation, an opt-out approach may be preferable.

It will be essential for the communities that adopt the RER to carefully monitor and evaluate the impacts of the RER and be able to share the results of their experiences for future revisions and/or to encourage other communities to opt-in.

	Covers significant # of buildings across the province	Clear jurisdiction	Ability for communities to take early action	Consistent approach across the province	Ease of Administration
Existing options available to local governments					
Voluntary — zoning and amenity bonuses, phased development agreements, and fiscal tools.	No	Yes	Yes	No	Yes
Mandatory — Development Permit Area requirements.	Depends on number of communities and size of area in each community.	No - untested in courts	Yes	No	Yes
Mandatory — Service Area Bylaw	Depends on number of communities and size of service area in each community.	No - untested in courts	Yes	No	Yes
Mandatory — Concurrent authority for local governments.	Depends on number of communities that enact bylaw.	Yes	Yes	No	No precedent in B.C. for such authority on building energy.
Options available if provincial government amends the current legislation					
Amend provincial building code to require renewable energy.	Yes	Yes	No	Yes	Amendments needed to legislation.
Requirement with option for local governments to voluntarily opt-in.	Depends on number of communities that join.	Yes	Yes	Yes	Amendments needed to legislation.
Requirement with option for local government to voluntarily opt-out.	Depends on number of communities that join.	Yes	Yes	Yes	Amendments needed to legislation.
Amend the Community Charter /LGA to provide authority to LGs	Depends on number of communities that enact bylaws.	Yes	Yes	No	Amendments needed to legislation.

Table 3 - Comparison of Regulatory Options

2.6 Process for governments (local and provincial) to enact the preferred approach

A RER enacted through an opt-in requirement in the *Local Government Act* could occur through the following steps:

1. Build awareness of the potential RER with staff at local and provincial governments.
2. The minister responsible for the *Local Government Act* would direct staff to start the process of developing an opt-in requirement.
3. Ministerial staff would develop the proposed renewable energy requirements as well as provide the rationale, scope and potential language to be used by local governments in by-laws in order to enact the requirements.
4. Local governments would be invited to sign up for the opt-in requirement.
5. If sufficient support was provided for the opt-in RERs, the appropriate Minister would develop a ministerial order to amend the *Local Government Act*.
6. The ministerial order would state the rationale and scope of the amendment and also state the names of the local governments that must comply.
7. Local governments that have opted to enact the RER will update relevant by-laws and enforcement processes to implement the requirement in their communities.

3. Costs and Savings Associated with the RER

3.1 Cost and savings summary

In this section of the report, the cost for compliance with the proposed RER for different building types, using a variety of eligible energy sources and technologies, are presented with figures. These figures are estimates only and may not reflect the costs of compliance — whether higher or lower — that developers and builders experience once the requirement is in place.

It is also noteworthy that the examples provided here are not exhaustive: other technologies not listed or modeled could provide the means for builders to comply with the RER in a more cost effective manner. The technologies selected and discussed here — Ground Source Heat Pumps, Solar PV, Solar Hot Water and Solar Air Heating and Pellet Stoves — are meant to illustrate how different technologies impact building cost and their relative ability to comply with the RER. These technologies were chosen to provide a range of costs, energy provision and specific services. Examples of other technologies not modeled in detail are air-source heat pumps, biomass heating systems (aside from pellet stoves), as well as possible configurations of district heating or cooling.

Several factors will influence the initial cost of compliance with a RER, and it is important to keep these in mind when reviewing the figures in this section. Some factors affect primarily the initial cost of the system, others affect the ongoing energy costs and savings.

Factors affecting the cost of system installation:

- **Experience:** Builders and developers, as well as municipal staff, will quickly improve their capacity to assess the lowest-cost path to compliance. This will help drive down prices following adoption of the RER.
- **Renewable energy sector development:** The growth of local and regional industries supporting the renewable energy sector will ensure there is competition for services and supplies, and the overall increase in the size of the sector, will help lower costs.

- **Decision-making:** Designers, developers and builders often make trade-offs in the building design process to meet customer expectations. If there are additional costs in one area of a building design, architects and engineers may be able to find savings in other areas in order to remain within a target budget. Some builders find that a building that is designed from the start to integrate renewable energy may be built with no cost increase or, in some cases, lower building costs.²⁰ In this analysis, any cost savings resulting from downsizing or elimination of other building systems are not included (see below for a more thorough discussion of full vs marginal cost).
- **System Cost:** Construction and energy systems costs in the commercial sector can be variable and depend on context. For example, B.C.'s 2007 CPR states that the cost of installing ground-source heat pumps (GSHP) varies from \$22 to \$165 per square meter of floor space, depending on the type of system and its size.²¹
- **Taxes:** Applicable provincial and/or federal taxes are not included in the cost analysis.
- **Grants:** A variety of grants and incentives are available in B.C. to reduce the upfront costs of renewable energy technologies. These various programs are not included in the calculations here.

Factors affecting the cost of system maintenance and operation:

- **Building efficiency:** as discussed earlier, the requirement to meet a fraction of building energy through a renewable system creates incentives and a framework to improve building energy efficiency – which in turn decreases ongoing energy costs. This possible improvement in energy efficiency is not considered in this analysis; the modeled scenario assumes the same energy demand as baseline cases.
- **Energy prices:** savings or additional costs can come from switching the source of energy needed to power, heat or cool a building. Forecasted changes in energy prices are included in this analysis (see section 3.2).
- **Carbon taxes:** The added cost of carbon taxes on energy prices is not included in the analysis, but is expected to improve the relative economic value of low carbon or zero carbon renewable energy sources such as those that are eligible for the RER. The electricity grid in BC is also a relatively low-carbon energy source compared to combustion of natural gas.
- **Maintenance costs:** The addition or replacement of systems can have an impact on the cost of maintenance, such as increased or decreased repair and scheduled maintenance activities. The cost estimates presented in this analysis do not attempt to quantify these changes.

²⁰ Adrian Hewitt, “The MertonRule Briefing February 2009.”

²¹ BCH CPR. Commercial. Pg. 69. GSHP HVAC systems range from \$22 to \$165, depending on the heat source, location of building and the cost of drilling. An average cost is in the range of \$85/m².

- **Financing:** This analysis does not include the cost of financing the potential added capital cost associated with the installation of the renewable system.
- **Life of system:** systems are assumed to have an operating life of 25 years. While this assumption does not affect directly ongoing cost, it will affect economic performance measures such as the internal rate of return (IRR) and net present value (NPV). Both the IRR and the NPV will increase if systems have a longer life, and decrease if they have a shorter life.

Thus, the cost estimates in this section assess the financial benefits (e.g. NPV and IRR), considering two primary factors:

1. The full cost of installing the renewable energy system, and
2. Changes in operating energy costs (e.g. lower energy costs for the building operator).

We use the internal rate of return (IRR) to compare the different scenarios. Internal rates of return are commonly used to evaluate the desirability of investments; the higher a project's internal rate of return, the more profitable are future cash flow, if compared at present value to the upfront investment. Thus, IRRs allow us to compare projects with different up-front investment. As it is itself a rate (the discount rate at which future cash flows equal initial investment), it is independent of assumptions on discount rate. However, it does not inform us on the magnitude of investment needed or that of the returns – for these, one should refer to the Net Present value of the project.

Full cost versus incremental cost

The construction cost in the B.C. building industry varies significantly within and between different building types. Table 6 in section 3.3 outlines the lower and upper bounds of construction costs for different project types in B.C.

One complicating factor in assessing the real cost of compliance is the difficulty in understanding the incremental cost of the renewable energy technologies selected versus the full cost of the technologies. Full cost is understood to be the cost of designing, purchasing, installing and commissioning a renewable energy system, whereas the incremental cost assesses both the full cost of the selected renewable system as well as any savings associated with corresponding changes in the building design (e.g. not installing a comparable conventional energy system).

For example: the full cost of a GSHP system for a hospital is \$1.25 million. The alternative to the GSHP is the installation of an equivalent natural gas system, costing \$500,000. The incremental cost of the GSHP is \$750,000 ($\$1,250,000 - \$500,000 = \$750,000$), which is less than the full cost of the GSHP.

3.2 Energy Costs

Electricity Costs

The following table shows the forecast electricity rate increases used for the analysis in this chapter.²²

Table 4: Forecast electricity prices

Year	Real rate increase	Commercial rate (\$/kWh)	Residential rate (\$/kWh)
2010		0.082	0.075
2011	5.50%	0.086	0.079
2012	11.40%	0.096	0.088
2013	3.50%	0.099	0.092
2014	6.00%	0.105	0.097
2015	5.50%	0.111	0.102
2016	5.40%	0.117	0.108
2017	3.40%	0.121	0.112
2018	1.50%	0.123	0.113
2019	2.30%	0.126	0.116
2020	2.80%	0.129	0.119
2021	0.90%	0.130	0.120
2022	0.90%	0.131	0.121
2023	0.90%	0.133	0.122
2024	0.90%	0.134	0.123
2025	0.90%	0.135	0.125
2026	0.90%	0.136	0.126
2027	0.90%	0.137	0.127
2028	0.90%	0.139	0.128
2029	0.90%	0.140	0.129
2030	0.90%	0.141	0.130
2031	0.90%	0.143	0.131
2032	0.90%	0.144	0.133
2033	0.90%	0.145	0.134
2034	0.90%	0.146	0.135
2035	0.90%	0.148	0.136
2036	0.90%	0.149	0.137

Natural Gas Prices

Natural gas prices are based on US Energy Information Agency forecast spot prices (“Henry Hub Spot Price”).²³ The BC supplemental delivery and midstream charges are

²² BC Hydro. Integrated Resource Plan. Meeting #1. December 14, 2010. 2011 IRP Technical Advisory Committee Summary Brief.

²³ See <http://www.eia.gov/oiaf/aeo/tablebrowser/>. Accessed July 10th, 2011.

added to the commodity price to give the final commercial and residential rate.²⁴ The delivery and midstream charges are assumed to increase at 2% annually over the period.

Table 5: Forecast natural gas prices

Year	Henry Hub Spot Price	COMMERCIAL (supplement delivery and midstream charge)	RESIDENTIAL (supplement delivery and midstream charge)	Commercial rate (\$/GJ)	Residential rate (\$/GJ)	Vancouver Island rates (commercial and residential) (\$/GJ)
2010	\$4.66	\$3.96	\$4.53	\$8.62	\$9.19	\$13.35
2011	\$4.72	\$4.04	\$4.62	\$8.75	\$9.34	\$13.35
2012	\$4.74	\$4.12	\$4.71	\$8.86	\$9.45	\$13.55
2013	\$4.80	\$4.20	\$4.81	\$9.00	\$9.61	\$13.79
2014	\$4.81	\$4.29	\$4.90	\$9.10	\$9.72	\$13.98
2015	\$4.91	\$4.37	\$5.00	\$9.28	\$9.91	\$14.25
2016	\$4.99	\$4.46	\$5.10	\$9.45	\$10.09	\$14.53
2017	\$5.01	\$4.55	\$5.20	\$9.56	\$10.22	\$14.74
2018	\$5.06	\$4.64	\$5.31	\$9.70	\$10.37	\$14.98
2019	\$5.13	\$4.73	\$5.41	\$9.86	\$10.54	\$15.25
2020	\$5.32	\$4.83	\$5.52	\$10.14	\$10.84	\$15.64
2021	\$5.52	\$4.92	\$5.63	\$10.44	\$11.15	\$16.04
2022	\$5.67	\$5.02	\$5.75	\$10.69	\$11.42	\$16.41
2023	\$5.87	\$5.12	\$5.86	\$11.00	\$11.74	\$16.83
2024	\$6.11	\$5.22	\$5.98	\$11.33	\$12.08	\$17.28
2025	\$6.28	\$5.33	\$6.10	\$11.61	\$12.38	\$17.68
2026	\$6.42	\$5.43	\$6.22	\$11.86	\$12.64	\$18.05
2027	\$6.57	\$5.54	\$6.34	\$12.11	\$12.91	\$18.43
2028	\$6.64	\$5.65	\$6.47	\$12.30	\$13.11	\$18.74
2029	\$6.68	\$5.77	\$6.60	\$12.45	\$13.29	\$19.02
2030	\$6.74	\$5.88	\$6.73	\$12.62	\$13.47	\$19.32
2031	\$6.83	\$6.00	\$6.87	\$12.83	\$13.70	\$19.67
2032	\$6.97	\$6.12	\$7.00	\$13.09	\$13.97	\$20.06
2033	\$7.09	\$6.24	\$7.14	\$13.34	\$14.24	\$20.45
2034	\$7.23	\$6.37	\$7.29	\$13.60	\$14.52	\$20.85
2035	\$7.44	\$6.50	\$7.43	\$13.94	\$14.88	\$21.33
2036	\$7.44	\$6.63	\$7.58	\$14.07	\$15.02	\$21.61

Pellet prices

The retail value of biomass pellet in northern BC is currently \$229/tonne, or approximately \$0.042/kWh (based on energy content of 19.7 GJ/tonne).^{25,26} The price of biomass is assumed to increase at 2% per year for the time period of the analysis.

²⁴ Fortis Energy. Residential: <http://www.fortisbc.com/NaturalGas/Homes/Rates/Pages/default.aspx>. Commercial: <http://www.fortisbc.com/NaturalGas/Business/Rates/Pages/default.aspx>.

²⁵ Personal communication with local retailer. June 2011.

3.3 The B.C. building industry — construction costs

The construction cost in the B.C. building industry varies significantly between and within different building types. The table below outlines the lower and upper bounds of construction costs for different project types in B.C.

Table 6: B.C. Construction Costs

<i>Project Type</i>	Cost (\$/sq.m)		Cost (\$/sq.ft)	
	<i>Low</i>	<i>High</i>	<i>Low</i>	<i>High</i>
Hospitals, Research and Teaching Laboratories	\$4800	\$6500	\$446	\$604
High-Rise Residential	\$2800	\$3500	\$260	\$325
Low-Rise Condominiums	\$1500	\$1800	\$139	\$167
Townhouses (Wood Frame)	\$1500	\$1900	\$139	\$177
Shopping Centres	\$1900	\$2300	\$177	\$214
Office (High-Rise)	\$2200	\$3000	\$204	\$279

Residential construction, including low-rise condominiums and townhouses, are the lowest cost building type with construction costs as low as \$1500 per square meter. This is compared with hospitals and teaching facilities, where costs can be more than four times higher per square meter (i.e. up to \$6500 / m²).

The upper end of building costs range by 20 to 35 per cent across different project-type categories. This variation provides some context for the incremental or additional cost associated with compliance of the renewable energy requirement.

Current energy costs used in the analysis are presented in tables 1 and 2 above.

Table 7: Energy Costs, Commercial²⁷

Region	Lower Mainland	Vancouver island	Southern interior	Northern
Gas Cost (\$/GJ)	\$7.86	\$13.35	\$7.84	\$7.84
Electricity Cost (\$/kWh)	\$0.08	\$0.08	\$0.08	\$0.08

²⁶ Wood Pellet Association of Canada. Presentation. <http://www.pellet.org/linked/2010-05-26%20gordon%20murray%20yukon.pdf>. May 2010.

²⁷ Sources: Natural gas (Fortis Business Rates. www.fortisbc.com/NaturalGas/Business/Rates/Pages/default.aspx); Electricity (BC Hydro. Medium General Service rate. www.bchydro.com/youraccount/content/business_rates.jsp).

3.4 Cost and benefits of compliance — residential sector

In the residential energy sector, the distribution of energy use is weighted towards space heating and water heating.

Table 8: Distribution of household energy use²⁸

Distribution of residential energy use, 2007 (Per cent)	Space heating 62.7%	Water heating 17.8%	Appliances 13.3%	Lighting 4.2%	Space cooling 1.9%
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Three residential samples are evaluated. The first is a single family duplex, with gas heat as the primary energy source. This same home is then modeled with electric heat. Each is evaluated in four regions. The third home modeled is an electrically heated row house; this is only evaluated for the Vancouver Island Region.

3.4.1 Single family duplex, gas heat

Key figures for the single family duplexes built to 2008 BC Building Code are presented in the following tables.

Single Family Duplex, Gas Heat			
Total Annual Energy Use ²⁹	Lower Mainland	27,412.78	kWh
	Vancouver Island	27,412.78	kWh
	Southern Interior	28,406.11	kWh
	Northern Region	34,245.56	kWh
Estimated Building Size		139.35	m ²
Estimated Construction Cost ³⁰		236,902.75	\$

Single Family Duplex, Electric Heat			
Total Annual Energy Use ³¹	Lower Mainland	23,240.00	kWh
	Vancouver Island	23,240.00	kWh
	Southern Interior	23,240.00	kWh
	Northern Region	23,240.00	kWh
Estimated Building Size		139.35	m ²

²⁸ Distribution of energy use within Household, from NRCan Office of Energy Efficiency. <http://oee.nrcan.gc.ca/publications/statistics/trends09/appendix-a.cfm?graph=13&attr=0>.

²⁹ Energy Consumption of new Building that meet 2009 BC Building Code. Cooper and Hood, B.C. New Low Rise Green Building Code Lifecycle Cost Analysis, 2007, p. 11-12

³⁰ Wood frame townhouse construction cost, average. Source: Construction costs from BTY Group. 2008. Newsletter. <http://www.bty.com/newsletters.htm>.

³¹ Energy Consumption of new Building that meet 2009 BC Building Code. Cooper and Hood, B.C. New Low Rise Green Building Code Lifecycle Cost Analysis, 2007, p. 11-12

Estimated Construction Cost ³²	\$236,902.75	\$
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3.4.2 Row house, electric heat (Vancouver Island only)

Key figures for the row house built to 2008 BC Building Code are presented in the following table.

Row House, Electric Heat, Vancouver Island			
Total Annual Energy Use: ³³	Vancouver Island	12,870	kWh
Estimated Building Size		111.48	m ²
Estimated Construction Cost: ³⁴		\$189,522.20	

Notes on methodology for analysis

- The GSHP and biomass systems are assumed to replace both heating and cooling energy use (only heating, in the case of biomass). For the first sample home, natural gas is assumed to provide both space heating and water heating. For the second and third examples, electricity is assumed to provide both space heat and water heat.
- The cost of GSHP is \$7.9/ ft², as described in the *BC Conservation Potential Review 2007* is used for the installation in the row house, which is lower than the cost for the single family duplex samples. This cost difference may reflect savings realized by developing a GSHP system that serves multiple units.
- The cost of GSHP for single family duplex is \$20,000³⁵
- The biomass system modeled is a pellet stove, with an estimated cost of \$4,000.
- The Solar Domestic Hot Water (SDHW) system is estimated to provide 50 per cent of hot water needs for each residential case. For the residential sector, the cost of a household system is \$7,200.³⁶

³² Wood frame townhouse construction cost, average. Source: Construction costs from BTY Group. 2008. Newsletter. <http://www.bty.com/newsletters.htm>.

³³ Energy Consumption of new Building that meet 2009 BC Building Code. Cooper and Hood, B.C. New Low Rise Green Building Code Lifecycle Cost Analysis, 2007, p. 11-12

³⁴ Wood frame townhouse construction cost, average. Source: Construction costs from BTY Group. 2008. Newsletter. <http://www.bty.com/newsletters.htm>.

³⁵ Bailie, Alison and Paul Cobb. Summary of Economic Costs and Benefits. Green Building Leaders Discussion Paper. www.greenbuildingleaders.ca.

³⁶ Average price for 546 systems installed in BC through Solar BC. www.solarbc.ca/install/households. July 2011.

- In order to recognize a different and higher cost of solar PV for small residential systems (compared to larger commercial systems) 8 \$/W is used for residential installations.³⁷ For the single family duplex, a 3kW solar PV system is modeled, for the smaller row house, a 2kW system is used.
- The solar resource used for each region is:³⁸
 - Lower mainland: 950 kWh/kW
 - Vancouver Island: 950 kWh/kW
 - Southern Interior: 1150 kWh/kW
 - Northern: 1050 kWh/kW
- The Net Present Value (NPV) and Internal Rate of Return (IRR) calculated for each building type and scenario are based on 25-year life of technology and 5% discount rate unless otherwise indicated.
- The renewable energy system costs are (\$, % of construction cost):³⁹
 - GSHP: \$20,000 (8%) for single family duplexes
 - GSHP: \$9,480 (5%) for row houses
 - Solar DHW: \$7,200 (3-4%)
 - Solar PV (3 kW system): \$24,000 (10%)
 - Solar PV (2 kW system): \$16,000 (8%)
 - Pellet Stove: \$4,000.00 (2%)

3.4.3 Results tables

Table 9: Single family duplex, natural gas heat, results table.

	Renewable Energy	Energy provided by renewable energy Source (kWh/year)	Percent of building energy from RE sources (%)	NPV	IRR
Lower Mainland	GSHP	17,709	65%	-\$18,406	-12%
	Solar DHW	2,440	9%	-\$5,507	-6%
	Solar PV (3 kW)	2,850	10%	-\$18,436	-6%
	Pellet Stove	17,188	63%	-\$6,306	N/A*

³⁷ Dauncey, Guy. Personal communication. BC Sustainable Energy Association. July 2011.

³⁸ NRCan Solar Resources Map. Source: https://glfc.cfsnet.nfis.org/mapserver/pv/index_e.php.

³⁹ Baile, Alisona and Paul Cobb. Summary of Economic Costs and Benefits. Green Building Leaders Discussion Paper. <http://www.greenbuildingleaders.ca/docs/gbl-estimated-costs-summary-may17.pdf>

Vancouver Island	GSHP	17,709	65%	-\$14,133	-4%
	Solar DHW	2,440	9%	-\$4,918	-4%
	Solar PV (3 kW)	2,850	10%	-\$18,436	-6%
	Pellet Stove	17,188	63%	-\$2,158	-1%
Southern Interior	GSHP	18,350	65%	-\$18,383	-12%
	Solar DHW	2,528	9%	-\$5,458	-6%
	Solar PV (3 kW)	3,450	12%	-\$17,505	-5%
	Pellet Stove	17,811	63%	-\$6,396	N/A*
Northern Region	GSHP	22,123	65%	-\$18,246	-11%
	Solar DHW	3,048	9%	-\$5,171	-5%
	Solar PV (3 kW)	3,150	9%	-\$17,970	-6%
	Pellet Stove	21,472	63%	-\$6,928	N/A*

* Because forecasted pellets prices are higher than forecasted natural gas prices for the mainland, there are no cost savings associated with these systems and therefore IRR cannot be calculated.

Table 10: Single family duplex, electric heat, results table.

	Renewable Energy	Energy provided by renewable energy Source (kWh/year)	Percent of building energy from RE sources (%)	NPV	IRR
Lower Mainland	GSHP	15,013	65%	-\$3,520	3%
	Solar DHW	2,068	9%	-\$3,648	-1%
	Solar PV (3 kW)	2,850	12%	-\$18,436	-6%
	Pellet Stove	14,571	63%	\$8,617	21%
Vancouver Island	GSHP	15,013	65%	-\$3,520	3%
	Solar DHW	2,068	9%	-\$3,648	-1%
	Solar PV (3 kW)	2,850	12%	-\$18,436	-6%
	Pellet Stove	14,571	63%	\$8,617	21%
Southern Interior	GSHP	15,013	65%	-\$3,520	3%
	Solar DHW	2,068	9%	-\$3,648	-1%
	Solar PV (3 kW)	3,450	15%	-\$17,505	-5%
	Pellet Stove	14,571	63%	\$8,617	21%
Northern Region	GSHP	15,013	65%	-\$3,520	3%
	Solar DHW	2,068	9%	-\$3,648	-1%
	Solar PV (3 kW)	3,150	14%	-\$17,970	-6%
	Pellet Stove	14,571	63%	\$8,617	21%

Table 11: Row house duplex, electric heat, results table.

	Renewable Energy	Energy provided by renewable energy Source (kWh/year)	Percent of building energy from RE sources (%)	NPV	IRR
Vancouver Island	GSHP	8,314.02	65%	-\$430	5%
	Solar DHW	1,145.43	9%	-\$5,080	-5%
	Solar PV (2 kW)	1,900.00	15%	-\$12,290	-6%

Pellet Stove	8,069.49	63%	\$3,072	11%
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3.4.4 Results

The cost of building homes that comply with the renewable energy requirement varies depending on the type of technology selected, and the economics for the builder and homeowner vary from technology to technology and region to region, mainly in response to different energy costs.

GSHP

The economic benefits of GSHP are most apparent in cases where the cost of the alternative heating energy source is relatively high, which is the case for electric heating. The IRR for GSHP for electrically heated single family duplexes and row houses is 3% and 5% respectively, with NPV of -\$3,520 and -\$430 respectively, both relatively close to zero given the cost of the system, meaning that given the assumed discount rate (5%) the present value of future savings is close to the initial capital investment. For natural gas heated homes, the IRR result is negative and the NPV is significantly less than the cost of the RE system.

The geothermal or ground-source heat pump system is expected to exceed the RER requirements, as it will provide 100 per cent of the heating and cooling load for the building (65 per cent of total energy demand).

SHW

SHW systems, just like GSHP systems, provide the best value in cases where heating is provided by electricity and not natural gas (due to the relatively low cost of gas). For homes with gas water heating, the IRR ranges from -4 to -6% and the NPV is also negative and close to 70% of the value of the system. For duplexes with electric water heating, the solar hot water systems has an IRR close to zero (-1%). The business case for row houses --- which have lower hot water demand, is not as good, with an IRR of -5.

These SHW systems are expected to meet 9-10% of the renewable energy demand for residential buildings.

Solar PV

Solar photovoltaic systems are currently the most costly of the renewable energy systems modeled, at \$24,000 for a 3kW residential system, and \$16,000 for a 2kW system. The economics of the solar systems will vary from region to region depending on the solar resource available (see section 3.5 for information on solar resources in each region). In each case, the IRR for solar PV systems is negative (ranging from -5% to -6%).

The solar PV systems are expected to meet from 9-12% of the energy demand for the homes modeled and would therefore (in most cases) satisfy the requirements of the RER.

Biomass (Pellet stoves)

Biomass pellet stoves provide the best economic value in cases where they replace electric heating systems: in these cases we find the IRR to be as high as 21%. The IRR for biomass pellets is close to zero (-1%) for homes with natural gas on Vancouver Island, where the cost of gas is higher. For gas heated duplexes on the mainland, the forecasted price of natural gas is less than that of pellets, and therefore there will be no cost savings resulting from this investment. Since there are only negative cash flows, IRRs cannot be computed.

Biomass systems are relatively inexpensive installations that provide sufficient energy to exceed the RER requirements and can lead to energy cost reduction when it displaces electric heat or natural gas on Vancouver Island.

3.5 Cost and benefits of compliance - commercial sector

To understand the cost implications of a RER for developers and builders in the commercial sector, four sample buildings were evaluated — a large commercial building, a hospital, a school, and a multi-unit residential building⁴⁰ — in four regions of the province: the lower mainland, Vancouver Island, the southern interior and Northern B.C. The costs and benefits of complying with the renewable energy requirement using common technologies — ground source heat pumps, solar PV, solar air heating, solar water heating — were then evaluated (see Table 13, Table 14, Table 15, and Table 16).

In the commercial and institutional building sector, the national average for distribution of end-uses is presented in the following table. Space heating and cooling are responsible for 57 per cent of all energy use, with water heating at eight per cent.

Table 12: Commercial sector, distribution of energy use

Commercial energy use by end-use, 2007 (per cent)	
Space Heating	50%
Water Heating	8%
Auxillary Equipment	17%
Auixillary Motors	8%
Lighting	10%
Space Cooling	7%
Street Lighting	0.1%

Notes on methodology

⁴⁰ Large commercial building (15,000 sq.m, \$25 million construction cost, 15619 GJ annual energy use); Hospital (15,000 sq.m; \$97 million construction costs, 28000 GJ annual energy use); School (12,000 sq.m, \$48 million construction costs, 11800 GJ annual energy use); Multi-unit residential building (1,200 sq.m, \$2.04 million construction costs, 1032 GJ annual energy use).

- The tables in the following sections provide some guidance on key energy and cost factors associated with compliance with a RER. The technologies and energy sources used in this assessment should not be considered exhaustive, as there are many other eligible energy sources and applications examined here, and technologies can be used in combination to maximize cost and energy efficiency during the design phase.
- The Net Present Value (NPV) and Internal Rate of Return (IRR) calculated for each building type and scenario are based on 25 year life of technology and 5% discount rate.
- The energy use of each sample building is based on figures provided by the BC Hydro Conservation Potential Review.⁴¹

A brief explanation of the methodology used for each of the four technologies used is included here.

- **Ground source heat pump (GSHP):** The GSHP system is assumed to replace the conventional heating and cooling systems, and therefore will meet 57 per cent of the buildings projected energy needs (see distribution of energy use in building, above). Three different GSHP installation costs are used in the tables below: the low cost is \$22/m² of building space, the average cost assumed to be \$85/m², and the high cost is \$165 /m².⁴² Cost savings result from the decrease in natural gas use, but these savings are offset by increases in electricity use. The energy cost savings are determined by subtracting the increased electricity use from the decrease in natural gas use. Note that in some cases, the findings indicate that overall energy costs increase by a small margin. The IRR is evaluated for each of the low, average and high cost scenarios.
 - For both residential and commercial buildings, the capital cost savings that accrue from downsizing and/or eliminating a conventional energy system are not included (e.g. removing natural gas furnaces), nor are any increases in capital costs associated with including ‘peaking’ heating and cooling systems (e.g. supplemental baseboard heating). These figures are difficult to estimate as system designs and costs vary from case to case, but it is recognized that this could impact the financial assessment (in some cases making the investment more favourable).
- **Solar photovoltaic (solar PV):** For commercial buildings, solar PV systems are sized to meet the 10 per cent renewable energy requirement, taking into account the different solar resources of each of the four geographic regions studied. For the same building, a smaller PV array will be required in a region with a greater resource (e.g. southern interior), as each solar panel will produce more energy.

⁴¹ Energy intensity source: BC Hydro CPR 2007- Commercial, Fuel Switching, Appendix F:I.

⁴² Source: BC CPR. Commercial. Pg. 69. GSHP HVAC systems range from \$22 to \$165, depending on the heat source, location of building and the cost of drilling. An average cost is in the range of \$85/m².

The installed cost of solar PV is 5 \$/W for commercial buildings. Total system cost will depend on the size of the system needed to meet the 10% RER.⁴³ (In order to recognize a different and higher cost, 8 \$/W is used for residential installations.⁴⁴)

- The solar resource used for each region are:⁴⁵
 - Lower mainland: 950 kWh/kW
 - Vancouver Island: 950 kWh/kW
 - Southern Interior: 1150 kWh/kW
 - Northern: 1050 kWh/kW
- **Solar air heating:** Solar air heating systems are sized to meet approximately 10 per cent of the overall building energy needs.⁴⁶ In practice, the system size may be higher or lower, depending on building orientation, design and other factors. The solar air heating system produces 1.87 GJ/m² of cladding area, at a cost of \$118/m².⁴⁷ Cost savings are based on energy from the solar air heating system displacing natural gas use.
- **Solar hot water (SHW):** The solar water systems are applied only to the multi-unit residential buildings and the hospital, as these facilities are assumed to have higher than average hot water heating demands, when compared to the rest of the commercial and institutional building sector (see table above).
 - For the Commercial sector and for multi-unit residential building (MURB) and the Hospital, the SHW system is sized to meet 10 per cent of the building energy demand, similar to the methodology applied with previously described solar technologies. The cost of solar water heating used in the analysis is \$2,500 per panel,⁴⁸ with each panel 2.8 m² of area and energy output of 4.4 GJ annually per panel.⁴⁹ Cost savings are based on energy from the SHW system displacing natural gas use.

⁴³ International Energy Agency Roadmap. http://www.iea.org/papers/2010/pv_roadmap.pdf. Pg. 18. Listed as \$4000-\$6000 USD per kWh installed.

⁴⁴ Dauncey, Guy. Personal communication. BC Sustainable Energy Association. July 2011.

⁴⁵ NRCan Solar Resources Map. Source: https://glfc.cfsnet.nfis.org/mapserver/pv/index_e.php.

⁴⁶ In the case of the hospital, where energy intensity – GJ/m² – is higher the system does not meet the requirement as there are assumed to be space limitations. Note that this is not necessarily the case.

⁴⁷ Department of Energy Federal Technology Alert. Incremental cost is only 55 per cent of the retrofit cost shown here. http://www1.eere.energy.gov/femp/pdfs/FTA_trans_coll.pdf

⁴⁸ Bailie, Alison and Paul Cobb. Summary of Economic Costs and Benefits. Green Building Leaders Discussion Paper. www.greenbuildingleaders.ca.

⁴⁹ Panel size and energy output figures based on sample technology from Government of Canada, Canmet Directory. http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/eng/renewables/solar_thermal/sdhw_directory.html.

3.5.1 Multi-unit residential building

The MURB used in the analysis is a new, 1200 m² residential building, which is relatively small construction.⁵⁰

Key notes on the sample building, include:

- 1200 m² of floor space
- Construction cost: \$2,040,000
- Energy intensity: 0.86 GJ/m²⁵¹
- Total annual energy use: 1032 GJ per year for the sample building.

For each technology selected, the results show that compliance with the RER can be achieved.

Results

For GSHP, the IRR varies significantly depending on the installation cost (from -10% to 14%). The analysis reinforces the need to evaluate buildings on a case-by-case basis as the context and the system costs will influence the results.

Solar PV installations for MURBs can provide sufficient renewable electricity to meet the RER, but the installed cost relative to the building cost is higher than the other alternatives in the evaluation.

Solar air heating systems provide the best IRR (at 15%) due to their relatively low cost and the significant energy savings that they provide. The added cost of these systems, as a percentage of construction costs, is minimal.

Solar water heating systems can provide sufficient energy to meet the RER at an added cost of approximately 3% of construction costs. However, given the low cost of natural gas, the present value of forecast energy savings is less than the cost of the system (IRR = -5%)

Table 13: MURB, renewable energy analysis⁵²

Region	Multi-unit Residential Building			
	Lower Mainland	Vancouver Island	Southern Interior	Northern

⁵⁰ Size used in this analysis is a Pembina estimate. This size building is eligible for BC Hydro pilot programs for energy efficiency in the commercial sector, as it is below the 1800m² limit. See: www.bchydro.com/powersmart/builders_developers/high_performance_building_program.html.

⁵¹ Source: Finch, Graham et al. Energy Consumption in Mid and High Rise Residential Buildings in BC. BEST2-Energy Efficiency-Session EE3-1.

⁵² Systems costs as described in each table are the full system cost and not the incremental cost.

Energy Intensity (GJ/m ²) ⁵³	0.86	0.86	0.86	0.86
Building Annual Energy Use (Total, GJ)	1,032	1,032	1,032	1,032
Ground Source Heat Pumps				
Unit RE Production (GJ/m ²)	0.47	0.47	0.47	0.47
Total RE Production (heat+cool load, GJ)	588	588	588	588
GSHP System Cost (avg - \$85/m ²)	\$102,000	\$102,000	\$102,000	\$102,000
GSHP System Cost (low - \$22/m ²)	\$26,400	\$26,400	\$26,400	\$26,400
GSHP System Cost (high - \$165/m ²)	\$198,000	\$198,000	\$198,000	\$198,000
GSHP System Cost (% construction cost - avg case)	5.00%	5.00%	5.00%	5.00%
Net Present Value	-\$80,732	-\$41,117	-\$80,732	-\$80,732
IRR (avg case)	-6%	1%	-6%	-6%
IRR (low cost)	2%	14%	2%	2%
IRR (high cost)	-10%	-4%	-10%	-10%
Solar PV				
Installed system size (kW installed)	30	30	25	27
Renewable Energy Production (kWh)	28,667	28,667	28,667	28,667
Renewable Energy as percent building demand	10%	10%	10%	10%
Solar PV System Cost	\$150,877	\$150,877	\$124,638	\$136,508
Solar PV System Cost (percent of construction cost)	7.4%	7.4%	6.1%	6.7%
Revenue from power (net metering, 0.10\$/kWh)	\$2,867	\$2,867	\$2,867	\$2,867
Net Present Value	-\$95,467	-\$95,467	-\$70,477	-\$81,782
IRR	-3%	-3%	-2%	-3%
Solar Air Heating				
Estimated system size for sample bldg (m ²)	60	60	60	60
Energy from solar system (GJ)	112	112	112	112
Renewable Energy as percent building demand	11%	11%	11%	11%
Cost of solar system (\$)	\$7,104	\$7,104	\$7,104	\$7,104
Cost of solar system (percent of construction cost)	0.35%	0.35%	0.35%	0.35%
Net Present Value	\$9,352	\$9,352	\$9,352	\$9,352
IRR	15%	15%	15%	15%
Solar Hot Water (SHW) Heating				
Number of SHW panels required	23	23	23	23
System size (total panel area, m ²)	66	66	66	66
Estimated system cost, per panel	\$2,500	\$2,500	\$2,500	\$2,500
SHW system cost	\$58,636	\$58,636	\$58,636	\$58,636
SHW system cost (% of construction cost)	3%	3%	3%	3%
Energy from SHW system (GJ)	103.20	103.20	103.20	103.20
NPV	-\$40,987	-\$40,987	-\$40,987	-\$40,987
IRR	-5%	-5%	-5%	-5%

⁵³ Source: Finch, Graham et al. Energy Consumption in Mid and High Rise Residential Buildings in BC. BEST2-Energy Efficiency-Session EE3-1.

3.5.2 School

The school used in the analysis is based on a real-world development in B.C. — a 500 student capacity middle school recently constructed in Coquitlam.⁵⁴

Key figures include:

- 12,000 m² of floor space
- Construction cost: \$48,000,000
- Energy use: 0.99 GJ/m² (Lower mainland and Vancouver Island), 1.12 GJ/m² Southern Interior, and 1.78 GJ/m² in the Northern Region.⁵⁵

Results

For each technology selected, the results show that compliance with the RER can be achieved. A GSHP system would add 2% to the cost of construction (for assumed average cost of \$85/m²) and would exceed the requirement of the RER. The IRR of the GSHP is dependent on the installed cost, ranging from -9% to 16% depending on the region and cost of natural gas.

A solar PV system would add between 3.4% and 5.9% to construction costs if designed to meet the RER requirement, depending on the region.

A solar air heating system of 750 m² would comply with the RER except in the case of the northern school, where the energy intensity is higher (here, a larger system would be required for compliance). The solar air heating system provides the best economic value, with IRR figures close to 15% and very low additional cost during construction.

Table 14: School, Renewable Energy Analysis

Region	School			
	Lower Mainland	Vancouver Island	Southern Interior	Northern
Energy Intensity (GJ/m ²) ⁵⁶	0.99	0.99	1.12	1.78
Building Annual Energy Use (Total, GJ)	11,852	11,852	13,441	21,393
Ground Source Heat Pumps				
Unit RE Production (GJ/m ²)	0.47	0.47	0.47	0.47
Total RE Production (heat+cool load, GJ)	6,756	6,756	7,661	12,194
GSHP System Cost (avg - \$85/m ²)	\$1,020,000	\$1,020,000	\$1,020,000	\$1,020,000
GSHP System Cost (low - \$22/m ²)	\$264,000	\$264,000	\$264,000	\$264,000

⁵⁴ B.C. Major Projects Inventory. June 2010. Ministry of Small Business, Technology and Economic Development.

⁵⁵ Source: BC Hydro CPR 2007- Commercial, Fuel Switching, Appendix F:I

⁵⁶ Source: Finch, Graham et al. Energy Consumption in Mid and High Rise Residential Buildings in BC. BEST2-Energy Efficiency-Session EE3-1.

GSHP System Cost (high - \$165/m ²)	\$1,980,000	\$1,980,000	\$1,980,000	\$1,980,000
GSHP System Cost (% construction cost - avg case)	2.13%	2.13%	2.13%	2.13%
Net Present Value	-\$782,949	-\$327,982	-\$757,684	-\$631,237
IRR (avg case)	-6%	2%	-5%	-2%
IRR (low cost)	3%	16%	4%	8%
IRR (high cost)	-9%	-3%	-8%	-6%
Solar PV				
Installed system size (kW installed)	347	347	325	566
Renewable Energy Production (kWh)	329,232	329,232	373,364	594,240
Renewable Energy as percent building demand	10%	10%	10%	10%
Solar PV System Cost	\$1,732,801	\$1,732,801	\$1,623,322	\$2,829,712
Solar PV System Cost (percent of construction cost)	3.6%	3.6%	3.4%	5.9%
Revenue from power (net metering, 0.10\$/kWh)	\$32,923	\$32,923	\$37,336	\$59,424
Net Present Value	-\$1,096,418	-\$1,096,418	-\$917,910	-\$1,695,273
IRR	-3%	-3%	-2%	-3%
Solar Air Heating				
Estimated system size for sample bldg (m ²)	750	750	750	750
Energy from solar system (GJ)	1,399	1,399	1,399	1,399
Renewable Energy as percent building demand	12%	12%	10%	7%
Cost of solar system (\$)	\$88,802	\$88,802	\$88,802	\$88,802
Cost of solar system (percent of construction cost)	0.19%	0.19%	0.19%	0.19%
Net Present Value	\$116,895	\$116,895	\$116,895	\$116,895
IRR	15%	15%	15%	15%

3.5.3 Hospital

The hospital used in the analysis is based on a real-world development in B.C.; the 55 bed Fort Saint John Hospital in combination with a 123 bed residential care facility.⁵⁷

Key figures include:

- 15,000 m² of floor space
- Construction cost: \$48,000,000
- Energy use: 1.83-1.85 GJ/m² (Lower mainland, Vancouver Island and Southern Interior), 2.29 GJ/m² in the Northern Region.⁵⁸

Results

For each technology selected, the results show that compliance with the RER can be achieved.

The full cost of the GSHP is only 1.3 per cent of the construction costs. The IRR values (from -6% to 30%) reflect the high variability in the system installation configurations and costs; however, the analysis does indicate that compliance with the RER using GHSP technology will add significant value for some builders.

A solar PV system would add between 3.4 to 4.7 per cent to construction costs, depending on the region and could be sized to comply with the RER. Due to the high cost of the installed system, the economics of solar PV are not particularly favourable.

In the example provided, a solar air heating system of 1250 m² would provide eight to nine per cent of the buildings energy needs, which is not enough for full compliance with the RER.⁵⁹ The size of the system will depend on the design and orientation of the building. However, since solar air heating provides positive IRR figures at relatively low cost, it could be combined with other technologies to ensure the building complies with the RER.

A SHW system was also evaluated for the hospital. The system cost is \$1.5 to 1.9 million dollars (2% of construction costs).

Table 15: Hospital, renewable energy analysis

Region	Lower Mainland	Vancouver Island	Southern Interior	Hospital Northern
<hr/>				

⁵⁷ B.C. Major Projects Inventory. June 2010. Ministry of Small Business, Technology and Economic Development.

⁵⁸ Source: BC Hydro CPR 2007- Commercial, Fuel Switching, Appendix F:I

Energy Intensity (GJ/m ²) ⁶⁰	1.85	1.83	1.85	2.29
Building Annual Energy Use (Total, GJ)	27,729	27,435	27,790	34,407
Ground Source Heat Pumps				
Unit RE Production (GJ/m ²)	0.47	0.47	0.47	0.47
Total RE Production (heat+cool load, GJ)	15,805	15,638	15,840	19,612
GSHP System Cost (avg - \$85/m ²)	\$1,275,000	\$1,275,000	\$1,275,000	\$1,275,000
GSHP System Cost (low - \$22/m ²)	\$330,000	\$330,000	\$330,000	\$330,000
GSHP System Cost (high - \$165/m ²)	\$2,475,000	\$2,475,000	\$2,475,000	\$2,475,000
GSHP System Cost (% construction cost - avg case)	1.31%	1.31%	1.31%	1.31%
Net Present Value	-\$773,332	\$275,123	-\$772,357	-\$667,138
IRR (avg case)	-2%	7%	-2%	-1%
IRR (low cost)	8%	30%	8%	11%
IRR (high cost)	-6%	1%	-6%	-5%
Solar PV				
Installed system size (kW installed)	811	802	671	910
Renewable Energy Production (kWh)	770,247	762,085	771,952	955,746
Renewable Energy as percent building demand	10%	10%	10%	10%
Solar PV System Cost	\$4,053,934	\$4,010,973	\$3,356,312	\$4,551,169
Solar PV System Cost (percent of construction cost)	4.2%	4.1%	3.4%	4.7%
Revenue from power (net metering, 0.10\$/kWh)	\$77,025	\$76,208	\$77,195	\$95,575
Net Present Value	-\$2,565,100	-\$2,537,916	-\$1,897,831	-\$2,726,593
IRR	-3%	-3%	-2%	-3%
Solar Air Heating				
Estimated system size for sample bldg (m ²)	1,250	1,250	1,250	1,250
Energy from solar system (GJ)	2,332	2,332	2,332	2,332
Renewable Energy as percent building demand	8%	9%	8%	7%
Cost of solar system (\$)	\$148,004	\$148,004	\$148,004	\$148,004
Cost of solar system (percent of construction cost)	0.15%	0.15%	0.15%	0.15%
Net Present Value	\$194,826	\$194,826	\$194,826	\$194,826
IRR	15%	15%	15%	15%
Solar Hot Water (SHW) Heating				
Number of SHW panels required	630	624	632	782
System size (total panel area, m ²)	1,765	1,746	1,768	2,190
Estimated system cost, per panel	\$2,500	\$2,500	\$2,500	\$2,500
SHW system cost	\$1,575,506	\$1,558,810	\$1,578,992	\$1,954,934
SHW system cost (% of construction cost)	2%	2%	2%	2%
Energy from SHW system (GJ)	2,772.89	2,743.51	2,779.03	3,440.68
NPV	-\$1,101,277	-\$1,089,606	-\$1,103,714	-\$1,366,497

⁶⁰ Source: Finch, Graham et al. Energy Consumption in Mid and High Rise Residential Buildings in BC. BEST2-Energy Efficiency-Session EE3-1.

IRR -5% -5% -5% -5%

3.5.4 Large commercial building

The large commercial facility used in the analysis is based on a real-world development in B.C.; a large box-store constructed in Campbell River.⁶¹

Key figures include:

- 15,329 m² of floor space
- Construction cost: \$32,000,000
- Energy use: 1.02 GJ/m² Lower mainland, 1.01 GJ/m² Vancouver Island, 1.09 GJ/m² Southern Interior, and 1.27 GJ/m² in the Northern Region.⁶²

Results

For each technology selected, the results show that compliance with the RER can be achieved.

The full cost of the GSHP is for an average construction approximately 4% of the construction costs. The IRR is 17% for Vancouver Island, where the cost of gas is higher than on the mainland and there are annual energy cost savings to be realized. In other regions, there are annual operating cost savings but they do not entirely offset the additional cost of construction (this is reflected in the IRR values that are smaller or negative).

A solar PV system large enough to achieve compliance on its own would add 10 per cent to construction costs. The IRR ranges from -2% to -3% in the case provided.

A solar air heating system of 1000 m² would provide over 10 per cent of building energy needs, ensuring compliance with the RER, at an IRR of 15%.

Table 16: Large commercial, renewable energy analysis

Region	Large Commercial			
	Lower Mainland	Vancouver Island	Southern Interior	Northern
Energy Intensity (GJ/m ²) ⁶³	1.02	1.01	1.09	1.27
Building Annual Energy Use (Total, GJ)	15,619	15,507	16,698	19,417
Ground Source Heat Pumps				
Unit RE Production (GJ/m ²)	0.47	0.47	0.47	0.47
Total RE Production (heat+cool)	8,903	8,839	9,518	11,068

⁶¹ B.C. Major Projects Inventory. June 2010. Ministry of Small Business, Technology and Economic Development.

⁶² Source: BC Hydro CPR 2007- Commercial, Fuel Switching, Appendix F:I

⁶³ Source: Finch, Graham et al. Energy Consumption in Mid and High Rise Residential Buildings in BC. BEST2-Energy Efficiency-Session EE3-1.

load, GJ)				
GSHP System Cost (avg - \$85/m2)	\$1,302,965	\$1,302,965	\$1,302,965	\$1,302,965
GSHP System Cost (low - \$22/m2)	\$337,238	\$337,238	\$337,238	\$337,238
GSHP System Cost (high - \$165/m2)	\$2,529,285	\$2,529,285	\$2,529,285	\$2,529,285
GSHP System Cost (% construction cost - avg case)	4.05%	4.05%	4.05%	4.05%
Net Present Value	-\$992,543	-\$399,084	-\$975,383	-\$932,141
IRR (avg case)	-6%	2%	-5%	-4%
IRR (low cost)	3%	17%	3%	5%
IRR (high cost)	-9%	-3%	-9%	-8%
Solar PV				
Installed system size (kW installed)	457	453	403	514
Renewable Energy Production (kWh)	433,858	430,742	463,833	539,367
Renewable Energy as percent building demand	10%	10%	10%	10%
Solar PV System Cost	\$2,283,465	\$2,267,061	\$2,016,667	\$2,568,413
Solar PV System Cost (percent of construction cost)	9.1%	9.1%	8.1%	10.3%
Revenue from power (net metering, 0.10\$/kWh)	\$43,386	\$43,074	\$46,383	\$53,937
Net Present Value	-\$1,444,847	-\$1,434,468	-\$1,140,327	-\$1,538,729
IRR	-3%	-3%	-2%	-3%
Solar Air Heating				
Estimated system size for sample bldg (m2)	1,000	1,000	1,000	1,000
Energy from solar system (GJ)	1,866	1,866	1,866	1,866
Renewable Energy as percent building demand	12%	12%	11%	10%
Cost of solar system (\$)	\$118,403	\$118,403	\$118,403	\$118,403
Cost of solar system (percent of construction cost)	0.47%	0.47%	0.47%	0.47%
Net Present Value	\$155,861	\$155,861	\$155,861	\$155,861
IRR	15%	15%	15%	15%

3.6 Conclusion

Meeting the proposed 10% RER is possible given the technologies on the market today. This analysis looked at certain technologies, building types and regions, but was not a comprehensive overview of all possible compliance paths.

The main conclusions are summarized in the tables and discussion below. We use the internal rate of return (IRR) to compare the different scenarios because this allows us to compare their relative profitability, independently from the size of the capital investment. Table 17 and

Table 18 present a comparison of IRRs for the five technologies considered and seven building classes.

In addition to the sources of uncertainty associated with the assumptions made in calculations (see section 3.1), it important to remember that is IRRs and NPVs are tools to assess and compare different capital investment based on their capacity to generate revenues (or savings). While making a return on the investment is a nice addition, it is not the only factor considered when making decisions on purchases and home improvements. Most home improvements do not generate any revenue solely based on cash flows, and many customers are willing to pay a premium for more ecological products, whether they reduce future costs or not. Other factors are also to be considered to assess worthiness of a project, increased self reliance, air quality, protection from increase in energy costs, leadership, and a desire to reduce one’s contribution to climate change.

Table 17 Range of internal rate of return (IRRs) for the three residential building types and four renewable technologies considered.

	Row House Electric Heat	Single Family/Duplex Electric Heat	Single Family/Duplex Gas Heat
Pellet Stove	****	****	N/A ⁶⁴
Ground Source Heat Pump (GSHP)	**	**	*
Solar Domestic Hot Water (SHW)	**	**	*
Solar PV	*	*	*

**** 10% or more
 *** 3% to 10%
 ** -3% to 3%
 * -12% to -3%

⁶⁴ Because forecasted pellets prices are higher than forecasted natural gas prices for the mainland, there are no cost savings associated with these systems and the IRR cannot be calculated.

Table 18 Range of internal rate of return (IRRs) for the four commercial building types and four renewable technologies considered.

	Hospital	Large Commercial	MURB	School
Solar Air Heating⁶⁵	****	****	****	****
Ground Source Heat Pump^{66,67} (GSHP)	* to ****	* to ****	* to ****	* to ****
Solar PV	**	**	**	**
Solar Hot Water Heating⁶⁸ (SHW)	*	not modeled	*	not modeled

**** 10% or more
 *** 3% to 10%
 ** -3% to 3%
 * -12% to -3%

3.6.1 Key conclusions:

- All analyzed technologies can meet the 10% requirement; many exceed this value (for example GSHP and pellet systems, which meet up to 65% of total energy demand).
- Other options are possible as well but were not considered here, including other forms of biomass, biogas, air and water source heat pump, micro-hydro, wind, waste heat recovery, and diverse configurations of district heating and cooling.
- The business case for heating technologies increase significantly when heat is electric, because of its significantly higher forecasted cost (on average about 2.5 times that of natural gas).
- Cost effectiveness varies. Because of their affordability, the technologies with the best business cases are solar air heating (for commercial buildings), and pellet stove (for residential buildings), with IRRs over 10%.
- Solar PV for commercial buildings, and solar hot water (SDHW) and ground source heat pumps (GSHP) for electrically heated residential buildings are in the

⁶⁵ These are assumed to displace natural gas as the energy source for space or water heating.

⁶⁶ These are assumed to displace natural gas as the energy source for space or water heating.

⁶⁷ The wide range of IRRs values for ground-source heat pumps (GSHP) in commercial building is due to the fact that the cost of these system varies highly for commercial buildings depending on the type of system and its size. Cash flows for a low, average, and high cost system were estimated.

⁶⁸ These are assumed to displace natural gas as the energy source for space or water heating.

next IRR range, with IRR between -3% and 3%. Given the many assumptions required for this analysis, and the uncertainty associated with these, we deem that these technologies could be cost effective, in the right context.

- Given the low cost of natural gas, no technology has a solid business case for residential buildings that are gas heated. Solar hot water for commercial, despite its relatively low cost, does not have a strong business case either because it also displaces natural gas.
- The main difference in the economics between the four regions considered is due to the higher price of natural gas, which is ~43% higher on Vancouver Island than in other regions. Variations in heating demand (~25% higher in northern area) also contribute to some regional variation. Differences in renewable resources (eg solar potential) are secondary effects.

4. Potential GHG Savings

Research and modeling completed in Phase I for the Green Building Leaders project shows that a 10 per cent RER, when applied in municipalities in B.C., can result in GHG emission reductions. For both Dawson Creek and Campbell River, the proposed RER was modeled assuming a 10 percent reduction in energy use from each building.⁶⁹ The actual reductions may be more when the RER is applied in reality.

4.1 Dawson Creek

GHG emissions from residential and commercial buildings are expected to increase by 24 per cent between 2010 and 2030 if new policies are not put into place to alter those trends. Within this 24 per cent, emissions from residential and commercial buildings increase by 17 per cent and 37 per cent respectively.

The model assumes a mix of residential building types and energy sources, though the greatest numbers are in the single family, gas heat group. In the commercial model, small office and small retail are two of the largest groups within a sector that also includes food retail, hospitals, education facilities and other commercial facilities.

Key information on the growth in the residential and commercial sector is provided in the following two tables:

Table 19: Residential buildings for RER modeling, Dawson Creek

Residential	2020	2030
New homes since 2010	1,755	3,689
Pre-2010 homes	4,569	3,733
Homes that have been renovated	2,383	5,009
Homes that have been sold (excluding new homes)	1,921	4,037

⁶⁹ The building stock estimates are based on the information that staff supplied (on number of homes and buildings and typical numbers of annual sales, renovations and teardowns). Per building energy consumption estimates are derived from a number of sources including the BC Hydro and Terasen Gas Conservation Potential Reviews.

Table 20: Commercial buildings for RER modeling, Dawson Creek

Commercial (1000 ft ²)	2020	2030
New Floorspace since 2010	1,418	3,147
Pre-2010 Floorspace	2,589	2,116
Floorspace Renovated	1,445	3,206
Floorspace sold (excluding new floorspace)	1,112	2,468

The renewable energy requirement, as described, does not influence the performance or operation of existing buildings. Rather, it is targeted at the new building sector. In Dawson Creek, based on estimated growth rates, 1119 homes would be subject to the requirement before 2030, resulting in 200 tonnes of GHG reductions. In the commercial sector, over 5 million square feet of floor space would be subject to the requirement, resulting in 1700 tonnes of GHG reductions.

These findings are summarized here.

Table 21: Buildings and floorspace influenced by RER, Dawson Creek

Impact of 10% RER	Residential (#homes)	Commercial (1000 ft ²)
Buildings and floor space impacted in 2020 ⁷⁰	532	2256
Buildings and floor space impacted in 2030	119	5007

Table 22: GHG savings from RER, Dawson Creek

	Residential	Commercial	Total
GHG Savings (Mt) (2020)	0.1	0.8	0.9
GHG Savings (Mt) (2030)	0.2	1.7	1.8

⁷⁰ Includes major renovations in addition to new construction

4.2 Campbell River

GHG emissions from homes and buildings in Campbell River are projected to increase by 17 per cent in 2030, relative to 2010 levels. The renewable energy requirement would lead to reductions in GHG emissions in the building sector.

The model assumes a mix of residential building types and energy sources, though the greatest numbers are in the single family, gas heat group. In the commercial model, small office and small retail are two of the largest groups within a sector that also includes food retail, hospitals, education facilities and other commercial facilities.

The average growth rate for the residential and commercial sector used in modeling is 1.1 and 2.6 per cent, respectively. Key information on the growth in the residential and commercial sector is provided in the following two tables:

Table 23: Residential buildings for RER modeling, Campbell River

Residential	2020	2030
New Homes since 2010	3,884	8,212
Pre-2010 homes	9,676	7,906
Homes that have been renovated	5,085	10,751
Homes that have been sold (excluding new homes)	3,801	8,036

Table 24: Commercial buildings for RER modeling, Campbell River

Commercial (1000 ft ²)	2020	2030
New Floorspace since 2010	4,028	9,244
Pre-2010 Floorspace	6,164	5,036
Floorspace Renovated	3,579	8,215
Floorspace sold (excluding new floorspace)	6,519	14,961

In Campbell River, based on estimated growth rates, 2,742 homes would be subject to the requirement before 2030, resulting in 300 tonnes of GHG reductions. In the commercial sector, over 13 million square feet of floor space would be subject to the requirement, resulting in 3400 tonnes of GHG reductions.

Table 25: Buildings and floor space influenced by RER, Campbell River

Impact of 10% RER	Residential (#homes)	Commercial (1000 ft ²)
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Buildings and floor space impacted in 2020 ⁷¹	1,297	5,896
Buildings and floor space impacted in 2030	2,742	13,532

Table 26: GHG savings from RER, Campbell River

	Residential	Commercial	Total
GHG Savings (Mt) (2020)	0.2	1.5	1.7
GHG Savings (Mt) (2030)	0.3	3.4	3.7

⁷¹ Includes major renovations in addition to new construction

5. Overview of the RER Options

This section describes the options that were considered in the design of each aspect the RER. The recommended RER option is described in section 6.

The questions and discussion presented here represent a synthesis of both internal discussions and discussions with key stakeholders in the development of the RER, and do not represent the final RER (for the text of the proposed RER, please see section 6). For a full description of the consultation process, see section 8.

5.1 Technical Aspects of the RER

In most jurisdictions where RERs have been implemented, they have been articulated as buildings requiring a certain component of their energy needs from on-site renewable energy technologies. In other words, a component of the projected energy use for the building must be from renewable resources, and must be harnessed using technologies that are integrated with the building itself or with community-based systems.

5.1.1 RER Focus – Renewable energy or GHG

Two units of measure and compliance were considered in the design of the RER: energy and GHGs. In other words, a building would be required to reduce either its energy demand or its GHG emissions compared to a baseline through the use of eligible renewable energy sources.

A focus on a renewable energy production and use as a primary objective of the RER, opens the opportunity to motivate energy efficiency improvements in buildings (see section 1.5) and can result in reductions to both heating energy (primarily natural gas) and electricity. An energy-based RER is more likely to be inclusive of all energy service providers and utilities (who can also benefit from energy efficiency improvements) and is more likely to engage all sectors of the renewable energy industry (including both renewable heat and power). For the building industry, it also allows greater flexibility and creativity in identifying an approach that meets — or surpasses — the requirement in a cost-effective manner.

Other advantages of a focus on energy as a main unit of measure in a RER include:

- familiarity for the building sector. The building sector already uses and/or has access to a variety of data and tools to benchmark, measure and evaluate building energy performance.

- Replicability across jurisdictions: the GHG profile of energy sources (electricity in particular) is highly variable from province to province – a focus on energy will facilitate sharing lessons and experiences across jurisdictions (from both a policy and private stakeholder perspective) if other regions follow B.C.’s lead and adopt a RER.

While designing an RER with GHGs as the main unit of compliance ensures that the climate change objectives of the RER are achieved, there is concern that the added complexity of a GHG focus would slow the adoption of the policy (in BC, and across jurisdictions) without conferring a significantly greater environmental outcome. A GHG focus would also miss opportunities to reduce reliance on energy sources that have ecosystem impacts aside from GHG emissions.

5.1.2 Eligible sources of renewable energy

Alignment with the definitions of renewable energy in B.C. legislation was determined as optimal in order to avoid conflict or confusion.

As per the *BC Clean Energy Act* (2010), qualifying energy sources include biomass, biogas, geothermal heat, hydro, solar, ocean, wind or any other prescribed resource, as per Section 1 of the 2010 *BC Clean Energy Act*. Energy sources can be used for heat, cooling or power requirements.⁷²

In addition, the capture of waste heat is included as an eligible source of energy.

Mixed fuel or multi-fuel systems were also considered for compliance. Here, it was noted that in some cases, builders or operators might require or desire a back up energy supply to ensure energy supply security. In these cases, operators could maintain flexibility to use either conventional or renewable supplies, but consideration should be given to ensuring a minimum amount of renewable energy is used.

The phasing-in of renewable energy supply may be necessary depending on construction and commissioning plans (e.g. natural gas as the primary energy source at the time of occupancy with a planned transition to biomass or biogas feedstock post-occupancy).

5.1.3 Performance or prescriptive-based

The main differences between a performance and prescriptive system are outlined in Table 27.

⁷² The *BC Clean Energy Act* of 2010 defines “clean or renewable resource” as biomass, biogas, geothermal heat, hydro, solar, ocean, wind or any other prescribed resource. See Bill 17 – 2010, *BC Clean Energy Act*, available online at: http://www.leg.bc.ca/39th2nd/1st_read/gov17-1.htm#part1.

	Description	Key Conclusions
Performance-based Renewable Energy Requirements	<p><i>How it works</i></p> <ul style="list-style-type: none"> - Developers are required to use on-site renewable energy to reduce their building's anticipated greenhouse gas emissions by a specified percentage (e.g. 10%). - Applicable to new construction and major renovations. - Provides a high degree of flexibility in how a developer wants to meet the requirement (different types of renewable energy, energy efficiency, district heating systems). <p><i>Examples:</i> Merton, London</p>	<p>Costs have been much lower than anticipated and the perceived risks of renewable energy have been reduced.</p> <p>While they were designed to spur renewable energy, the biggest effect has been to encourage energy efficiency and district heating.</p> <p>Combined impact of London's policy has been a 26% reduction in greenhouse gas emissions - even though the policy only requires a 10% reduction.</p>
Prescriptive Renewable Energy Requirements	<p><i>How it works</i></p> <ul style="list-style-type: none"> - Developers are required to install a certain capacity or meet a certain amount of a building's demand with a specified type of on-site renewable energy. - Most frequently used for solar energy. - Often applies developments of all sizes. <p><i>Examples:</i> Spain, Israel</p>	<p>Requirements have been set as high as 70% of domestic hot water demand needing to be met by solar.</p> <p>Evidence that regulations applying to new construction have also enabled a viable market in existing stock.</p>

Table 27 – Performance vs. Prescriptive Approach

Based on feedback from stakeholders, a performance-based approach is desirable. This improves the acceptability of the program from region to region (e.g. resources and resource prices may vary by region) and encourages innovation among builders and developers. A performance approach ensures builders have the flexibility to select the most cost-effective option available and to choose a compliance path they are comfortable implementing. A solely prescriptive approach is not desired.

The performance-based approach is favoured, because:

- It provides necessary flexibility for developers; and
- The prescriptive path adds complexity that may require differentiation between regions as resources and cost-effectiveness vary.

That being said, representatives from the development community and local governments have indicated that an accompanying document outlining some examples of compliance paths would be useful to accompany a performance-based approach (see section 8 for more on accompanying resources).

5.1.4 Setting the bar – minimum RER levels

Assuming that BC's RER will be based on a minimum percentage of total building energy (a performance-based approach) this section describes the options for such a percentage.

Merton, U.K., implemented a 10 per cent RER that was in line with national targets to meet 10 per cent renewable energy by 2010 and net zero GHG buildings by 2016.⁷³

To determine a target for B.C. 10 per cent was used as a starting bar. Through workshops, consultation and modeling it was determined that a 10 percent requirement would result in a deviation from business as usual in terms of GHG reductions at the community level as well as in the building sector. It was also determined that most market-ready technologies would be able to generate at least 10% of the average building's energy needs.⁷⁴

The RER is to be reviewed at regular intervals and can be adjusted up or down based on experience and community or industry feedback.

For both mixed fuel systems and phased-in systems (discussed in section 5.1.2) the recommended approach is to maintain the 10 per cent RER as the standard.

5.1.5 Treatment of energy efficiency

As outlined in section 1.5, there are three main approaches to encouraging energy efficiency in conjunction with a RER:

1. Set the RER as a per cent of the total energy used by a building.
2. Set the RER as a per cent of total energy used by a building, but vary the RER percentage based on energy performance.
3. Use energy performance to set requirements and allow a mix of renewable energy and energy efficiency to meet them.

As mentioned in section 1.5, this report only assessed option 1, which is discussed below.

With option 1, increased energy efficiency is not a specific requirement of the RER. However, builders and developers are encouraged to recognize that measures taken to lower energy requirements can be cost effective as they can reduce projected building energy consumption, and (subsequently) the amount of energy required for compliance with the RER. Builders are strongly encouraged to maximize energy efficiency during the building design phase.

Since the 10 per cent requirement is based on the total projected energy use of the building, any investment in improved energy efficiency will by definition reduce the absolute amount of energy required from renewable sources and technologies. The benefit of pursuing additional energy efficiency (beyond the building code minimum requirements) is the opportunity to scale down the size or supply (and consequently the

⁷³ Zirnhely, Hayes and Matt Horne. On-site Renewable Energy Requirements for Buildings. 2010. Available online at <http://www.greenbuildingleaders.ca/publications>

⁷⁴ See section 3 for a more in-depth discussion of this.

cost for the builder or operator) of the chosen renewable energy system. This could result in significant cost savings with respect to the renewable energy system size. For example, a more efficient building may require a less expensive two-panel SWH system for compliance, whereas without efficiency improvements a three-panel system would be required.

5.1.6 Under what legislation or act could the RER be implemented?

This question is examined in more detail in section 2 of the report.

5.2 Establishing the scope of the RER

5.2.1 What buildings are (or are not) required to comply with a RER?

In general, all residential and commercial buildings would be expected to comply with the RER. Industrial buildings are not considered within the scope of the RER since the energy consumption patterns of the building can be highly variable (depending on intended end-use) or difficult to define and create a baseline.⁷⁵

While both Merton and East Gwillumbury provide, or plan to provide, exemptions for small developments and relatively small residential/commercial buildings (e.g. less than 6-10 houses for residents, or buildings that are less than 1000sq.m), this is viewed as unnecessary, and even undesirable in B.C. This conclusion was reached at staff and council workshops where it was decided that:

- Increasing the number of exemptions increases administrative burdens and costs;
- Exemptions that have been used or proposed in East Gwillumbury or Merton would not transfer well to rural B.C., since most developments would not have to comply with the RER;
- Increasing or adding exemptions can create confusion and conceivably even discord amongst developers and between developers and the local government as the exemption is discussed and negotiated; and
- A lower requirement (e.g. less than 10 per cent renewable energy) would be a better approach than providing exemptions.

Exemptions that are based on cost of compliance are not included in the proposed design since there are relatively low-cost compliance options for residential and non-residential buildings. See section 3 for more information on cost implications. Determination of what constitutes acceptable justification of non-compliance would increase the

⁷⁵ For the same reasons, some types of commercial buildings should also be considered for exemption, but this is beyond the scope of this project.

administrative burden for local government and the addition of exemptions adds complexity to the program design when simplicity and ease of implementation is preferable.

5.2.2 Off-site renewable purchases

The purchase of off-site renewable energy, from third party energy suppliers (e.g. Bullfrog Power) is discussed in this section.

5.2.2.1 Electricity

The province of B.C. already has programs in place that are designed to promote the input of clean, renewable energy to the provincial grid, including targets and provisions under the *Clean Energy Act*. This includes investments in clean energy and technology, a bioenergy strategy, self-sufficiency in electricity and achievement of net-zero GHG emissions from electrical generation facilities.

Programs such as Calls for Power and the Standing Offer Program exist to promote external electricity grid additions, whereas a RER's objective is to increase the uptake of renewable energy in the building sector directly at the building site or on a community scale.

Therefore, the purchase of electricity from offsite systems connected to the provincial electricity grid is not an acceptable compliance path.

5.2.2.2 Thermal energy

Connecting to a small, locally based third party utility offering renewable district thermal energy services would be considered an acceptable compliance path. See also section 5.3.4 for a discussion on mixed fuel systems.

5.3 Compliance and assessment

It is important to ensure that there exists sufficient local capacity to assess and evaluate building compliance. The following approaches focus on using existing practices and requirements in order to streamline the process for builders and reduce additional administrative burden on local governments.

5.3.1 How should compliance be measured?

It is important for all stakeholders that the research and reporting burden of complying with the RER does not increase significantly. With this in mind, the most straight-forward approach seems to be to use current industry standard modeling tools. Builders and developers would demonstrate through use of industry standard modeling tools (eg. Modeling Software accepted and listed in ASHRAE 90.1 Standard) the total projected building energy requirements. This is to be accompanied with evidence that 10 per cent of the projected building energy requirements will be met with eligible renewable energy. Builders and developers will, however, be required to have their energy use and

renewable energy models completed and/or verified by approved third-party sources or companies (e.g. certified housing advisors⁷⁶ or professional engineers).

Mixed use and phased development projects will need to be considered separately. It is beyond the scope of this project to determine compliance measurement for these projects.

5.3.2 Options for ensuring compliance and penalties for non-compliance

Assuming that the preferred approach of a provincial opt-in regulation is followed and implemented at the local level, the inclusion of penalties for non-compliance is limited to the mechanisms available at the local level. The use of local-level mechanisms to ensure compliance ensures that builders and developers have improved access to decision-makers through local channels. However, there is no desire for additional applications and permitting process.

As a result of these considerations, there are two opportunities for local governments to ensure compliance:

- At the building design stage, local governments can withhold development permits until such time that developers have demonstrated a plan for compliance with the RER.
- At the building occupancy stage, local governments can withhold occupancy permits if compliance with the RER is not met.⁷⁷

In the latter case, local governments can request that builders provide proof that the renewable energy system has been installed and commissioned by obtaining a commissioning report from the certified installed or professional engineer.

5.3.3 Can continued compliance (post-occupancy) be ensured?

Compliance beyond the issuance of an occupancy permit would be difficult to include in the RER, since there are few mechanisms to ensure continued compliance. The addition of compliance checks post-occupancy would also increase the administrative burden.

⁷⁶ Natural Resources Canada maintains a database of certified home energy advisors.
<http://www.oee.nrcan.gc.ca/residential/personal/new-home-improvement/contact-advisors.cfm>.

⁷⁷ Some local governments have chosen to dispense the occupancy permitting process. In these cases, the local governments who have opted in to the RER must determine a suitable permitting process and compliance path for builders.

However, monitoring and evaluation of continued compliance as well as actual energy use and performance (that is, when compared with modeled energy use during design stage) would be valuable for RER evaluation. Local and/or provincial governments could include provisions for RER evaluation and review that consist of revisiting design versus actual building performance and compliance rates post-occupancy.

5.3.4 Compliance of mixed-fuel or multi-fuel systems

Feedback from stakeholders indicates that inclusion of mixed- or multi-fuel systems might be necessary for builders and developers as well as operators in order to meet the required energy supply security and reduce the risk of supply interruptions or shortages. In some cases, it may be necessary to commission a building using conventional energy supplies before the renewable energy system is operational. For example, at the time of occupancy, when the handling facility for a biomass storage system is not complete, the building must rely on natural gas from a multi-fuel system. Accordingly, use of mixed fuel systems would be permitted.

5.3.5 Credits and trading

In order to meet the RER, developers may want to trade “credits” between buildings or sites. For example, a developer may wish to use “extra” renewable energy on one building and consider the “extra” to be a credit towards another building. For ease and transparency of implementation, the following principles should be applied.

Future/other projects - The distribution or generation of credits for buildings that exceed the RER that might be used for compliance in future construction or traded with other developers should not be included in the RER design.

Trading between buildings in one development - Builders may aggregate total projected or modeled energy use as well as renewable energy supply for compliance in a single, multi-building development. This allows some flexibility within a property or site in cases where it is cost effective to exceed compliance for one or more individual buildings in lieu of all buildings on the site meeting the 10 per cent requirement. For example, one set of buildings under one permit may have a significant advantage as a solar resource due to their site-specific, physical orientation.

5.4 Timing for RER

Implementing the RER as soon as possible is preferable to ensure as many buildings as possible are being built to the RER specifications. Consultations with developers indicated that developers are used to having a 6-8 month lead-time between introduction and enforcement of new building regulations. During this time, supporting resources and education would need to be provided. See section 8 for a further discussion of the supporting resources that would need to accompany the RER.

It would also be possible to delay the implementation of the RER until more technologies are market ready. However, as is shown in section 3, many options are available now.

6. The Proposed RER

The proposed RER at its highest level would be articulated as follows.

All new residential and commercial buildings must meet 10 per cent of their estimated annual energy consumption with eligible on-site or community-based renewable energy. Compliance is mandatory in jurisdictions where the requirement has been adopted.

Section 6 synthesizes the discussion from section 5 into the preferred approach for the key elements of the RER.

6.1 Definitions

The following definitions and terms are used in the description of the RER:

- **Renewable energy:** Any prescribed resource, as per section 1 of the 2010 *BC Clean Energy Act*, including, but not limited to: biomass, biogas, geothermal heat, hydro, solar, ocean, wind.
- **The site:** the property upon which the building is being constructed.
- **On-grid:** Buildings or communities that are connected with the primary provincial electricity or natural gas infrastructure.
- **Off-grid:** Buildings or communities that do not have access to provincial infrastructures, are self-sufficient in their energy needs and/or rely on a local, isolated grid for electricity.
- **On-site energy generation:** Heat or power generation that occurs on the building or building property.
- **Off-site energy generation:** Heat or power generation that occurs outside the boundaries of the building property and is not integrated with the building(s) energy system(s).
- **Community-based energy:** Systems that harness or generate energy (thermal or electricity) for use by one or more buildings within the same locality.

6.2 Compliance flexibility

Builders and developers may choose how to meet 10 per cent of the building's energy needs using any of the eligible technologies as described in section 6.6.

6.3 Energy efficiency

Energy efficiency that exceeds the current building code or measures taken that serve to reduce the projected building energy requirements are not specific conditions included in the RER.

6.4 Inclusions

All new residential and commercial buildings are required to comply with the RER.

6.5 Exemptions

No exemptions are permitted.

6.6 Eligible technologies

Eligible technologies must:

- Use renewable energy (as defined in section 6.1);
- Provide thermal (heating or cooling) or electrical power, or combination thereof;
- Not result in a net increase in energy demand from natural gas and electricity utilities' infrastructure; and
- Not result in an increase in GHG emissions.

6.6.1 On-site technologies

All technologies or approaches that harness renewable energy and are integrated with the building and building systems (e.g. heating, cooling, ventilation, water heating, electrical) are eligible. Examples include, but are not limited to: solar water heating, solar air heating, solar photovoltaic, small scale wind turbines, small scale hydro power, air and ground source heat pumps, wood or pellet heating, other biofuels.

6.6.2 Community-based technologies

Community-based energy systems that provide energy for more than one building or residential unit must provide 10 per cent of the projected energy requirement for the

overall development, and must provide some renewable energy to all buildings or units in the development.

6.6.3 Off-site systems

Thermal

The purchase of thermal energy (i.e. space heating and/or cooling service, hot water) from utilities is an eligible compliance path, provided the energy delivered is from an approved renewable source or from the capture of waste heat.

Electricity

The purchase of grid-sourced renewable energy from electricity retailers is not an eligible compliance path.

6.7 Integration with Provincial Electricity Grid

Eligible technologies can be integrated with the provincial electricity grid. Should the technology provide more electricity than can be used by the building or development in question at any point in time, electricity can be provided to the electricity grid for distribution through provincial infrastructure.

6.8 Compliance

6.8.1 Determining energy use and renewable energy supply

Before construction begins, builders and developers must demonstrate the total projected building energy requirements of each new building in question through the use of industry standard modeling tools. This is to be accompanied with evidence that 10 per cent of the projected building energy requirements will be met with eligible renewable energy. Building modeling must be completed and/or verified by an approved third party.

6.8.2 Compliance mechanisms

Builders must submit the requirements in section 4.8.1 prior to obtaining a building permit. Where applicable, and as a condition of the occupancy permit, post-construction building inspectors are needed to ensure that construction followed the building plan submitted and that all renewable systems have been commissioned by a professional engineer or certified installer.

6.8.3 Phased compliance

Builders and developers are permitted to suspend full compliance on phased district energy projects in the event that: one, immediate compliance is not feasible and that, two,

the energy source(s) at the time of construction can be converted to a renewable source in a reasonable timeframe.

6.8.4 Multiple buildings, credits and trading

Transfer of credits, offsets, trading or other mechanisms designed to accumulate or exchange credit among builders or developers or buildings are not eligible compliance paths. All new buildings that are required to comply will be expected to meet the requirement in accordance with the principles in section 5.3.5.

Multiple buildings on the same site or under the same development permit may aggregate total projected building energy requirements and total supply of renewable energy.

6.9 Enforcement

Local governments will manage compliance and enforcement, the mechanisms of which should align with existing systems where possible. Possible enforcement mechanisms include: withholding development permits at building design stage until such time that developers have demonstrated a plan for compliance with the RER, or withholding occupancy permits at building occupancy stage if compliance with the RER is not met.

6.10 Timing of RER

The RER should be effective 6-8 months after publication for those local governments that chose to sign on.

6.11 Review of the RER

6.11.1 Purpose of review

The purpose of the RER is to support B.C.'s clean energy and climate change objectives. Therefore, it is anticipated that the RER will be updated to reflect provincial objectives and to continue to encourage the adoption of renewable energy in the building sector.

6.11.2 Timing of review

The RER will be reviewed: one, if and/or when provincial clean energy or climate change policies are modified; two, if provincial building codes are changed; or three, if a period of a maximum of three years has passed since the last review.

In addition, the RER will be reviewed 1 year after adoption.

7. Implementation of the Recommended RER

7.1 Implications for various parties

If the recommended RER is enacted through the opt-in legislative option, as recommended in section 2, there will be on-the-ground implications for various parties in each community. Specifically, this section outlines the potential on-the-ground implications of an opt-in RER for local governments, developers, contractors, real estate agents and the public. This section also outlines the barriers to successful RER implementation as well as potential solutions.

7.2 Barriers and Solutions

The barriers to the implementation of a RER can be divided into six broad categories:

1. Lack of staff capacity;
2. Lack of qualified professionals;
3. Lack of knowledge;
4. Incremental costs;
5. Lack of market demand; and
6. Insufficient support from local governments.

7.2.1 Lack of staff capacity

Barrier: The ability of a local government to administer and enforce a RER may be limited by its staff capacity. Although a RER is designed as an opt-in regulation at the provincial level, the administration and enforcement, as mentioned previously, happens at the local level, and includes, among other duties, paperwork processing and building inspections.

Solution:

- Provision of provincial resources and/or incentives to allow for additional staff capacity if necessary.
- Development of efficient administration and monitoring processes at the provincial level to help local governments incorporate the administration of the RER into existing local government processes. This could include the development of specific checklists to help local government staff to assess if a building met the RER, or clear reference materials for both staff and developers.
- The minimization of requirement exceptions.

7.2.2 Lack of qualified professionals

Barrier: In some communities, there may be a limited number of qualified professionals (e.g., contractors, energy modelers, engineers, architects) to provide design, installation and maintenance services for building energy efficiency and renewable energy technologies.

Solutions:

- The provincial government can play a role in providing education and training to developers, contractors, and other professionals to develop the necessary on-the-ground capacity to install and maintain renewable energy and energy efficiency technologies.
- Local governments can provide education and training opportunities for developers, contractors, and other professionals in their region.

7.2.3 Lack of Knowledge

Barrier: Lack of knowledge and understanding by the staff, developers, real estate agents and the public of legal elements of the RER.

Solution:

- Development of clear reference materials for local government staff, developers, real estate agents and the public by the provincial government. These materials should include detailed technical guidance documents, as well as marketing and communication tools.

Barrier: Lack of knowledge on how to incorporate energy efficiency and renewable energy technologies into building designs to comply with a RER (particularly for smaller developers).

Solutions:

- The provincial government can play a role in developing clear technical reference materials to complement the RER. These technical documents should clearly outline the potential ways to comply with the requirements of the RER in each region of B.C. The development of clear documents to communicate the compliance requirements (such as checklists) is critical.
- The technical documents should also be accompanied with effective outreach and communication by both the provincial government and the local government. Either level of government could provide educational resources such as workshops, and other opportunities for education and training.
- The integration of compliance requirements for the RER into existing processes already familiar to developers and contractors in order to facilitate compliance.

Barrier: Lack of acceptance from developers, real estate agents, buyers for the energy efficient or renewable energy features. Given that the addition of renewable energy technology *could* increase the incremental cost of a building, both developers and real estate agents are concerned about how to communicate the benefits of a building that incorporates energy efficiency and renewable energy.

Solutions:

- The provincial government or the local governments can help to develop educational, communication and marketing materials specifically designed to communicate the benefits of energy efficiency and renewable energy to the public (i.e. homebuyers).
- Both the provincial government and/or the local governments can host specific education and training workshops for real estate agents to help them understand the new requirement and how to sell it.
- The provincial government could implement a province-wide labeling system for buildings. By labeling all new buildings with an Energiguide score that communicates the energy efficiency and the use of renewable energy in the building, this would give a concrete tool to developers, contractors and real estate agents to communicate the benefits to the public. This would also give a mechanism to compare the energy efficiency and use of renewable energy of homes and buildings.

7.2.4 Incremental costs

Barrier: Administrative cost to the local government to administer and enforce a RER could be a barrier. Local governments currently administer the application of the building code and typically manage and execute building inspections and permits.

Solution:

- Incentives from the provincial government can help cover any incremental costs to local governments to administer the RER.

Barrier: Potential additional incremental cost to developers to incorporate additional energy efficiency and renewable energy technologies into building design.

Solutions:

- Provincial incentives can help cover any incremental costs in the short term. As the market for renewable energy technology matures, the cost for renewable energy will decrease and the need for provincial government incentives will fall as well. However, as developers and contractors initially learn how to comply with a RER in a cost-effective way, incentives to cover some or all of the incremental costs of incorporating renewable energy technology into a building may help overcome this barrier.

- Local government incentives (eg. density bonus, permit fee rebates, etc)
- Utility incentives, such as a better feed-in tariff, net metering and district energy incentives

7.2.5 Lack of market demand

Barrier: Lack of a market for buildings with additional energy efficiency or renewable energy features could be a barrier. Developers, contractors and real estate agents have identified that members of the general public are not unified in demanding homes with higher energy efficiency or with renewable energy systems, and therefore, may not be uniformly willing to pay higher prices for these features.

Solutions: To transform the market for greener homes and buildings, a combination of strategies is likely necessary. The theory of market transformation recognizes that different tools are likely necessary to continue to transform the market for greener homes and buildings in support of a RER. Key tools include:

- Development of educational, communication and market materials targeted to the general public,
- Provincial incentives to help developers and contractors overcome key barriers, and incentives for the public to purchase a higher energy efficiency homes or buildings,

7.3 Supportive resources and materials

As outlined in the sections above, there are some key barriers that may affect the successful implementation of a RER for local governments, developers, contractors, real estate agents and the public. The provincial government has a roll to play in providing the necessary support to enable successful implementation of a RER. Key resources and materials include:

- Incentives and grants to help overcome additional costs associated with implementing an RER.
- Educational, communication and marketing materials for local governments, developers, contractors, real estate agents and the public. It is critical that clear technical documents are developed for local governments, developers and contractors to ensure that the information is available to those parties implementing the RER. Communication, education, and marketing materials are also critical to provide to those entities who may be buying or selling the homes and buildings.
- Education and training for local government staff, such as building inspectors, developers and contractors to ensure that those entities understand how to comply with the RER, and that they are aware of the tools and resources available.

8. Engagement Process

Key design questions were established for the development of the renewable energy requirement, as described in section 4, and a series of iterative workshops were held to collect feedback from key stakeholders as the RER was being developed. Through the process of this project, the following stakeholders were engaged:

- Staff, council and key community stakeholders in the following communities:
 - Dawson Creek, and
 - Campbell River.
- Representatives from the following ministries⁷⁸:
 - Ministry of Energy and Mines:
 - Buildings and Safety Branch, and
 - Electricity and Alternative Energy Division;
 - Climate Action Secretariat;
 - Ministry of Community, Sport and Cultural Development;

8.1 Summary of Local Government Engagement

Two local governments, Dawson Creek and Campbell River, were selected to participate in-depth in the initial design stages of the renewable energy requirement. By consulting with two key communities during the design process, feedback on the development of the renewable energy requirement could be integrated early in the design process.

Dawson Creek and Campbell River were selected as the in-depth partner communities because:

- Both staff and Council in Dawson Creek and Campbell River have demonstrated leadership in searching for solutions to improve the energy efficiency and the use of renewable energy in buildings, and both have a high degree of commitment to being leaders on this file in B.C.
- Dawson Creek and Campbell River identified that exploring requirements for renewable energy on new buildings is a key priority.
- Dawson Creek and Campbell River are from two very different regions in B.C., which could affect the feedback provided on the renewable energy requirement. Our goal was to work with two communities that represent a

⁷⁸ BC Building Code (Christine Webb and John Nicol – attended Meeting #1 only, due to other work commitments), BC Ministry of Energy and Mines (Geoff Turner, Janice Larson), BC Ministry of Environment (Ted Sheldon, Scott Cutler), BC Ministry of Community, Sport and Cultural Development (Heike Schmidt), Solar BC/BCSEA(Nitya Harris), BC Hydro (Toby Lau, Katherine Rossokha, Hamideh Abolghasemi Riseh) Local workshops attended by municipal staff and council (Dawson Creek, and Campbell River).

range of communities in B.C.

8.1.1 Iterative workshops

As the renewable energy requirement was being developed, a series of iterative workshops were held to collect feedback from key stakeholders.

The following workshops were held as part of the consultation and design:

- Design workshop with staff and Council in Dawson Creek;
- Design workshop with staff and Council in Campbell River;
- Design workshop with the Task Force on Energy and Emissions (including key invited developers and contractors) and the Development Advisory Commission in Campbell River; and
- Design workshop with developers, contractors, building inspectors and real estate agents in Dawson Creek.

The feedback obtained through these workshops is summarized in Appendix A.

8.2 Summary of provincial government Engagement

Three meetings were held with staff from provincial government ministries that were most relevant when considering renewable energy requirements in buildings, as noted above. The timing and objectives of the three meetings were to:

Meeting 1: November 1, 2010

1. Bring together a group of people all working on or interested in Renewable Energy (RE) requirements;
2. Identify the role of each party in developing a Renewable Energy requirement; and
3. Gather feedback on the work plan and next steps.

Meeting 2: January 20, 2011

1. To discuss ideas on potential design elements for a renewable energy requirement for houses and buildings in B.C., including feedback from:
 - Workshops with staff and council in Dawson Creek and Campbell River, and
 - Email responses from provincial government staff.
2. Provide ideas in preparation for stakeholder workshops in Dawson Creek and Campbell River.

Meeting 3: May 3, 2011

1. To discuss feedback from community workshops on potential design of renewable energy requirement, and
2. Provide ideas for next phases of the renewable energy requirement initiative

The meetings provided an opportunity for provincial government staff to provide suggestions and feedback on the project and the design of the renewable energy

requirement. The staff appreciated these opportunities, based on their comments during and after the meetings.

A summary of these meetings is included in Appendix A.

9. Recommendations

9.1 Recommendations for adoption of RER

Based on the research and feedback collected through this project, Pembina recommends that B.C. adopt a RER. The RER should be adopted as an opt-in regulation, similar to the implementation of the solar hot water readiness regulation and should follow the principles and framework suggested in section 6 – The Proposed RER. At its highest level, the RER should be expressed as:

All new residential and commercial buildings must meet 10 per cent of their estimated annual energy consumption with eligible on-site or community-based renewable energy. Compliance is mandatory in jurisdictions where the requirement has been adopted.

9.2 Next steps for adoption

The next steps for adopting the RER in B.C. include the following:

- Build support and awareness for the RER among additional local governments, developers, renewable energy industry and real estate agents.
- Provide briefings to relevant B.C. provincial government ministries on the findings of the project.
- Identify and undertake any areas of further research that are needed to answer any outstanding questions and move the RER forward.
- Develop supporting resources for local governments and developers to accompany the implementation of the RER.
- Develop higher energy efficiency standards in conjunction with the RER to ensure maximum effectiveness in its implementation
- Implement the RER as soon as possible, taking these necessary steps into account

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Appendix A – Meeting Summaries

Summary of meetings with Campbell River and Dawson Creek

Workshops were held with staff and council in both Dawson Creek and Campbell River in December 2010. Follow-up workshops with key stakeholders in the development community were held in March 2011 in both Campbell River and Dawson Creek.

Four key questions were presented for feedback in each workshop. A summary of the discussion is provided below.

Question #1: Should a renewable energy requirement be performance-based or prescriptive?

Feedback from staff and council workshops: Both Dawson Creek and Campbell River observed that the benefit of the performance path is that it accounts for regional differences, and allows developers to implement locally-appropriate, cost-effective technology options. Both groups also highlighted that some technology options may not be appropriate in all regions of the province, which makes the implementation of a prescriptive requirement challenging. However, both groups also identified that a prescriptive requirement may be simpler for developers to implement. The conclusion reached by both groups was that it might be best to have both a performance and a prescriptive path, as long as both paths resulted in equivalent outcomes. Dawson Creek suggested articulating a performance requirement but including an appendix or schedule outlining a prescriptive compliance path. This approach allows developers to use cost-effective, locally-appropriate technology but at the same time provides a clear path forward for developers who want or need clear direction.

A suggestion raised in the Campbell River workshop was that the requirement could be designed to include incentives to go beyond the minimum requirement, in either a performance or prescriptive compliance path. The policy could establish a series of incentives up to 100 per cent of the building energy coming from renewable energy. This approach would help encourage additional renewable energy technology implementation, and does not take away the market advantage of those developers already doing “more” (i.e., already incorporating energy efficiency, renewable energy, and other green features into their buildings).

Feedback from community stakeholder workshops: In general, the feedback from the community stakeholder meetings echoed the feedback from the staff and council workshops. The performance approach was seen as the best way to ensure that regional differences were taken into account and that there was flexibility provided to developers and builders to choose the most cost-effective options for their own regions. However, there was support for a combination approach (i.e., having both a performance and prescriptive compliance path). It was flagged that some of the smaller developers and builders (as well as individuals building their own homes) may not have access to the resources and information necessary to comply with a performance-based renewable energy requirement. It was suggested that a guidance document be developed that outlined several potential ways to comply with the regulation in each region. Information for developers, contractors, builders and real estate agents was seen as critical.

Question #2: Should there be exemptions?

Feedback from staff and council workshops: Both Campbell River and Dawson Creek were less supportive of exemptions than expected. Both communities identified that if the Merton or East Gwillimbury exemptions were implemented in Dawson Creek and Campbell River, a large proportion of all developments would be exempt from the requirement.

In Dawson Creek, the consensus was that there shouldn't be either cost or size exemptions in a renewable energy requirement. Developers should be able to account for the renewable energy requirement at the design phase, and therefore should be able to make design decisions to comply with the requirement. Exemptions may create an uneven playing field for developers, and would increase the administration costs to administer the requirement. Dawson Creek staff and council would prefer to see a lower renewable energy requirement rather than to include exemptions in the requirement.

In Campbell River, overall, staff and council did not support size or building-type exemptions. Some participants in the workshop agreed that cost exemptions allow for some flexibility for developers. The suggestion was raised that rather than including an explicit cost or size exemption, incentives could be used to encourage greener developments.

Feedback from community stakeholder workshops: Again the feedback from the stakeholder workshops echoed the feedback from the staff and council workshops. In this case, the stakeholders from the building industry identified that exemptions in the requirement would create an uneven playing field for developers in the community, in other words, there would be the incentive to "game the system". There was a clear preference expressed for the requirement to apply consistently for all builders and developers. Incentives to comply — or to go beyond the minimum requirement — were seen as preferable to exemptions.

Question #3: How do you ensure compliance?

Feedback from staff and council workshops: Both Campbell River and Dawson Creek generally agreed that energy savings, modeled using nationally available tools, as a condition of a building permit and compliance audit that would be completed as a condition of the occupancy permit could be an appropriate compliance system. However, in both workshops, several questions were raised that need to be addressed.

Additional compliance questions:

- Who is responsible for completing the compliance audits?
- How in-depth are the audits?
- Who pays for the audits?
- What is the incremental cost to the local government?
- Do local governments need to create enabling bylaws for the compliance process?
- Who sets the bar to measure the renewable energy output? Should we assume the manufacturer's optimal output? Should we assume a percentage of the optimal output?
- What happens if buildings do not comply?
- What training or tools are needed to ensure compliance?
- How do we ensure on-going compliance?

Feedback from community stakeholder workshops: The compliance model as suggested by the Pembina Institute was generally agreed to in the stakeholder workshops. The stakeholders from the building industry also identified that the penalty for non-compliance needs to be clear. In general, there was agreement that if the building were built-to-plan (and this building was modeled to comply with the renewable energy requirement), the building should pass the compliance audit. It should not be necessary to measure the energy output of the renewable energy system in order to pass the compliance audit.

It was also raised the issue that there will be a cost to builders and developers to comply with any renewable energy audit, and that incentives to help cover this cost may initially help developers and builders to absorb this cost.

Key questions that were raised in these workshops:

- Who will pay for the audits?
- What happens if the house doesn't comply after it's built?

Question #4: Are there local government staffing capacity challenges for the implementation of the renewable energy requirement at the local government level? (Staff and council workshops only).⁷⁹

⁷⁹ This question was only asked at the Dawson Creek workshop due to time constraints at the Campbell River workshop. This question was not asked at the community stakeholder meetings either as it was not relevant to that audience.

Feedback from staff and Council workshops: In general, if the onus is placed on developers to provide the information, Dawson Creek staff generally has the capacity to administer a renewable energy requirement. However, reporting to staff from the developers needs to be clear and consistent. Outsourcing some of the auditing or compliance verification tasks could ease any staff capacity challenges. In general, if exemptions are included in the requirement, staff capacity could become more challenging.

Dawson Creek staff and Council identified that if a renewable energy requirement is implemented at the provincial level, provincial resources should be provided to assist local governments in administering the requirement.

Question #4: Are there other barriers to the implementation of a renewable energy requirement? What potential solutions can you suggest to overcome the barriers? (Community stakeholder workshops only).

Feedback from community stakeholder workshops: The final question in the community stakeholder asked participants to identify additional barriers and solutions to the implementation of a RER. A summary of the barriers and solutions are outlined below.

Barriers	Solutions
Cost for builders and developers to comply with an RER	<ul style="list-style-type: none"> - Incentives (i.e., tax incentives or grants) for builders to comply. - Incentives (i.e., tax incentives or grants) for home-buyers to purchase energy efficient homes.
Lack of awareness about energy efficiency and renewable energy	<ul style="list-style-type: none"> - Education and marketing targeted at home-buyers, real estate agents and/or developers.
Low cost of energy in B.C.	<ul style="list-style-type: none"> - Increase the cost of energy to make efficiency and renewable energy measures more attractive.
Perceived (un)reliability of technology	<ul style="list-style-type: none"> - Demonstration projects in the community. - Promote the use of simple, proven technology options.
Lack of trained energy auditors and contractors in some regions	<ul style="list-style-type: none"> - Education and training for auditors and contractors.

Summary of meetings with Provincial Government staff

The staff that attended the meetings provided feedback on the potential design of the RER, legislative options for implementation, and the process that Pembina undertook. The following notes provide general considerations and opinions from staff but not consensus statements; the feedback was requested and provided as part of an evolving dialogue rather than final recommendations or official positions.

Potential design

Many staff noted that energy efficiency should be high priority and wanted to ensure that RER did not hinder efforts on energy efficiency. However, some staff noted that if the renewable energy policy were part of energy performance standards (rather than as a specific renewable requirement) renewable energy would likely not be installed by most developers.

Staff saw advantages for the performance-based approach based on general trends in regulations, but also recognized a need for clear information for builders on how to comply

Costs

Staff were interested in getting more information on costs and benefits, particularly the cost and performance from actual projects on the ground. Cost was important for determining design requirements, but the staff were not able to provide specific requirements for cost effectiveness tests.

Exclusions

Most staff indicated that exclusions would likely be needed for a RER and were surprised at the feedback from local government staff (generally against use of exclusions). The provincial government staff did not provide specific reasons or situations where exclusions would be necessary,

Legislative approach

Feedback was solicited from provincial government staff on preferred options for legislative change, but little specific feedback was provided. A couple staff members noted that they were unsure of whether the legislative authority for a RER existed in the building code or local government act. A couple staff also noted that provincial-level approach would not suit all municipalities due to different conditions in the different municipalities.

Process

Staff were positive about the process undertaken in the project. While some staff felt that they did not have time to participate in all meetings, the staff that joined appreciated the opportunity to be part of discussions at the idea and design generation time. Staff that could not make meetings were interested in outcomes and requested minutes and reports on progress of the initiative. Provincial staff

were particularly interested in feedback from local government staff and developers in the two communities.