Bridging to the Future in Squamish, BC

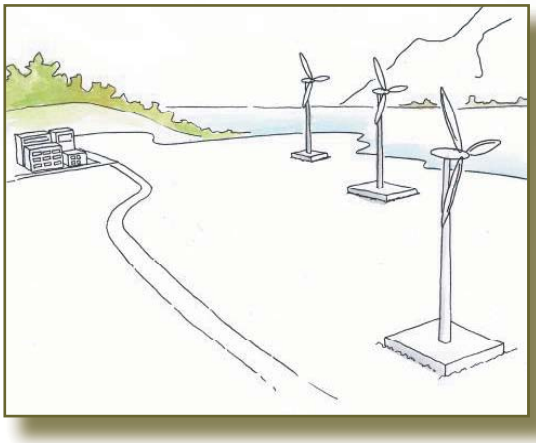
Summary Report

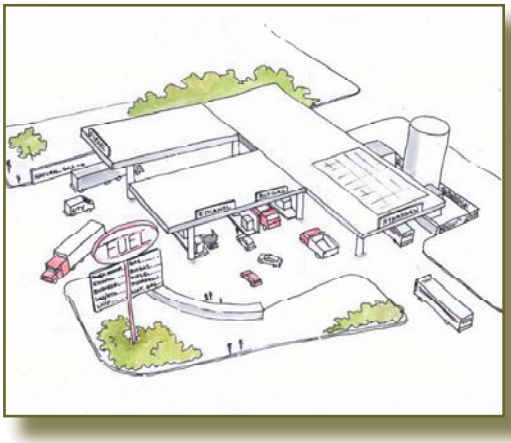
New Directions for Energy System Design

Prepared for District of Squamish

March 2007

Prepared by
The Sheltair Group





"The living city is not an island: its metabolism is interlinked to surrounding ecosystems and its people and culture networked to other viable urban cells to form a living and developing tissue, a net primary producer, not a parasitic system."

Bridging to the Future in Goa, India

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Summary

This report is intended to be a first milestone on the pathway to energy sustainability for the District of Squamish. The report explores three important new directions for the District: a collaborative approach to integrated energy system design; a rational framework for managing the process of change over the longer-term; and 'catalyst' projects and policies for quickly directing the community onto a sustainable pathway. The report provides the District with a tool for taking next steps and for setting new directions if necessary.

Bridging to the Future (BttF) is a project occurring not only in Squamish, but also in four other urban regions around the world where urban regions are interested in taking leadership in energy planning and energy technology. A sustainable energy pathway for Squamish is arguably an essential element of the community's future livability, prosperity and resiliency. It offers a tool for protecting the public interest in an era of deregulation and globalization, and provides a way for energy systems to contribute to climate change protection, air quality, community economic development, and long-term resiliency. However, the challenges are great, including conflict between multiple jurisdictions and mandates, complexity and a rapid pace of change in technology, and a lack of financing and expertise needed to get things started. The new directions for Bridging to the Future in Squamish are intended to overcome these obstacles.

A collaborative is based on a commitment by participants to periodically meet to share plans and discuss options in a positive way. To the extent that consensus is achieved, it then becomes possible to align plans and policies, and use each participant's unique power and influence to achieve a shared set of goals. A collaborative approach can be useful in energy system design at three scales, or 'tiers': (1) corporate operations such as civic buildings and fleet, (2) municipal services such as water and roads, and (3) regional systems such as housing stock, and electrical power. A collaborative approach is essential at the regional scale because so many major players are involved. Ideally, a regional energy collaborative engages four sectors: a) government (all levels), b) civil society and utilities, c) academia and d) private firms.

As part of this project, an interdepartmental committee was formed within the District of Squamish, and an informal collaborative was formed for designing for Tier 3 (regional systems). The committee and the collaborative were both brought together for two workshops in Squamish in May, 2006, on energy system design. It is now recommended that the interdepartmental committee be transformed into an internal Energy Management Task Force for the District; and that the District explore financing for a part-time energy manager to coordinate the work of the Task Force. It is also recommended that the energy manager draft terms for an on-going regional collaborative, and schedule an official meeting of the collaborative to meet with Council and the public, and to finalise a vision for sustainable energy systems.

A rational framework for energy system design provides the region with clarity on the stages in design, from visioning to implementation, and with a process for learning and 're-alignment' so that the contents can adapt over time. The framework proposed for Squamish is referred to as an 'adaptive management

framework'. The framework supports the political leadership in Squamish, by generating workable policies that address the community's priority issues. The framework contains five stages: *scoping* the situation, *envisioning* and target-setting, *exploring* the options, *implementing* the best ideas and *monitoring* the results. This report contains much of the information needed to complete the scoping and envisioning stages. The predominant energy source at present is hydro electricity, closely followed by gasoline and then natural gas. Greenhouse gas emissions per capita in Squamish were 7.62 tonnes/year in 2005, somewhat higher than surrounding communities because of the large amount of commuting, but lower than the Canadian average because of the low-carbon electricity generated in BC. Under a business as usual scenario, greenhouse gas emissions are expected to increase by approximately 64% by 2025.

Energy resources were surveyed and the district has an exceptionally broad range of potential renewable energy resources, most of which appear to be commercially viable on superficial examination, despite the relatively low prices for energy in BC. The District already has a number of vision statements and energy-related objectives from its Growth Management Study, draft Official Community Plan, and Smart Growth on the Ground Concept Plan that are consistent with setting new directions for energy system design. In addition, Council passed a 12-Step Pledge to reduce greenhouse gas emissions in February, 2007. The Pledge indicates that the District will strive to meet, and ideally, exceed Kyoto Protocol targets and timelines for reducing global warming by taking action in District operations and the community by committing to initiating 12 key actions.

A target-setting workshop was held in February, 2007 to consider targets for energy and greenhouse gas emissions. A set of four bold, 'over-arching' targets was subsequently adopted by Council on March 27, 2007 (see Table 1). These are longer-term targets that are set for 2015 and 2030.

Table 1: Four Visionary Targets

One Tonne Total	Total greenhouse gas emissions per capita for regional energy systems are reduced to less than one tonne by 2030.
Stepping Towards Net Positive Energy	Total renewable energy generation on-site exceeds the total energy consumption for buildings and transportation by 2015.
Self-reliance & Security for Critical Energy	On-site infrastructure can separately satisfy critical energy needs, including essential lighting, communications & space conditioning.
Adaptable & Diverse Homes & Businesses	At least 5 distinct energy sources each provide 5% or more of the total energy for buildings and total energy for transportation by 2015.

A set of shorter-term targets for 2010 were also considered and subsequently adopted by Squamish Council in March, 2007 following the target-setting workshop. The BC Buildings Plan for Energy Efficient Buildings has established targets to assist in the reduction of greenhouse gas emissions and energy consumption in new developments and existing buildings. The District of Squamish adopted all six of the provincial targets at the March 27, 2007, Council meeting. At the same meeting, Council also joined the Federation of Canadian Municipalities (FCM) Partners for Climate Change Program.

The third key direction proposed for *Bridging to the Future in Squamish* is to initiate at least 4 prominent catalyst projects. Catalyst projects help to accelerate positive changes by allowing everyone to quickly learn about the new directions and actually try out different technologies and policies. The projects are designed to demonstrate and reinforce themes that will hopefully apply to many future developments. Each catalyst project is described in terms of its basic features and its role in emphasising new directions.

The first project is an extension of the recent Smart Growth on the Ground Concept Plan - it is proposed that a specific block (or cross-section of blocks) be redeveloped as a showcase of the many design innovations for streetscapes, landscapes, and technologies. The second project is a small-scale demonstration of a responsive, local network for electricity; electricity is generated locally at several different locations – house, vehicle, river, wind – and then managed with smart meters to create a system that responds to changes in available energy, that ensures critical needs are met even in the event of emergencies, and that allows renewable energy and local investments to power new growth in the community. The third project is a district energy system that evolves in parallel with the waterfront developments, and that begins by providing buildings with hot water from natural gas boilers, and evolves into electrical co-generation powered primarily by biomass. The fourth catalyst project is a multi-modal, multi-fuel transportation hub that becomes a new gateway to Squamish; it is intended as a showcase of alternative transportation technology and fuels, and a nexus for a wide variety of roads, trails, and rail transportation.

The following are recommended next steps for working towards completing and implementing a full community energy plan:

1. Develop an action plan as part of the community energy plan to achieve the short-term (2010) and long-term (2015 and 2030) targets and to implement Council's 12-step Pledge for Reducing Greenhouse Gas Emissions
2. Draft a terms of reference for the proposed regional energy collaborative, approach organizations for participating in the collaborative, and hold an inaugural meeting
3. Approach potential partners and convene a meeting to develop a concept plan for each catalyst project
4. Conduct a feasibility study and concept plan for each project, seeking funding support if necessary for research and writing
5. Transform the interdepartmental committee into an internal Energy Management Task Force for the District

6. Explore financing for a part-time energy manager to coordinate the work of the District's Energy Management Task Force and to provide the secretariat function for the regional energy collaborative.

1. Introduction

This report is intended to be a first milestone on the pathway to energy sustainability for the District of Squamish. The report explores three important new directions for the District: a collaborative approach to integrated energy system design; a rational framework for managing the process of change over the longer-term; and 'catalyst' projects and policies for quickly directing the community onto a sustainable pathway.

In addition to the District of Squamish, the BC Ministry of Environment and BC Ministry of Community Services provided funding for this project.

The collaborative approach brings together different departments within local government, and different sectors within the whole community (civil, private, academic) so that participants can align their plans and policies. The rational framework allows everyone to share a foundation of information, creating a common vision and a coordinated set of strategies that together provide the District with an integrated energy plan, climate change plan and air quality management plan. The catalyst projects and policies help to accelerate learning in those areas where new technologies and alternative approaches are most critical at present.

Preliminary research indicates that the District is well poised to benefit from new technologies such as smart growth, green buildings and sustainable infrastructure. By adopting the three new directions, it is hoped that the District will quickly become a showcase of innovative and alternative energy technology and a leading example of energy efficient planning and design. Moreover, the local area is well endowed with renewable energy sources and, thus, the potential exists for Squamish to become a more self-reliant community and a net contributor of diverse and renewable energy to other communities in the Sea-to-Sky corridor, and beyond. In general, the District of Squamish is in a position to become an exceptional example of energy sustainability.

Systems thinking is the art of simplifying complexity, seeing through chaos, managing interdependency, and understanding choice. We see the world as increasingly more complex and chaotic precisely because we use inadequate concepts to explain it. "Once we understand something, we no longer see it as chaotic or complex."
J. Gharajedaghi
Systems Thinking 2006

The focus of this report is '*energy system design*' – a term that emphasises the importance of a systems perspective and a design process. The systems perspective is the best way to manage the complexity of energy supply and demand within communities. The design process is the best way to merge human creativity and expertise with the group intelligence that comes from public participation and regular interaction between experts.

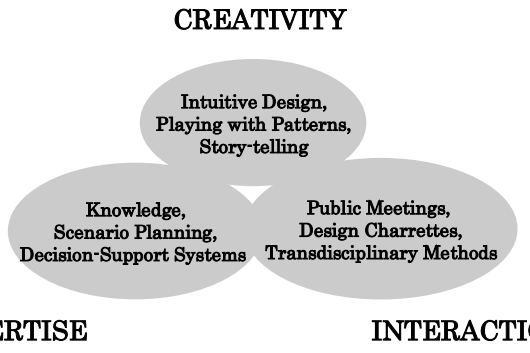

Figure 1: Energy system design is a process that blends creativity with expertise and interaction

The time horizon for this report extends to 2025-2030 – a long time in the history of a growing community like Squamish, especially in an era when technology and values are also changing at an accelerating pace. Longer time horizons make it possible to 'backcast' from an ideal energy system to the present. Thus, energy system design is about staying on the critical path, managing change, and staying in control of fate. Long-term horizons also introduce increased uncertainty and risk. Thus, energy system design is about creating systems that are adaptable, and inherently more resilient.

Structure of the report

There are three additional parts to this Introduction:

- a **background section** describes how ***Bridging to the Future*** (BttF) is a project occurring not only in Squamish, but also in four other urban regions around the world;
- a **benefits section** outlines how a sustainable energy pathway for Squamish is an essential element of the community's livability, prosperity and resiliency; and
- a **new policies section** describes various policies, programs and initiatives that are now in place to help the District move forward.

The main body of the report is divided into three sections, one for each of the new directions:

Section 2) A Collaborative Approach

Section 3) An Adaptive Management Framework, and

Section 4) Catalyst Strategies.

Each section includes three parts: (a) an overview of the basic concept, (b) a description of the work already accomplished, and (c) recommendations for the next steps. Key technical information (including the energy and GHG emissions baseline and forecast) is included in a separate technical report.

Like any design exercise, the development of sustainable energy systems for the District is best viewed as an iterative process. As the design progresses through stages, from visioning to implementation, a spiralling process helps designers delve deeper into the issues at each stage. Once the 'first cut' has been completed, it becomes possible for decision-makers to review the preliminary results and re-direct the process as necessary, before the whole design exercise is repeated once again, from top to bottom, with increasingly more detail and substance. From the perspective of iterative design, this is a milestone report that presents a first cut of what might be an energy pathway for Squamish. The report provides the District with a tool both for taking next steps, and for setting new directions if necessary.

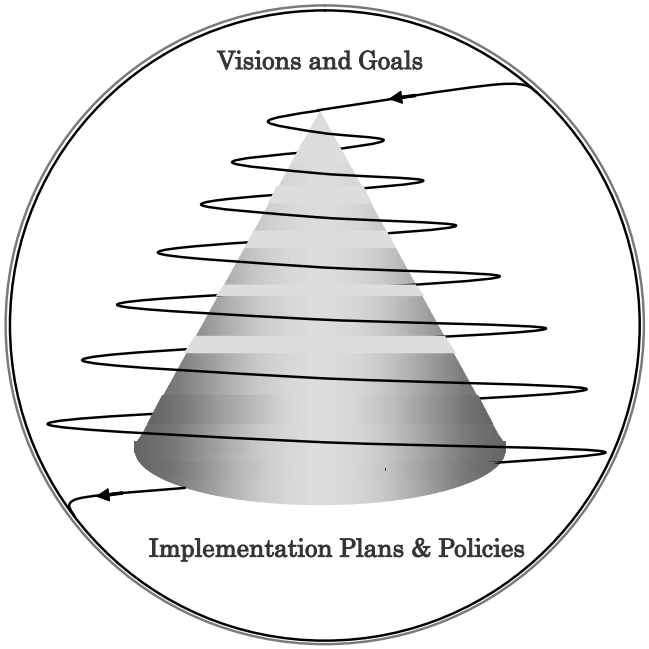

Figure 2: This report is the first iteration in a circular process; each cycle of design directs the next, creating increasing amounts of detail and substance.

Background to the Bridging to the Future Project

Bridging to the Future (*BttF*) is a Canadian-led exercise in advanced energy system design involving urban regions in Canada, the Netherlands, Japan, China, and India. The project uses innovative spatial planning tools and processes to assist regions with preparing and implementing long-term energy pathways. The pathways are intended to integrate energy conservation and efficiency into all aspects of urban design, and to use scarce and diminishing resources – like natural gas – as a bridge to a renewable and sustainable energy system.

In 2005, with support from Squamish planning staff and the B.C. Ministry of Environment, the District of Squamish was selected as the Canadian case study for *Bridging to the Future*. A number of factors help to make the District of Squamish an ideal first case study:

- the District Council and its Sustainability Corporation have adopted policies to support environmental technologies and alternative energy sources;
- Squamish has a central location in the Sea-to-Sky corridor, an area encompassing a number of BC's most successful efforts in local energy planning;
- the energy pathway can build upon the excellent spatial planning recently completed in Squamish as part of a *Smart Growth on the Ground* initiative;
- the community expects a rapid pace of growth, which creates new opportunities and imperatives for wise infrastructure investments;
- a federal department, NRCan, has undertaken extensive hazards assessment work in the region, developing tools and information useful for energy system design; and

- the District has recently completed population forecasts, and the groundwork for a new Official Community Plan, which together provide a good foundation for analysing and evaluating energy options.

Figure 3: Squamish is centrally located on the Sea to Sky corridor, a region known across Canada for leadership in energy design

BttF is the second phase of a project launched by the energy industry world-wide, through the International Gas Union. The first phase involved the creation of a 100-year sustainability plan for Greater Vancouver, as part of the *Sustainable Urban Systems Design* competition. A number of the regions and teams that competed in the creation of 100-year plans, are now collaborating and sharing ideas as part of *BttF.* In both phases, the funds provided by the International Gas Union have been supplemented by partners in the host countries. In Canada, financial contributions have been provided by the BC Ministry of Energy, Mines & Petroleum Resources, the BC Ministry of Community Services, and the Community Action on Energy Efficiency initiative.

Ultimately, it is hoped that the BttF case study in Squamish will provide other communities in Canada with a template for developing long-term energy pathways, and implementing new policies and projects. The work-to-date has already contributed to the 2006 *World Gas Conference* in Amsterdam, and the 2006 *UN World Urban Forum* in Vancouver.[1] The results for Squamish were presented in an official UN networking session titled: *Bridging to the Future: Exploring Collaborative Approaches to the Integration of Energy Systems Planning with Urban Physical Planning.*

[1] Results from other regions participating in Bridging to the Future can be found on the international web site: www.bridgingtothefuture.org

Potential Benefits and Challenges

In the 1950s and early 1960s, many of the smaller municipal power systems in BC were absorbed into the provincial system and ultimately amalgamated by W. C. Bennett to form BC Hydro (1962). Since that time, communities have come to rely upon provincially regulated, all-purpose energy utilities, and an abundant supply of hydroelectricity, natural gas and petroleum products. As a consequence, local authorities have been released from the responsibility of estimating energy supply and demand, and investing in energy infrastructure. Energy planning is now largely restricted to simply hooking up or filling up. Most municipalities and regions today lack the mandate, expertise, and budgets for energy system design. This is a problem. Over the last decade the energy situation has changed significantly. Many compelling arguments now exist for re-engaging local government in energy system design. In the case of the District of Squamish, the arguments include:

1. **Public Interest** – Energy firms and utilities in BC are increasingly being integrated into a continental marketplace, a process that is outside of local control. On the one hand, they have essential expertise and some very supportive programs. On the other hand, they are becoming less sensitive to local needs, less capable of sharing information, and less secure about long-term conditions and plans. Thus, at a time when design in Squamish needs to become long-term and integrated, trends are often developing in the opposite direction. The best solution is for the local community to take some leadership, and work in concert with many players, including BC Hydro and Terasen, to seek a long-term pathway that uses energy resources in optimal ways and that helps maintain public interest at a time of rapid change, increased foreign ownership and deregulation.
2. **Air Quality** – Air pollution is almost entirely related to energy emissions and, thus, a sustainable long-term energy system design is also a pathway to improving air quality. Squamish is located in the Sea-to-Sky airshed and 'shares its air' with the communities in the region, extending from Bowen Island to just north of Pemberton. Although air pollution in the Sea-to-Sky Corridor has not reached levels experienced in the worst parts of the Lower Mainland, the levels of contaminants are already a problem at times, and projections for future development indicate that, without preventative action, air quality will deteriorate in the future (Sharing the Air, 2005). In addition to protection of the health of residents, clean air and prevention of smog events is a priority for this region due to its economic dependence on tourism and recreation, based in part on the attraction of the outdoors as clean, natural spaces.
3. **Climate Change Protection**- a majority of Squamish's energy supply is provided by fossil fuels in the form of natural gas, propane, and transportation fuels. The burning of these fuels results in increased concentrations of carbon dioxide, methane, nitrous oxide, and ozone, trapping radiation in the atmosphere and contributing to global climate change. Other sources of GHG emissions - solid waste disposal, agriculture and industrial processes – are also present, but the real culprit is the very

high current consumption of fossil fuels. Energy system design can help a community like Squamish manage the transition to renewables, and use the precious, relatively clean and rapidly diminishing fossil fuels like natural gas as a bridge to the future.

4. **Smart Growth –** The *Smart Growth on the Ground* plan for Squamish is an important first step towards sustainable energy system design. In a location of expected rapid growth and development, the potential is especially great for Smart Growth land use patterns based upon low and medium density, pedestrian friendliness, mixed use, and distinct neighbourhoods. This style of development simultaneously improves livability while reducing dependence on fossil fuels (i.e. the automobile), and creating opportunities for more efficient energy generation and distribution within the community.
5. **Community Economic Development –** Energy system design can include investments that create local jobs and businesses, for example in retrofits of buildings and streets, and in the operation of neighbourhood or regional energy supply systems. Instead of exporting money (about $52 million per year) to purchase power and gas and petroleum from elsewhere, the money is circulated locally. Energy investments also serve to reduce lifecycle costs and increase comfort and health of buildings and infrastructure. Businesses and homes cost less to operate and the work force becomes more productive and satisfied.
6. **Resiliency and Security** – Energy systems are a part of the critical infrastructure for Squamish that is increasingly vulnerable. Lessened demand for energy can reduce the community's vulnerability to major increases and fluctuations in fuel prices, and possible fuel shortages in the future. An energy strategy can also ensure some critical amount of local energy generation to help see the community through disasters or unexpected interruptions in supply. Reduced GHG emissions help to reduce climate change – something that may threaten the tourism-based economy of Squamish, increase the potential for flooding in the estuary, or threaten the downtown area due to a rise in sea levels.

While the benefits listed above may be substantial, so too are the challenges of energy system design. Three challenges in particular stand out. Firstly, the complexity of energy technology is rapidly increasing. Planners are faced with a bewildering number of new options to consider at the local level, from photovoltaics and solar water heaters on rooftops, to fuel cells and plug-in vehicles on the roads. Secondly, the extra time and attention for energy system design can exacerbate existing problems related to inadequate financing for infrastructure, and the downloading of responsibilities. Thirdly, local governments often lack the means to implement new policies for energy systems, especially where the results may conflict with the work of other senior governments. For example, the provincial building codes cannot easily be customized to reflect local targets, the Ministry of Transport may refuse to align their long-term plans with those of local governments, or BC Hydro may be unwilling to accommodate local rate structures, local generation or the sharing of the electrical grid. These challenges emphasise the importance of clearly communicating what the District is seeking from others,

including technical guidance, financial support and business partnerships, and a cooperative policy.

New Policies and Related Initiatives

Both the Federation of Canadian Municipalities (FCM) and the Union of British Columbia Municipalities (UBCM) provide assistance to local governments engaged in energy planning and climate change protection. In addition, information and guidelines may be available from not-for-profit groups, notably the International Council for Local Environmental Initiatives (ICLEI), The Natural Step (TNS) Canada and *Smart Growth on the Ground* (SGOG).

Possibly the most significant activity now occurring at the local level is the Partners for Climate Protection (PCP) program co-sponsored by FCM and ICLEI. The PCP is a voluntary program that currently has well over 100 participants, including all provincial and territorial capital cities, and all the municipalities in the BC Lower Mainland. The program guides municipalities through five milestones, as listed in Table 1. In March 2007, the District of Squamish Council joined the PCP program. With this report and the accompanying Technical Report, the first two milestones have been completed (a greenhouse gas emissions inventory and forecast for municipal operations and the community as a whole) and high-level work on Milestone 3 has been completed (a high-level opportunities assessment and development of catalyst strategies).

At present, only two municipalities (North Vancouver and Vancouver) have moved beyond Milestone 3, and are actually implementing their climate change action plan. The PCP program provides a good template for developing action plans for climate change although, in the case of Squamish, it is desirable to expand the scope to include a more integrated and long-term approach that integrates greenhouse gas reduction with other goals, including regional air quality, community economic development and self-reliance.

Table 1: Milestones in the Partners for Climate Protection Program

Five milestones to The Partners for Climate Protection Program
Milestone 1: Create a greenhouse gas emissions inventory and forecast for both municipal operations and the community as a whole.
Milestone 2: Set an emissions reduction target.
Milestone 3: Develop a greenhouse gas emissions plan to set out how emissions and energy use in municipal operations and the community will be reduced.
Milestone 4: Implement the greenhouse gas emissions plan through collaboration amongst local government and community partners.
Milestone 5: Monitor progress and report results regarding greenhouse gas emissions.

Recently, the Federal Government, in partnership with the provinces, has begun to support investments in sustainable infrastructure by local governments. A significant portion of the tax monies from gasoline sales now being redistributed

through UBCM, will be allocated to strengthening local government capacity for Integrated Community Sustainability Planning (ICSP). Such planning efforts may include regional growth strategies and integrated air quality and community energy plans. Funds will also be used to help with on-the-ground projects, especially projects that focus on reduced greenhouse emissions, cleaner air and cleaner water. Implementation of catalyst projects for ***Bridging to the Future*** in Squamish may be eligible for funding, if such projects are including in an ICSP application.

2. A Collaborative Approach

Concept of a collaborative approach

In a collaborative process, no one is in control. Instead, a collaborative is based on a commitment by participants to periodically meet, share plans and discuss options in a positive way. This commitment is crucial to success, but does not require participants to compromise or give away any of their mandated authority, budget or independence. Only in those areas where consensus is achieved is each member of the collaborative expected to participate in a coordinated approach. To the extent that consensus is achieved, it then becomes possible to align plans and policies and use each participant's unique power and influence to achieve a shared set of goals.

The collaborative process is distinct from the more common hierarchical models of governance shown in Figure 4. The regulatory, advisory and consultative approaches are much more hierarchical. The 'free market' approach lacks any hierarchy, but is typically more fragmented and short-term than the collaborative approach. In many cases, it is possible for all these models to co-exist. For example, a regulator like the District's planning department may participate in a collaborative by 'taking off' their regulatory hat temporarily. In the collaborative, they can explore how regulations might need to be adapted to achieve new goals for the region as a whole system. Away from the collaborative, they continue to regulate, at least until changes are made through new policy.

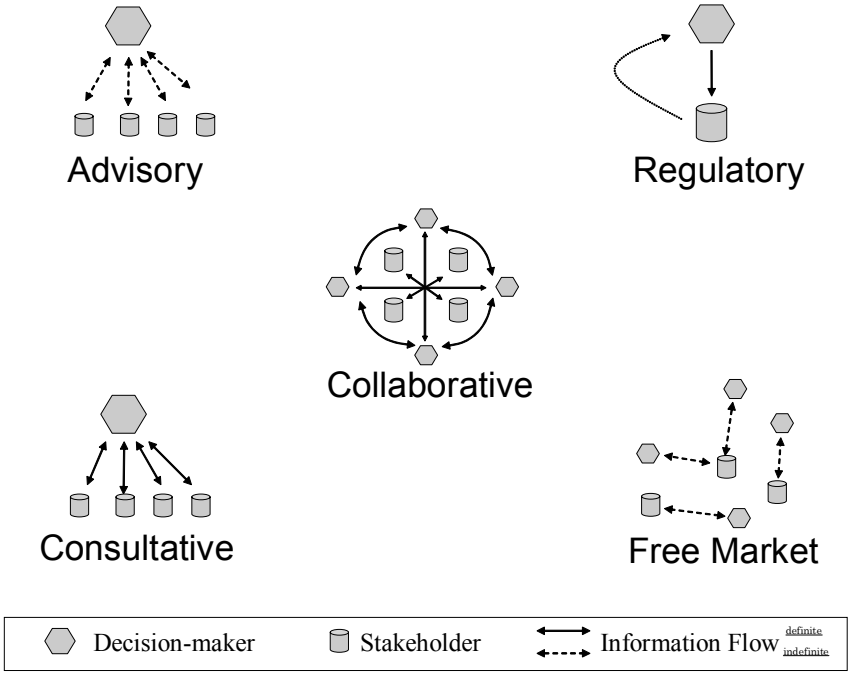

Figure 4: In a Collaborative process no one is in control, but where consensus is achieved, everyone is asked to align their individual plans and policies

Energy system design can be divided into three levels, or 'tiers', as illustrated in Figure 5. The tiers vary depending upon the scope of issues and the level of local government control. A collaborative approach can be valuable at each tier, although it becomes increasingly important as we move outwards from Tier 1 to Tier 3.

- Tier 1 is at the centre and has the narrowest scope but is fully within the sphere of influence of the District. This is where the focus of planning is on corporate operations such as management of municipally-owned buildings and vehicles. This is sometimes referred to as 'house in order' planning. Because local government has direct control over such issues, it becomes possible to take leadership initiatives such as a 'green' civic centre or a program to convert city-owned vehicles to alternative transportation fuels. Because energy is a cross-cutting issue that is affected by every department, an effective Tier 1 plan usually requires sustained input from an interdepartmental committee. Some municipalities may hire an 'energy manager' to work with all the departments in a collaborative fashion; others may invoke a special department to prepare and implement energy plans under direct supervision from the mayor or council.

Figure 5: A collaborative approach is essential at the outside or third Tier where many different policies must be integrated or aligned

- Tier 2 is the middle ring, and it is here that local government can focus on energy planning for services such as water and sewerage, or roads and transit (the latter in conjunction with BC Transit). Because of mandated authority and control over taxes, fees and other financing mechanisms, it is possible for local governments to influence energy system design and energy demand in these service areas. Many of these services are delivered in strict accordance with policy documents, each of which has its own set of objectives and timelines. Ideally, the groups responsible for such documents can become engaged in a collaborative exercise to align the documents around common and new priorities for energy such as, for example, reducing greenhouse gases, or promoting the best use of natural gas, or re-using waste energy for current functions. In essence, a collaboration among the service agencies and departments means that the energy plan is located INSIDE parts of each policy document. It becomes integrated.
- Tier 3 is the outside ring, where the focus moves to include many regional systems, including electricity, gas and privately-owned buildings and vehicles. In a mixed economy, the local government becomes just one player among many who demand or supply energy within the region. The scope of players is surprisingly large. Many regional systems, like land use and economic activity, may ultimately have a significant impact on how energy is generated and consumed within the community. Policies established by other jurisdictions – regional, provincial, national and even international – also impact energy systems. The only way to achieve effective long-term planning in this third tier is for local government to become a participant in a regional collaborative. If necessary, the local government must champion and support such a collaborative.

At the first tier, collaboration may still be useful as an efficient management style. At the second tier, collaboration becomes a means for very different departments and agencies to share knowledge, and integrate their strategies. At the third tier, collaboration becomes essential because it is the only way to achieve cooperation and synergy within a mixed economy, and across multiple jurisdictions. It can be difficult to create a collaborative process because nobody has the capacity or mandate to facilitate the process. Ideally a collaborative process for Tier 3 energy system design will engage a cross-section of participants from different sectors, including government, and the private, civic and academic sectors. This balanced approach to collaboration is illustrated in Figure 6. Each sector brings a different skill set and mindset, and may be essential to a workable long-term pathway.

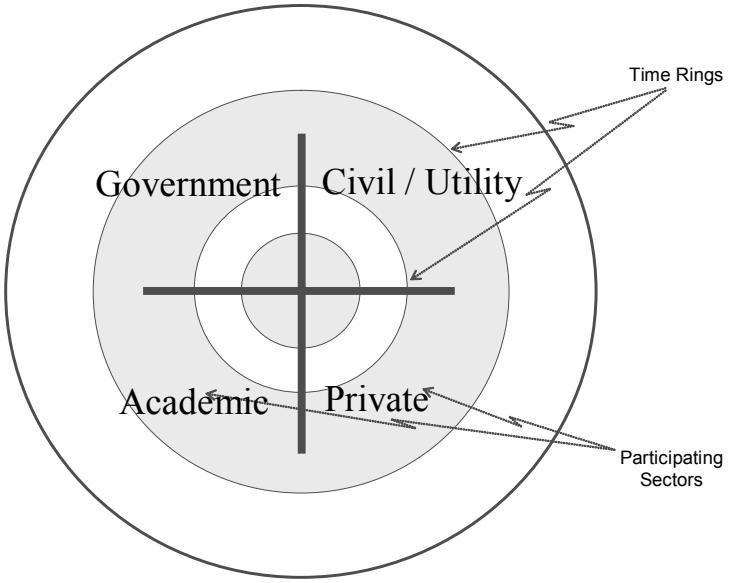

Figure 6: A Collaborative functions best when all four sectors become engaged in short and long-term strategies

Although all sectors are present, participation by local government (i.e. the District of Squamish) in such a collaborative process is very important. Participation allows the District to align government actions with an overall regional strategy so that everyone is rowing in the same direction. Local government is also recognised, as bringing a long-term mandate and many unique policy instruments, which increase the collaborative's credibility and its capacity to manage change.

Work accomplished on a collaborative approach

At the commencement of *Bridging to the Future* in Squamish, an interdepartmental committee was established, including planning, engineering, environment and the Sustainability Corporation. A staff member was designated to coordinate and communicate within the District and between the consultant team. This committee engaged with groups from outside local government in a larger exercise of scoping and envisioning energy systems for the region as part of a set of workshops that were held in May, 2006. With help from the BttF committee, many other groups were identified as potential participants in a regional collaborative on energy system design. The participants in the proposed collaborative come from all four sectors, as is shown in Figure 7.

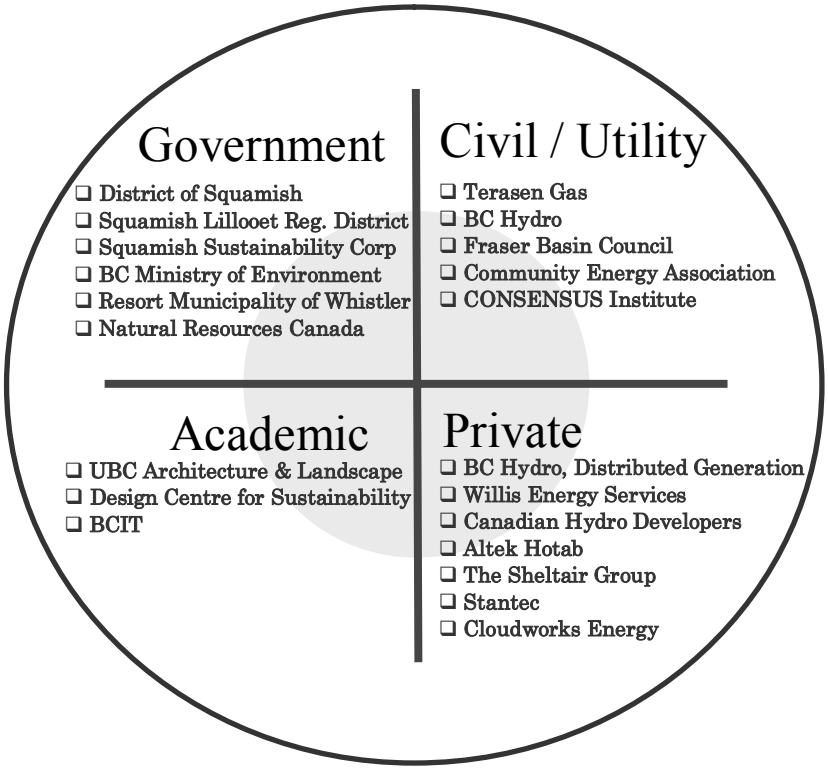

Figure 7: Tier 3 participants in the District of Squamish collaborative workshops on *Bridging to the Future*, May 2006

In May, 2006, the full list of participants from the regional collaborative participated with the District's committee in two day-long workshops in Squamish. The first workshop focused on a review of related activities by each participant and the identification of new opportunities. The second workshop involved a tour of the region, and focused on setting priorities and identifying possible partnerships and projects. The highlights of both workshops are summarised in minutes.[2]

Recommended future directions for a collaborative approach

1. **Transform the BttF committee into an internal Energy Management Task Force for the District of Squamish**
   The District has direct control over municipal corporate energy and associated air contaminants and GHG emissions. Management within the District is a shared responsibility among the relevant departments, including finance, facilities and operations. As part of supporting the visions and targets of the regional collaborative, it is recommended that a permanent interdepartmental task force be established for aligning plans related to energy system performance. The committee needs to be supported by a staff member who dedicates a percentage of their time to

[2] Minutes of May 8, 2006, and May 29, 2006, collaborative meetings have been circulated to participants and are available upon request.

this end. One of the first tasks for this Task Force will be to establish specific performance targets for the corporation. The provincial targets that were adopted by Council in March, 2007 for existing and new institutional buildings, are a starting point. Such targets should reflect the special opportunities of the corporation for providing leadership and saving money in such areas as building operations, fleet purchasing and management, lighting and employee transportation. Targets should also be consistent with the priority action areas and targets established by a regional collaborative for the community as a whole. Responsibility for achieving targets needs to be allocated to the appropriate department.

2. **Explore financing for an energy manager & a regional secretariat**
   Squamish may qualify as a PowerSmart partner with BC Hydro. If so, it may be possible to obtain funding from BC Hydro for a part-time energy manager. This funding could also help to support the work required by an energy manager to facilitate a collaborative process at all three tiers with the energy manager also serving as the regional energy collaborative secretariat.

3. **Draft terms of reference for an energy collaborative process within region**
   A suggested mandate and terms of reference for the proposed energy collaborative should be circulated stipulating the broad intent and the level of commitment desired. Quarterly meetings over the next three years may be necessary (at least until 2010), along with agreement to discuss plans and priorities and work together in areas where consensus is achieved.

4. **Schedule an inaugural regional energy collaborative meeting**
   Another meeting of key players can officially launch the collaborative, assuming the District is willing to function as the secretariat (convening meetings, taking minutes, facilitating discussion). One or more District council members should be invited to attend, in addition to members of the interdepartmental task force and all the participants from past collaborative meetings also invited. This initial meeting would ideally be coordinated to dovetail with a public meeting in the district on visions, targets, and desired outcomes. The baseline energy information and suggested targets and projects in this report should assist in the preparation for this meeting.

5. **Involve the Sea-to-Sky Air Quality Coordinating Committee in the Regional Collaborative on Energy System Design**
   In developing an implementation plan, it is recommended that the District of Squamish continue supporting and participating in the Sea-to-Sky Air Quality Coordinating Committee and endorse the draft Air Quality Management Plan (AQMP) that this committee has created.[3] The Sea-to-Sky AQMP represents an integrated approach to managing air quality, energy and GHG emissions, and provides a convenient

[3] The West Coast Environmental Law Association has prepared a report providing model by-laws for municipalities to manage local air quality: www.wcel.org/issues/climate

mechanism for developing synergies with neighbouring communities. The integrated approach is especially relevant for Squamish, given the very high percentage of energy emissions currently attributed to commuting and other trips within the corridor.

3. An Adaptive Management Framework for Energy in Squamish

The Concept of an Adaptive Management Framework

The framework used by *Bridging to the Future* is a rational, hierarchical pyramid of five layers, with alignment and feedback loops, as shown inFigure 8. The top of the pyramid is where thinking about energy systems is abstract, general and long-term; the bottom is where design and plans become specific, detailed and short-term. By following an explicit set of stages, and using standard terms, the framework helps to keep everyone on track during the process of energy system design:

- *Scoping* sets the overall context, including the baseline measurement for the core energy indicators, trends, business-as-usual forecasts and driving forces;
- *Envisioning* includes vision statements, goals and targets;
- *Exploring* involves creative thinking, design workshops, scenario planning and strategic thinking;
- *Implementing* requires use of policy tools – information, education, incentives, pricing, regulation – to manage change, and may involve special programs and projects;
- *Monitoring* involves collecting and feeding back information on key indicators, to stimulate learning and refresh each of the visions, strategies and actions at appropriate intervals; and
- *Alignment* between the layers means that any changes must cascade through the framework, and in so doing, maintain the rational connections that add strength to the plans.

The whole process of design, from scoping through to monitoring, combined with learning and realignment, helps the energy system design for Squamish improve with time and adapt to changing circumstances. Hence the term 'Adaptive Management Framework'.

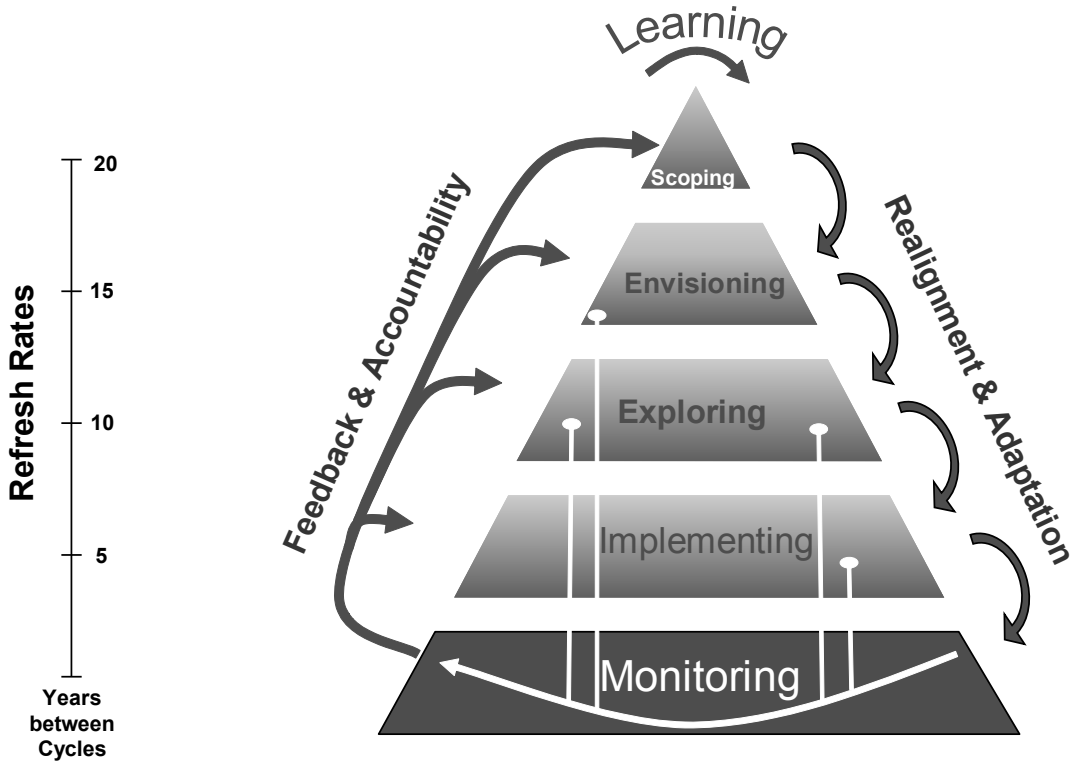

Figure 8: Technical planning requires a rational framework that aligns visions with actions and that provides periodic feedback for accountability and learning over time

The framework illustrated in Figure 8 represents a rational approach to planning, based on technical analysis and creative thought. It is not a substitute for political decision-making. The political process is illustrated in Figure 9. The political process requires much more debate and dialogue, community outreach and public participation. Politics serves to identify the most important priorities or issues for consideration within a framework. Politicians want a successful resolution of the issues of concern to their constituency. For example, community priorities may be air quality or energy reliability, or climate change or the 'new green economy'.

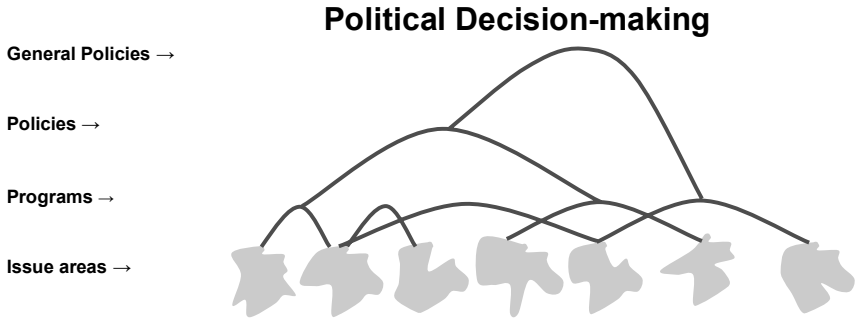

Figure 9: Identifying and resolving issues of concern are key to a successful political process

Whatever the political priorities may be, the rational framework provides an essential tool for producing strong and workable plans for improving performance over time in areas of concern. The framework is especially useful when used to organise discussion and decisions within a collaborative process where communications can be challenging due to the many different perspectives and disciplines. Thus, long-term energy planning within an urban region combines two mutually supportive processes - political priority setting and a rational framework for change management. Figure 10 illustrates this important dynamic.[4]

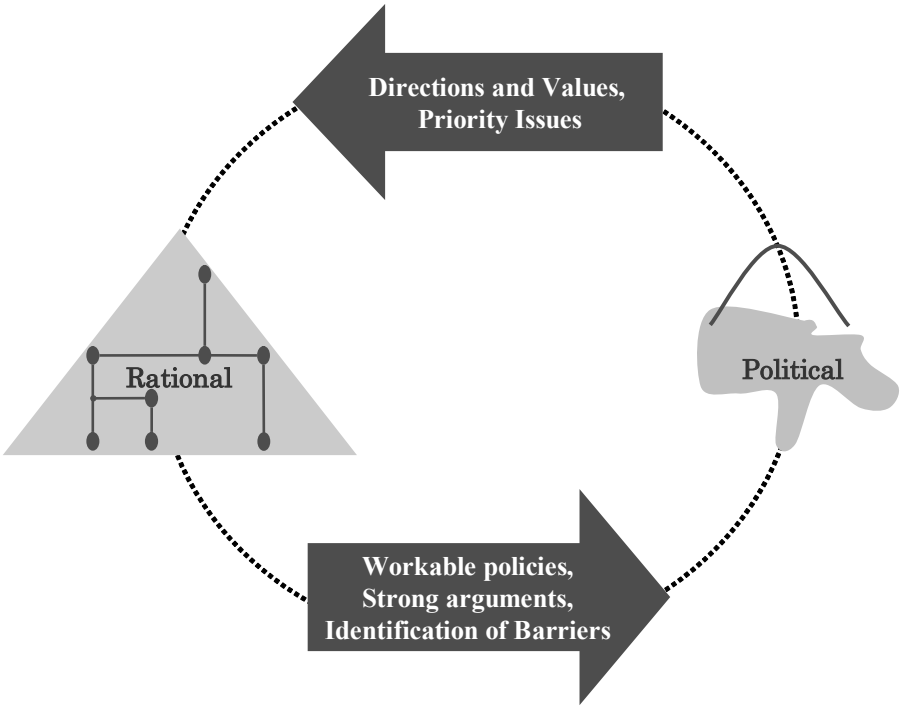

Figure 10: A virtuous circle is created when the political process identifies priority issues and a rational framework manages the changes

Work accomplished on An Adaptive Management Framework

Scoping

Scoping is the most intensive part of the energy systems design process. Substantial information must be collected, analysed and presented before anything else can happen. In this first phase of Bridging to the Future, scoping has involved a description of the current energy system, the preparation of a baseline report on energy demand and supply flows, identification of potential energy sources and alternative systems, and the forecast of a Business-as-Usual energy system to the year 2025.

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[4] For detailed discussion of the dynamic refer to Bryson, John M.; Crosby, Barbara C. (1992) Leadership for the Common Good: Tackling Public Problems in a Shared-Power World; Jossey-Brass Inc. San Francisco, Ca. 94104

Baseline Energy System

The baseline year for the energy system analysis is 2005 and the planning horizon is 2025. The current energy system for Squamish reflects the region's history, climate, economy, demographics, building stock, job market and provincial infrastructure. A detailed description of these factors is provided in the accompanying Technical Report. Baseline data for 2005 are presented in two parts: the amount of energy used and GHG emissions generated by the municipal operations of the District, and the energy consumption and GHG emissions generated by the community as a whole. Also included is a detailed breakdown of energy consumption by fuel type and end use, and estimates of greenhouse gas emissions and combined air contaminants. The Technical Report has been structured to be compatible with Milestones 1 and 2 of the Partners for Climate Protection program.

Corporate Energy Consumption and Greenhouse Gas Emissions, 2005

For the corporate energy and emissions inventory, municipal operations data were obtained by district staff from Terasen, BC Hydro and from the fleet manager. The energy consumption data were then translated into GHG emissions. Corporate energy consumption in 2005 was estimated at 43,700 GJ. Approximately 36% of energy consumption was for buildings, 26% for water and wastewater treatment, 19% for parks operations, 15% for fleet vehicles, and the remaining 4% for streetlights and dyke pumping.

Corporate GHG emissions are estimated at 1,268 tonnes of CO2 equivalents for 2005, which translates to approximately 0.08 tonnes per person. Approximately 36% of the GHG emissions were from the vehicle fleet, 32% from park operations, 22% from buildings, 9% from water and wastewater treatment, and 1% from streetlights and dyke pumping.

Community Energy Consumption and Greenhouse Gas Emissions, 2005

Information for the community-wide baseline energy demand and supply has been gathered from a number of sources, including the BC Assessment Authority database, population statistics, utility accounts and EnerGuide evaluations. An effort was made as part of this research, to develop an empirical database on the building stock based upon site visits and detailed energy audits. For the single-detached residential stock, it was possible to select typical homes from a database of approximately 30 homes already audited in Squamish. EnerGuide contractors[5] and homeowners agreed to share this data.

For the commercial stock, reference buildings were identified as being typical of their class, based upon judgement of knowledgeable local experts. Permission was obtained from owners and visits to the building provided sufficient information to model the building energy use and water consumption on an annual basis. Stock aggregation methods were then used to estimate energy flows for all buildings of each type, and for the stock as a whole. A cross-section of reference buildings audited for *Bridging to the Future* is shown in Figure 11.

[5] Data on Energuide Evaluations were provided by Building Insight Inc.

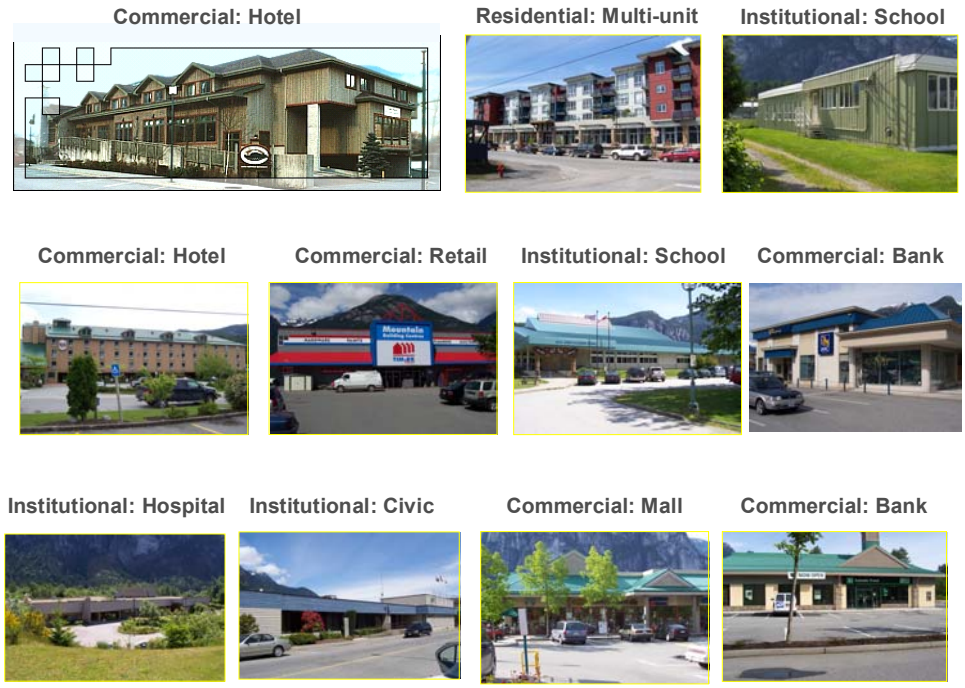

Figure 11: Energy demand and potential for the existing commercial and MURB stock is based upon audited performance of reference buildings, each chosen to represent a building type

In 2005, residents and businesses within the District consumed almost 2,500,000 GJ of energy, representing an expenditure of $52 million. On a per capita basis, this is equivalent to 159 GJ/year, or more than $3,300 per person, per year. Community-wide emissions of GHGs in Squamish are estimated at 120,000 tonnes per year in 2005, which corresponds approximately to 7.62 tonnes per person, per year. A breakdown of GHG emissions by activity is summarised in the Technical Report. More than three-quarters of GHG emissions in the District are generated as a by-product of combustion. Transportation is the largest contributor to GHG emissions, with approximately 64% of emissions attributed to light duty vehicles such as passenger cars, SUVs and light trucks. However, a portion of these emissions is related to vehicles stopping for fuel on their way to other destinations in the Sea-to-Sky Corridor.

The community-wide energy system (not including municipal operations) in Squamish is summarised as a flow diagram in Figure 12. In this 'Sankey' diagram, the width of each noodle is proportional to the total energy flow. A review of the diagram reveals that the predominant energy source is hydro electricity, closely followed by gasoline. The gasoline is used for commuting and is a relatively large part of the total, due to the very large percentage of the labour force (~35%) that commutes to work in either Vancouver or Whistler. Natural gas, at 13%, is the third most common energy source and is used mostly for space

heating, although a significant portion of natural gas (along with some coal) is also used to generate electricity.

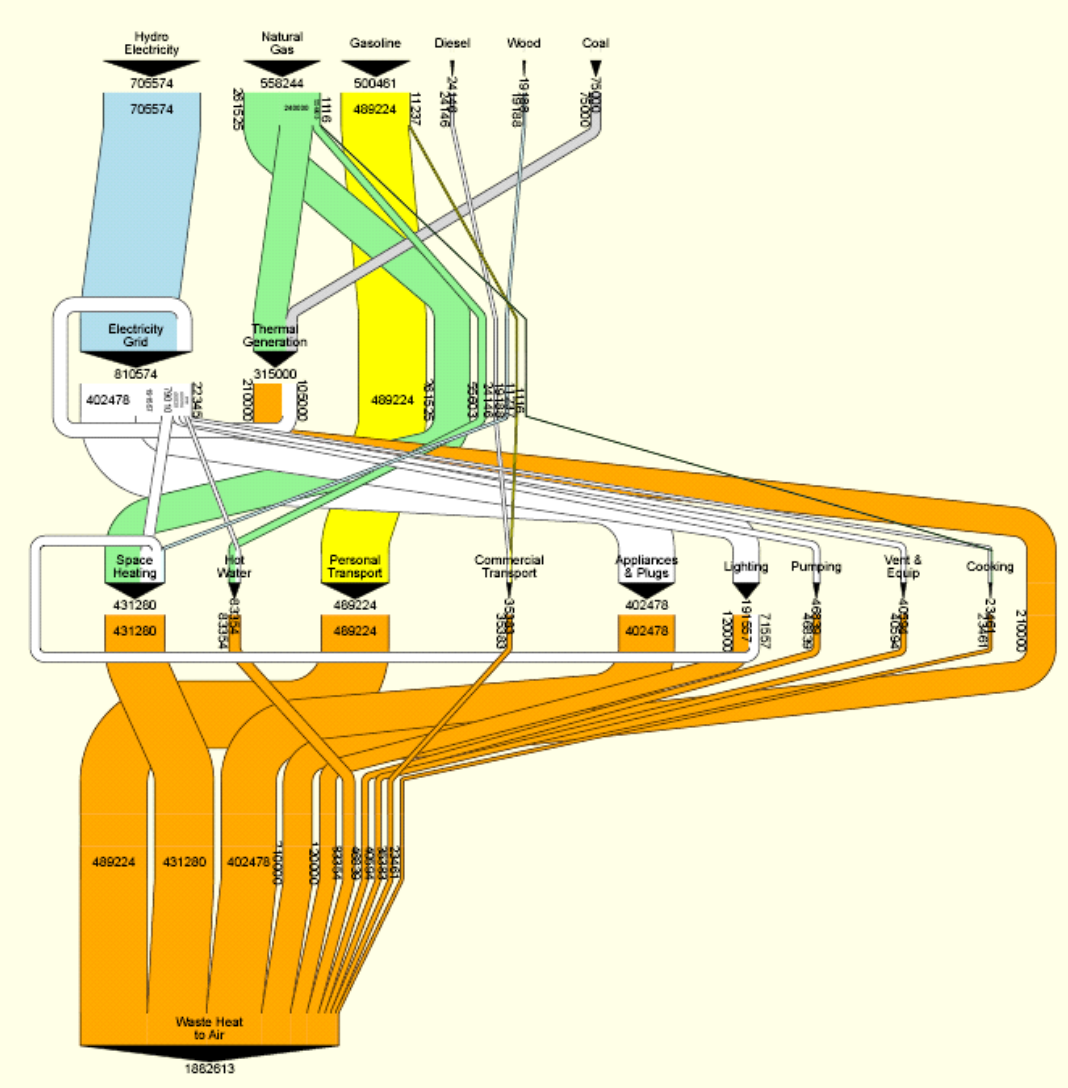

Figure 12: Energy flows through Squamish reveal large quantities of fossil fuels used for space heating, electricity generation and personal transport

Business-as-Usual Forecast

Energy was forecast for the period 2005 to 2025 by applying factors that account for population and economic growth, technical innovation and shifts in the local economy to a more urbanised economy. The most significant factor is the projected increase in population growth, expected to increase from 15,700 in 2005 to 28,700 people in 2025, representing an increase of 83%.

Corporate Energy Consumption and Greenhouse Gas Emissions Forecast

The corporate energy forecast was developed for the period from 2005 to 2025 based on assumptions of population and economic growth and how these will impact municipal service delivery. Estimates project that total energy consumption from corporate sources will rise, but remain constant on a per capita

basis, at 2.8 GJ. This represents the Business-as-Usual scenario of what the corporate energy consumption may be in 2025, and does not take into account increased efficiencies in vehicle technologies, building materials and the availability of newly-developed fuel types. For energy consumption, the Business-as-Usual scenario indicates that corporate energy consumption will increase from 43,669 GJ in 2005 to 77,700 in 2025, representing a 78% increase. Under the Business-as-Usual Scenario, the total corporate GHG emissions would increase from 1,268 tonnes in 2005to 2,300 tonnes in 2025.

In March, 2007, Squamish joined the Partners for Climate Protection program (PCP). The PCP program has a voluntary target of 20% reduction in corporate emissions over approximately a 10-year period.

Community Energy Consumption and Greenhouse Gas Emissions Forecast

A community-wide Business-as-Usual forecast was also developed. Land-use zoning was used to estimate the likely build-out scenario for housing and commercial development, based upon current regulations. Figure 13 shows a computer-generated image of the Squamish valley with new buildings distributed over the landscape.

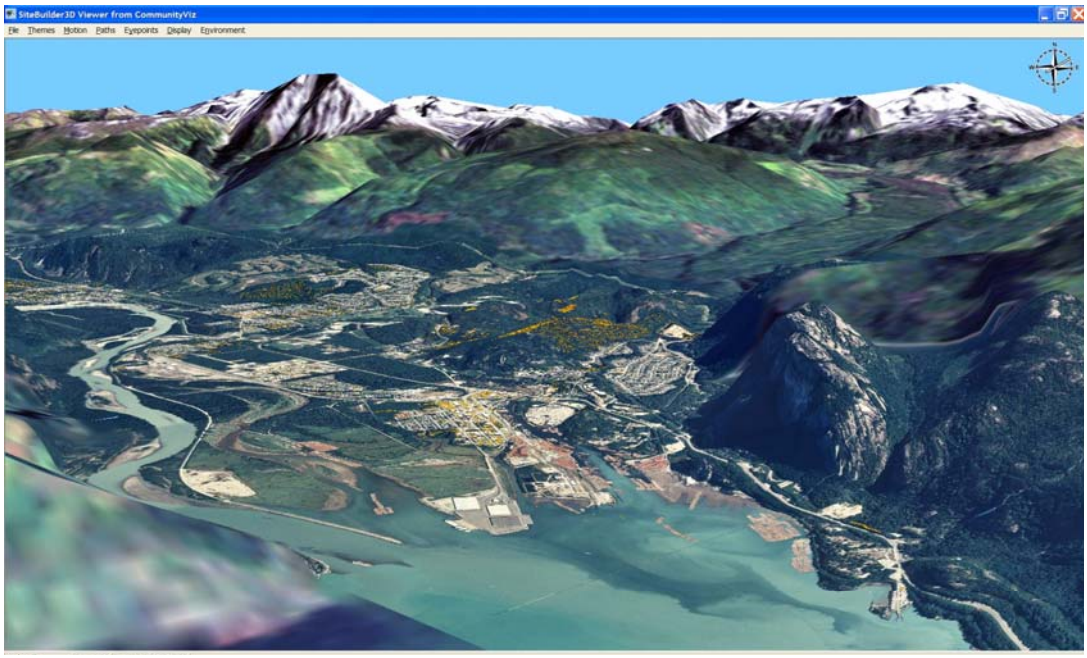

Figure 13: A visualisation of Squamish in 2025 shows many new buildings distributed over the landscape, in accordance with current zoning

Based upon these assumptions, energy consumption is expected to increase from 2.5 million GJ in 2005 to 4.1 million GJ in 2025, representing a 64% increase over the 20-year period. Increases in different fuel types are presented in Figure 14. On a per capita basis, GHG emissions are projected to decline from 7.62 tonnes of CO2e/capita/year in 2005 to 6.84 tonnes/capita/year in 2025.

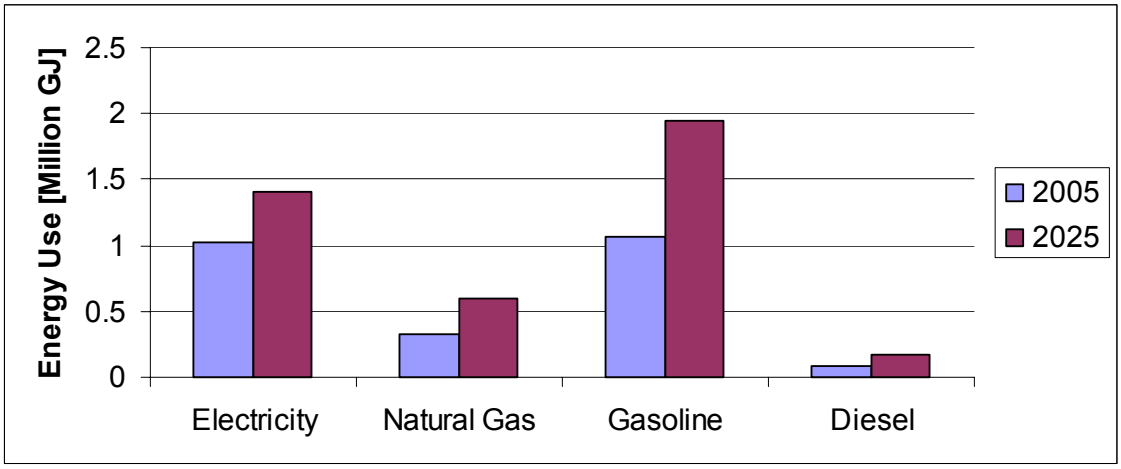

Figure 14: A Business-as-Usual forecast shows an increase in all types of community energy consumption in Squamish in 2005

The Squamish EnergyScape

The District of Squamish has numerous potential sources of energy, including a mix of imported resources, and a mix of local, renewable sources, in plentiful supply. The 'energyscape' for Squamish is full of potential, and if desired, energy diversity and energy sustainability could become a distinguishing characteristic of the community.

Squamish is located on one of the two primary corridors bringing electricity into the Lower Mainland from the interior dams. A sub-station is located at the Cheekye Fan. Squamish also has direct access to BC's natural gas resources via the Terasen pipeline from Vancouver. Natural gas is unusual for a small community such as Squamish, which is surrounded by steep mountains, glaciers and rivers. The region is especially well connected by road, rail and sea, which makes it practical to transport many other types of energy sources on an as-needed basis from the surrounding hinterland, or from Greater Vancouver. Gasoline and diesel are trucked to storage tanks in the community. A small amount of propane is stored next to the highway in Squamish.

Local energy resources are diverse and a detailed inventory is warranted. Some wood burning is traditional in homes. However, the region has access to a very large area of forested land which could become a sustainable source of biomass and would be sufficient for supplying most of the energy needs within Squamish, once facilities are provide for harvesting, transport (by rail), and a local combined heat and power system. A satellite image of the Squamish area and vicinity, in Figure 15, provides a view of the scale of forested land within Squamish and the surrounding area.

Figure 15: Satellite infrared photography reveals surrounding forested land, and the potential for biomass as a source of renewable energy

Squamish is located in a valley with seven glacially-fed rivers, and an almost incredible number of potential sites for harvesting micro hydro. Part of the challenge is to locate sites where impacts on the environment are minimal and where the energy resource can be developed in ways that increase the sustainability, prosperity and resiliency of the local community. Figure 16 shows some of the many existing micro hydro sites, many of which are serving individual properties in remote areas. One of the micro hydro sites, located on the Mamquam River, has already been developed as part of the BC Hydro system (see photos).

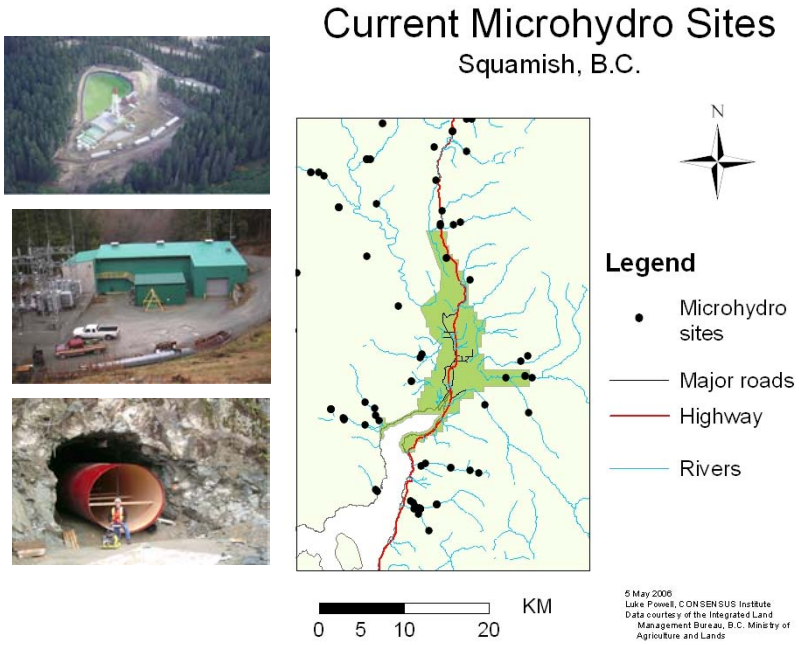

Figure 16: Many of the rivers flowing into the steep Squamish Valley have potential for micro hydro. Most existing sites are very small scale, but the BC Hydro site on the Mamquam, shown in the photos, is an exception

Squamish, an Aboriginal name for 'mother of the winds', has long been known for strong winds. A map of average wind speeds for the entire region, shown in Figure 17, indicates a number of locations with potential for commercial wind power, especially along the ridge north of the town and out in the harbour. The challenge is how to finance the investment and how to obtain public acceptance for locating windmills on the landscape. A study is currently underway to explore the full potential of the area for wind power. The study is being conducted in partnership with Western Economic Diversification Canada, Community Futures Development Corporation of Howe Sound, District of Squamish, Squamish Sustainability Corporation, and Suncor Energy. Once a full year of wind monitoring data have been recorded, the community will be able to better estimate the economic feasibility of this resource.

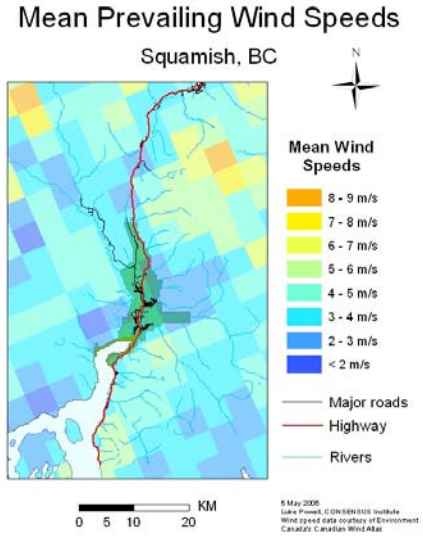

Figure 17: Mean prevailing wind speeds have been crudely mapped for the Squamish District, and indicate potential for commercial wind power along the ridges and in the harbour.

Solar power is an under-utilized resource in the Squamish area. A shading map for the valley at the Winter solstice, shown in Figure 18, reveals that the large majority of building and parking locations in the town are receiving direct sunshine. Thus, solar water heaters should be able to provide a majority of water heating, and photovoltaic systems could soon be used to provide a wide variety of on-site electricity.

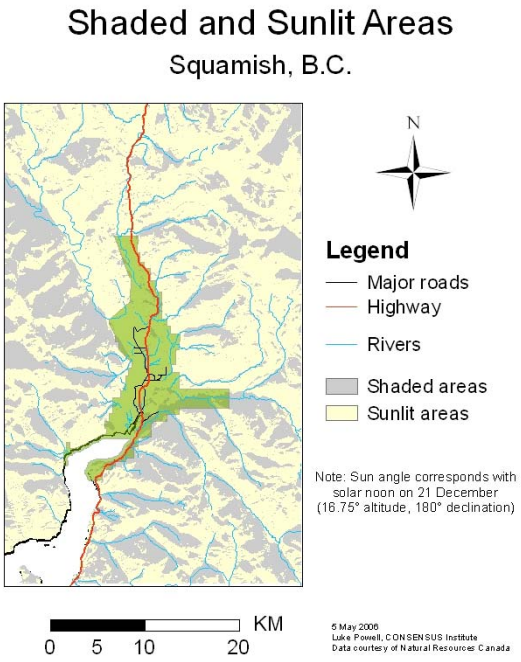

Figure 18: Almost all of the Squamish valley receives direct sunshine at noon on Winter Solstice, indicating significant potential for solar energy systems

Squamish is one of three locations within BC with moderate to high potential for geothermal energy. This is shown in Figure 19. The only commercial geo-thermal system in BC is located relatively close to Squamish, just west of Pemberton. What is impossible to know, without expensive drilling, is how deep the boreholes must be to access thermal energy from the thermally active locations.

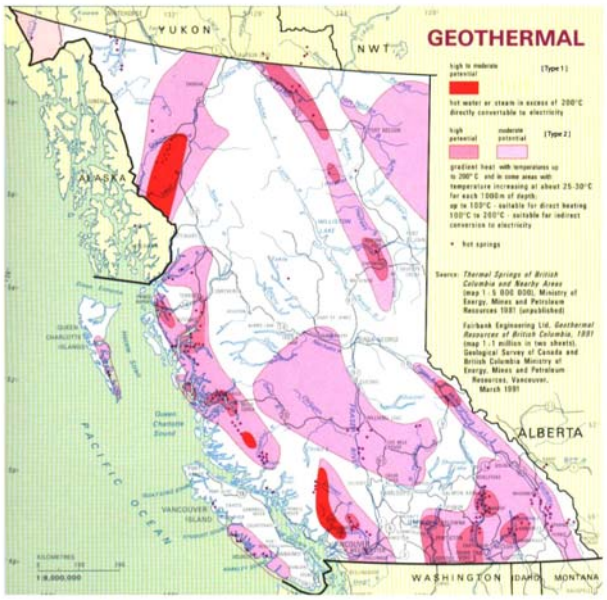

Figure 19: Squamish is exceptional because it has moderate to high geothermal potential

Envisioning

Squamish has an opportunity to develop a comprehensive and broad community vision supported by measurable targets which can help guide the entire region into an energy efficient and economically resilient future. Important visioning work has already occurred within Squamish, and provides the context for sustainable design. Additional visioning should soon be possible with support from a regional collaborative body. It also makes sense to adapt the visions and targets that were recently developed by other communities on the Sea-to-Sky corridor – City of Vancouver, City and District of North Vancouver and Resort Municipality of Whistler - where much of the leadership in sustainable design is occurring in BC, and where some common directions might be mutually supportive.

A vision for energy system design should be an extension of the existing visions for sustainability already adopted by the Council and the community:

> *"We are a spectacular seaside mountain community where people come to live, learn, work and play in harmony. We are caring, vibrant, and diverse. We are leaders in fostering social integrity, economic development, and environmental sustainability."*[6]

> *"The District's OCP is guided by a commitment to develop in a manner that is sustainable – environmentally, fiscally, economically, and socially – so that our children and our grandchildren can satisfy their needs in the future and continue to enjoy the opportunities and amenities that Squamish offers. This commitment entails balancing the protection of the environment with the needs of a growing population and economy."*[7]

In addition to these vision statements, Council passed a 12-Step Pledge in February, 2007, to reduce greenhouse gas emissions. The Squamish Pledge indicates that the District will strive to meet and, ideally, exceed Kyoto Protocol targets and timelines for reducing global warming. This will be achieved by taking action in District operations and the community and committing to initiating and achieving 12 key actions (see Appendix A).

In addition, on July 27, 2004, the District of Squamish Council passed a motion to draft a long-term sustainable energy strategy in association with its Wind Energy Initiative: to position Squamish as the first community in British Columbia to do so; to investigate how the District can take an equity position in the new infrastructure; and to simultaneously pursue opportunities that would establish Squamish as a central player in the development of the Hydrogen Highway.

The District's Growth Management Study, the draft Official Community Plan, and Smart Growth on the Ground (SGOG) Concept Plan for Downtown Squamish contain a number of objectives and strategies that support reduced energy use.

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[6] District of Squamish 2004-2008 Strategic Plan and the Draft Official Community Plan (October 2005)

[7] Draft Official Community Plan (October 2005)

The energy-related objectives in the Draft Official Community Plan (October 2005) are summarised in Table 2.

Table 2: Official Community Plan Objectives Directly Related to Energy

Objective	Source
Conserve energy, water, materials and other resources in residential buildings	Draft OCP Growth Management and Housing and Residential Lands sections
Encourage industrial development that conserves energy, water, materials, and other resources	Draft OCP Industrial Lands and Economic Development sections
Conserve energy, water, materials and other resources in institutional buildings	Draft OCP Community Services and Facilities section
Provide leadership in the conservation of energy, water, and material resources	Draft OCP Utilities section
Provide leadership in sustainable municipal infrastructure servicing	Draft OCP Utilities section
Develop a connected and integrated network of bikeways and commuter trails connecting major activity areas	Draft OCP Transportation section
Improve access to public transit	Draft OCP Transportation section
Encourage transit, rail, and marine travel service for regional passenger travel	Draft OCP Transportation section
Promote sustainable resource management practices in association with the use of the District's natural resource base	Drat OCP Resource Management section

Source: Draft Official Community Plan (October 2005)

The Smart Growth on the Ground Concept Plan for Downtown Squamish has already identified a number of possible targets directly related to the sustainability of the Squamish energy system. Most of these targets are related to developing more complete neighbourhoods that require much less use of automobiles. However, the SGOG has also proposed a target of LEED Gold rating (or equivalent) for all public buildings. As precedents, they cite the City of Vancouver, where LEED Gold has already been achieved on the new National Works Yard, and where LEED Gold has been adopted for all large civic buildings and all public buildings in the showcase neighbourhood of Southeast False Creek. The 2010 Olympic Committee has adopted LEED Silver as a minimum, and is aspiring to LEED Gold for all new and renovated facilities.

As the District updates its Official Community Plan, there may be an opportunity to strengthen and expand the language around the management of energy, GHG emissions and air quality. For example, the City of North Vancouver has adopted the following energy goal in its OCP:

> *To encourage meeting the present and future energy service needs of the community in a manner that is efficient and cost-effective; that is*

environmentally responsible (locally, regionally, and globally); and that fosters local economic development.

The goal is supported by the specific objectives:

Energy System Design Objectives

- To promote energy efficient building design and practices for all development projects and City-owned buildings.
- To implement Community Energy Systems as a means of providing heat energy for applications such as space heating and domestic hot water provided that it is demonstrated to be economically and technically feasible, and meets the City's sustainability goals and objectives.
- To collaborate with partners and agencies in the transportation and development fields to jointly achieve energy conservation.
- To reduce greenhouse gas emissions by measures such as transportation alternatives to the automobile, including increased transit, and a network of walking and cycling paths.
- To encourage the planning, design and construction of energy efficient neighbourhoods and buildings to minimize green house gas emissions.[1]

[1]Source: City of North Vancouver Official Community Plan (adopted 2002).

By reviewing the programs and standards established by others, it becomes possible to imagine a set of specific targets for Squamish. Based upon the additional opportunities and broader scope adopted for the Energy System Design in Squamish, a set of four bold and challenging targets were proposed by the consultant team (see Table 3). These are longer-term targets that are set for 2015 and 2030. The four 'over-arching' targets were subsequently adopted by Council in March, 2007, following a target-setting workshop that was held in February, 2007. It is believed that the target to reduce greenhouse gas emissions to 1 tonne/capita/year is one of the boldest energy targets adopted to date by any municipality in Canada. The one tonne target corresponds to the International Panel on Climate Change target for climate stabilization.

Table 3: Four Visionary Targets

One Tonne Total	Total greenhouse gas emissions per capita for regional energy systems are reduced to less than one tonne by 2030.
Stepping Towards Net Positive Energy	Total renewable energy generation on-site exceeds the total energy consumption for buildings and transportation by 2015.
Self-reliance & Security for Critical Energy	On-site infrastructure can separately satisfy critical energy needs, including essential lighting, communications & space conditioning.
Adaptable & Diverse Homes & Businesses	At least 5 distinct energy sources each provide 5% or more of the total energy for buildings and total energy for transportation by 2015.

A set of shorter-term targets for 2010 were also considered and subsequently adopted by Squamish Council in March, 2007, following the target-setting workshop. The BC Buildings Plan for Energy Efficient Buildings program was launched by the Province in September, 2005. The Plan has established targets to assist in the reduction of greenhouse gas emissions and energy consumption in existing and new buildings. The District of Squamish adopted all these targets at the March 27, 2007 Council meeting (see Table 4). At the same meeting, Council also joined the Federation of Canadian Municipalities (FCM) Partners for Climate Change Program.

Table 4: 2010 Targets from BC Buildings Plan for Energy Efficient Buildings

Building Sector	Energy Efficiency Target
New single family and row house residential buildings	Achieve an EnerGuide for New Houses rating of 80 by 2010, reducing average energy consumption in new homes by 32%.
New multi-unit residential buildings	Achieve energy performance of 25% better than the Model National Energy Code for Buildings by 2010, reducing average energy consumption by 37%.
Existing single family and row house residential buildings	Reduce the energy consumption in 12% of existing buildings by an average of 17% by 2010.
Existing multi-unit residential buildings	Reduce the energy consumption in 16% of existing buildings by an average of 9% by 2010.
New industrial, commercial and institutional buildings	Achieve energy performance 25% better than Model National Energy Code for Buildings by 2010 and reduce the average energy consumption by 20%.
Existing industrial, commercial and institutional buildings	Reduce the energy consumption in 20% of existing buildings by an average of 14% by 2010.

Notes: 1) MNECB = Model National Energy Code for Building (Canada)
2) EnerGuide is a Federal rating system for evaluating annual energy consumption. With the recently announced ecoENERGY Efficiency Initiative, this system or a new system may be developed.

Exploring

A number of methods were used to explore the potential for a sustainable energy system in Squamish. The diversity of potential energy sources raised the question of whether any or all of these options might be economically feasible. To explore this question, a computerized evaluation tool was applied. Referred to as RETScreen (Renewable Energy Technology), the software was developed by Natural Resources Canada and is now in use by over 100,000 people in 213 countries. The software guides the process of benefit cost analysis for a broad range of energy systems. Applied to Squamish, the results of the analysis are shown in Figure 20. Solar space heating, wind, micro hydro and solar hot water, all show a positive net present value. Biomass is negative, but only very slightly, and still deserves a closer look.

RETScreen 

System	Benefit / Cost Ratio	Return on Investment	Net Present Value
Solar MURB Apartment Building	1.9	18.2	$ 93,000
Wind 5 Turbines, 6 m/s @ 65m high	1.6	16.3	$ 728,000
Micro Hydro Stawamus River	1.6	18.6	$1,711,000
Geo-exchange 190 m2 home	1.6	16.6	$ 7,000
Solar DHW House family of four	1.1	11	$ 300
Biomass District Heating, 7 Buildings	0.9	9.1	-$ 43,000

Figure 20: Preliminary Benefit/Cost analysis of renewable energy technology for Squamish

Part of the difficulty with alternative energy development is the uncertainty over future costs for fossil fuels and grid electricity. Even small changes in these costs can have a major impact on the economics of alternatives. At present, the costs of energy are relatively very low in BC, as shown in Figure 21, which makes it more difficult to adopt technologies that are now the norm in many other parts of the world. However, the alternative technologies have many other benefits and may also help to place Squamish in the forefront when prices rise.

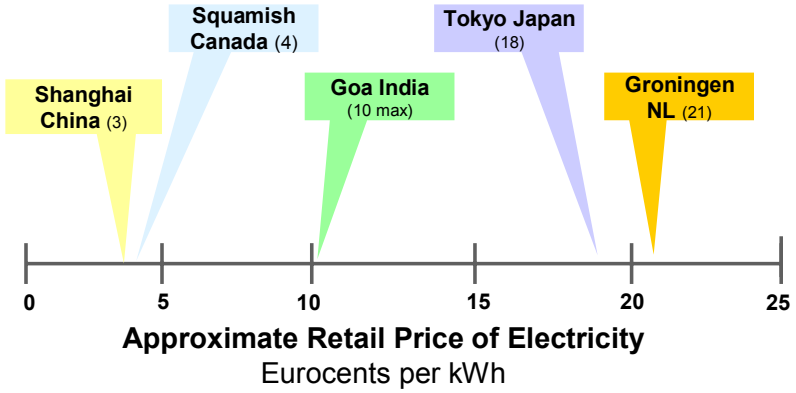

Figure 21: Electricity prices and other types of energy are relatively inexpensive, and present an obstacle to investment in renewable systems.

An exploration of energy system design options has also identified a number of activities occurring within the District that could be woven together into the broader fabric of sustainable energy leadership. Part of the challenge is bringing the various groups together so that they can brand their work as part of a larger vision. Some of the specific activities to be integrated in such a plan might include:

- Municipal fleet conversion to biodiesel fuel pilot project;
- Squamish Sustainability Corporation Wind Energy project;
- Proposed run-of-river micro-hydro operations in Squamish and the SLRD;
- Alternative district energy system for the large-scale brownfield development sites on the waterfront;
- Quest University's existing geothermal heating throughout their development site;
- Closure of Carney's organic recycling
- Proposed partnerships with European companies using district-heating (biomass, or waste-to-energy) and stand-alone solar heating systems;
- 2008 closure of the Squamish Cheekeye landfill and potential for methane collection; and
- Potential application of energy based industry at Woodfibre site.

Many of these projects can be integrated around the key targets and visions discussed earlier. A threshold of activity might help the 'new energy' industry find a home in Squamish and become a centre for diverse, clean and reliable energy technology.

Recommended future directions for an Adaptive Management Framework

1. **Conduct a visioning and target-setting exercise involving the public, collaborative partners, and the District Council**
   District Council already adopted a set of four visionary targets in March, 2007. The next step is to expand the visioning and target-setting process

to include members of the proposed collaborative, which will help launch regional discussions on energy systems design.

2. **Develop a background document and web site on Energy Initiatives**
   It is proposed that a web site be developed focusing on the key new directions for the Squamish Energy System Design, including the structure of the collaborative process and the visions and targets from the framework. The web site can be used to introduce public and private sector partners of the regional energy collaborative on how a kaleidoscope of project ideas and activities are helping to achieve the targets.

4. Catalyst Projects and Policies

The Concept of a Catalyst Project

The third key direction proposed for *Bridging to the Future in Squamish* is to initiate catalyst projects and policies. As the term implies, a catalyst project is designed to accelerate positive changes already occurring within the community at a pace that is neither too slow nor too fast. Catalyst projects combine the best features of pilot and demonstration projects - they allow everyone to quickly learn new ideas by trying out something different, and they also demonstrate and reinforce new directions and themes that may apply to many future developments.

From a long-term perspective, catalyst projects help to keep the region on a critical path so that targets can be reached within a reasonable time period. Figure 22 illustrates this process - the catalyst projects help to reverse trends in the wrong direction, keeping the District somewhere between the critical path and the preferred path until goals are achieved.

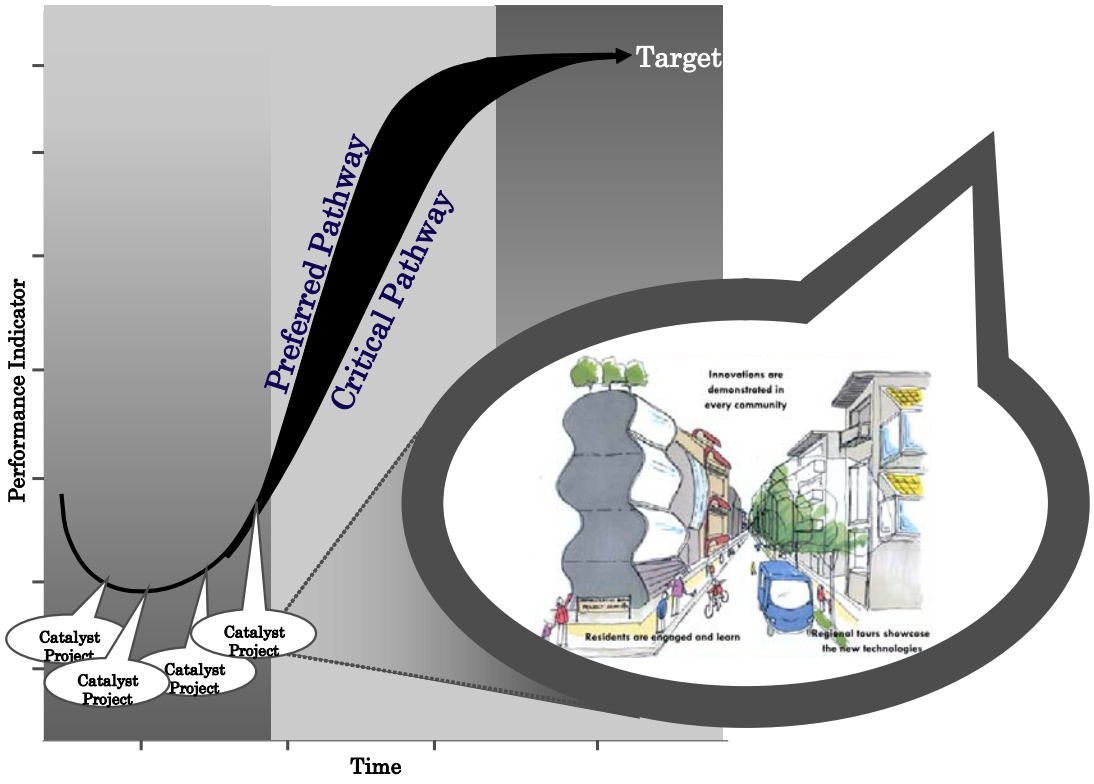

Figure 22: Catalyst projects help to reverse trends in the wrong direction, and set directions toward the long-term targets for energy systems

Catalyst projects are usually combined with innovative new policies because so often it is the existing policies (regulations, financing arrangements, liability) that represent the biggest barriers to progress. Catalyst projects become an opportunity to 'try out' new policies, and to formulate new agreements between agencies. An effort was made to consider all of the options and to choose projects

that include a balance between long-term solutions and short-term improvements. As shown in Figure 23, regional systems often have very different rates of change and are spread out over the 'rings of time'. On the inside track are the fast-moving elements like market behaviour, or Information and Communications Technologies (ICT). These short-lived elements change rapidly and thus, provide an important means of adapting to changing circumstances. Further out, the slow moving elements like the landscape and cultural beliefs provide the security needed for long-term investments and also constrain the type of interaction between many of the other systems.

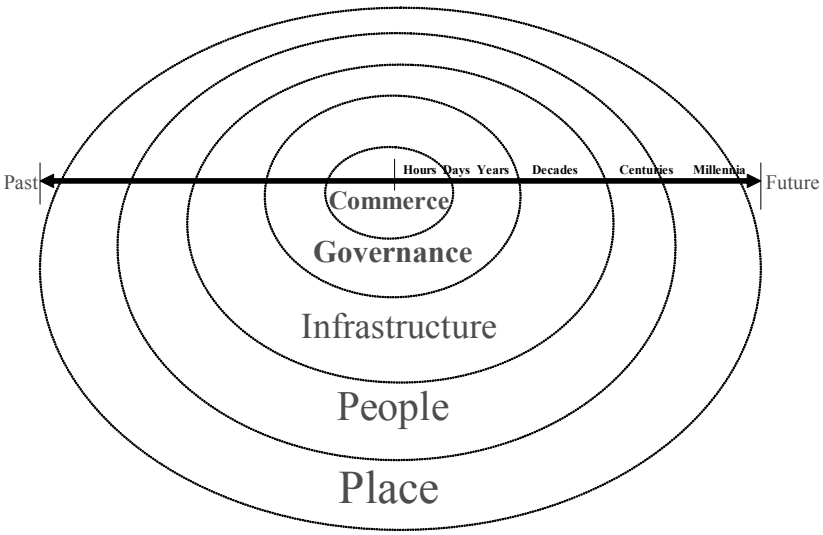

Figure 23: The 'rings of time' reflect the very different lifetimes and rates of change for urban systems which influence energy demand and supply options. (Logarithmic scale)

The concept of Smart Growth, for example, is an attempt to design the slow moving elements of land use and circulation patterns so that they minimise the demand for transportation over the long-term. In the same way, it makes sense to situate, orient and design buildings and neighbourhoods in ways that facilitate the use of local energy sources, and the exchange of energy between various users so that the community can squeeze the most value out of each energy source. These decisions will bear fruit for hundreds of years. Once the slow-moving elements are optimized, then it becomes important to focus on the performance of the faster elements, like the choice of heating systems or types of vehicles, making choices that work well in the short term, and that step forward in the right direction.

Work accomplished on An Adaptive Management Framework

The brainstorming work conducted in the collaborative workshops helped to identify a number of catalyst projects that are suitable for directing the Squamish energy pathway. Four initial projects have been identified as especially suitable:

1. Smart Growth on the Ground

Basic idea: Select a block (or cross-section of blocks) within Squamish that is suitable for redevelopment, and with a variety of building types and potential for

connected trails and open space. Work with property owners, neighbours and a collaborative team of planners and developers to apply the broad range of Smart Growth guidelines that have already been proposed for buildings, streets, trails and green space in the core area. Monitor the successes and challenges. Provide signage and other information to educated passers-by.

Adopting substantive changes in land use and circulation policy usually takes considerable time and effort and must be coordinated with the regular cycles of policy review and change. However, a catalyst project in one 'pilot' location can help everyone – planners, design professionals, public, politicians - learn more about what is possible and how to make it work. The project also becomes a showcase for the new 'patterns' and a place of pride for the community as well as a means to enhance acceptance and uptake in the short term.

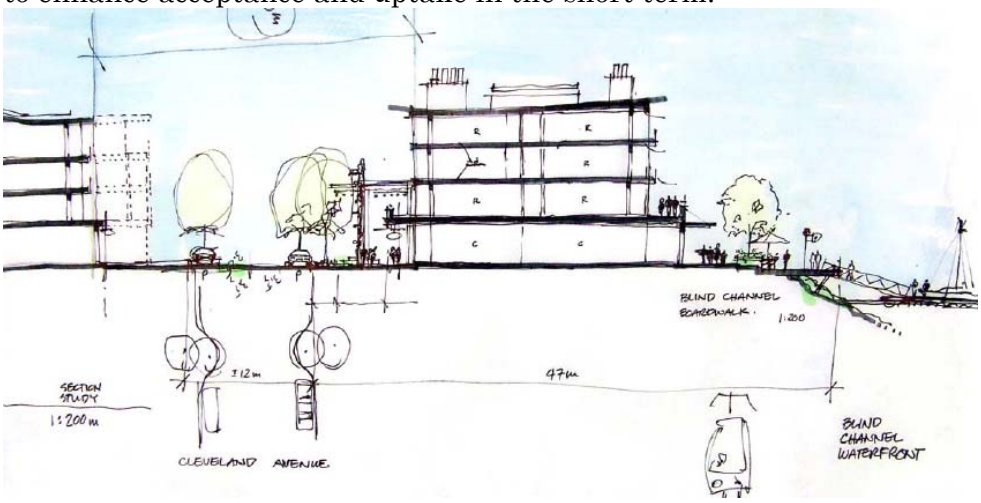

Figure 24: An existing street or block within the town is used to showcase the many features and functions of Smart Growth design (source: Smart Growth on the Ground)

New themes and directions: This catalyst project will reinforce many of the key themes and principles of Smart Growth and green design. In general, the object is to counteract sprawl by designing neighbourhoods that are compact, distinct, mixed-use, pedestrian friendly, and well connected to efficient infrastructure and quality employment. More specifically:

- Streets are social and lively, easy to access, open and bright, well-treed, and designed to manage storm water on-site where possible; and
- Buildings are diverse in appearance and setbacks, resilient to earthquakes and floods, energy efficient, accessible, mixed-use, and designed in styles that reflect the local history, climate and culture.

Potential Partners:

- Smart Growth on the Ground consortium
- Downtown Squamish Business Improvement Association

- Squamish Oceanfront Development Corporation
- Local developers
- Owners of larger properties
- Communications groups (local cable)
- Community groups engaged with land use issues
- Utilities (BC Hydro, Terasen, etc.)
- Community Energy Association
- UBC, University of Victoria, Simon Fraser University, Quest University

2. A Responsive Local Network for Electricity

Basic idea: Establish a working example of an intelligent local network for distributed generation of renewable electrical power and smart metering of buildings. In essence, a local network is a self-organising cluster of electricity users nested within the provincial grid, as shown in Figure 25. The local network can share surpluses among the nodes. It can also use the provincial grid as a kind of storage system, taking or giving back as needed. The local network keeps investments within the community as the demand for power grows. It also avoids the loss of land and power associated with long-distance transmission and conversion.

The local network will initially connect a true diversity of users and generation technologies to emphasise how anything, from fuel cell vehicles, to solar homes, to stand-alone windmills, can link to the network and exchange energy. Smart meters in each location make two-way flows and variable pricing possible. The users are charged more at times when local and renewable power is unavailable, or when the provincial grid is depending upon thermal generation (gas and coal) to meet peak demands. The smart meters also allow for non-essential demand to be controlled remotely so that peak demand for the local network is controlled within limits. Also, in the event of an emergency, the meters can cut back each user to the minimum required for critical needs, helping the whole community survive through temporary outages.

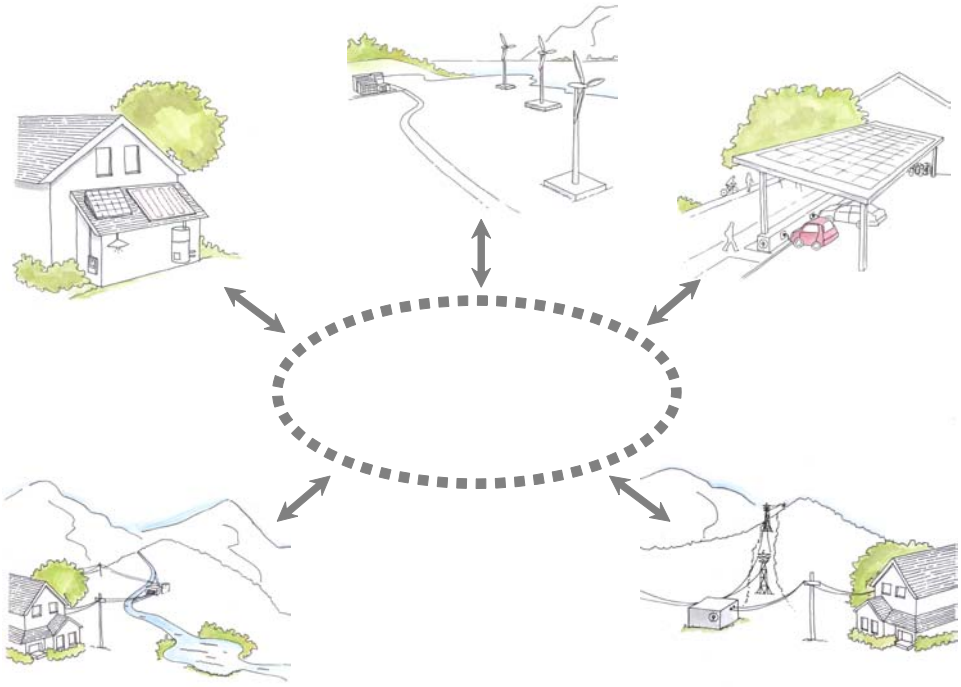

Figure 25: A local electricity net illustrates how many locations can generate electricity, and share surpluses at different times

New themes and directions:

- Renewable energy systems synchronized with growth of town
- Community economic development through local investments
- Local self-reliance through on-site generation
- Market reform using incentives to affect behaviour
- Shock resilient design through diverse, modular, and cellular systems
- Adaptability through easier uptake of innovative technologies

Potential Partners:

- BC Hydro distributed generation is a potential partner
- BC Hydro has a pilot program in place for net metering, which may be extended to Squamish
- Manufacturers of smart meters are interested in demonstration sites
- Local entrepreneurs and homeowners may wish to be a part of the showcase project
- Many companies may wish to provide a small example facility to showcase their wind generators, run-of-the river generators, PV panels, and so on.
- Community Energy Association
- UBC, University of Victoria, Simon Fraser University, Quest University

3. A District Heating and Power System

Basic idea: The waterfront redevelopment neighbourhoods in Squamish are designated as an 'energy precinct', where most buildings will ultimately be connected to a district energy system. The system is designed to evolve over time, at low cost. Buildings are required to be constructed with technology suitable for district energy, including exterior connection hardware and plumbing for district hot water, cool water and electricity. A district energy facility is located within the energy precinct, close to the terminus of the rail line. Phase I of the district energy system begins with a single, all-purpose natural gas fired boiler, sized to meet the first phase of development. Boilers are added as needed. As the development builds out, and demand aggregates, Phase II begins with the addition of a cogenerator to supply base electrical loads in addition to hot and cool water, and the boilers become back-up systems. Natural gas is supplemented with biomass from the forests, delivered by rail. Eventually, the biomass becomes the predominant energy source for the energy precinct.

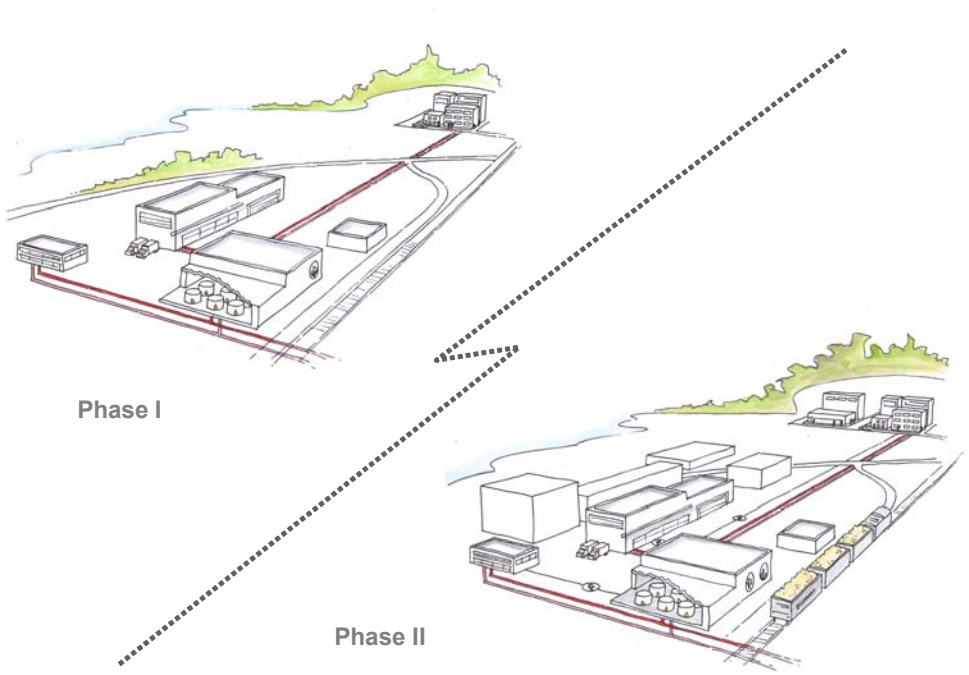

Figure 26: A small-scale district heating plant at the end of the terminal uses natural gas to heat the new waterfront developments; later the system evolves to provide electricity and to use biomass delivered by rail

New themes and directions:

- Long-term planning and evolution of infrastructure
- Looping and cascading of energy within the community

- Community economic development through local investments
- Local self-reliance through on-site generation
- Shock resilient design through diverse, modular, and cellular systems
- Adaptability through easier uptake of innovative technologies
- Natural gas as a bridging fuel
- Facilities matched to the local loads and densities

Potential Partners:

- Terasen Gas has substantial expertise and practical knowledge from implementing the district energy systems in the Lonsdale area of N. Vancouver
- A number of European companies (Swedish, German, Danish) have extensive experience in biomass fuels and district energy systems, and have already expressed interest in becoming long-term business partners.
- Large existing or future building owners in downtown (e.g. proposed Capilano College campus in downtown)
- Squamish Oceanfront Development Corporation
- Downtown Squamish Business Improvement Association

4. A Hub for Alternative Energy and Transport

Basic idea: The redevelopment of the highway gateway into Squamish is expanded to include a multi-model, multi-fuel transportation hub for the town. The hub is designed to seamlessly connect the many modes of travel so that visitors and residents can conveniently choose the mode most appropriate for their needs. The hub connects the many pathways identified in the Smart Growth plans for foot and cycle trails, heavy rail to Vancouver and Whistler, light rail to downtown and waterfront, bus, car co-ops and car pool vans. The hub also includes the country's most diverse and innovative fuelling station with, as an example, electrical charging stations powered by rooftop PV panels, hydrogen for the new fuels cell buses on the hydrogen highway, bio-diesel for the new truck co-op fuels shared with City of Vancouver, ethanol for visitors, compressed natural gas for the municipal fleet. The larger land areas on the edge of town provide the space and security systems to make this hub an icon of integrated energy system design for Canada.

The location of Squamish, mid-way between Vancouver and Whistler, has meant that, for a long-time, the community has been best known to visitors as a 'pit stop', and to residents as a 'bedroom community' for workers who commute by automobiles. The challenge now is to transform this image into something positive and consistent with energy leadership.

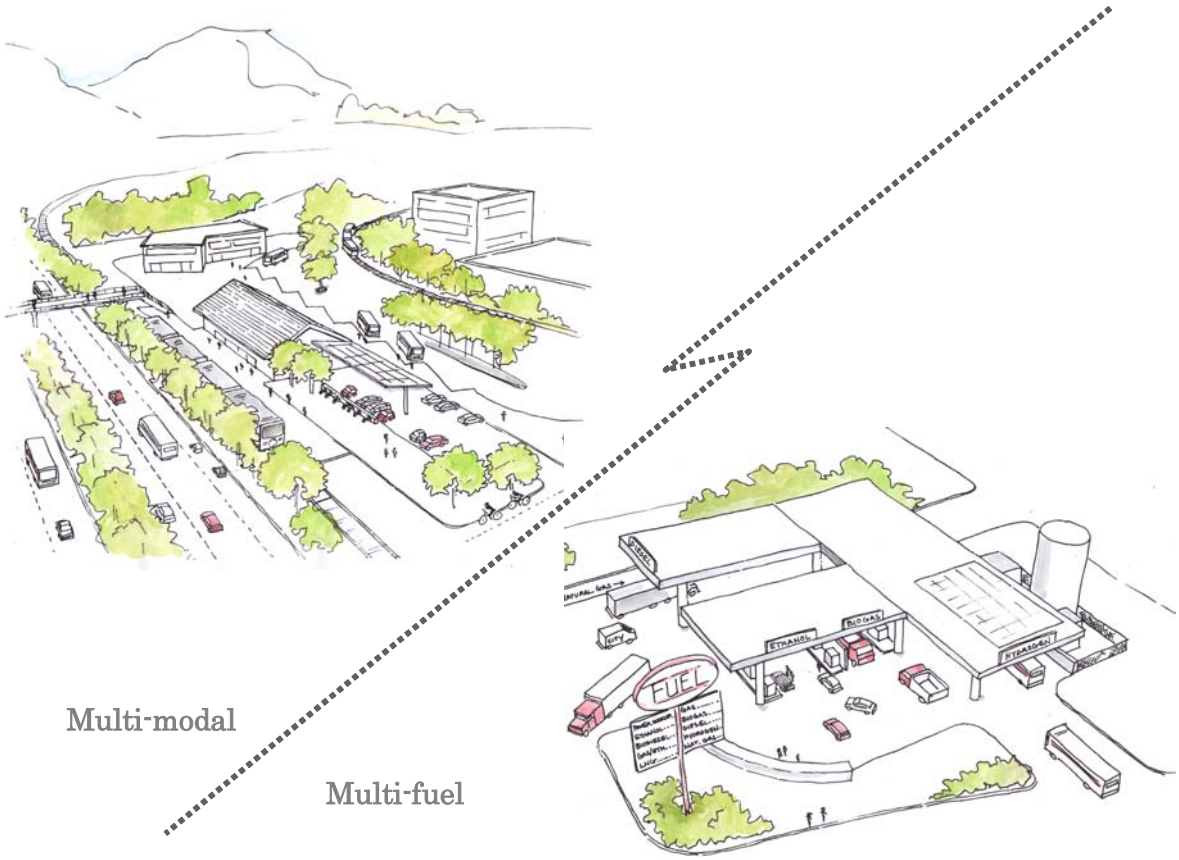

Figure 27: A transportation hub provides seamless connectivity between a great diversity of modes and unequalled choice in energy sources

New themes and directions:

- Long-term planning and evolution of infrastructure
- Looping and cascading of energy within the community
- Integrated systems of all types
- Adaptability through easier uptake of innovative technologies
- Natural gas as a bridging fuel
- Facilities matched to the local loads and densities
- An image of the community as a leader in energy sustainability
- A collaborative energy strategy within the Sea-to-Sky corridor

Potential Partners:

- Smart Growth on the Ground consortium
- BC Hydrogen Highway network
- Hydrogen and Fuel Cells Canada
- BC Transit
- Alternative / conventional fuel distributors
- BC Ministry of Transportation
- UBC, University of Victoria, Simon Fraser University, Quest University

Recommended future directions for Catalyst Projects

1. **Approach potential partners and convene a meeting to develop a concept plan for each catalyst project.**

2. **Conduct a feasibility study and concept plan for each project, seeking funding support, if necessary, for research and writing.**
   Each catalyst project needs to be developed into a project, complete with a pro forma. Each project should begin with reference to the vision and targets for the District, so that the overall systems perspective is reinforced. The written study should be overseen and edited by the participating partners in the collaborative.

3. **Submit applications for co-funding.**
   The feasibility studies provide a suitable foundation for grant applications so that the projects can receive support from senior government programs such as the Provincial Community Action on Energy Efficiency Program, the FCM Green Funds, the UBCM Integrated Community Sustainability Plans and the Infrastructure Canada grant programs. A more extensive list of funding sources to approach has been provided in the accompanying Technical Report.

Appendix A: Squamish's 12-Step Pledge to Reduce Greenhouse Gas Emissions

Unanimously Adopted by Council on February 6, 2007

The District of Squamish will strive to meet and, ideally, exceed Kyoto Protocol targets and timelines for reducing global warming pollution by taking action in our own operations and our community and committing to initiating and achieving the following:

1. Conduct an inventory of global warming emissions in municipal operations and in the greater community in order to set reduction targets and create an action plan.
2. Adopt and enforce anti-sprawl land-use policies, preserve open spaces, and create compact walkable and bikeable communities.
3. Promote transportation options such as bicycle and pedestrian commuter trails, commute-trip reduction programs, incentives for car-pooling, expanded public transit and regional transportation options, and adopt traffic policies that reduce idling.
4. Encourage and increase the use of clean, alternative, renewable energy. Purchase only "green", non-Greenhouse gas producing fuels.
5. Make energy efficiency a priority through building code improvements – i.e. building bylaws that set highest standards for insulation, mandatory that all new homes be "solar ready", all new homes have smart meters, practice and promote sustainable building practices using LEED standards or a similar system.
6. Purchase only Energy Star [or comparable] equipment and appliances for municipal use; help develop a program that encourages residents to purchase energy efficient equipment, use only reusable grocery bags and encourage businesses and residents to minimize plastic bag usage.
7. Increase efficiency of existing municipal facilities and infrastructure by retrofitting municipal buildings with energy efficient lighting, urging employees to conserve energy, solar water heating systems, car pooling programs, etc.
8. Increase the average fuel efficiency of the municipal fleet i.e. Hybrid / biodiesel; reduce the number of vehicles in fleet; launch an employee education program. Encourage fuel alternatives for the community.
9. Evaluate opportunities to increase pump efficiency in water and wastewater systems; institute water metering programs to encourage conservation, to locate leakage and inefficiencies, and maximize existing infrastructure; recover wastewater treatment and landfill methane for energy production.
10. Increase recycling rates in District operations and in the community through a complete compost, recycling and waste collection system.

11. Maintain and encourage healthy urban forests; promote tree planting where necessary and institute tree removal bylaw to increase shading and maximize CO2 absorption.
12. Educate the public, schools, other jurisdictions, professional associations, businesses and industry about reducing global warming pollution, and be an example of how it can be done efficiently, economically and sensitively.