Research Report

Energy Sector

FCM | Green Municipal Fund
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RESEARCH REPORT: ENERGY SECTOR

–Final Report –

[27083]

Prepared for:

Federation of Canadian Municipalities

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EXECUTIVE SUMMARY

The Federation of Canadian Municipalities (FCM) Green Municipal Fund (GMF) engaged the services of Marbek Resource Consultants to review the issues and trends related to sustainable energy in municipalities and to document typical and best practices, as well as emerging technologies.

Broadly, the municipal energy sector refers to all aspects of energy supply and use within and by a municipality. Taking the vantage point of aspects over which municipal governments can exercise some control, this includes:

- Energy services and energy service technologies in municipally-owned facilities
- Energy services and energy service technologies in other facilities within the municipality
- The generation of energy within municipalities (e.g., district heating, co-generation)
- The storage, distribution and supply of energy within municipalities.

The primary goal of management for sustainable energy is to meet energy service needs with energy sources, energy infrastructure and energy service technologies that minimize damage to municipal, regional and global air, land and water resources and that support healthy human economic and social systems.

The Canadian best practices depicted in this report were selected through a comprehensive web-based review. The review involved various sources, including:

- Municipal, provincial, and federal awards that recognise sustainable energy
- Municipal, provincial, and federal funding programs that provide financing to sustainable energy projects
- Publications (including case studies) from organizations within the energy sector
- Publications of recognized best practices from various sources (ex. municipal boards and associations, municipal planning departments, consultants in the energy field, conferences, etc.)
- Personal communications with municipal representatives and experts in the field

Issues

The key issues affecting energy sustainability are shown in the following Exhibit E.1 and described in the Report.

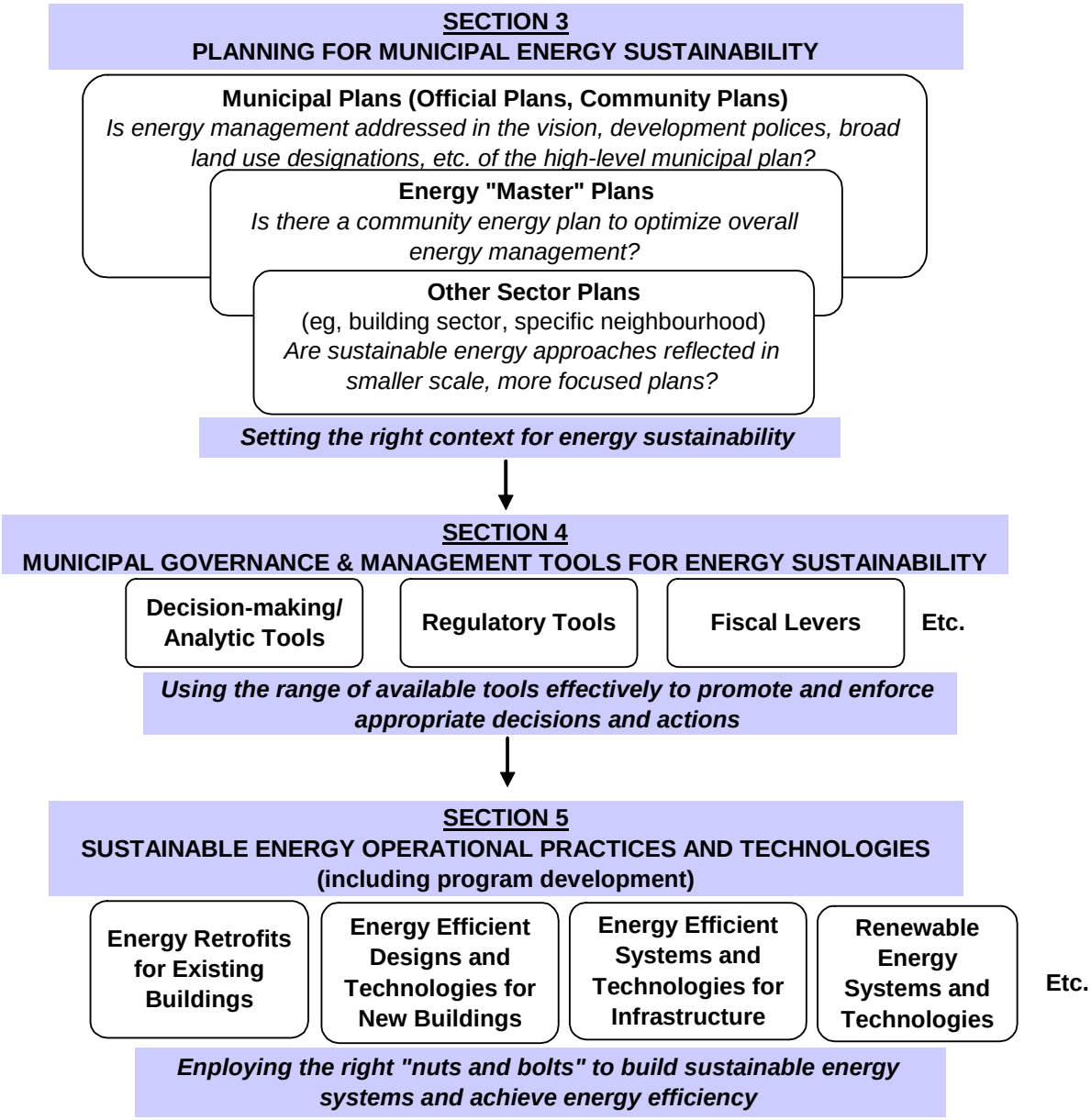
Exhibit E.1
Energy Sustainability Issues

Cross-cutting	Planning, Governance, Management	Operational Practices, Technologies
• Energy costs • Cost and revenue squeeze • Infrastructure rehabilitation needs • Growing government and utility support • Green demographics	• Municipal powers and governance • Absence of enforceable national level sustainability standards and requirements for municipal top level plans • Lack of political will • Valuation approaches	• Siting large and small scale wind power developments • LEED certification and standards

Cross-cutting	Planning, Governance, Management	Operational Practices, Technologies
	• Municipal jurisdiction to set energy performance standards • Transaction costs	

Practices

The following exhibit illustrates the scope of sustainable energy best practices covered in this report.



Sustainable Energy Best Practice Trends

An ideal approach to achieve energy sustainability in municipalities would involve:

- Implementing urban design and development approaches that support intensification and thereby facilitate more efficient and affordable energy infrastructure options;
- Building diverse, flexible, and scaled energy supply infrastructure and using energy from multiple locally-available, non-depletable sources so that the overall energy supply is the aggregate of multiple low-impact sources;
- Thermodynamically matching the quality of the energy supply to the quality of the energy service needs; and
- Reducing or eliminating demand through various technical and management best practices.

The breadth and depth of sustainable energy best practices documented in this report is evidence that municipalities in Canada are making considerable progress. Municipal progress on energy sustainability can be found in a wide range of municipalities, in every region, of every size and of every type. Municipalities continue to be active in delivering sustainable energy practices and technologies to their facilities and, in some cases, to the community as a whole. In comparison, the planning and municipal governance tools needed to support such initiatives are lagging in reach, but there is evidence that this is being addressed among many municipalities.

Comprehensive, integrated community planning is vital to advance sustainable energy because of the inherent infrastructure, operations, and governance issues involved. However, the implementation of best practices in this area is challenging because of the broad range of jurisdictions and stakeholders with conflicting interests. Fortunately, there are some examples of partial success, including community-level integrated planning in British Columbia, Alberta, Ontario, and Quebec.

Corporate, institutional and public concern for action on the environment has never been higher, particularly for action on climate change. This concern is manifesting itself in many ways, all of which together contribute to a growing momentum to find and apply sustainable energy solutions. Governments and utilities offer today an array of financial and non-financial measures in support of sustainable energy solutions, some of which target municipalities directly and others which target the various constituencies of which a municipality is comprised.

Many of the more substantial best practices in energy sustainability are being advanced by larger, urban municipalities. These solutions are not getting much uptake in the smaller, urban or rural municipalities. This is a trend that may continue in the short- to medium-term unless additional resources can be identified to help the smaller communities.

The scope and pace by which sustainable energy solutions can be implemented in municipalities will continue to be impeded by the combined forces of fiscal squeezes and political inertia. Provincial governments are transferring greater responsibilities to municipalities, but increased financial transfers do not often accompany these responsibilities. At the same time, there continues to be a lack of political will to implement the appropriate policies and actions in order to encourage and advance sustainable energy practices in municipal operations and the community. This is a trend that is likely to continue in the short- to medium-term.

Results and Financial Implications

Many sustainable energy strategies and solutions offer direct operating and capital savings or revenue streams to municipalities, such as green procurement, district energy systems, renewable energy production and energy efficiency measures. Unfortunately, there is little information on actual measured outcome-level results, costs, or the cost-effectiveness of best practices adopted by Canadian municipalities. The business case for sustainable energy applications is being undermined by the lack of a robust evidence inventory of program and project performance. In the absence of performance data, it is very difficult to measure project and performance effectiveness.

Municipal investments in sustainable energy still tend to be sub-optimal, for a variety of reasons. With very few exceptions, municipalities use conventional calculation techniques to do the business case assessment for these projects and the valuation methods do not estimate the non-energy financial benefits stream. The challenges to municipalities moving forward, from a financial perspective, will be:

- Properly making and selling the case using full valuation,
- Access to internal budgets for capital and operating measures,
- Time and resources to investigate and possibly develop innovative financing approaches by which funds could flow to sustainable energy projects over the long-term and
- Overall, establishing the operating conditions whereby transactions costs of development and delivery can be reduced to make sustainable energy projects and programs attractive for investment.

Opportunities and Threats

Exhibit E.2 lists opportunities and threats to achieving sustainable energy solutions in municipalities. It is important to reiterate that this list of opportunities and threats does not encompass all of the issues which municipalities face today in achieving environmental sustainability.

Exhibit E.2: Overview of Key Issues for Sustainable Community Development – Municipal Energy Sector

Issue	Sub-Issue	Threat	Oppor-tunity
Cross-cutting			
Energy costs	Rising energy costs affect the costs of running municipal operations and affect the municipal economy. Investments in energy efficiency and alternatives are also part of the "green economy". There is an opportunity to attract dynamic businesses and professionals and which can even lead to direct business spin-offs for municipalities.	X	X
Cost and revenue squeeze	Provincial governments are transferring greater responsibilities (e.g., for transit operations, social services, affordable housing, environmental planning, and infrastructure provision) to municipalities, but increased financial transfers do not often accompany these responsibilities.	X	

Issue	Sub-Issue	Threat	Oppor-tunity
Infrastructure rehabilitation needs	Offers some opportunities relating to the development of sustainable energy solutions in municipalities, particularly when the infrastructure rehabilitation opportunities occur in: i) urban core areas where roads and pipe upgrades require massive excavations and ii) where large brown-field tracts of land are considered for redevelopment.	X	X
Growing government and utility support	A tremendous and immediate opportunity for municipalities to leverage investments in sustainable energy projects via a plethora of government and utility programs.		X
Green Demographics	"Early adopters" can uncover the latent demand for the introduction of energy sustainability initiatives. Municipalities can then use this market shift to their advantage in order to advance energy sustainability solutions on a larger scale.		X
Municipal planning-governance-management for energy sustainability			
Municipal powers and governance	Municipalities cannot create sustainable communities without the coordinated assistance of upper levels of government. Furthermore, municipal revenue sources are limited.	X	
Absence of enforceable national level sustainability standards and requirements for municipal top level plans.	Requirements for top level plans fall under provincial jurisdiction but vary significantly according to province. This makes it very difficult to characterize and target best practice to support energy sustainability in top level plans.	X	
Lack of political will	Lack of political will to implement the appropriate policies and actions in order to encourage and advance sustainable energy practices in municipal operations and the community.	X	
Valuation approaches	The business case for sustainable energy is undermined by two key factors: incomplete valuation of financial benefits; and outmoded methods and tools to conduct business case analysis (simple payback vs. life cycle costing).	X	X
Municipal jurisdiction to set energy performance standards	The scope for legally-binding municipal influence over building energy efficiency is for practical purposes quite limited in most jurisdictions.	X	
Transaction costs	Significant transaction costs for developers trying to implement energy sustainability projects because municipal and utility planning and permitting processes do not keep up with technological innovations. Furthermore, it is difficult for building inspectors to determine whether a proposed innovation provides protection to the public equivalent to that of prescriptive code requirements due to lack of information/education.	X	
Operational practices and technologies			
Siting large and small scale wind power developments	Lack of municipal permitting processes, approvals processes and zoning bylaws geared to wind development. Real and perceived issues relating to noise and setbacks.	X	
LEED certification and standards	Municipal opportunity to utilize an existing performance standard that is recognized as a legitimate standard in North America and one that is supported by program executors in both Canada and the states.		X

Implications for Municipal Energy Management

The broad implications are as follows:

- ***Baseline practices***: Certain key "baseline" practices and systems will support the adoption of management and technical best practices, improve the business case for sustainable energy and provide the metrics to help support decision-making and planning for adoption of sustainable energy solutions. Baseline practices may include: Energy management information systems (EMIS); Measurement and verification (M&V) including use of the International Performance Measurement and Verification Protocol (IPMVP); Energy performance benchmarking; and Sustainable energy valuation.

- ***Capacity building***: Implementing advanced performance solutions and ensuring performance improvements are sustained over the long term could be accomplished by municipalities that commit to: an energy management organizational needs assessment; and, by developing customized training that addresses corporate management best practices needs and gaps in their municipality, as determined from the needs assessment. Municipalities can build capacity in the area of making and selling a business case for a sustainable energy investment by identifying appropriate decision analysis support tools and training staff on their use. Municipalities should also build capacity through staff training and use of available tools for the key elements of sustainable energy programming, such as program design, staffing and budget management, monitoring tracking and reporting, and program evaluation.

- ***Project priorities***: There is a large array of system and component level applications to bring energy sustainability solutions to existing and new facilities and developments in municipalities. Sustainable energy project types that could be considered by municipalities interested in leading edge technologies and practices may include: Performance requirements and measurement; Sustainable neighbourhoods and communities, including both greenfield and brownfield developments; district energy / integrated energy systems; renewable energy applications; new construction and existing facility renovations considering whole building energy performance; and energy performance improvement in existing water and wastewater treatment facilities.

- ***Programs***: A focus on sustainable energy programs by municipalities would address the reality that "change management" has to occur to sustain a pathway that will lead to sustainable energy in Canadian municipalities. As opposed to a project, a program is a means of bringing solutions to a target marketplace over a period of time necessary to sustain change. Through the lens of market transformation, sustainable energy programs become the vehicle by which municipalities can begin to foster change in the sectors that extend beyond the jurisdiction of their own facilities.

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GLOSSARY OF TERMS

Term	Definition
Biomass	Biomass refers to living and recently dead biological material, such as plants and wood waste that can be used as fuel for industrial production.
Brownfield	Abandoned and idle industrial and commercial sites in cities and other urban areas sometimes characterized by environmental degradation and contamination. The term "brownfield" is used to distinguish these sites from "greenfields," undeveloped land outside of cities and urban areas.
Building envelope	A building envelope is the separation between the interior and the exterior environments of a building. It serves as the outer shell to protect the indoor environment as well as to facilitate its climate control.
Cogeneration	Production of two useful forms of energy such as high-temperature heat and electricity from the same process. For example, while boiling water to generate electricity, the leftover steam can be sold for industrial processes or space heating. Also known as combined heat and power.
Combined heat and power	Production of two useful forms of energy such as high-temperature heat and electricity from the same process. For example, while boiling water to generate electricity, the leftover steam can be sold for industrial processes or space heating. Also known as cogeneration.
Demand Side Management	The planning, implementation, and monitoring of utility activities designed to encourage consumers to modify patterns of electricity usage, including the timing and level of electricity demand. It refers to only energy and load-shape modifying activities that are undertaken in response to utility-administered programs. It does not refer to energy and load-shaped changes arising from the normal operation of the marketplace or from government-mandated energy-efficiency standards. Demand-Side Management covers the complete range of load-shape objectives, including strategic conservation and load management, as well as strategic load growth.
Digester gas	Digester gas is produced through the process of anaerobic digestion, which is the breakdown of organic material without the use of oxygen (as opposed to aerobic digestion). When anaerobic digestion occurs, it produces gas that can be used to generate energy.
District energy	Production of steam, hot water or chilled water, or any combination including all three, at a single central utility plant for distribution to other buildings through a network of pipes.
EcoLogo	EcoLogo is North America's most widely recognized and respected certification of environmental leadership. By setting standards and certifying products in more than 120 categories, EcoLogo helps you identify, trust, buy, and sell environmentally preferable ("green") goods and services.
Emissivity ceiling	Emissivity is best defined as the ability of a surface to radiate heat. Materials which radiate the maximum amount of heat possible have an emissivity of 1. Low emissivity ceilings specifically deal with the radiant part of the heat load. In most community ice rinks, the radiant heat load is the single largest heat source the refrigeration system must remove to keep the ice at its desired temperature.
Energy footprint	An energy footprint is a measure of land required to absorb the CO2 emissions. This approach focuses on the outcome of energy use that is CO2 emissions, to highlight the problem and pave the way for corrective action to be taken.

Term	Definition
Energy Star	The international Energy Star symbol is a simple way for consumers to identify products that are among the most energy-efficient on the market. Only manufacturers and retailers whose products meet the Energy Star criteria can label their products with this symbol.
Faucet aerator	A device screwed into the end of a faucet spout that mixes air into flowing water, and controls flow to reduce splashing.
Free cooling	Free cooling is where the low outside air temperature is utilised for chilling water in the process or in air conditioning, rather than being used in part or all in the air-cooled chiller plant.
Gasification	Gasification is a process that converts carbonaceous materials, such as coal, petroleum, or biomass, into carbon monoxide and hydrogen by reacting the raw material at high temperatures with a controlled amount of oxygen. The resulting gas mixture is called synthesis gas or syngas and is itself a fuel. Gasification is a very efficient method for extracting energy from many different types of organic materials, and also has applications as a clean waste disposal technique.
Greenhouse Gas	Those gases, such as water vapour, carbon dioxide, nitrous oxide, methane, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride, that are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation, thus preventing long-wave radiant energy from leaving Earth's atmosphere. The net effect is a trapping of absorbed radiation and a tendency to warm the planet's surface.
Green Leaf	The Green Leaf Program is directed at the hospitality industry. Offered at two levels, it enables hotels to succeed with their eco-efficiency savings and environmental commitment. The Green Leaf Program also provides the professional and leisure traveler verified environmentally responsible options.
Green power	Electricity that is generated exclusively from "green", environmentally friendly resources (e.g. solar, wind, tidal, geothermal, biomass).
Ground-source heat	A ground-source heat pump uses the earth or ground water or both as the sources of heat in the winter, and as the "sink" for heat removed from the home in the summer.
Induction lighting	Induction lighting, sometimes called the electronic light bulb, is emerging as one of the newest technologies in lighting. This new technology lighting offers high efficacy and a very long life. Induction lighting lamp has a shape very similar to that of an incandescent lamp. This makes it useable in a variety of applications offering improved efficiency. Compared with the incandescent lamp, the induction bulb is about 4 times as efficient and lasts over 20 times longer. In fact, these lamps are rated between 10,000 and 20,000 hours.
Landfill gas	Gas that is generated by decomposition of organic material at landfill disposal sites. The average composition of landfill gas is approximately 50 percent methane and 50 percent carbon dioxide and water vapour by volume. The methane percentage, however, can vary from 40 to 60 percent, depending on several factors including waste composition (e.g. carbohydrate and cellulose content). The methane in landfill gas may be vented, flared, combusted to generate electricity or useful thermal energy on-site, or injected into a pipeline for combustion off-site.

Term	Definition
Net zero energy	This refers to a situation when the operating energy use of the building will not result in the incremental energy consumption of non-renewable energy. The applications will rely on advanced design to significantly reduce the energy load and that the "gap" in required energy supply will either be met by purchased energy supply (e.g., from the grid and/or district energy system), on-site renewable energy or some combination of the two options.
Peak demand	The maximum load during a specified period of time.
Potable water	Water which is free from impurities that may cause disease or harmful physiological effects, such that the water is safe for human consumption.
T8 lighting	Industry nomenclature for a fluorescent lamp that is 8 one-eighths of an inch in diameter (i.e., one inch diameter). A T12 lamp is 12 one-eighths or 1.5 inches in diameter.
Transition fuel	Refers to energy sources that can be used to transition from a high to low carbon economy.
Waste heat recovery	Any conservation system whereby some space heating or water heating is done by actively capturing by-product heat that would otherwise be ejected into the environment. In commercial buildings, sources of water- heat recovery include refrigeration/air-conditioner compressors, manufacturing or other processes, data processing centres, lighting fixtures, ventilation exhaust air, and the occupants themselves. Not to be considered is the passive use of radiant heat from lighting, workers, motors, ovens, etc., when there are no special systems for collecting and redistributing heat.

1. INTRODUCTION

1.1 BACKGROUND

The Federation of Canadian Municipalities Green Municipal Fund (FCM GMF) supports communities to improve air, water and soil quality, and to address climate change. The Fund provides low-interest loans and grants, builds capacity, and shares knowledge to support municipal governments and their partners in developing communities that are more environmentally, socially and economically sustainable. Information sharing among municipal practitioners and technology transfer for best practices are important features of the GMF funding program, designed to increase the capacity of communities to undertake leading practices in Canada.

The Federation of Canadian Municipalities commissioned Marbek Resource Consultants to undertake research on current and best practices of Canadian municipalities in the energy sector.

1.2 OBJECTIVES

The objectives of this Energy Sector report are to:

- Identify issues, trends, technologies, best practices, and Canadian examples related to municipal progress in energy sustainability.
- Provide current and comprehensive information that will serve as a reference document.

1.3 SCOPE AND DEFINITIONS

1.3.1 The Energy System

The energy system can be thought of as comprising five main elements:

- Energy services – What people, businesses and institutions actually need or want energy for, such as a well-lit office, a warm house, the movement of widgets along an assembly line, the ability to move from A to B.
- Energy service technologies – The equipment that provides an energy service; for example, a lamp system to provide light, a furnace or boiler to provide heat, a conveyor belt that moves widgets, a car that provides mobility.
- Energy forms – Energy is utilized and used in various forms including electricity, refined petroleum products (RPPs), natural gas, biomass and sunlight.
- Energy distribution systems – The systems through which energy is supplied to municipalities (electricity transmission system, pipeline systems for gas or for district heat, etc.).
- Energy storage systems – It makes sense to run some kinds of power generating systems at capacity even during periods of the day when demand is low. When supply

exceeds demand, energy can be stored (e.g., in batteries or by pumping water up to a reservoir) so it is available when demand is high. Energy storage is useful for both grid-based energy systems and distributed energy systems.

1.3.2 Scope of the Municipal Energy Sector

Broadly, the municipal energy sector refers to all aspects of energy supply and use within and by a municipality. Taking the vantage point of aspects over which municipal governments can exercise some control, this includes:

- Energy services and energy service technologies in municipally-owned facilities
- Energy services and energy service technologies in other facilities within the municipality
- The generation of energy within municipalities (e.g., district heating, co-generation)
- The storage, distribution and supply of energy within municipalities.

Most of the energy currently consumed within municipalities is attributed to activities beyond municipal jurisdiction and operations. However, as touched on in this document, there are also opportunities for and means by which municipalities can influence sustainable energy solutions beyond their jurisdictional boundaries.

While energy-consuming modes of transportation within municipal boundaries – and in particular municipal transit systems -- are also legitimately part of the municipal energy system, they are not addressed within this report (See Section 1.4.2).

1.3.3 Defining Sustainable Energy[1]

As a "triple bottom line" concept,[2] sustainability involves practices that:

- Protect or restore the natural <u>environment</u> (reduce the environmental footprint);
- Avoid harm (and ideally increase benefits) in relation to <u>social</u> and health indicators, and result in a more equitable distribution of benefits; and
- Are <u>economic</u> to maintain over the long term and/or don't impede the emergence of other sustainable approaches.

The concept of life-cycle is integral to sustainability. Thus energy sustainability must be considered in relation to the cumulative effect on environmental, social and economic conditions through all phases of activity – from the construction of required facilities and manufacturing of equipment; to energy generation, distribution, use, and storage; to the retirement/decommissioning of facilities and equipment. [3]

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[1] Many key features of a sustainable approach to energy were brilliantly articulated thirty years ago as a concept called "soft path energy". See Amory Lovins, *Soft Energy Paths-Towards Durable Peace*, Friends of the Earth International 1977.

[2] This triple bottom line approach is reflected in various "sustainability frameworks" including: i) the Natural Step, ii) the Triple Bottom Line, iii) the Melbourne principles, iv) Environmental Management Systems, and v) Cradle to Cradle.

[3] Many key features of a sustainable approach to energy were brilliantly articulated thirty year ago as a concept called "soft path energy". See Amory Lovins, *Soft Energy Paths: Towards a Durable Peace*, Friends of the Earth International 1977.

Energy sustainability – and sustainability in general -- is therefore a relative concept. Even the more sustainable sources of renewable energy result in some impacts over their life-cycle.[4] For example, the processing of silicon during the manufacture of conventional photovoltaic panels is itself quite energy intensive.[5]

Thus the primary goal of management for sustainable energy is to meet energy service needs with energy sources, energy infrastructure and energy service technologies that minimize damage to municipal, regional and global air, land and water resources and that support healthy human economic and social systems. A bit more specifically, sustainable energy approaches should:

- Contribute to the goal of stabilizing atmospheric concentrations of greenhouse gases
- Limit emissions of other pollutants or other hazards to the environment
- Not involve substantial health hazards or social injustices
- Not substantially deplete energy or other resources
- Foster and sustain a secure, widely accessible and relatively stable energy supply that supports the municipal economy.

It is also important to note that there is a strongly-held if implicit assumption that energy-use and economic health are tightly coupled. Thus in addition to "decoupling" environmental impacts from energy use (i.e., finding ways to produce and use energy that do not impose continually increasing environmental burdens), there is also a philosophical and practical shift required to decouple energy from the economy (i.e., to find ways to have a healthy economy without increasing energy use). This requires in turn an orientation to dematerialisation (reducing the resource throughput required to serve economic functions) and decreased consumption (doing well with less).

1.3.4 Municipal Sustainable Energy

Functionally, there are two key pathways through which the goal of energy sustainability in municipalities can be achieved: development/delivery of more sustainable forms of energy (cleaner and/or renewable sources); and more efficient use of energy. As elaborated in sections 3 through 5 of this paper, there are many planning and implementation solutions that can be employed in support of these pathways.

Energy sustainability is a "long-run" concept; it can't be achieved overnight. Indeed, to fully optimize both the demand and supply pathways requires application of integrated "systems approach" to planning and implementation. The resulting ideal -- an "integrated municipal energy system" – was well described in the report emerging from a recent Canadian workshop on the subject.[6] These characteristics are further depicted in Exhibit 1.1

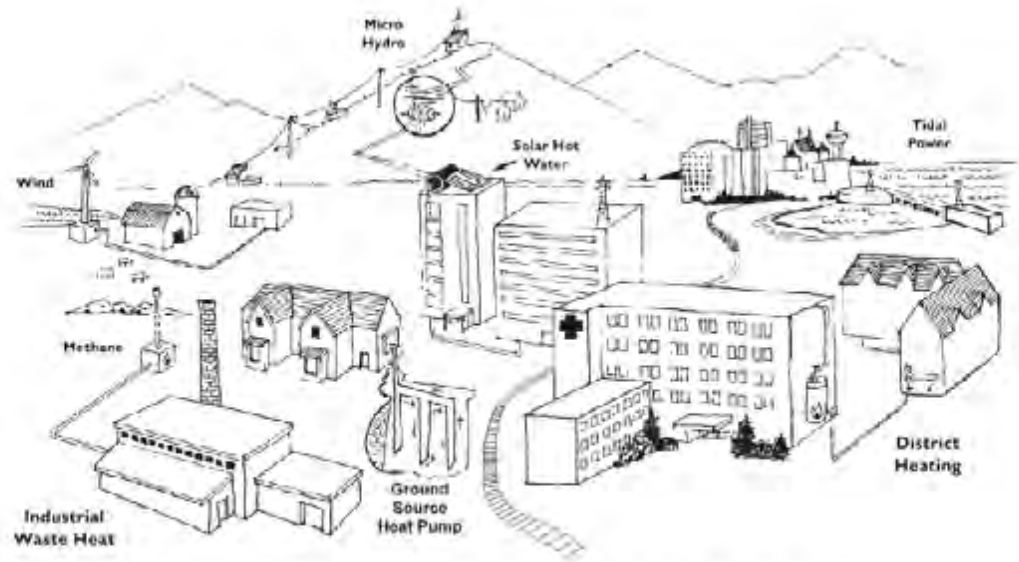
[4] Alex Lantsberg, *Sustainable Urban Energy Planning -A Roadmap for Research and Funding*, prepared for the California Energy Commission Public Interest Energy Research Program, June 2005.

[5] Fthenakis, Vasilis and Hyung Chul Kim, *CdTe Photovoltaics: Life Cycle Environmental Profile and Comparisons*, presented at the European Material Research Society Meeting, Symposium O, Nice, France, May 29-June 2, 2006

[6] Quality Urban Energy Systems of Tomorrow (QUEST). *Integrated Energy Systems in Canadian Communities: A Consensus for Urgent Action*. March 2008

- Clustered, higher density, mixed-use developments of housing, commercial space and industry in which various technical and management best practices are applied to ensure efficiency (e.g., end-use efficiency technologies, operational and behavioural change, load management);
- District energy/utility grids and cascading of energy use between industrial, commercial and residential applications;
- Smaller scale urban energy systems, distributed more widely, located closer to and within buildings, integrated with elements of buildings, and integrated with other infrastructure systems; and
- Increasing contribution from solar, geothermal, wind, hydro, landfill gas and municipal/agricultural/industrial/forestry waste, supplemented by larger scale electricity and gas grids as necessary.

Exhibit 1.1: Some Possible Features of an Integrated Energy Future



Source: Green Municipalities - A Guide to Green Infrastructure for Canadian Municipalities prepared for the FCM by the Sheltair Group, May 2001

In a general sense then, an ideal approach to meet the sustainability conditions described in 1.3.3 would involve:

- Implementing urban design and development approaches that support intensification and thereby facilitate more efficient and affordable energy infrastructure options;
- Building diverse, flexible, and scaled energy supply infrastructure and using energy from multiple locally-available, non-depletable sources so that the overall energy supply is the aggregate of multiple low-impact sources;[7]

[7] Michael Wiggin (NRCan), Innes Hood (The Sheltair Group), Andrew Pape-Salmon (Pembina Institute), Nic Rivers and Matt Horne (Simon Fraser University), Cities Plus - *Energy Foundation Paper: Infrastructure*, July 2002, p. 9 (http://www.citiesplus.ca/cdsubmission/pdf/c2/c2_Energy_foundation_paper.pdf - date accessed: June 2008).

- Thermodynamically matching the quality of the energy supply to the quality of the energy service needs;[8] and
- Reducing or eliminating demand through various technical and management best practices.

1.4 ORGANIZATION AND APPROACH

1.4.1 Structure of this Report

Section 2 of this report provides an overview of key issues that affect the pursuit of energy sustainability in the municipal context. How these issues play out can depend on:

- Jurisdictional differences (i.e., the kinds of requirements or constraints imposed by provinces and territories on their municipalities), and

- The location, type and size of municipality.

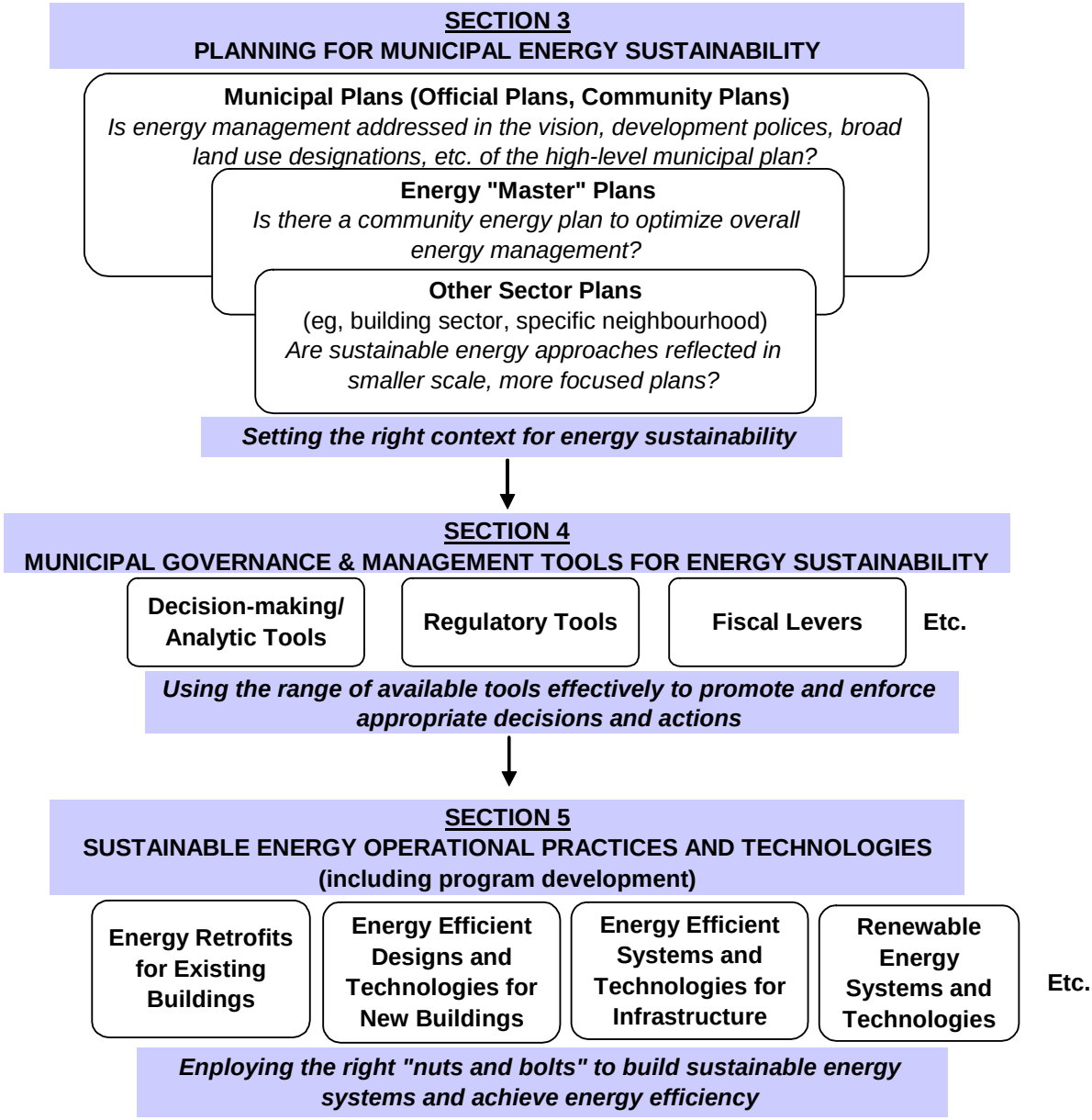
Section 3, 4 and 5 represent the core of the report. They address municipal practices relevant to energy sustainability, with an emphasis on best practices, in the sequence illustrated in Exhibit 1.2 on the following page.

Section 6 briefly discusses some of the financial performance metrics and implications related to energy sustainability.

Section 7 provides some concluding thoughts and recommendations for moving forward in support of energy sustainability in municipalities.

[8] For example electricity should be used to meet needs, such as lighting, that require this kind of high quality energy. Especially if it is fossil-fuel generated, it should not be used for applications like space heating that can be satisfied with lower quality energy.

Exhibit 1.2: Report Structure – Sections 3, 4 and 5



1.4.2 Relationship to Other Sectors

Municipal energy sustainability is served by many of the same overall development and design approaches required for municipal sustainable development more generally. To briefly summarize, the energy and carbon intensity of communities can vary significantly depending on land use planning and zoning, transportation infrastructure and green space, as well as site and building design. Municipalities have primary authority and responsibility for regulating land use and development, and therefore can have considerable influence over these factors.[9] Compact, mixed-use urban development supports energy sustainability because it optimizes efficient use of infrastructure, makes community energy systems feasible, enables more needs to be met locally, and supports effective public transit.

As the production and use of energy is the most cross-cutting source of environmental impacts and opportunities, energy issues are also integral to sustainability initiatives in all other sectors. However, the focus in this report is *primarily* on plans, approaches and technologies that focus specifically on how energy is supplied, delivered and used, rather than on broader issues of municipal and urban form. That said, it is neither possible nor desirable to completely segregate the larger design dimensions out of the current report, and they are referenced as appropriate in the context of ideal and best practices. This report does not address transportation-related energy issues, and pays relatively less attention to water-related infrastructure as compared to alternative energy systems and buildings. These related areas of concern, while key to good energy management, were omitted to limit the subject matter to a reasonable amount and because they were viewed as being more aligned with other sectors, such as sustainable community planning, municipal water management, transportation, etc.

1.4.3 A Note on Methodology

The characterization of energy sustainability practices in this report is primarily the result of:

- Secondary research to scope the field of approaches comprising of external document and web site review complemented by Marbek in-house files; and

- Interviews with officials in best practice communities, to assess the actual performance of apparently leading approaches, and to fill in gaps and bring greater certainty on some of the practices and issues.

Where possible, practices in all three areas (planning, governance/management and operational practices and technologies) are described along a continuum from “ideal” to best in Canada to typical current practice in Canada. What we characterize as “ideal”

[9] Energy Research Group/MK Jaccard and Associates, *Statement of Work B: Community Measures in the Buildings and Transportation Sectors: GHG Reductions in the Short and Long Term - Final Report*, submitted to the Municipalities Table, National Climate Change Process, September 1999 (http://www.emrg.sfu.ca/EMRGweb/pubarticles/Reports%20on%20Municipalities%20and%20Transportation/munitable.pdf - date accessed: June 2008).

provides valuable information regarding what is technically feasible, as well as the basis for understanding the constraints and trade-offs that may make the ideal unattainable in real-world municipal settings. It also establishes a point of comparison for existing best practices in Canada, to give a sense of how progressive these practices are.

Best practices are those that are more effective at delivering desired outcomes (objectives) than typical practice. In the context of energy sustainability, best practices are proven plans and strategies, actions, and technologies that serve to meet the objectives described above. In reality, there are trade-offs amongst these objectives, and it can be difficult to compare and rank amongst approaches and technologies that meet different objectives in varying degrees. Also, as noted above, not all planning approaches, management tools and infrastructure and equipment options work equally well in the many different kinds of municipalities that exist in Canada. Where relevant, we explicitly address the replicability and appropriateness of best practices in different settings.

Characterizing current practice is a particular challenge, given the breadth of the energy sector, the range of types of practice we address, the typically large variability between municipalities, and the general lack of statistically-valid research across the country on what municipalities are doing in the energy sector. Consequently, the assessment of current practice draws primarily on professional judgement and/or an imputed relationship to best practice. We also draw on professional experience to provide a sense of trends, in particular the degree to which typical practice is moving in the direction of best practice.

2. KEY ISSUES

This section provides an overview of key issues that exert an influence, either positive or negative, on progress towards energy sustainability in municipalities. These key issues represent the drivers for decision-making and challenges facing municipal governments wishing to implement sustainable energy practices and projects now and in the future.

This section is organized as follows.

- The first sub-section discusses issues that cut across all aspects of achieving energy sustainability in municipalities.
- The second sub-section presents issues that relate to the topics covered under sections 3-5 of the report.

Note that each heading in which a specific issue is introduced also refers to whether the issue is a barrier to or opportunity for sustainable energy in municipalities.

- The section concludes with a summary table of key issues discussed in this section and their applicability to Canadian municipalities. Among other things, the table identifies the relevance of the issues as they apply to energy sustainability in municipal operations versus the municipality as a whole.

Case Example: Increasing Municipal Energy Costs

Halifax Regional Municipality's corporate spending on energy increased by over 60% from 2002 to 2007, and now exceeds $20 million per year. Energy costs in the entire HRM increased by over 40% in the same time period and now exceed $1.3 billion per year. Energy costs have increased faster than the growth in energy consumption.

From Halifax Regional Municipality *Community Energy Plan, Task 7, Final Report*, November 2007

2.1 CROSS-CUTTING ISSUES

2.1.1 The End of Cheap Energy Supply: Barrier and Opportunity

The key driver for advancing sustainable energy may well be the cost of energy supply, rather than environmental considerations. Oil prices are currently running in the range of $120/bbl to $135/bbl and the 52 week range is $89/bbl to $133/bbl.[10] As demand for oil outstrips conventional supply, the costs of conventional energy and, in particular, the costs of refined petroleum products (RPPs) will likely continue to rise, as they have over the past decade.[11] This affects the direct costs of energy supply (e.g., customer purchase of fuel oil) and the indirect costs (e.g., electricity costs will be impacted in regions of the country where oil is used to generate electric power).

[10] Crude oil price forecast (http://www.oil-price.net/ - date accessed: June 2008).

[11] As noted in the International Energy Agency (IEA) November outlook: *Although production capacity at new fields is expected to increase over the next five years, it is very uncertain it will be sufficient to compensate for the decline in output at existing fields and meet the projected increase in demand.* Many economists are predicting $U.S.100/bbl and rising as the norm, rather than the exception. Jeff Rubin, *$100 Oil*, prepared for CIBC World Markets – StrategEcon, July 18, 2007 (http://research.cibcwm.com/economic_public/download/sjul07.pdf - date accessed: April 2008).

The accompanying textbox illustrates the impact that this phenomenon can have, showing how rising energy costs affect the costs of operating municipal operations, as well as the municipal economy as a whole. The likelihood of an eventual economy-wide price on carbon, as recently called for by the National Round Table on the Environment, will also drive up conventional energy prices.[12]

The following points further elaborate on the possible implications, both inside and beyond the boundaries of municipal operations.

Municipal Operations

The municipal buildings and infrastructure that exist or are currently being constructed will almost certainly, within their lifetimes, cost substantially more to operate. In the short term, this issue can actually work against efforts to plan and implement sustainable energy solutions because of a focus on other, competing concerns. As energy operating costs rise, operating and capital budgets for other important needs become increasingly at risk, including existing municipal services, building maintenance and planned capital works projects.

Municipality as a Whole

Rising energy costs affect business margins resulting in less money flowing into the local economy and possibly leading to business closures and wholesale economic decline. These realities have implications for the municipal tax base, as well as for municipal budgets.

Municipalities are in competition to attract businesses, professionals and workers; even more so in the globalized economy. The energy cost squeeze has to be taken into consideration as a factor that can be controlled through sustainable energy solutions. Dollars that leave the community are not available to generate the "economic multiplier" benefits that come from money spent in the community.[13] The Urban Institute notes that "long-term planning for municipal or corporate sustainable growth and economic vitality is requiring an approach that looks beyond traditional areas of concern, that within the lifecycle of buildings and urban form being created today, changes in the design, efficiency and technology will be required for how we heat, cool and power built spaces and transport people."[14]

The corollary to this issue is that, over time, an aggressive commitment to sustainable energy development will help create conditions that can help to attract and retain

[12] National Round Table on the Environment and the Economy, *Getting to 2050: Canada's Transition to a Low-emission Future,* January 2008.

[13] US Department of Energy – Tomorrow's Energy Today for Cities and Countries, *The Jobs Connection: Energy Use and Local Economic Development*, November 1996 (http://www.cpfund.ca/pdf/the-jobs-connection.pdf - date accessed: April 2008).

[14] Canadian Urban Institute

businesses.[15,16] The anticipated benefits of the "green economy" have been recognized by some municipalities, such as the City of Guelph which explicitly recognizes and seeks to promote this in its new Community Energy Plan. Money spent on locally supplied renewable energy supply, such as solar, biomass and wind, is likely to have a higher probability of staying within the community. It has been argued that community-owned local power may be particularly advantageous on these counts.[17]

2.1.2 Cost and Revenue Squeeze: Barrier[18]

This is an issue that only exacerbates the circumstances caused by rising energy costs. Municipalities in Canada are increasingly caught in a financial vice. On the one hand, provincial governments are transferring greater responsibilities (e.g., for transit operations, social services, affordable housing, environmental planning, and infrastructure provision) to municipalities, but increased financial transfers do not often accompany these responsibilities. On the other hand, raising property taxes is seen as regressive and ratepayers have made it clear that they are not willing to tolerate ever-increasing property taxes.

These combined trends are forcing municipal governments to increase their use of alternative revenue sources, such as new taxes, user fees, private-public partnerships, and development charges. While these new approaches to revenue generation provide access to funds in the short-term, they cannot provide the level of funds needed to develop and implement long-term solutions for energy sustainability and other pressing needs like infrastructure renewal.

2.1.3 Infrastructure Rehabilitation Needs: Barrier and Opportunity

The infrastructure deficit of Canadian municipalities has reached $123 billion and Canada has used up 79 percent of the service life of its public infrastructure.[19] Local governments face pressures to build/update transit facilities, drinking water and sewage systems, and extend urban road networks. At the moment, this is both a barrier and

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[15] Chris Corps, Asset Strategics and Doug Webber, Halsall Engineering, *Canadian Perspective-Green Progress in Canada*, a presentation to the Advancing Green Buildings meeting in LBL for the Commission for Environmental Cooperation, October 2006.

[16] As an example of how fostering clean technology businesses can pay off, San Francisco's payroll tax-exclusion for clean energy technology businesses, introduced in 2005, has helped make the City a hub for clean technology businesses. American Institute of Architects, Local Leaders in Sustainability – *A Study of Green Building Programs in our Nation's Communities*, 2007, p. 26 (http://www.aia.org/SiteObjects/files/LLinSustain_FullReport.pdf – date accessed: April 2008).

[17] A significant body of research points to substantial economic, social and environmental benefits in the community ownership of renewable energy projects when measured against the commercial development of renewable generation. [Community power] taps into local sources of capital through private investment, helping to reduce the cost of capital, lower financial risk, and minimize environmental impacts while stimulating community economic development. Canadian Renewable Energy Alliance, *Framework for a Model National Renewable Energy Strategy for Canada*, June 2006 (http://www.canrea.ca/pdf/CANREA_Full_Nat_RE_Strat_July%2006.pdf – date accessed: April 2008).

[18] Marbek Resource Consultants Ltd. and Corps, *Sustainable Community Planning in Canada: Status and Best Practices*, June 2008, p.9.

[19] Mizra, S., *Danger Ahead: The Coming Collapse of Canada's Municipal Infrastructure*, prepared for the Federation of Canadian Municipalities, 2007.

opportunity for sustainable energy. How municipalities respond to these circumstances will determine the direction this issue will follow.

From the standpoint of energy, there are a growing number of municipalities in which electricity distribution bottlenecks are becoming more frequent leading to concerns about power reliability and/or quality. There are communities where the distribution infrastructure is aging and utility distribution managers are faced with the difficult challenge of maintaining an aging infrastructure at a time when their companies are under pressure to lower costs. This issue acts as an economic barrier for municipalities, particularly as many of the distribution problems are located in the core areas of cities, where intensification is desired.

This picture of aging infrastructure also offers some opportunities relating to the development of sustainable energy solutions in municipalities, particularly when the infrastructure rehabilitation opportunities occur in: i) urban core areas where roads and pipe upgrades require massive excavations and ii) where large brownfield tracts of land are considered for redevelopment. (In Canada there are an estimated 30,000 brownfield sites and brownfields represent about 12% of the existing urban land area).[20]

These circumstances lend themselves to the development of district energy transmission systems, further discussed in section 5. Indeed, some of the more innovative urban developments emerging in Canada – such as Dockside Green in Victoria (described in section 4) are taking place on brownfield sites. It has also been suggested that local authorities can use their "franchise" power -- control over streets and other rights-of-way that utilities need for distribution -- to influence utility policies and projects relating to infrastructure development and rehabilitation.[21]

2.1.4 Growing Government and Utility Support: Opportunity

There exists in Canada today, a plethora of government and utility programs that support sustainable energy solutions. Some of these programs can be utilized to improve the energy performance of municipal operations; others can be used by consumers, businesses and institutions. In short, this is a tremendous and immediate opportunity for municipalities to leverage investments in sustainable energy projects. These opportunity areas are categorized into the following groups.

Provincial Policies and Programs to Support Sustainable Energy

Several provinces now have policies and programs in place to support “green” and/or renewable energy alternatives, and many have established specific targets. For example, Prince Edward Island’s “Energy Framework and Renewable Energy Strategy” aims to have utilities acquire at least 15% of electrical energy from renewable sources by 2010. The B.C. Energy Plan calls for at least 90% of all electricity generated in the province to

[20] Marbek Resource Consultants Ltd., in association with the Sheltair Group, *The Built Environment Strategic Roadmap* 2005-2030+ *Consultation Draft*, prepared for the Office of Energy Efficiency-Natural Resources Canada, Nov 2005, p. 34.

[21] ICLEI Local Governments for Sustainability, *Saving the Climate – Saving the Cities, Chapter 4, Towards a Local Action Plan* (http://www.iclei.org/index.php?id=1666 – date accessed: April 2008).

continue to come from clean or renewable sources and to achieve electricity self-sufficiency by 2016. Ontario's target is for 10% of energy to come from new renewable sources by 2010.[22] Comparable renewable targets have been set in numerous other jurisdictions (e.g., 10% by 2006 in New Brunswick; 10% by 2010 in the NWT).

Increasingly, electric utilities are introducing programs to bring these provincial policies into fruition. Through a standard pricing regime, these programs help to bring certainty to the market value of independent power. They also help to reduce transaction costs through clear and consistent contracting and other rules. Typically, generators are offered a fixed price or a hybrid pricing scheme which may combine, for example, a base rate plus a portion to increase indexed to inflation plus a portion relating to the reliability of the power supply during peak hours. For example, in Ontario, through the OPA standard offer program, solar PV generators will be paid a fixed price of 42.0 cents per kWh for the full 20-year term of the contract.[23] B.C. Hydro has initiated a "Clean Power Call" to ensure that the province has sufficient clean electricity to meet its electricity needs.[24]

Programs also exist to purchase power from combined heat and power (CHP) developments including: i) natural gas-fired industrial cogeneration, ii) by-product fuel-fired industrial cogeneration, iii) district energy cogeneration and iv) renewable fuel-fired industrial cogeneration.

Demand-Side Management

A wide array of provincial and federal programs exist to help energy users reduce their energy operating costs. These programs generally fall into four categories.

- *Resource acquisition*: This refers to financial incentives to reduce the capital cost of energy efficiency and/or demand reduction investments.
- *Offset business case risk*: This refers to financial incentives to reduce the cost of feasibility studies.
- *Market transformation*: This refers to collaborations among institutions, manufacturers and other trade allies to increase the market share of energy efficient products.
- *Training*: This refers to activities designed to improve technical and management capabilities and competencies and, therefore, help to build the market environment for sustainable energy performance improvements.

[22] Ontario Ministry of Energy. *Building Ontario's Future: Results Based Plan 2007-2008* (http://www.energy.gov.on.ca/index.cfm?fuseaction=about.plan0708 – date accessed: April 2008).

[23] Ontario Power Authority, *Standard Offer Program – Renewable Energy - for small electricity generators: An Introductory Guide* (http://www.powerauthority.on.ca/sop/Storage/44/3985_SOPInformationBrochure.pdf - date accessed: April 2008).

[24] BC Hydro, *Clean Power Cell*, December 17, 2007 (http://www.bchydro.com/info/ipp/ipp48319.html - date accessed: April 2008).

2.1.5 Green Demographics: Opportunity

There are signs of growing awareness of environmental issues and indications that Canadians are ready to commit to behaviour changes needed to foster environmental sustainability in their communities. This commitment translates to consumers willing to pay a higher price for low impact energy supply, either as an energy commodity (i.e., green power) or in terms of building quality (e.g., EnerGuide for Houses certified home or Net Zero Energy homes). These households and consumers are, in effect, the "early adopters" and they provide fertile ground for the introduction of energy sustainability initiatives.

This is a market shift that municipalities can use to their advantage to advance energy sustainability solutions. There are many examples of this growing shift; two are discussed below.

Characteristics of Green Early Adopters

A study undertaken in 2005 for CMHC examined the characteristics of home buyers who could be categorized as early adopters for net zero energy healthy housing homes.[25] Typically, these consumers have previously owned a home; have a higher than average education and have higher incomes. They also report adopting other environmental habits (e.g. recycling, use of transit, etc.).[26] The research also indicated that energy efficient or renewable energy features (windows, high-efficiency furnace, solar PV, etc.) and indoor air quality are important overall selling features, associated in part with energy cost savings and reduced environmental impact.[27]

Purchase of Premium Green Power

Both publicly and privately owned enterprises are helping to advance sustainable energy by offering customers a green power electricity supply. A green power rate is offered to customers at a cost premium relative to the other power rates that are available. Increasingly, customers are signing up to these offerings which has the effect of increasing the demand for low-impact renewable electricity supply.

ENMAX, City of Calgary owned utility, was the "trail blazer" and has been offering the "Greenmax" program to both residential and commercial customers since 1998.[28] The number of customers who have signed up to Greenmax has steadily risen and has a

[25] Marbek Resource Consultants and Environics Research, *Qualitative Consumer & Industry Research*, prepared for CMHC April 28, 2005.

[26] Ibid.

[27] CMHC- EQuilibrium is a national housing initiative that brings the private and public sectors together to develop homes that combine resource and energy-efficient technologies in order to reduce their environmental impact. Twelve homebuilding teams were selected to build EQuilibrium demonstration projects across Canada that will be used for public education and awareness starting in 2008. (http://www.cmhc-schl.gc.ca/en/inpr/su/eqho/eqdepr/index.cfm - date accessed: April 2008).

[28] Approximately 22,000 residential and 200 commercial customers September 30, 2005. Pollution Probe, *A Consumer Guide to Green Power in Canada* (http://www.pollutionprobe.org/whatwedo/greenpower/consumerguide/alberta.htm - date accessed: April 2008).

positive effect on the green power industry in driving up demand for supply (ENMAX has direct ownership position in Alberta wind power developments).

Bullfrog Power, established in 2005, offers residential and business consumer's renewable energy based electricity supply in both Ontario and Alberta. It counts several municipalities among its customers (e.g., in Ontario, York region, town of Caledon, Guelph).

2.2 ISSUES RELATING TO MUNICIPAL PLANNING-GOVERNANCE-MANAGEMENT FOR ENERGY SUSTAINABILITY (SECTIONS 3 AND 4)

2.2.1 Municipal Powers and Governance: Barrier

Municipalities cannot, on their own, create sustainable communities without the coordinated assistance of upper levels of government. This continues to be a significant barrier to energy sustainability.

While the responsibilities of municipal government have changed dramatically during the past 150 years, the constitutional framework within which municipal governments must govern has not changed at all. Provinces prescribe the legal and fiscal authorities available to municipal governments, typically through a detailed list of powers.[29]

More specifically, the provincial governments establish the "ground rules" of what municipalities can do and how they should and do it, through Planning or Municipal Acts, environmental standards, transportation system standards, building codes, and other means. Furthermore, the revenue sources of Canadian municipalities are limited: local governments collect only a small portion of total government tax revenues in Canada. Provincial and federal spending in urban areas (e.g., on highways, transit, or airports) have a major impact on development patterns and economic well-being.

If we look at the provincial legislative and regulatory context through a national lens, we see a "patchwork" of requirements, frameworks and consequent possibilities and constraints (further explored in section 3.1). With energy sustainability as a goal, this patchwork has the effect of creating limitations to what can be done, creating uncertainty and increasing transaction costs. Indeed, not much has changed since the following recommendation was tabled from the 1999 report from the municipalities table for the National Climate Change Process:

> *Legislative authority, whether it is general or specific, should explicitly extend municipal jurisdiction to issues of energy use and efficiency. We recommend the amendment of appropriate provincial legislation to require consideration of GHG emissions impacts during the preparation of official community plans (and other official plans) and during individual development approvals.*[30]

[29] Federation of Canadian Municipalities, *Early Warning: Will Canadian Cities Compete?*, prepared for the National Round Table on the Environment and the Economy, May 2001 (http://www.fcm.ca/english/documents/compete.pdf - date accessed: April 2008).

[30] Energy Research Group/MK Jaccard and Associates, *Statement of Work B: Community Measures in the Buildings and Transportation Sectors: GHG Reductions in the Short and Long Term - Final Report*, submitted to the Municipalities Table,

2.2.2 Absence of enforceable national level sustainability standards and requirements for municipal top level plans: Barrier

Building on the previous issue, this issue refers specifically to the realm of planning for energy sustainability. Again, as elaborated in section 3, we see a patchwork of provincial requirements for "top level" municipal plans. There are very real limitations to requirements for these plans to incorporate energy sustainability and no framework for governance and accountability to measure and evaluate performance. In effect, there is no national standard of best practice to guide top level planning for energy sustainability (see section 4.1 for some best practice examples that offer potential for replication in Canada, e.g., the "Municipal Energy Conservation Template" developed by the Association of Municipalities of Ontario).

2.2.3 Lack of political will to implement plans: Barrier

As discussed, respectively in sections 3 and 4, there are many instances of top level municipal planning language and instances of governance tools which aim to advance sustainability in communities. However, there is a view among municipal planning officials and the community at large that a lack of political will exists to implement the appropriate policies and actions.

As noted in a recent report, "*provincial and municipal governments can lack political will to create a systems of rates and charges that would ensure new development is not subsidized by existing areas, or to ensure the true economic, social, and environmental costs of infrastructure services are borne by sprawling areas rather than by other ratepayers. This ends up severely limiting the financial and sustainability impacts of sustainable community planning.*"[31]

A recent study undertaken for several municipalities in B.C involved interviewing 50% of decision-makers involved in the community planning process to: i) determine the extent of sustainability knowledge and understanding held by local government employees and council members interviewed, ii) investigate how local governments integrate the principles of sustainability into planning practices and iii) identify challenges and opportunities to incorporating sustainability principles into local planning mandates and initiatives. A key outcome from the interviews was the identification of lack of political will as a barrier; however, this included both political and citizen will.[32]

National Climate Change Process, September 1999 (http://www.emrg.sfu.ca/EMRGweb/pubarticles/Reports%20on%20Municipalities%20and%20Transportation/munitable.pdf - date accessed: June 2008).

[31] Marbek Resource Consultants Ltd. and Ray Tomalty (CORPS), *Sustainable Community Planning in Canada: Status and Best Practices*, prepared for Federation of Canadian Municipalities, June 2008.

[32] Sustainable Community Development, *Community Research Connections* (http://www.crcresearch.org/node/344 - date accessed: June 2008).

This observation was echoed in a report conducted for the Ontario Professional Planners Institute.[33]

2.2.4 Valuation Approaches: Barrier

In the final analysis, sustainable energy solutions can only be implemented in municipalities through financial investments, both capital and operating, to provide both energy management and renewable and clean energy. Such financial investments are supported by business case analyses to confirm that there will be a sufficient return on investment. Unfortunately, the business case for sustainable energy is undermined by two key factors: i) an incomplete valuation of the financial benefits stream and by ii) outmoded methods and tools to conduct business case analysis.

Incomplete valuation of the financial benefits stream

Current business case practice undervalues the financial and economic benefits of sustainable energy by either ignoring or undervaluing the following benefits:

- Productivity improvements (e.g., reduced employee absenteeism, lower vacancy)[34]
- Health benefits (e.g., through reduced air emissions)
- Environmental benefits (e.g., the value of reduced environmental compliance costs).

Most jurisdictions rely on the Total Resource Cost (TRC) cost benefit test to assess the costs and benefits of demand side management. Because the TRC test does not value adverse externalities (e.g. air emissions, health impacts, and climate change), the full range of DSM opportunities are not being realized.[35]

These types of distortions affect not only internal decision-making, but access to financing. For example, green buildings are undervalued because the current standards-based approach to property valuation takes little account of environmental and associated economic and social conditions and risks.[36]

Even calculation of the energy savings stream often overlooks key benefit factors. For example, energy demand fluctuates daily and seasonally but prices -- and in particular electricity prices -- often do not reflect the real-time higher costs associated with providing energy in periods of high demand.

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[33] Melanie Hare, Urban Strategies Inc., *Exploring Growth Management Roles in Ontario: Learning from "Who Does What" Elsewhere*, prepared for the Ontario Professional Planners Institute, September 2001 (http://www.ontarioplanners.on.ca/pdf/growth_101001_position.pdf - date accessed: June 2008).

[34] Chris Corps, Asset Strategics and Doug Webber, Halsall Engineering, *Canadian Perspective-Green Progress in Canada***,** a presentation to the Advancing Green Buildings meeting in LBL, prepared for the Commission for Environmental Cooperation, October 2006.

[35] Energy Efficiency Working Group-Energy Sector Sustainability Table, *Institutional and Regulatory Barriers to Demand-Side Management in Canada*, November 2007, p. 19.

[36] Property valuation, used in more than 130 countries, is a standards-based business and is required for stock exchanges, banks, government, and insurance. There are valuation techniques that can address sustainability, but their use is limited. See Chris Corps, Asset Strategics, *Valuing Sustainability- An Introductory Executive Summary*, prepared for the Commission for Environmental Cooperation, 2007, p.2.

When calculation oversights are corrected, the payback on sustainable energy investments often improves significantly. Estimates indicate that including the quantifiable non-energy benefits can increase the overall value of the investment by a minimum of 30% and possibly as high as four times the value of the energy benefits alone.[37]

Outmoded methods and tools to conduct business case analysis

Many organizations still use the "simple payback" method to assess the business case for sustainable energy investments. The simple payback method merely describes how long it will take, in months or years, for the investment's energy savings (or other operational savings) to pay for the initial cost of the system.[38] This method is deficient for sustainable energy valuation because it does not address future savings and costs that occur after payback is reached, such as the costs of maintaining the system. It also does not differentiate between product alternatives that have different service lives.

Life-cycle cost (LCC) analysis is a preferred method but it still does not have widespread use in municipalities and other sectors of the economy. The LCC analysis takes into account the total cost of owning, operating, maintaining and even disposing of the building, equipment or system over a given timeframe (usually the life of the building). These costs are typically expressed in terms of net present value (NPV), which is the net value of all costs and savings, expressed in today's dollars. NPV makes it possible to compare costs that occur at different points in time. The analysis accounts for the time-value of money, recognizing the many ways building owners can spend or save their money compared to spending it on, for example, an energy efficiency upgrade.

2.2.5 Municipal Jurisdiction to Set the Bar Higher for Energy Performance in Buildings: Barrier and Opportunity

This issue refers to whether municipalities will be able, at some time in the future, obtain the governance authority to set their own energy performance standards. It should be acknowledged that some provinces are upgrading the provincial building codes to advance energy performance levels (e.g., Ontario). However, the question is the degree to which municipalities can set the bar even higher and introduce their own mandatory performance requirements. Though enforceable authority at the municipal level is not entirely absent, the scope for legally-binding municipal influence over building energy efficiency is for practical purposes quite limited in most jurisdictions.

Certainly there are a few such examples, including the City of Vancouver.[39] Yellowknife is another city that is specifying energy efficiency standards for new buildings. The B.C.

[37] Marbek Resource Consultants, *Framework for Quantifying Non-Energy Benefits of Industrial Energy Efficiency Projects*, prepared for the Office of Energy Efficiency, May 2006, p.5.

[38] For example, if the system cost $1000 and reduced energy use by $200 annually, the simple payback would be five years ($1000/$200=5).

[39] Metro Vancouver, *Building Green: Design Best Practices* (http://www.gvrd.bc.ca/buildsmart/energy.html - date accessed: April 2008). The Vancouver performance standard also cites ASHRAE/IESNA Standard 90.1-1989.

municipality of Ucluelet has sent a request to the provincial government to amend the Municipal Government Act to allow Ucluelet and other municipalities in the province the ability to pass bylaws that incorporate higher energy standards, such as LEED Silver in all new buildings.[40]

2.2.6 Transaction Costs: Barrier

Sustainable energy solutions, both on the demand- and supply-side, require significant innovation, both management and technical, to be successful. This barrier refers to the fact that institutionally, municipal and utility planning and permitting processes are not keeping up with the innovations and, consequently, there remain significant transaction costs to the developers trying to implement energy sustainability projects. Green developers are generally of the view that if the "playing field" is level, that they can compete successfully. Reduction of transaction costs is a key factor in levelling the field.

Sustainable energy supply projects require an assortment of environmental assessment, licensing and permitting requirements which, depending on project type, can be onerous and result in high transaction costs. This is an issue that occurs at several levels of development, large scale to very small scale. At the larger scale, utilities with "clean energy" offers typically include municipal zoning approvals as a key project evaluation criterion. At the smaller end of the scale, there have been numerous calls to reduce these burdens in light of the typically small size of operations and the comparatively low impact, [41] including among builders constructing "net zero energy" homes.[42]

On the demand side, as further elaborated in this section, as well as section 5, there are opportunities for developers and builders to have the flexibility to design to specific performance standards, rather than prescriptive requirements. The performance based approach gives these builders flexibility to bring innovative solutions to the marketplace.

However, this places more of a burden on the municipal approvals process in which planners and site/building inspectors must be educated on the leading practices that embody these energy sustainability projects. The lack of information or education makes it difficult for building inspectors to determine whether a proposed innovation provides protection to the public equivalent to that of prescriptive code requirements.

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[40] In fact, BC's Community Charter legislation that came into force in 2004 does recognize shared provincial-municipal interest in regulating building standards, which does give municipalities and regional districts power to establish building by-laws, subject to provincial authorities and to provincial approval. Under the Buildings and other Structures Bylaws Regulation, "Bylaws that establish technical building standards that are different from the standards established by the BC Building Code will require approval by the Minister responsible. A council/regional board is also restricted from extending or changing the application of the BC Building Code, as specified in the regulation." In effect, therefore, opportunities to implement energy efficiency or green building standards may be fairly limited. *Community Charter*, SBC 2003, Chapter 26, Sections 8, 9, and 53. (http://www.qp.gov.bc.ca/statreg/stat/C/03026_00.htm - date accessed: June 2008);

Government of British Columbia, Ministry of Community Services, Community Charter (http://www.cserv.gov.bc.ca/lgd/gov_structure/community_charter/services_regulatory/concurrent_regulation.htm - date accessed: June 2008).

[41] Canadian Renewable Energy Alliance, *Framework for a Model National Renewable Energy Strategy for Canada*, June 2006. (http://www.canrea.ca/pdf/CANREA_Full_Nat_RE_Strat_July%2006.pdf – date accessed: April 2008).

[42] Marbek Resource Consultants, *Net Zero Energy Healthy Housing Initiative Qualitative Consumer and Industry Research*, prepared for CMHC, 2006.

2.3 OPERATIONAL PRACTICES AND TECHNOLOGIES

2.3.1 Siting Large and Small-Scale Wind Power Development: Barrier and Opportunity

Canada today has over 1,000 MW of installed wind turbine generator capacity. Wind power offers a renewable low-impact source of electric power and is particularly relevant to meeting sustainable energy goals in rural municipalities. The most common turbines installed in the last couple of years appear to be horizontal-axis systems in the 1 to 2 MW range, usually with a nacelle height of about 80 metres, and a blade diameter of about 80 metres.[43] However, as wind becomes a more popular and viable alternative, its expansion as a practical, long-term solution faces several barriers, some of which can and need to be directly addressed by municipalities.

As stated in a recent report, "*future growth of wind in the province will depend largely on the existence of effective regulatory processes at the municipal level. Without appropriate municipal permitting processes, approvals processes and zoning bylaws, further wind development will be greatly impeded*."[44] In one form or another, these issues can foster a "not-in-my-backyard" push back among residents which becomes a major impediment to approving proposed wind developments.

Some of the more important issues are:

- *Setbacks* (the distance between wind turbines and dwellings, property lines, roads and other human developments): The issue is safety and community acceptance relating to four main sub-issues- a) ensuring public safety in the event of ice shedding or turbine failure, b) ensuring acceptable sound levels for surrounding receptors-see discussion below, c) ensuring minimum impact on radio, radar and telecommunications and c) ensuring minimal impact on sensitive environments.

- *Sound*: This is a key element in securing community acceptance of siting wind power developments and contains elements of both perception and fact. At present, Ontario is the only provincial jurisdiction with a noise assessment guideline specifically intended for wind turbine generators, recognising that the maximum sound power output generally corresponds with high background sound levels. In the rest of Canada, a number of assessment guidelines, methodologies and criteria are currently in use. Hence, there are two key related issues that emerge: i) how to advance and share information that helps to dispel circumstances of disinformation, ii) how to address the "patchwork" of regulatory requirements addressing noise.

- *Siting Small wind developments:* CanWEA recommends that small wind energy systems be defined as: a wind energy conversion system consisting of a wind turbine,

[43] Howe Gastmeier Chapnil Ltd, *Wind Turbines and Sound Review and Best Practice Guidelines*, prepared for the Canadian Wind Energy Association, Feb 2007, p.6.

[44] Canadian Wind Energy Association, *Canadian Wind Energy Association Position on Setbacks for Large-Scale Wind Turbines in Rural Areas (MOE Class 3) in Ontario*, September 2007, p. 1 (http://www.gov.mb.ca/stem/energy/wind/files/cwea_position.pdf - date accessed: June 2008).

a tower, and associated control or conversion electronics, which has a rated capacity of not more than 300 kW, and which is intended to provide electrical power for use on-site (either behind the meter or off-grid) and is not intended or used to produce power for resale. Over the next ten years it is expected that sales of small wind turbines will increase significantly nationwide, with notable growth in on-grid residential and farm applications. However, only a handful of Canadian municipalities contain small wind provisions in their zoning by-laws, with widely inconsistent and often unduly restrictive regulations. Zoning laws geared to large-scale or commercial wind energy development and policies for all wind turbines regardless of size may not be appropriate for small-scale wind installations.[45]

2.3.2 The LEED® Certification System and Standards: Opportunity

The flagship green building certification system is Leadership in Energy & Environmental Design (LEED®). In Canada, LEED® is administered by the Green Building Council (CaGBC). It is becoming a significant driver in building design and construction and, potentially, in stimulating sustainable neighbourhood developments. In this regard, there is an opportunity for municipalities to reference LEED® as the required performance level for buildings and, eventually, for neighbourhoods. As elaborated in this document, several Canadian municipalities are already doing this. By doing so, municipalities tap into an existing performance standard that is recognized as the legitimate standard in North America and is supported by program executors in both Canada and the U.S.

LEED® is a performance-based approach that encourages innovation and creativity among the design-build community to attain required point ratings and certification. Energy efficiency is a key component within the LEED system. It is becoming the "standard" for North American municipalities to reference in establishing either voluntary or mandatory requirements for municipal owned-operated buildings and many municipal governments are looking at measures to promote adoption more broadly within their boundaries.

In Canada, the next generation of LEED® is slated for 2009 offering enhancements and features that are currently being piloted. This process is driven by the following objectives:

- More efficient and faster certification process
- Streamlined certification for owners and mangers with multiple properties
- Ability to measure performance benefits
- Ability to inform decisions relating to continuous improvement

LEED® is also moving beyond individual buildings to develop the LEED® for neighbourhoods. The U.S. Green Building Council (USGBC) is collaborating with the

[45] eFormative Options, LLC & Entegrity Wind Systems, Inc. Heather Rhoads-Weaver *et al*, *Small Wind Siting and Zoning Study: Development of Siting Guidelines and a Model Zoning By-law for Small Wind Turbines (under 300kW)*, prepared for the Canadian Wind Energy Association, April 2006 (Revised September 2006) (http://www.canwea.ca/images/uploads/File/EN/Small_Wind_Siting_Guidelines.pdf - date accessed: June 2008).

Congress for the New Urbanism and the Natural Resources Defence Council to develop the LEED® for neighbourhoods through an initial pilot phase.

2.4 SUMMARY TABLE OF KEY ISSUES

This table summarizes the key issues discussed in this section and their applicability to Canadian municipalities. Among other things, the table identifies the relevance of the issues as they apply to energy sustainability in municipal operations versus the municipality as a whole.

Exhibit 2.1: Overview of Key Issues for Sustainable Community Development – Energy Sector

Issue	Sub-Issue	Applicability (Region/Province) (S,M,L) (Rural, Urban) (Remote/Northern)	Relevance to municipal operations or community as a whole
Cross-cutting			
Energy costs	Rising energy costs affect the costs of running municipal operations and affect the municipal economy. Investments in energy efficiency and alternatives are also part of the "green economy". There is an opportunity to attract dynamic businesses and professionals and which can even lead to direct business spin-offs for municipalities.	All	Both
Cost and revenue squeeze	Provincial governments are transferring greater responsibilities (e.g., for transit operations, social services, affordable housing, environmental planning, and infrastructure provision) to municipalities, but increased financial transfers do not often accompany these responsibilities.	All	Predominantly operations, but community as a whole also affected
Infrastructure rehabilitation needs	Offers some opportunities relating to the development of sustainable energy solutions in municipalities, particularly when the infrastructure rehabilitation opportunities occur in: i) urban core areas where roads and pipe upgrades require massive excavations and ii) where large brown-field tracts of land are considered for redevelopment.	Core areas of urban municipalities and all high growth municipalities	Predominantly operations, but community as a whole also affected
Growing government and utility support	A tremendous and immediate opportunity for municipalities to leverage investments in sustainable energy projects via a plethora of government and utility programs.	All	Both
Green Demographics	"Early adopters" can uncover the latent demand for the introduction of energy sustainability initiatives. Municipalities can then use this market shift to their advantage in order to advance energy sustainability solutions on a larger scale.	M, L, Urban	Both
Municipal planning-governance-management for energy sustainability			
Municipal powers and governance	Municipalities cannot create sustainable communities without the coordinated assistance of upper levels of government. Furthermore, municipal revenue sources are limited.	All	Community
Absence of	Requirements for top level plans fall under	All	Community

Issue	Sub-Issue	Applicability (Region/Province) (S,M,L) (Rural, Urban) (Remote/Northern)	Relevance to municipal operations or community as a whole
enforceable national level sustainability standards and requirements for municipal top level plans.	provincial jurisdiction but vary significantly according to province. This makes it very difficult to characterize and target best practice to support energy sustainability in top level plans.		
Lack of political will	Lack of political will to implement the appropriate policies and actions in order to encourage and advance sustainable energy practices in municipal operations and the community.	More for larger urban communities with higher population growth.	Both
Valuation approaches	The business case for sustainable energy is undermined by two key factors: incomplete valuation of financial benefits; and outmoded methods and tools to conduct business case analysis (simple payback vs. life cycle costing).	All	Both
Municipal jurisdiction to set energy performance standards	The scope for legally-binding municipal influence over building energy efficiency is for practical purposes quite limited in most jurisdictions.	All	Community
Transaction costs	Significant transaction costs for developers trying to implement energy sustainability projects because municipal and utility planning and permitting processes do not keep up with technological innovations. Furthermore, it is difficult for building inspectors to determine whether a proposed innovation provides protection to the public equivalent to that of prescriptive code requirements due to lack of information/education.	All	Predominantly community, but operations also affected
Operational practices and technologies			
Siting large and small scale wind power developments	Lack of municipal permitting processes, approvals processes and zoning bylaws geared to wind development. Real and perceived issues relating to noise and setbacks.	Predominantly rural	Both
LEED certification and standards	Municipal opportunity to utilize an existing performance standard that is recognized as a legitimate standard in North America and one that is supported by program executors in both Canada and the states.	All	Both

3. PLANNING FOR MUNICIPAL ENERGY SUSTAINABILITY

Sustainable energy planning approaches are the planning activities of municipal councils and staff to identify what actions will be taken over a future time interval to ensure greater energy sustainability. In the context of this report, planning approaches pertain to strategic level resource use decisions (land, energy, water, existing infrastructure, staff and community human resources, economic resources). Strategic planning approaches establish what the functionality and layout of the community will be in the future, including municipal infrastructure and levels of service. Examples of planning approaches include development of official plans, community energy plans, and sector plans.

Section 3.1 sets the context for the discussion of current and best sustainable energy planning practices by describing the different levels of municipal planning relevant to energy sustainability, and the potential for an integrated relationship between these levels. Section 3.2 provides some commentary on current practice and trends, followed by an overview of some best practices in Canadian municipalities in section 3.3.

It is axiomatic that although planning is a key foundation for change, even the best plan will have little impact without the commitment, skills and tools to execute it. The value of the planning approaches discussed in this section of the report can only be realized if the kind of governance and management tools and the operational practices and technologies discussed in sections 4 and 5 are used to implement the plan.

It is worth reiterating here that the term “energy sustainability” is used as a sort of short-hand. Municipalities are more likely to speak in terms of energy planning and management in general, and in terms of discrete dimensions of energy sustainability in relation to energy supply/distribution and energy efficiency.

3.1 OVERVIEW OF AN INTEGRATED APPROACH TO MUNICIPAL PLANNING FOR ENERGY SUSTAINABILITY: SETTING THE CONTEXT

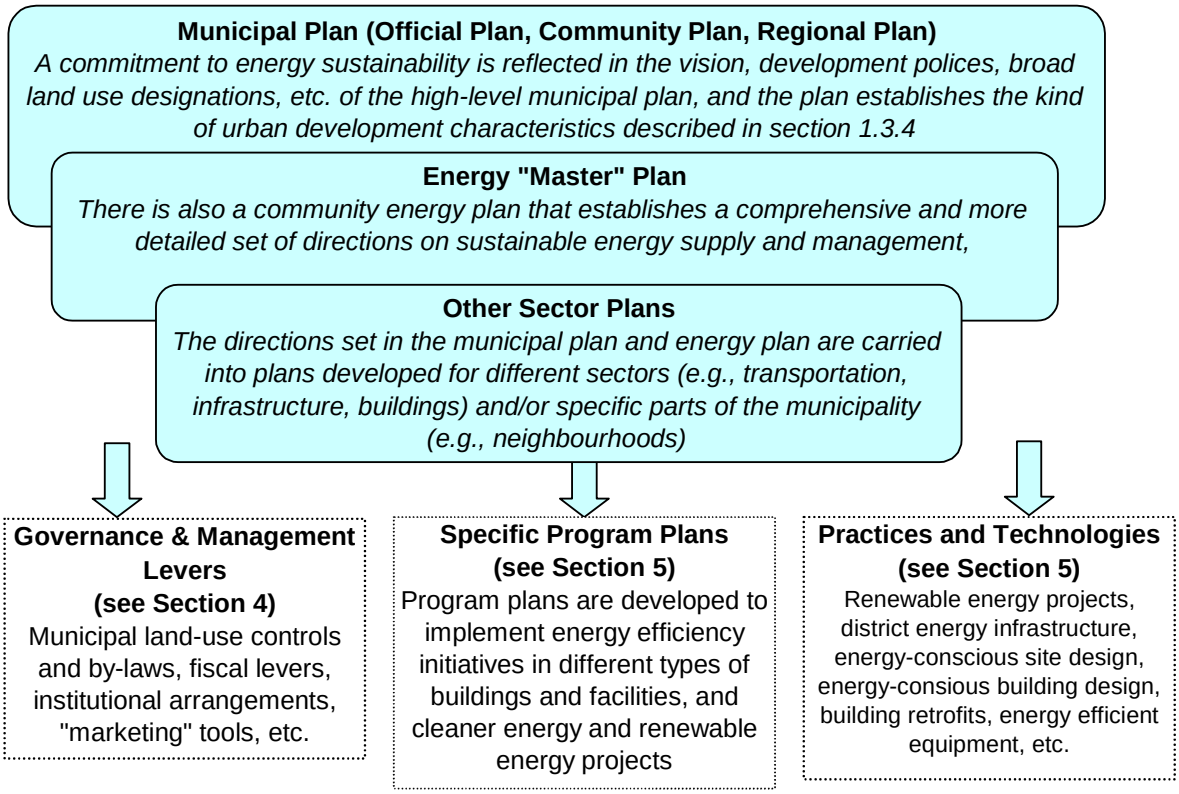
3.1.1 Planning for Energy Sustainability

To come up with ways of meeting well-rationalized energy service needs that fulfill the conditions of sustainability identified in Section 1.3.4, municipalities would ideally plan for energy in a way that:

- Addresses each of the elements of the energy system itself (as described in Section 1.4.1) and the relationships between them
- Addresses the interface between the energy system and all other municipal systems/sectors
- Considers all of these relationships in the context of the three dimensions of sustainability.

How would such an approach translate into the municipal planning process? Since systems are “nested”, and since energy cuts across all aspects of municipal operation, such an approach should be carried through from the top levels of planning down to specific programs and projects, as illustrated in Exhibit 3.1.

Exhibit 3.1: An "Idealized" Planning Context for Municipal Energy Sustainability



In reality, as further described in section 3.1.3, the type of planning that is carried out by municipalities across Canada tends to vary depending on the relevant legislative and policy context set by the provinces and territories, as well as on the nature of the municipality. Nonetheless, virtually all municipalities undertake at least some planning related to one of more of the planning levels depicted in Exhibit 3.1,[46] so at least in a general sense, they have the opportunity to address energy sustainability in their planning. But not all smaller municipalities have formal "plans".

[46] Canadian Institute of Planners

3.1.2 Opportunities for Municipal Energy Management Planning: Some Additional Background

The "Top Level" Municipal Plan

Many municipalities in Canada have a high-level plan that establishes a comprehensive framework to guide the ongoing development of a municipality. The focus is primarily on land use designations, the proper integration of land uses, and ensuring necessary services.[47] Key land use and infrastructure decisions therefore flow from the municipal plan: things like density limits or targets, the mix of uses, and high-level priorities and approaches with respect to transportation, water and energy infrastructure. (As further discussed below, different sectors may also be addressed in individual "master plan" that are linked to the municipal plan.)

Illustrative Example of the Relevance of Municipal Planning to Sustainable Energy: The Case of District Energy

By integrating district energy options into planning documents and approval processes, a municipality demonstrates its commitment to using district energy to contribute to community growth, economic development and long-term sustainability.

Municipalities can help create the conditions that support the development of a district energy system by encouraging the concentration of urban form, particularly the mixing of high-density residential and commercial buildings. When these land uses are located close together, they generate considerable demand for space heating and cooling. The higher the thermal load in the buildings served by a district energy system, the lower the unit costs related to energy infrastructure per square metre of building.

Source: Gilmour, Brent and John Warren, Canadian Urban Institute. *The New District Energy: Building Blocks for Sustainable Community Development*, On-Line Handbook, January 2008.

The influence of these top-level plans on energy sustainability plays out over the long-term. The fundamental urban design conditions for energy sustainability were briefly described in section 1.3.4. A plan favouring single-use designations (i.e., strong separation between residential, commercial/ institutional and industrial uses) and low-density development would guarantee higher reliance on personal vehicles and higher energy demand in relation to other municipal services (e.g., water, street lighting). But in terms of more specific implications for energy sustainability, it would also undermine the future potential for district energy systems.

It is important, therefore, that top-level municipal plans reflect a broad and compelling vision for energy sustainability. In addition to driving overall urban design in the right direction for reduced energy demand and preferred energy supply options, the top-level plan would ideally also articulate core principles and goals in relation to energy supply and use, establish a limited number of related ambitious priorities, and map these priorities into the policy areas (e.g., transportation, housing, economic development, community services) addressed in the plan. As reflected in Exhibit 3.2, the Ontario government provides impressively cogent direction to its municipalities on how energy should be addressed in official plans.

[47] Infrastructure Canada, Research and Analysis Division, *The Path Towards Sustainability: An Evaluation of the "Sustainability-ness" of Selected Municipal Plans in Canada*, December 2006 (http://www.infrastructure.gc.ca/research-recherche/alt_formats/pdf/rn08_e.pdf - date accessed: June 2008).

Exhibit 3.2: Excerpt from Ontario's Policy Document to Guide Municipalities in the Development of their Official Plans[48]

1.8 Energy and Air Quality

1.8.1 Planning authorities shall support energy efficiency and improved air quality through land use and development patterns which:

a. promote compact form and a structure of nodes and corridors;
b. promote the use of public transit and other alternative transportation modes in and between residential, employment (including commercial, industrial and institutional uses) and other areas where these exist or are to be developed;
c. focus major employment, commercial and other travel-intensive land uses on sites which are well served by public transit where this exists or is to be developed, or designing these to facilitate the establishment of public transit in the future;
d. improve the mix of employment and housing uses to shorten commute journeys and decrease transportation congestion; and
e. promote design and orientation which maximize the use of alternative or renewable energy, such as solar and wind energy, and the mitigating effects of vegetation.

1.8.2 Increased energy supply should be promoted by providing opportunities for energy generation facilities to accommodate current and projected needs and the use of renewable energy systems and alternative energy systems, where feasible.

1.8.3 Alternative energy systems and renewable energy systems shall be permitted in settlement areas, rural areas and prime agricultural areas in accordance with provincial and federal requirements. In rural areas and prime agricultural areas, these systems should be designed and constructed to minimize impacts on agricultural operations.

The Energy "Master" Plan

Master plans provide more detailed direction related to policies, programs, activities and accountabilities in a given area. An energy master plan -- commonly referred to as a community energy plan or CEP – looks at opportunities for improved energy efficiency, cleaner energy and renewable energy. A CEP makes most sense in municipalities where there are a range of energy supply and demand issues and opportunities. It can compliment a municipality's authority to undertake top-level community planning, and demonstrates community leadership on energy sustainability. The starting point is typically a picture of current energy use.

A dedicated CEP is the most obvious example of ideal practice, but other kinds of master plans – including the more broad-based sustainable community plans and climate-change action plans -- can also be used as platforms for detailing approaches to energy sustainability.

[48] *Ontario's Provincial Policy Statement*, Section 1.8 (http://www.mah.gov.on.ca/Page1485.aspx - date accessed: June 2008). The Provincial Policy Statement provides policy direction on matters of provincial interest related to land use planning and development. As a key part of Ontario's policy-led planning system, the Provincial Policy Statement sets the policy foundation for regulating the development and use of land.

Other "Sector" Plans and Strategies

The principles and objectives identified in municipal plans and community energy plans also need to be reflected in the practical directions set in any other "sector" plans or strategies, whether these address selected "functional" municipal sectors or specific geographic sectors of the municipality.

Examples of the kinds of "functional" sectors for which municipal plans are sometimes developed include transportation, housing, economic development, industry, agriculture, and community services. Such plans afford important opportunities to ensure that energy sustainability goals are taken into account in satisfying the energy service requirements of the sectors in question.

Many municipalities also develop land use and servicing plans that establish the framework for development in specific areas or tracts of land. Planning at smaller scales can offer unique scope for an integrated approach to energy sustainability.

3.1.3 The Jurisdictional Context for Municipal Energy Planning

Complicating an assessment of actual current and best practices in municipal planning for energy sustainability is the variability across Canada with respect to what municipalities are required or permitted to do in relation to the plans described above. Exhibit 3.3 summarizes the variation across Canada with respect to requirements for top-level municipal plans. As per the table, Alberta, Manitoba, Ontario, Quebec and the Yukon all require municipalities to prepare these kinds of high-level, comprehensive municipal plans. In the other provinces such plans are optional, and are encouraged to varying degrees.[49]

These municipal plans must of course respect the jurisdictional limits of municipalities, which also vary by province and territory. For example, some provinces, such as Alberta, define the powers of local government relatively broadly.[50] Legislation in some other provinces is more prescriptive, giving municipality's delegated authority in relation to a limited number of express powers. Also, by virtue of special provincial acts a small number of individual municipalities have unique land-use and development powers.[51] A Charter City is one that is governed by provincial legislation that offers the City certain powers and responsibilities that are not given to other municipalities in the province.[52]

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[49] Infrastructure Canada, Research and Analysis Division, *The Path Towards Sustainability: An Evaluation of the "Sustainability-ness" of Selected Municipal Plans in Canada*, December 2006 (http://www.infrastructure.gc.ca/research-recherche/alt_formats/pdf/rn08_e.pdf - date accessed: June 2008).

[50] Federation of Canadian Municipalities, *Early Warning: Will Canadian Cities Compete?*, prepared for the National Round Table on the Environment and the Economy, May 2001 updated January 2002.

[51] For example: *The City of Vancouver has a unique system of land use control under the Vancouver Charter S.B.C. 1953, c. 55. The Charter planning powers are substantially different from those applicable to other British Columbia municipalities. The City of Winnipeg has natural person powers under the City of Winnipeg Charter, S.M. 2002, c. 39.* Donald Lidstone, *Assessment of the Municipal Acts of the Provinces and Territories*, prepared for FCM, April 2004.

[52] The six charter cities in Canada are Saint John, Montreal, Toronto, Winnipeg, Lloydminster and Vancouver.

Exhibit 3.3: Jurisdictional Overview Vis-à-vis Sustainable Energy Requirements in "Top Level" Municipal Plans

Jurisdiction, legislation	Top-level plan required?	Energy sustainability issues addressed?	Other notes
British Columbia Local Government Act (1996); Community Charter (2003)	**Not required** A local gov't *may* adopt an *official community plan*. (Minister can require adoption of *regional* growth strategies.)	No mention of energy vis-à-vis OCPs. Regional growth strategies "should work toward" planning for energy supply and promoting efficient use, conservation and alternative energy.	The *Community Charter Act* (2003) gives councils some powers in terms of agreements for provision of energy, and some authority in relation to conservation of energy in the building sector. Various other provincial energy initiatives may help support municipal planning and action, including the *BC Energy Plan* and the *Community Action on Energy and Emissions* initiative.
Alberta Municipal Government Act (2000)	**Required** Municipalities over 3500 must prepare a *municipal development plan*.	Not addressed	
Saskatchewan *Planning and Development Act* (2007)	**Not required** An *official community plan* is not automatically required, but the Minister can require one.	Not addressed with respect to OCPs.	The Act establishes ministerial power to set standards and requirements for energy efficiency in subdivisions (e.g., solar orientation).
Manitoba *Planning Act* (2005)	**Required** *Development plans* are required for municipalities or planning districts.	No mention of energy in Planning Act	The *Land Use Policies Regulations* promote consideration of energy conservation in subdivision design. The *Energy Act* (2007) has a strong sustainability orientation and gives the provincial government broad latitude to establish policies and plans.
Ontario *Planning Act* (1990) and *Municipal Act* (2001)	**Required** *Official plans* must be prepared and approved.	S.2 of the Act defines the supply, efficient use and conservation of energy as matters of provincial interest; so they are addressed in the Provincial Policy Statement as described in Exhibit 3.2).	The *Planning Act* requires that a subdivision draft plan "have regard to the extent to which" it optimizes energy supply, efficient use and conservation. Under the *Municipal Act*, municipalities may arrange for programs to encourage the efficient use and conservation of all forms of energy (with reference to energy systems, substitution, load shifting, etc.) The *Energy Conservation Leadership Act* gives the province powers to require public agencies (including municipalities) to prepare energy conservation plans.

Jurisdiction, legislation	Top-level plan required?	Energy sustainability issues addressed?	Other notes
Quebec *Land Use Planning and Development Act*	**Required** Regions (regional county municipalities) must have a *land use planning and development plan* and municipalities must adopt a planning program consistent with it.	No mention of energy.	Quebec's *Act Concerning the Conservation of Energy in Buildings* allows the Minister to delegate authority to a municipality.
New Brunswick *Community Planning Act* 1973	**Not required** A *municipal plan* or *rural plan* is not required but the Minister can require one as part of a regional plan.	No mention of energy.	The *Energy Efficiency and Conservation Agency Act* creates some potential latitude for municipalities to partner with the Agency for program development.
Nova Scotia *Municipal Government Act* 1998	**Not required** A council may adopt a *municipal planning strategy* for all or part, of the municipality.	A municipal planning strategy *may* include policies with respect to the use and conservation of energy, including the height and siting of developments	Nova Scotia has statements of provincial interest in 5 areas. There is nothing specific to energy efficiency or other dimensions of energy sustainability in any of these, although the statement on infrastructure directs municipalities to develop planning documents that promote efficient use of community infrastructure and limit sprawl.
Prince Edward Island *Planning Act* 1988	**Not required** Preparation of an *official plan* is not required under the Act.	Nothing on energy. (An OP must include a statement of economic etc. "and environmental objectives".)	The *Subdivision and Development Regulations* under the Act contain provisions to support wind energy. PEI's *Renewable Energy Act* supports RE generation, including by municipalities.
NFLD & Labrador Urban and Rural Planning Act 2000	**Not required** A council *may* prepare a *municipal plan*.	A municipal plan shall provide for the use and conservation of energy	Neither the Development Regulations of 2001 nor the Interim Development Regulations of 2003 address energy.
Yukon Territory *Municipal Act* 2002	**Required** Municipal councils must adopt an *official community plan*.	Nothing on energy. (The plan must address "environmental matters in the municipality")	
Northwest Territories ***Planning Act* 1988 (also applies to NUNAVUT)**	**Not required** A council *may* resolve to prepare a *general plan* for how the municipality is to be developed or redeveloped.	Nothing on energy.	

Notwithstanding the variations, the following quote from the Fraser Basin Council respecting the scope for BC municipalities to influence building energy performance is more broadly applicable to sustainable energy measures in municipalities across Canada:[53]

> *Local governments' statutory authority is derived from the Local Government Act and the Community Charter. Neither statute was written with energy efficiency in mind, so enabling language on energy efficiency is noticeably absent. However, local governments are developing innovative policies within the existing statutory framework. Some want to challenge the statutory limitations.*

And beyond the main municipal act in each jurisdiction, there are other statutes and regulations that shape conditions for municipal energy sustainability. Municipalities wishing to address energy sustainability in their plans must respect these conditions. Some specific key variations between municipalities in different jurisdictions are reflected in the analysis of management and operational practices and technology options in Sections 3 and 4 of this report.

Although expectations regarding the existence of municipal plans and their treatment of energy need to be tempered by jurisdictional realities as well as the size and capabilities of the municipality, the scope for municipalities to plan for a sustainable energy future may be greater than it seems. There is evidence of a trend toward more liberal interpretation of municipal authority by courts and tribunals, as long as their plans and policies are well-considered and are not in conflict with provincial policy.

In sum, there is some evidence to suggest that municipalities in jurisdictions where comprehensive plans are required or strongly encouraged are more advanced in sustainability planning, and by extension probably also better equipped to plan for energy sustainability.[54] However, Exhibit 3.3 also illustrates that few of the provincial acts that govern municipal planning establish requirements to address any aspects of energy sustainability. As previously noted, Ontario is an important exception. (Refer back to Exhibit 3.2.)

3.2 CURRENT PRACTICE IN MUNICIPAL PLANNING FOR ENERGY SUSTAINABILITY

No broad-based surveys on energy sustainability planning in Canadian municipalities were found during the research for this report. The following overview is based on some sampling, combined with professional knowledge and experience.

3.2.1 Top-Level Municipal Plans

A review of twelve randomly-selected top-level plans from municipalities of various sizes across the country confirms that the degree to which energy sustainability commitments are addressed in top-level municipal plans varies broadly. At a broader

[53] Fraser Basin Council, *Community Action on Energy Efficiency: Local Government Policy Tools, Final Report*, June 2007.

[54] Ibid.

level, it is important to note that the coverage and in particular the level of detail of top-level plans also vary considerably. Plans reviewed range from fewer than 20 pages to over 400 pages.

- Two of the twelve municipalities included in the random sampling – Surrey, BC and Strathcona County, AB – were actually on par with those selected as Best Practice cases for Appendix D. They have therefore been added to that Appendix, so please refer to it for more detail.

- However, seven of the plans were at the other extreme: they contained no substantive references to energy efficiency (or other dimensions of energy sustainability).[55]

- The three other plans contained reference to very limited, discrete measures to encourage energy conservation and efficiency.

    - The 2003 City of Ottawa Official Plan policy on energy conservation states that, "when reviewing development applications, community design plans or concept plans, the City will: i) encourage the design of local road layout to provide opportunity for south-facing windows and ii) require, where feasible, buildings to be oriented to maximize the potential from solar energy and use landscaping to provide summer shade and protection from winter winds".
    - Similarly, the 1998 Municipal Development Plan of the Town of Legal, AB indicates that in reviewing plans and subdivision proposals the Town "should give consideration to the design of more energy efficient subdivisions" via such techniques as solar orientation and landscaping.
    - The 2001 Development Plan of the Thompson Planning District (MB) notes that the City's northern location "warrants special consideration in design in order that energy conservation and efficiency are emphasised." However, the only explicit provisions are similar to those for Legal and Ottawa.

Notwithstanding the picture painted by this random selection of plans, there is evidence of a shift towards more systematic treatment of various dimensions of energy sustainability in top-level municipal plans. For example, partly in response to the provincial policy statement referenced in Exhibit 3.2, preliminary proposals for the updating Ottawa's Official Plan take a more comprehensive and aggressive approach to energy management.[56] Similarly, the Town of Wolfville – one of the seven sampled municipalities whose current plan contains no references to energy efficiency or other aspects of energy sustainability -- is undertaking a sustainable community planning review which appears likely to result in measures in the municipal planning strategy that favour energy sustainability.

[55] These plans are: the Official Community Plan for the City of Vernon, BC (2001, currently under review); the Municipal Strategic Plan of Lac Du Bonnet, MB (revised in 2006); the Official Plan of Thunder Bay, ON (2000); le Plan stratégique de la ville de Gatineau, QC (2003) and its associated Plan municipal d'activités 2008; and the Municipal Planning Strategy of the Town of Wolfville, NS (currently under review), and the Norman Wells Draft Community Plan (2004). The Municipal Planning Strategy of the Cape Breton Regional Municipality (2004) contains a policy to permit utility-scale wind turbines in the region, but no other aspect of energy is addressed.

[56] City of Ottawa, April 22, 2008, OP Document 1, *Official Plan Review Preliminary Proposals*.

In addition, the top-level municipal plans of an increasing number of municipal governments -- large and small[57] -- reflect a recognized need to shift towards higher-density, more compact development; and as previously mentioned, this is one of the most fundamental conditions for improved energy sustainability. As one amongst many examples, Toronto's Official Plan states that "growth will be directed to the Centres, Avenues, Employment Districts and the Downtown . . . in order to . . . improve air quality, energy efficiency, and reduce greenhouse gases".[58] Indeed some provinces are wading in to encourage municipalities to use planning tools to control sprawl.

Though the focus in this section of the report is on planning per se versus implementation, it is worth reiterating that a common and most critical flaw in municipal planning in general is a lack of follow-through delivery on policies, and an associated lack of evaluation and accountability. Some of the governance and management practices required to address this flaw are covered in Section 4.

3.2.2 Energy "Master" Plans

Energy master planning is the exception in Canadian municipalities. The current approach to energy planning, to the extent it is undertaken, focuses on improving the performance of discrete components of the energy system.[59]

The structure of municipal planning results in a "silo" effect, where planning responsibilities focus on specific areas such as land use, transportation and infrastructure. In this context, it is difficult to build an energy master plan becomes it necessarily must be integrated to be effective cutting across all areas of municipal responsibility. Nonetheless, as elaborated below, a still small but growing number of municipalities have special purpose plans targeted to improving energy sustainability. In this context, one indicator of current practice is the status of Canadian municipalities in relation to the Partners for Climate Protection (PCP) program and the "Plus Network".

The PCP planning process is a progression starting with a commitment to setting targets and then leading to the development and implementation of a plan for GHG emissions reduction in corporate (municipal) operations and/or on a community-wide scale. It is a 5 "Milestone" process, beginning with an inventory and ending with ongoing tracking and reporting of success in implementing the plan and meeting targets.

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[57] Ucluelet BC (http://www.ucluelet.ca/District/communityPlan.php - date accessed: June 2008), Swift Current AB (http://www.city.swift-current.sk.ca/pdfs/cityhall/eng/distdevplan.pdf - date accessed: June 2008), and Strathcona County AB are examples of relatively small municipalities whose municipal plans reflect recognition that compact form, density and/or mixed use are important from the point of view of energy sustainability.

[58] City of Toronto, *Official Plan for the City of Toronto*, Consolidated August 2007 (http://www.toronto.ca/planning/official_plan/pdf_chapter1-5/chapters1_5_aug2007.pdf – date accessed: April 2008). But it is also important to note that information in the Sustainable Community Planning Research Report and the Transportation Sector Research Report confirm, Canadian municipalities are not yet tackling these fundamental development issues in a concerted, forceful way, from the top-level plans down through to district plans, and through the development control levers that are further discussed in Section 4 of this report. Thus, urban development continues to be characterized by sprawl.

[59] Quality Urban Energy Systems of Tomorrow (QUEST), *Integrated Energy Systems in Canadian Communities: A Consensus for Urgent Action*, March 2008.

A total of 156 municipal governments in Canada are enrolled in the PCP program. The Local Action Plan, developed for Milestone 3, is a strategic document outlining how the municipality will achieve the community and corporate reduction targets. The plan includes input from the public, emissions reduction measures, and the implementation strategies required to reach Milestone 4.[60] Local action plans have been completed by only about 20 PCP municipalities. As further described under best practices below, a very small number of municipalities have achieved completion of the final PCP milestone.

The Plus Network is a network of over 30 cities and communities from around the world who share their learning and best practices about integrated long-term planning for sustainability.[61] A total of 12 Canadian municipalities are members of the Plus Network. Two of these are not members of the PCP Program. Of the remaining 10, some are still at the relatively early stages in the PCP Program.

3.2.3 Other "Sector" Plans and Strategies

There is no simple answer as to what constitutes "current practice" with respect to the treatment of energy issues in "functional" sector plans. In the first place, there is a lot of variation amongst Canadian municipalities in terms of whether and which sectors are addressed by plans, the focus and coverage of the plans that do exist, and how they fit within the broader municipal planning framework. And second, in the absence of a systematic review of a broad range of municipal secondary plans, there is no definitive basis for commenting on current practice with respect to how energy is addressed in these plans.

However, it can be expected that inadequate treatment of energy sustainability in high level plans will be mirrored in sector plans. While energy plays a role in all sectors, energy-related considerations are probably most relevant to sector plans that deal with the building and municipal infrastructure sectors and economic development (as well as transportation, but this is not addressed in this report). Nonetheless, it is by no means a given that such plans actually do address issues related to energy sustainability. The following are findings from another small random sampling:

- Although Ottawa's Infrastructure Master Plan (June 2003) does deal with some dimensions of sustainable infrastructure planning, it does not explicitly address the energy dimensions.
- The Greater Moncton Water Action Plan (1999) addresses pumping, treatment, transmission and distribution, but makes no mention the energy demands of these functions.
- Saskatoon's Housing Business Plan 2008 focuses on affordable housing but includes no mention of energy considerations.

[60] Federation of Canadian Municipalities, *Partners for Climate Protection*, (http://www.sustainablecommunities.fcm.ca/Partners-for-Climate-Protection/Milestone_three.asp - date accessed: April 2008).

[61] Sustainable Cities Plus Network, *Who We Are* (http://www.plusnetwork.icsc.ca/who-we-are-3.html - date accessed: April 2008).

- Energy considerations do not figure into the Halifax Regional Municipality's Economic Development Strategy 2005-2010 *(Strategies for Success)* or the Draft Strategic Economic Plan of Happy Valley-Goose Bay, Labrador.

Sector plans that address particular geographic areas of a municipality appear to be more common than "functional" sector plans. In Alberta, for example, municipalities may adopt *area structure plans* to establish the general land use, transportation, and servicing framework for specific areas undergoing substantial new development, and *area redevelopment plans* to address planning issues when rejuvenating existing developed areas. On the one hand, there is still ample evidence of the absence of systematic use of the opportunities such plans provide to make progress towards greater energy sustainability. A quick review of the district or neighbourhood development plans in four randomly selected municipalities reveals a dearth of consideration of energy issues.[62] And energy issues in general are notably absent from Manitoba's Guide for Developing Neighbourhood Plans.

In sum, based on the above and the relative rarity of the type of best-practice examples discussed in section 3.3.3, current practice in municipal sector planning is not strongly oriented towards sustainability in general or sustainable energy in particular. However, paralleling an increasing focus on sustainability in top-level planning, there is a growing trend towards district/neighbourhood-level sustainability planning. As further described in section 3.3.3, energy sustainability planning is a key part of this trend.

3.3 BEST PRACTICES IN MUNICIPAL PLANNING FOR ENERGY SUSTAINABILITY

The exemplary community profiles in Appendix C, and the additional best practice profiles in Appendix D, are source materials for many of the best practices summarized in this section. Additional examples are described in the text.

3.3.1 Top Level Municipal Plans

At its most basic, best practice in top-level municipal plans simply involves integrating energy objectives into the plan. This establishes both a culture and a legal basis for municipal sustainable energy actions. The approach taken in the Surrey BC Official Community Plan, briefly summarized in Appendix D, perhaps best exemplifies the kind of integrated approach described in Section 3.1. It takes into account relationships between energy and municipal development in a range of sectors, and gives attention to specific strategies, solutions and measures. To varying degrees, the other case examples included in Appendix D also demonstrate both systems-thinking, and a commitment to practical action. The verbatim excerpts from two other municipal plans, reproduced in Exhibit 3.4, further demonstrate the kind of explicit direction that is possible at this level of planning.

[62] These four are St. Albert in AB, Prince Albert, SK, Winnipeg MB, and Cape Breton Regional Municipality in NS. The June 2006 neighbourhood plan for Osborne Village in Winnipeg encourages the use of 'green' design principles, such as the use of sustainable building design, and the glossary definition of SBD refers to energy efficiency and renewable energy. The Cape Breton Secondary Planning Strategy for North End Sydney (2006) does reference the regional plan policy of permitting utility-scale turbines.

Also worth remembering in the context of best energy sustainability practices in high level planning is the direction Ontario has provided to municipalities regarding their municipal (official) plans, as reproduced in Exhibit 3.2.

3.3.2 Energy "Master" Plans

Best practice at the level of community energy plans is exemplified by the cities of Guelph, ON and Yellowknife, NT. Refer to Appendix C for detailed profiles. Both of these municipalities are also seeking to integrate the objectives and directions from these plans into their higher-level municipal plan. (Note that the Appendix C profiles contain information on implementation as well as planning.) Additional municipalities with best practice energy plans are briefly described in Appendix D.

Conditions for Successful Community Energy Planning

From its own mixed experience, the City of Kamloops has distilled some key conditions for successful community energy planning (Exhibit 3.5). Many of these conditions are exemplified in the Guelph and Yellowknife energy planning initiatives. Note that some of the elements needed for successful *implementation* of plans are discussed in Section 4 of this report. Other conditions that can be discerned from the experience of Guelph and Yellowknife, as well as from some of the best practices in Appendix D, include:

<u>Committed leadership</u>[63]
Notwithstanding the legitimate warning from Kamloops against over-reliance on individual champions, one or a small number of visionary and steadfast senior politicians or community leaders can be important for developing and maintaining momentum. In Guelph, the mayor is credited with being a driving force for the Community Energy Plan. In Yellowknife, the initial impetus came from the community but the cause was taken up by a City councillor.

<u>Management for change</u>
Commitment to a process of ongoing engagement is needed to ensure institutional and community alignment with the vision and objectives. This has numerous dimensions.

[63] Perhaps the best embodiment of sustainability leadership is Ray Anderson, former CEO of Interface Flooring. Driven by his passion and commitment, the company's "mission zero" is to "eliminate any negative impact our company may have on the environment by the year 2020".63 The company's articulation of the way forward reflects a willingness to think "out of the box" and honest recognition of the challenges. (From Interface Corporation, *Our Goals: Sustainability Overview* (http://www.interfaceinc.com/goals/sustainability_overview.html - date accessed: April 2008).

> *What we call the next industrial revolution is a momentous shift in how we see the world, how we operate within it, what systems will prevail and which will not. At Interface, we are completely reimagining and redesigning everything we do, including the way we define our business. Our vision is to lead the way to the next industrial revolution by becoming the first sustainable corporation, and eventually a restorative enterprise. It's an extraordinarily ambitious endeavour; a mountain to climb that is higher than Everest."*

Exhibit 3.4: Excerpts from Best Practice Municipal Plans

London, Ontario[64]

Energy Conservation

xv) The City shall promote energy conservation by:

(a) initiating, participating, and cooperating in conservation programs, including public education and awareness programs;

(b) encouraging denser, contiguous development: intensification of existing built up areas and the efficient use of existing infrastructure;

(c) incorporating energy conservation measures into site design, and into the design, construction and renovation of buildings; and

(d) encouraging the use of walking, bicycling, public transit and car pooling as alternatives to private automobile use.

xvi) The City will develop an energy conservation and air emission reduction strategy to:

(a) reduce energy use and expenditures for buildings, vehicles and equipment owned and operated by the City;

(b) reduce energy use and expenditures for the operation of water supply and sewage treatment systems; and

(c) promote multi-sector, community wide reductions.

London's plan also supports small wind energy conversion systems in agriculture:

A small wind energy conversion system (SWECS), consisting of one wind turbine and blades, one supporting tower and associated control or conversion electronics, may be a permitted use in the Agriculture designation. Zoning standards are established to govern compatibility with the main dwelling as well as the surrounding land uses.

St. John's, Newfoundland[65]

Energy conservation policies are included in the Municipal Plan because energy conservation is becoming increasingly important and because the requirements of energy efficiency run parallel with other development goals.

OBJECTIVES

- *Create a more compact urban form.*
- *Develop a land use pattern that reduces automobile transportation.*
- *Encourage site planning that achieves heating efficiency in buildings.*
- *Encourage construction of buildings that minimize energy consumption and achieve a high degree of energy conservation.*

POLICIES to Create a More Compact City Form

The City shall:

1. *increase densities in residential areas where feasible and desirable from a general planning and servicing point of view;*
2. *encourage conservation, compact renewal and infill in the older parts of the City; and*
3. *minimize sprawl by encouraging large-scale integrated developments in all expansion areas.*

POLICIES to Encourage Site Planning That Achieves Heating Efficiency in Buildings

The City shall increase the energy efficiency of new subdivisions by means of:

1. *street alignments that optimize favourable orientation of buildings in terms of sun and winds;*
2. *encouraging cluster housing in low density areas;*
3. *encouraging a compatible mix of residential buildings of varying densities in all zones; and*
4. *encouraging landscaping for energy conservation.*

POLICIES to Encourage Development of Energy Efficient Buildings

The City shall increase the energy efficiency of buildings by:

1. *encouraging low- to medium-density multiple dwellings; and*
2. *promoting energy efficiency in buildings, through building control regulations and incentives.*

[64] City of London, *Official Plan* (http://www.london.ca/Official_Plan/table-of-contents.htm - date accessed: May 2008).

[65] City of St. John's, *Community Objective* (http://www.stjohns.ca/cityservices/planning/pdfs/communityobjective.pdf - date accessed: May 2008).

Exhibit 3.5: Lessons Learned from Kamloops Community Energy Planning[66]

Keep it Personal
A community energy plan needs a sense of ownership from those who will implement it. Too much external involvement (including excessively influential developmental input from parties unwilling or unable to subsequently contribute to implementation) may be counterproductive.
Avoid Duplication
Where possible, integrate the plan with parallel programs (e.g. environmental management systems, sustainability indicator tracking programs etc) to improve efficiency, data consistency and relevance.
Nurture Organizational Links
A CEP thrives on partnerships between municipal, utility companies and other organizations, and depends on active engagement from all sides. All parties have much to gain from recognizing each others' needs, skills and resources and continuously working together towards common goals.
Build on Established Ways of Doing Successful Things
A CEP may need to be carefully integrated with existing successful organizational structures in ways that take advantage of ongoing successful activities and working relationships. Creative and workable mechanisms need to be found that effectively incorporate the basic needs of the CEP.
Don't Reinvent the Wheel
It may not be necessary to develop monitoring programs specifically for energy activities. Using existing or off-the-shelf tools, such as those offered by the FCM, saves time and resources.
Don't Over-Rely on Individual Champions
CEP developers should ensure that the knowledge and policies contained within CEPs are effectively institutionalized to ensure they will withstand changes to staff and local government officials.
Keep it Dynamic
Kamloops' experience illustrates the importance of regularly reviewing the achievements, barriers and opportunities of the plan, and noting changing wider social and economic changes that influence its implementation.

One important step taken by City council in Guelph has been to send clear messaging that the CEP is a priority and all branches of municipal government are expected to align plans, programs and decisions.

Steps in the Planning Process

Reflecting the conditions described above, there are some substantive dimensions of the planning process that are fairly consistently found in the best practice communities. In a general way, these elements conform to the widely used “plan, do, check, act” cycle of quality and environmental management systems, institutionalized in the International Organization for Standardization (ISO) 9001 and 14001 series. The key steps in this planning process are:

- Start with a comprehensive assessment of current energy use and supply conditions (see Exhibit 3.6 for a summation of the results of Yellowknife’s assessment, developed as an excellent communication tool)
- Clearly address (and distinguish between) both municipal corporate use and opportunities, and municipal-wide use and opportunities

[66] Community Energy Association, *Kamloops Community Energy Planning* (http://www.communityenergy.bc.ca/showcase-and-awards-introduction/kamloops-community-energy-planning - date accessed: May 2008).

- Include an analysis of opportunities for energy management, demand management and more sustainable energy supply, taking a broader set of municipal objectives than straight cost and pay-back into account in assessing these opportunities[67]
- Prioritize key areas which can result in significant performance improvements
- Develop program concepts and plans, and identify how a broad range of municipal instruments (as described in section 4) will be used to meet objectives
- Identify -- and delineate ways to meet -- capacity-building needs and opportunities
- Identify partners and approaches to partnership-building[68]
- Delineate approaches to stakeholder and general public engagement
- Ensure mechanisms for sustained resourcing
- Be explicit regarding accountability
- Establish clear targets and performance measures
- Specify monitoring and reporting systems
- Establish when and how the plan will be reviewed and revised.

In addition to these profiled communities, the status with respect to leading PCP communities is worth noting. As indicated above, about 20 municipalities have completed their Local Action Plan. A particularly comprehensive action plan was developed for the City of North Vancouver.[69] Seven of the 20 municipalities are in the implementation phase of both their corporate and community-wide action plans. So far, Whistler is the only municipality to have completed Milestone 5 at both the Community and Corporate levels (i.e., the only one to have implemented and tracked plans to ensure that actions and reductions are on target).

3.3.3 "Sector" or "Secondary" Plans and Strategies

Dockside Green, the subject of a detailed profile in Appendix C, is a best practice example of sustainable redevelopment planning for a remediated brownfield site. Notable features of the planning for this project include the fact that it was an iterative process, with the initial development concept established via a participatory planning process with the local community. The twelve guiding principles that evolved from this stage were the foundation for development by the City of a request-for-proposals for the development of the land. The organization that won the bid then became a co-developer of the project with the City, establishing a collaborative process for the further evolution of the plan, which was completed in September 2005. The plan addresses numerous dimensions of energy sustainability. The buildings are targeted to meet LEED (Leadership in Energy and Environmental Design) platinum certification, and to exceed the level of energy-efficiency required by the Model National Energy Code by 45 to 55%. There are currently 24 LEED-ND pilot projects registered across Canada, all within the provinces of BC, Alberta, Ontario and Quebec. (Refer to Section 4.2 for more on LEED.)

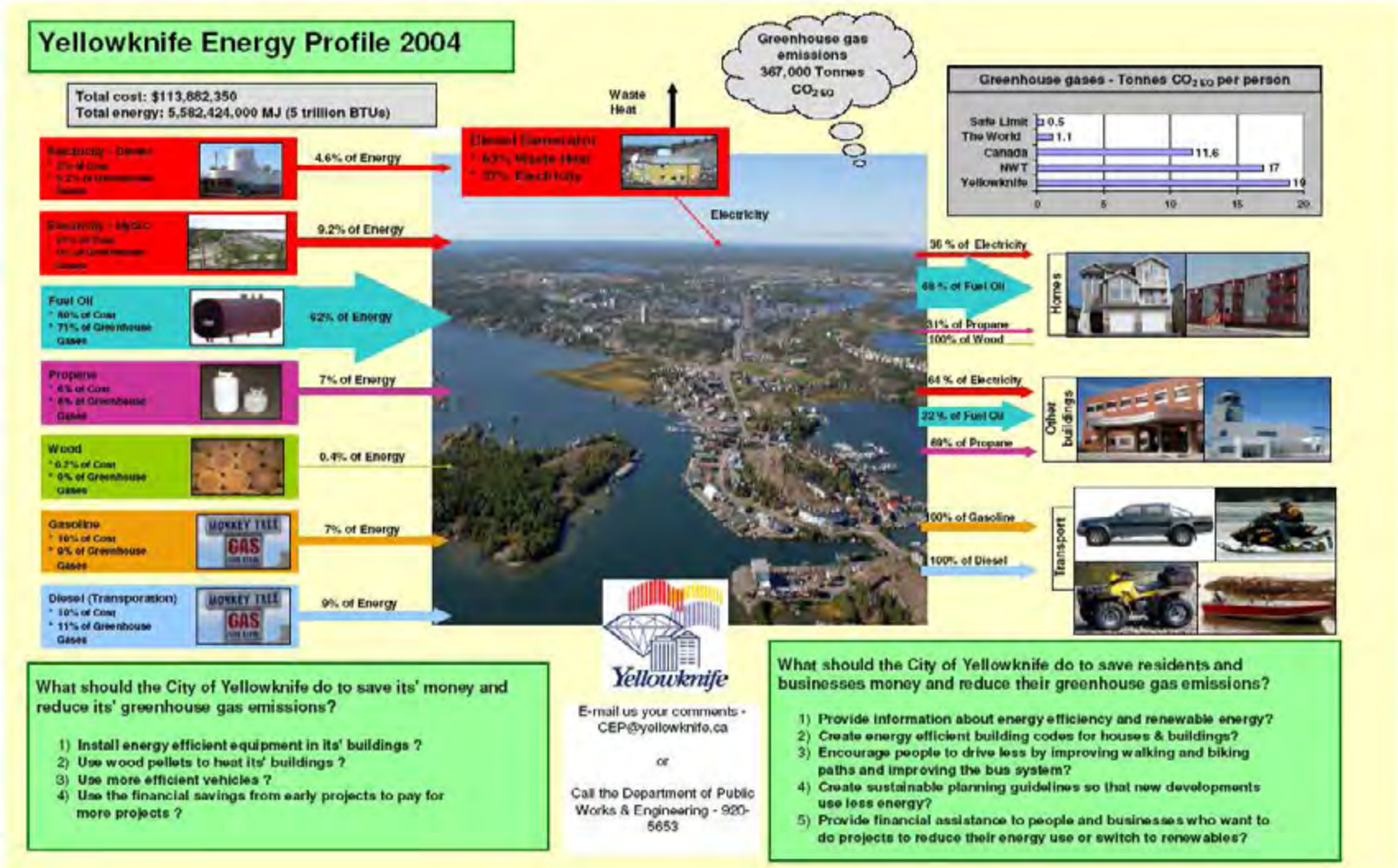
Other examples of best practice plans for both new and existing neighbourhoods are found in Appendix D.

[67] Full cost accounting and other tools to broadening the conventional approaches to assessment are discussed in Section 4.1.

[68] Partnership building should of course begin during the early planning phase.

[69] City of North Vancouver, *GHG Local Action Plan, February 2005* (http://www.sustainablecommunities.fcm.ca/files/PDF/final_CNV_LAP_rev_050304.pdf - date accessed: April 2008).

Exhibit 3.6: Yellowknife Energy Profile 2004



Source: Arctic Energy Alliance, Community Projects
(http://www.aea.nt.ca/files/COMMUNITY%20ENERGY%20PLANNING/YK%20Community%20Energy%20Profile%20Nov%2006.pdf – date accessed: June 2008).

3.4 SUMMARY TABLE

Exhibit 3.7 presents an overview of best practices presented in section 3 in relation to issues identified in section 2 (exhibit 2.1 provided an overview of key issues) and with respect to the applicability of issues identified to community size, region or province, and geographic location. Although the first category shown in this table, governance, is not explicitly discussed under a separate heading, it deserves being highlighted because of the far reaching implications on municipal planning practices. As shown, there are some key best practice attributes among a selection of provincial planning acts.

Exhibit 3.7: Overview of Best Practices in Municipal Planning Approaches

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments
Governance	Appropriate Governance authority and scope from the Provinces to enable municipalities to set performance and prescriptive requirements extending to the community as a whole.	• Municipal powers and governance • Municipal jurisdiction to set energy performance standards	All	B.C. *Community Charter Act* (2003) Sask *Planning and Development Act* Ont *Planning Act* (1990)- *Northwest Territories Municipal Act*	Some of the key attributes of these provincial Acts: • Give councils some powers relating to local energy supply, and some authority in relation to conservation of energy in the building sector • Establish ministerial power to set standards and requirements for energy efficiency in subdivisions (e.g., solar orientation). • Require that a subdivision draft plan "have regard to the extent to which" it optimizes energy supply, efficient use and conservation. • Allow the Minister to delegate authority to a municipality. • building energy standards can be controlled at a municipal level
Top Level Municipal Plans	• Embody an integrated, multi-faceted approach to ensure the conditions for sustained energy performance	• Absence of enforceable national level sustainability standards and requirements	All However, it's likely that small communities will strategically achieve these	Surrey, BC Ucluelet, BC London, ON St. John's, NL North Vancouver, BC Salmon Arm, BC Whistler, BC	These plans explicitly include: • Guidelines to promote compact development through Smart Growth • Specific actions in the energy sector, such as the use of alternative development standards and the use of the LEED Green Building Rating

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments
	improvements are in place. • Extend scope beyond the municipal operations to affect: i) new and existing buildings; ii) land use oriented to compact development; and iii) development of local renewable based energy supply. • Modify the Plan to reflect design guidelines and land use designations for specific land development or redevelopment projects.	for municipal top level plans • Lack of political will	results through region-level plans, not as community specific plans.	Calgary, AB Strathcona, AB	System • Encourage site planning that achieves heating efficiency in buildings • Review of by-laws to ensure support for energy efficiency, conservation and renewable and low-impact energy production.
Energy "Master" Plans	• Designed to have governance authority through a direct link to the Top Level Plan. • Modified municipal organizational structure to support implementation. • Designed and applied within a	• Absence of enforceable national level sustainability standards and requirements for municipal top level plans • Lack of	All However, it's likely that small communities will strategically achieve these results through region-level plans, not as community	Guelph, ON Yellowknife, NT Kamloops, BC North Vancouver, BC Whistler, BC Banff, AB Dawson Creek, BC Regina, SK Sudbury, ON Halifax, NS	Some of the key attributes are: • Integrates energy management and carbon management. • Draws a clear linkage between economic viability of the city and improved energy performance. • Coverage extends beyond municipal buildings and services as a city-wide plan. • Coverage extends to land use planning with policy goal to fully

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments
	framework of management best practices and continuous improvement. • Coverage extends beyond the municipal operations. • Include key public and private sector allies who can become potential co-funders for delivery and also become clusters for projects (e.g., universities). • Ongoing a budget allocation for energy management.	political will • Growing government and utility support • Energy costs	specific plans.		integrate the CEP and the city's Official Community Plan • Addresses energy supply (including generation), including renewable energy and district energy systems. • Cross-departmental teams of staff be directed to work with our partners and other stakeholders to implement the directions provided in the Community Energy Plan. • The process can result in mandatory energy performance standards for buildings beyond the municipal operations (e.g., in 2010, the EGH-80 standard will be mandatory for all new residential development and the CBIP standard to all new buildings, public and private, in Yellowknife in 2009.) • Assigned implementation responsibilities to the appropriate City department who work with dedicated Energy Coordinator on detailed implementation complete with tangible targets and timelines.
"Sector" or "Secondary" Plans and Strategies	• Start with a municipal vision, governed by the Top Level Plan and embedded in document used to	• Absence of enforceable national level sustainability standards and	Large and mid-sized municipalities.	Victoria, BC Langford, BC Vancouver, BC Lethbridge, AB Oakville, ON Montreal, QC	• Minimum building energy performance standards can be set in these plans for all types of buildings. • Allow development specific "mini-utilities" to be formed to supply

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments
	solicit out-sourced development proposals. • Use a triple bottom line accounting strategy incorporating environmental, economic, and social principles. • Apply fully integrated approach, encompassing technical best practices for energy management and energy supply.	requirements for municipal top level plans • Energy costs • Cost and revenue squeeze • Valuation approaches • Infrastructure rehabilitation needs • Siting wind power developments • LEED standards			energy. • Use as the platform to establish project specific "Master Development Agreements" between the municipality and the developer based on city design guidelines and policies, and the developer's proposal. These agreements become the basis for setting and reporting on performance measures for sustainability.

4. MUNICIPAL GOVERNANCE AND MANAGEMENT PRACTICES TO SUPPORT ENERGY SUSTAINABILITY

Municipal governance and management entails how municipalities uphold and implement decisions (versus what those decisions are – See Section 3 above) and the methods and approaches used by municipalities to assess how close they are to achieving or implementing the planning approaches and other goals established for the community. Governance and management therefore includes both institutional and human resource elements, such as organizational structure, staffing, and engagement of the public, as well as management elements, such as use of regulatory instruments (by-laws), development fees, performance measures, reporting and budgeting.

This section reviews the governance and management "tools" available to municipalities to implement sustainable energy initiatives. It reviews in order the following eight categories of tools:

- Decision support tools
- Land use controls and regulatory tools
- Fiscal levers and incentives to influence development
- Leading by example
- Institutional and financing arrangements for municipal projects
- Staffing
- Communications, education and engagement
- Monitoring and reporting.

Under each of these categories is a brief description of the nature of the tool, the state of current practice in relation to that tool, and best practice based on examples from municipalities that are in the lead in applying the tool to support energy sustainability. The discussion of best practices draws on the detailed community profiles in Appendix C and the short summaries of best practices in Appendix D. Best practice examples are also referenced in a table that summarizes the applicability of each of the tools (Exhibit 4.4).

4.1 DECISION-SUPPORT TOOLS (INFORMATION/ANALYSIS)

4.1.1 Overview

Basic elements of good planning and decision-making in any context are: assessment of current conditions (baseline assessment); identification of opportunities (options) to address needs and objectives in light of current conditions; and assessment of options. The decision-support tools discussed here are simply methodologies to help support these activities in the context of decision-making related to energy sustainability. An associated set of tools, discussed in section 4.1.6, relates to measurement, verification and reporting. These provide a basis for feedback on performance, to support continuous improvement in decision-making.

The general concepts reviewed here are applicable at any level of decision-making, from overall community energy planning, to neighbourhood design and development decisions, to choices in relation to specific programs and projects. Specific tools vary

depending on the level. The general categories and some associated examples are shown in Exhibit 4.1. Note that there are a large number of tools currently in play in each category, so the examples are illustrative, definitely not exhaustive.

Also worth mentioning is the Municipal Energy Conservation Template developed by the Association of Municipalities of Ontario (partly to assist municipalities to meet the potential requirement to prepare energy plans under the provincial Energy Conservation and Leadership Act, as noted in Exhibit 3.3). This template offers a simplified, phased approach to measuring total energy consumption, summarizing and assessing past energy management initiatives, and carrying out an opportunity assessment to develop an action plan.[70]

Exhibit 4.1: Types of Decision-Support Tools

Category and description/types of tools	Examples
Baseline assessment At the community (municipal-wide) level, an energy inventory is an important tool to help plan sustainable energy approaches. Baseline energy consumption (the energy used, generally on an annual basis) can be calculated using various tools including energy utility bill analysis, energy end-use profiles (e.g., equipment ratings and operating times) and technical and management benchmarking tools. Ideally, the information would be broken out by energy source (fuel oil, natural gas, electricity, etc.) and energy end use (heating, lights, pumps and motors, etc.). Depending on the nature of the initiative, other baseline conditions that may be useful to profile (at least in a narrative description) include things like: population size, density and growth rates; land uses; ecological conditions; and human resource and financial capacity.	There are many tools available to assist in calculating baseline energy consumption at community and project-specific levels. The BC Ministry of the Environment recently published an international review of community inventory best practices.[71] The protocol developed by Local Governments for Sustainability (ICLEI) has been widely influential. Together, the Federation of Canadian Municipalities and ICLEI have prepared a handbook for local governments to use in preparing inventories and forecasts of energy consumption and greenhouse gas emissions (as required for Milestone 1 of the Partners for Climate Protection Program).[72] ICLEI also offers a Clean Air and Climate Protection (CACP) software tool applicable to both government operations and the entire community.[73] The U.S. DOE Building Technologies Program directory provides information on a huge range of tools for evaluating energy efficiency, renewable energy, and sustainability in buildings.[74] The U.S. Energy Star for Local Government program offers a large range of useful products to municipalities,

[70] Association of Municipalities of Ontario, *Municipal Energy Conservation Template*, June 2007.

[71] Alex Boston, Holland Barrs Planning Group, *Best Practices and Better Protocols: Guidance for a comprehensive community emissions inventory system from a high level review of international best practices*, prepared for BC Ministry of Environment, November 2007. (http://www.env.gov.bc.ca/air/climate/ceei/inventory_best_practices.pdf - date accessed: May 2008).

72 ICLEI and FCM. *Developing Inventories for Greenhouse Gas Emissions and Energy Consumption: A Guidance Document for Partners for Climate Protection in Canada.* (http://www.sustainablecommunities.fcm.ca/files/Capacity_Building_-_PCP/pcp-ismd-pub-en.pdf - date accessed: May 2008).

73 Member cities of Partners for Climate Protection know this software as the TSA Greenhouse Gas Strategy Software for Municipalities.

[74] US Department of Energy, *Building Energy Software Tools Directory* (http://www.eere.energy.gov/buildings/tools_directory/ - date accessed: May, 2008).

[75] Energy Star, *ENERGY STAR for Local Government* (http://www.energystar.gov/index.cfm?c=government.bus_government_local – date accessed: May, 2008).

Category and description/types of tools	Examples
	including a Portfolio Manager for measuring and tracking energy use in buildings.[75]
Screening to identify opportunities (options) There are criteria and checklists that can assist municipalities to identify options to improve energy sustainability at a community-wide, neighbourhood-level or facility-specific level. Once general options are identified, technology-scans may be needed to hone in on specifics.	LEED (Leadership in Energy & Environmental Design) checklists can be referenced for both neighbourhood design[76] and individual buildings[77]. The checklists at both levels dedicate up to 17 points in the "Energy and Atmosphere" category. At both levels, most of the points in this category are for optimizing energy performance; but renewable energy and best practice commissioning also earn points. The "smart growth" and sustainability checklists for proposed development, further described in section 4.2 also address energy efficiency and clean and/or renewable energy options, though in varying degrees of detail.
Assessment of options A wide variety of tools and practices exist to help broaden the assessment of options beyond simple payback, as a way of better reflecting economic and environmental sustainability dimensions. For example: • Life cycle costing uses standard accounting procedures, but addresses the total financial cost of an asset (a product, structure or system) over the course of the life expectancy (including operating, maintenance and decommissioning/disposal costs).[78] • Full-cost accounting goes further. The Canadian Institute of Chartered Accountants defines it as: *the integration of an entity's internal costs (including all internal environmental costs) with the external costs relating to the impacts of the entity's activities, operations, products and/or services on the environment.*	There are numerous life-cycle costing protocols for specific applications. For example NRCan's RETScreen *Wind Energy Project Model* supports evaluation of the energy production, life-cycle costs and greenhouse gas emissions reduction for all types of wind energy projects. Numerous other protocols support life-cycle costing of buildings and building systems. One example is the approach developed for the Whole Building Design Guide.[80] ICLEI's *Life Cycle Cost Analysis Tool* is designed to support decision-making on energy-consuming equipment. Full cost accounting is more an ideal than a fully applicable methodology, but directionally, a commitment to consider "external" costs in municipal decision-making is important. Given that it will often not be practical or desirable to "monetize" all environmental impacts, it is important that information on these impacts

76 Canada Green Building Council. *LEED Canada-NC 1.0 Project Checklist.* http://www.cagbc.org/uploads/LEED%20Canada-NC%20Project%20Checklist.xls - date accessed: May 2008).

77 Canada Green Building Council. LEED Green Building Rating System for new construction and major renovations. LEED Canada-NC Version 1.0, December 2004. http://www.cagbc.org/uploads/FINAL_LEED%20CANADA-NC%201.0_Green%20Building%20Rating%20System.pdf - date accessed: May 2008).

78 For a good introductory overview see Life Cycle Costing: A Tool for Energy Efficient Procurement, a slide deck prepared by ICLEI as a guide for senior staff. It can be found at http://www.iclei-europe.org/index.php?id=4614 (date accessed: May 2008). For a good overview of different financial assessment methods also see: (1) Saskatchewan Energy Management's Technical Guide titled *A Guide For The Selection Of Energy Efficient Technologies.* (http://www.emtfsask.ca/pdfs/gdenefftech.pdf - date accessed: May 2008).

79 Definition of the Society of Environmental Toxicology and Chemistry (SETAC).

80 Fuller, Sieglande, *Life Cycle Cost Analysis*, Updated May 16 2008 (http://www.wbdg.org/resources/lcca.php - date accessed: May 2008).

81 PRé Consultants, *What is Life Cycle Assessment?* (http://www.pre.nl/life_cycle_assessment/life_cycle_assessment.htm - date accessed: May 2008).

82 Federation of Canadian Municipalities and National Research Council, *Environmental Protocols: Accounting for Environmental and Social Outcomes in Decision Making*, prepared for the National Guide to Sustainable Municipal Infrastructure series, November 2003 (http://sustainablecommunities.fcm.ca/files/Infraguide/Environmental_Protocols/Accounting_Environm_Soc_Outc_Dec_Mak.pdf - date accessed: June 2008). Also see L Sahely, Halla, Christopher A. Kennedy, and Barry J. Adams. *Developing sustainability criteria for urban infrastructure systems.* Can. J. Civ. Eng. 32: 72–85 (2005).

Category and description/types of tools	Examples
• A fuller understanding of environmental impacts can be achieved via environmental life-cycle assessment (LCA) methods. LCA is *an objective process to evaluate the environmental burdens associated with a product, process, or activity by identifying energy and materials used and wastes released to the environment . . .*[79] Comprehensive LCA methods are laborious. Streamlined approaches can be used by municipalities making major energy-system investment decisions. Alternatively, matrices to identify typical key areas of impact can be used. Ideally, sustainability considerations would be weighed collectively via an interactive, multi-criteria analysis to enable decision-makers to view the impacts of varying combinations of energy choices on these issues. Also ideally, there would be protocols to ensure that information from these kinds of analyses is provided to decision-makers involved in planning processes, municipal investment decisions, and review of proposed third-party development and projects.	be presented, along with financial assessments, to decision-makers. The Society of Environmental Toxicology and Chemistry (SETAC) provide a streamlined environmental life cycle assessment methodology involving five stages.[81] There are also matrix tools, such as the Leopold matrix, that can be used to help to identify potential environmental impacts. Though it does not address energy investments per se, a good general guide to integrating environmental and social values into municipal investment decision-making is the InfraGuide publication *Accounting for Environmental and Social Outcomes in Decision-Making*.[82] It provides a methodology for identifying, quantifying and monetizing or otherwise presenting outcomes and impacts.

4.1.2 Current Practice and Trends

Current practice often falls considerably short with respect to use of the kinds of decision-support tools described in Exhibit 4.1. But with respect to baseline conditions, the Partners for Climate Protection Program has stimulated municipal work on energy inventories. It is worth noting that the B.C. government's Community Energy and Emissions Inventory (CEEI) initiative will *provide* local governments with community energy and greenhouse-gas inventory baselines to help inform community decision making.

In terms of decision-making about energy options, where authorities use asset management tools to plan their infrastructure investments, the planning horizon is usually 5 to 10 years even when planning is for facilities with a very long life. (Also, long-term infrastructure plans are rarely integrated with other community planning processes.)[83] Similarly, simple payback (number of years to recoup up-front costs from annual savings) and short payback periods are still common in assessing the value of financial investments. However, other valuation approaches (e.g., net present value, which is the total value of the initiative in today's dollars) are also being used. And the kinds of costs being considered are increasingly extending beyond up-front costs, through tools such as life-cycle costing.[84] Moreover, management accounting practices to support decision-

[83] *Integrated Community Sustainability Planning - A Background Paper*. Planning for Sustainable Canadian Communities Roundtable, Organised by Prime Minister's External Advisory on Cities and Communities, September 21-23, 2005

[84] The following are verbatim examples from the InfraGuide publication in the *Decision-Making and Investment Planning* series, titled *Planning and Defining Municipal Infrastructure Needs*, December 2002: *Caledon, Ontario, uses an asset management program to help prioritize capital spending. The program uses a life-cycle analysis and cost-benefit analysis approach. The city indicates this has been in use for two years and is an objective management tool. Winnipeg, Manitoba is developing a sustainable asset management tool, which uses a life-cycle costing approach to planning infrastructure investments over the long term. Hamilton, Ontario is implementing a life-cycle asset management system that will forecast needs and sustainable financing*

making for infrastructure investment decisions also increasingly reflect attention to some indirect environmental and social costs, driven in part by increased attention to risk and liability. But the extent of accounting for costs associated with the environmental and especially social dimensions of sustainability is still limited, and where it is being pursued, the scope is quite conservative.

In general, municipalities wanting to make progress on energy sustainability will face uncertainty about which tools to use and when to use them; or in some cases, an absence of tools. Early adopters and leaders in the field tend to build and utilize their own tools (e.g., software tools to assess energy use trends and patterns), sometimes "borrowing" from what is available elsewhere. There is nothing inherently wrong with this approach, but it works against standardization and replication, in the absence of which the transaction costs of energy sustainability solutions will be needlessly high. However, there is room to build on and customize tools and techniques that have been developed or are under development by credible Canadian and international organizations, moving toward standardization.

4.1.3 Best Practice

In developing their community energy plans, both Yellowknife NT and Guelph ON (Appendix C) prepared comprehensive baseline studies of energy use (complete community energy profiles), and systematically identified opportunities. Guelph partnered with the relevant utility companies to complete its baseline study, and this relationship helped in overcoming barriers related to confidentiality of data.

The *Measurement and Verification Procedures Guideline* of Toronto's Better Buildings Partnership provides guidance on establishing baseline energy consumption for that program. It is an example of best practice at the level of individual facilities.

Related to the step of identifying options, a small number of municipalities are using sustainability checklists to inform their review of zoning and development permit applications. This is further discussed in section 4.2.

Yellowknife also offers a best practice approach with respect to assessment of options. Not only does it conduct full life-cycle costing for all major capital projects and purchases, it uses its targets of reducing emissions by 20% and energy use by 10% in municipal facilities as decision-making criteria.[85] Similarly, to help honour their commitments to reduce GHG emissions, both Yellowknife and the Town of Okotoks AB now explicitly integrate information from emissions calculations into decision-making. This influenced Okotoks' recent purchase of a 3kW solar PV system in the face of a

requirements for 100 years. The city has been using it for water and wastewater planning, and plans on incorporating all other aspects of infrastructure into it. Halifax, Nova Scotia is also implementing a life-cycle asset management system.

Federation of Canadian Municipalities and National Research Council, *Decision Making and Investment Planning: Accounting Planning and Defining Municipal Infrastructure Needs*, prepared for the National Guide to Sustainable Municipal Infrastructure series, April 2003 (http://www.sustainablecommunities.fcm.ca/files/Infraguide/Decision_Making_Investment_Planning/Planning_Defining_Mun_Infr_Nds.pdf - date accessed: June 2008).

[85] City of Yellowknife, *Implementing Yellowknife's Community Energy Plan*, March 19, 2007 (http://www.yellowknife.ca/__shared/assets/CEP_Implementation_Plan_April_20075539.pdf – date accessed: April 2008).

relatively long payback of 20 years. Yellowknife's recent purchase of a wood pellet boiler was also driven in part by the anticipated emissions reduction of 19%. The City of Spruce Grove AB is using life cycle analysis to factor environmental costs (short and long term) into purchasing decisions.[86]

Depending on circumstances, other approaches to identifying and selecting options for improved energy sustainability are also possible. The City of Victoria BC undertook an iterative process of engaging developers to identify opportunities to establish a model sustainable community, including sustainable energy dimensions. It began with an RFP to developers that included sustainability objectives and criteria, and continued on with a collaborative development process with the selected developer.

4.2 LAND USE CONTROLS AND REGULATORY TOOLS

4.2.1 Overview

Municipalities have prime responsibility for land use planning and exercise this responsibility via their municipal plans (as discussed in section 3.2) and associated zoning by-laws, which dictate the types of uses and forms of development within the broad land use designations identified in the municipal plan.

In addition to zoning, by-laws can address a very wide range of issues and situations, as long as they are not in conflict with provincial or federal laws. Within these powers there is considerable scope for influencing development patterns and behaviour in favour of sustainability.

In relation to these tools, ideal practice would involve i) eliminating regulatory barriers to energy sustainability and ii) consciously and aggressively ensuring that land-use designations and zoning by-laws promote energy efficient forms of urban development (e.g., compact mixed use), clean and renewable energy sources, and energy efficiency at the project level.

Especially in relation to new developments, ideal practice would involve comprehensive approaches (e.g., via district by-laws) to promote integrated energy solutions. LEED for neighbourhoods – a new approach developed by the US Green Building Council, the Congress for the New Urbanism, and the Natural Resources Defence Council – could offer the basis for this. LEED offers a flexible rating system, allowing points toward designation to be gained in a range of areas and through a variety of approaches. Given this flexibility, mandating LEED approaches does not constitute a straightjacket, but rather encourages innovative approaches.

Ideal practice would also include the application of municipal by-laws and the development approvals process as "carrot" and "stick" levers to foster developments that integrate higher levels of energy sustainability into projects. Municipalities would also use any room available to establish enforceable minimum energy performance for

[86] 2cg Waste Management Consulting Services, *Recycling Council of Alberta Green Procurement Research*, February 6, 2007. (http://www.recycle.ab.ca/images/stories/Download/RCA_GreenProcurement.pdf - date accessed: May 2008).

buildings. As noted in Section 2, jurisdiction with regard to buildings resides primarily at the provincial level, but municipalities can push the envelope to determine their jurisdictional room, and lobby for more room to exceed current provincial standards. Municipalities can also go the next step beyond setting standards, by requiring some form of third party verification of actual building performance. The cost of this could be offset by some of the fiscal and other levers described below.

4.2.2 Current Practice and Trends

With regard to regulatory levers, municipalities that are modifying land use designation and adjusting zoning by-laws to support high density, mixed use developments are still in the minority, but the trend is growing.[87] Few municipalities are using by-law powers and development approvals processes to force developers to deliver projects with a more sustainable energy profile.

There may be a trend towards developers looking for concessions on existing by-law requirements in exchange for delivering on energy efficiency and other green attributes.[88] This can be contentious, and needs to be carefully handled so that developers are not gaining concessions at the expense of community acceptance, especially for improvements that already make economic sense.

4.2.3 Best Practice

Land Use Designations and Controls

Leading municipalities are using various combinations of land-use designations and zoning by-laws and controls to direct development to a more compact "footprint", which specifically are designed to foster mixed-use and high-density development. For example, Kelowna, BC takes a high level approach with respect to city-wide land use designations by using OCP policies and zoning to direct growth into serviced areas. OCP policies include the establishment of a defined urban/rural/agricultural boundary and encouragement of mixed use developments.[89]

Quesnel, BC is also looking at the big picture in terms of land use designations in the downtown core and neighbourhood commercial centres. A number of OCP policies and zoning regulations aim at increasing density and reshaping toward mixed-use areas. Mixed-use policies include maintaining the downtown core for business, government, advanced education, tourist accommodation, recreation, cultural entertainment, and multi-family residential; maintaining a commercial-residential transition area for small

[87] West Coast Environmental Law, *Urban Growth and Development: Smart ByLaws Guide* (http://www.wcel.org/issues/urban/sbg/bylaws/ - date accessed: April 2008).

[88] Examples: Bowen Island municipality; Dockside Green

[89] West Coast Environmental Law, *Urban Growth and Development: Smart Bylaws Guide - Kelowna* http://www.wcel.org/issues/urban/sbg/Part1/ucb/ZI-Kelowna.htm - date accessed April 2008); City of Kelowna, *Kelowna 2020 – Official Community Plan, Chapter 6*, January 9, 2007 (http://www.city.kelowna.bc.ca/citypage/docs/pdfs/bylaws/Official%20Community%20Plan%20-%20Bylaw%20No.%207600/OCP%202020%20Chapter%2006%20-%20Urban%20Centres.pdf – date accessed: April 2008).

scale commercial and residential use; and directing mixed-use local commercial-neighbourhood development in other suitable areas.[90]

Other municipalities that have modified zoning bylaws to accommodate mixed-use development, sometimes partly in support of the implementation of district energy and alternative energy systems, include: Metro Vancouver (and several of the municipalities within this Regional District), Whistler BC, Strathcona County AB, Burlington ON, Markham ON, Toronto ON, and Montreal QC.[91] The City of Langford BC plans to apply the LEED neighbourhood development standards that it is drafting (in partnership with the CaGBC, private developers and the provincial ministry of Community Services) via by-laws as well as policies. The City of Vancouver is using a similar approach for the development of Southeast False Creek.

In addition, in some municipalities in British Columbia, Ontario and Nova Scotia, *comprehensive development zones* are being designated or considered, to allow the (re)development of a large site with a variety of land uses and development approaches. Municipal planners and the development applicant start with a blank slate with respect to zoning and build a unique zone for the site. This enables a municipality to negotiate detailed guidelines and specifications for integrated development.[92] It can be used, for example, to facilitate sustainable energy infrastructure such as cogeneration and district energy by creating dense, mixed-use (residential, commercial and institutional) communities on the site. This was the zoning used for the Dockside Green development in Victoria, BC. In BC's Sechelt District (Wakefield Beach at Mason Road) and Cowichan Valley Regional District (the O.U.R. Ecovillage), this form of zoning has also helped to support sustainability objectives, including sustainable energy.

Municipalities have additional room to influence development on land which they own. Victoria, BC developed the Dockside Green project (discussed in various other sections of this report) managed the redevelopment of a city-owned property with a clear vision of a development with energy and other environmental sustainability attributes. The City of North Vancouver has a policy of requiring developers who buy city-owned land to connect to its district energy system (Lonsdale).

Sustainability Checklists

At the level of individual development applications, some leading municipalities are using the approval process to "encourage" more sustainable projects. In Vernon BC, the applicant is required to assess the development proposal against a set list of sustainability measures.[93, 94] Following consultation with the applicant, a final checklist is completed

[90] West Coast Environmental Law, *Urban Growth and Development: Smart Bylaws Guide – Mixing Uses – Quesnel* (http://www.wcel.org/issues/urban/sbg/Part3/mixeduse/Quesnel.htm - date accessed: April 2008).

[91] The City of Burlington provides for a mixed use corridor in the City's zoning bylaws. *Planning, Zoning, Part 5: Mixed Use Corridor* (http://www.city.burlington.on.ca/Planning/zoning/Part5/ - date accessed: April 2008).

[92] West Coast Environmental Law, *Urban Growth and Development - Smart Bylaws Guide Part 3: Mixing Uses Comprehensive Development Zoning* (http://www.wcel.org/issues/urban/sbg/Part3/mixeduse/CD-Zoning.htm - date accessed: April 2008).

[93] Vernon's Smart Growth checklist must be completed by all applicants for Official Community Plan amendment, zoning bylaw amendment, subdivision, development permit or development variance permit. Corporation of the City of Vernon, *Smart Growth*

by staff for use by the Community and Economic Development Committee and Council in reviewing the application. As part of the "environmental sustainability" leg of its "triple bottom line" approach, the checklist includes energy efficiency and renewable energy.

New Westminster BC and Markham ON also have smart-growth checklists for proposed development. Markham's "performance measures document" (PMD) -- a compendium of environmental, design, transportation and pedestrian criteria -- has been integrated into the official plan as part of the development process. The PMD is a scorecard against which development applications can be judged. The checklist is used in a variety of ways in the development application process, including the review of the application by a Citizen Advisory Committee. Recommendations from this process have lead to changes in some development proposals. The PMD checklists for the "built form" theme, and more particularly the "green infrastructure" theme (two of five performance measurement themes) address a variety of energy conservation measures.[95]

The LEED® Certification System and Standards

Leadership in Energy & Environmental Design (LEED®), is a performance-based approach that has rapidly become a significant driver in encouraging innovation and creativity in the design and construction trades to attain required point ratings and certification. Energy efficiency is a key component within the LEED system.

The program, administered by the Green Building Council (CaGBC) in Canada, is becoming the "standard" for North American municipalities to reference for municipal owned-operated buildings. Many municipal governments are looking at measures to promote adoption more broadly within their boundaries.

The U.S. Green Building Council (USGBC) has moved beyond individual buildings by establishing a volume certification process that now allows owners to apply LEED to multiple buildings — both new and existing — or to an enterprise-wide portfolio, using a cost-effective, streamlined process. And as noted in Section 4.x, LEED® is moving beyond buildings by piloting LEED® for neighbourhoods. This is beginning to have an influence beyond buildings, to energy supply and distribution.

Building Performance Standards

Several municipalities use or are planning to use regulatory measures to foster sustainable development and, more specifically, to improve the energy performance of buildings. For example, the council of East Gwillimbury, ON passed a resolution to adopt a municipal policy directing developers of residential developments of ten or more units to construct to Energy Star qualification. In Yellowknife, NT, the Commercial Building Incentive Program (CBIP) standard will be required for

Development Checklist, (http://www.vernon.ca/services/pde/documents/smart_growth_development_checklist.pdf - date accessed: April 2008).

[94] The City of Port Coquitlam also has a Sustainability Checklist for Rezoning and Development Permit Applications, approved on January 23, 2006. (*City of Port Coquitlam Sustainability Checklist for Rezoning and Development Permit Applications*. http://www.city.port-coquitlam.bc.ca/__shared/assets/Sustainability_Checklist2040.pdf -- date accessed: April 2008) It is used to indicate how well a proposed application performs in relation to the sustainability goals contained in the Official Community Plan and Corporate Strategic Plan. (*UBCM Community Excellence Awards – Best Practices: Summary Report, City of Port Coquitlam*. (http://www.civicinfo.bc.ca/practices_innovations/port_coquitlam_sustainability.pdf - date accessed: May 2008). However, the checklist is limited with respect to energy efficiency or clean or renewable energy dimensions, although points are awarded for LEED certification.

[95] Markham Centre. Performance Measures Document. The Markham Centre Vision for Sustainability and Smart Growth. January 2004. (http://www.markham.ca/markham/aspc/markhamcentre/PDF/MkmCtr_PM_0401.pdf - date accessed: May 2008).

commercial buildings in 2009 and EnerGuide for Homes 80 (EGH-80) standards will be mandatory for all residential development after 2010. Hinton, AB is implementing and enforcing zoning by-laws and restrictive covenants in support of the development of an innovative Eco-Industrial Park includes integrated green site infrastructure. The buildings to be constructed in this development must meet LEED standards.[96]

With its own charter, Vancouver is the only BC municipality with the legal authority to directly implement an energy performance code. The Vancouver Energy Utilization Bylaw, introduced in 1991, regulates energy efficiency in all commercial and high-rise residential buildings. It is based on the ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers) 90.1 standard. [97] Ucluelet BC has petitioned the provincial government to amend the Municipal Act to permit all BC municipalities to pass bylaws that incorporate higher energy standards, such as LEED Silver in all new buildings, both public and private.

4.3 FISCAL LEVERS AND INCENTIVES TO INFLUENCE DEVELOPMENT

4.3.1 Overview

In relationships with the development community, municipalities have a range of fiscal levers and other incentives that can be used to foster innovation and favour strong energy sustainability initiatives at the project level. Strategically, these tools can be applied to innovative developments and projects to: i) reduce transaction costs, ii) reduce financial risk to incent "sustainable energy" development, iii) financially penalize status quo (brown) developments. The smart application of these tools helps enable municipalities to foster local innovation relating to the development of sustainable communities. The way in which these strategic outcomes can be attained is further elaborated below.

Reduce Transaction Costs

One of the most important outcomes that can be achieved is to reduce the transaction costs associated with developments that have significant sustainability attributes, such as the Dockside Green project in Victoria. Exhibit 4.2 presents the typical elements associated with the municipal approval and permitting process for land and building developments. For the time being, these types of projects (further elaborated in section 5) are perceived by city administrations as "out-of-the-box" and, hence, the transactions costs of getting site plans, building permits, etc approved can be higher than when compared with the status quo.

[96] Town of Hinton, *Eco-Industrial Park (EIP) (*http://www.eip.hinton.ca/ - date accessed: April 2008).

[97] Fraser Basin Council, in partnership with the Community Energy Association, *Energy Efficiency and Buildings: A Resource for BC's Local Governments*, 2007.

Exhibit 4.2: Quick Tour of Some Key Municipal Approval and Permitting Processes

Zoning and zoning by-laws set the framework for development, but their intent is carried via various processes of review and approval of development proposals at various stages.	
Reviews of Rezoning Applications	When a developer wants a change to existing zoning
Reviews of Minor Variance Applications	When a developer wants the right to vary from a by-law requirement
Site plan approvals	May be required before applying for a building permit
Development permits	Deal with the impact of a development on surrounding properties)
Building permits	Deal with issues like structural stability

The tools available to reduce transaction costs are:

- Waive or reduce development charges (collected to cover capital costs of services) and approvals fees to favour sustainable energy development
- Accelerate the time it takes to review projects
- Facilitate the process when more than one level of government is involved.

Development charges can be a particularly potent lever, since they can be a significant component of the cost of development. (By one recent estimate, they now average close to $25,000 per unit in Ontario.)

Reduce Financial Risk to Incent Sustainable Projects

In the short term, many developers are likely to perceive a financial risk associated with sustainable energy developments; some times, even if municipalities help to reduce transaction costs as discussed above. In these circumstances, municipalities can offer incentives to reduce financial risk. The tools available to reduce financial risk are:

- Co-funded partnership where the municipality finances a portion of the development
- Grants, loans or tax offsets
- Cover program costs for certification (e.g., LEED)
- Density bonuses or similar concessions to help offset higher costs of investment in energy efficiency
- Purchase carbon credits for future participation in carbon markets
- Allow transfer of development rights[98]

[98] In return for agreeing to development restrictions, landowners in low density areas are allocated development credits which can be sold for the privilege of developing at a higher density than otherwise allowed on property where intensification is desired.

Penalize Developments that don't meet Energy Sustainability Requirements

As noted in section 2, energy sustainability investment decisions are still not informed by cost accounting that incorporates environmental and health costs and then carrying such accounting forward to land, infrastructure and building development in municipalities. When such a full cost accounting framework is developed, then the players in the marketplace will operate and make decisions accordingly and this should lead to more developments that incorporate energy sustainability. However, until that time when such an accounting framework becomes reality, there are some tools with which municipalities can penalize or send negative cost signals associated with unsustainable projects. The tools that are include:

- Apply special surcharges to development charges
- Impose special levies and licensing fees
- Showcasing leading approaches through awards.

4.3.2 Current Practice and Trends

It has been argued that in some cases, the current structure for development charges encourages sprawl.[99] Also development charges do not reflect the full cost to municipalities of providing a comprehensive range of infrastructure services (physical, social, environmental); and this works against the interests of more sustainable development and the infrastructure to support it.

On the other hand, some municipalities are beginning to use development charges and other fiscal levers to encourage steps towards sustainability. Some, for example, offer exemptions from development charges to encourage remediation and development of brownfield sites. But given the challenges in designing administratively simple development charge regimes that will raise the funds needed to support anticipated growth, there is a general reluctance to introduce ad hoc measures. Moreover, municipalities do not necessarily have full scope to use development charges as a tool for sustainability. In Ontario, for example, the Development Charges Act (1997) limits what a municipality can charge on the basis of historical service levels.

Direct financial incentives (versus waiving of fees) are not commonly used to encourage voluntary action by the private sector.

4.3.3 Best Practice

In terms of the use of fiscal incentives and disincentives to influence urban form, Ucluelet BC uses a density bonus to encourage increased density while ensuring financial gains for the district. Their approach is to permit developers to build at a higher density

[99] Tomalty R and A Skaburskis, *Development Charges and City Planning Objectives: The Ontario Disconnect*, Joint Issue Canadian Planning and Policy/Canadian Journal of Urban Research, pp.142-161, 2003.

rate in exchange for providing parkland, amenities or cash to the municipality.[100] Other BC municipalities currently using density bonuses include Quesnel and Salmon Arm.[101]

In terms of specific buildings and facilities, there are also many initiatives underway. For example, Ucluelet also uses a density bonus (allowing builders to increase density by up to 5%) to encourage compliance with LEED guidelines.[102] For the construction of 220 homes under the Build Green program, the City of Lethbridge AB is providing a straight financial incentive. The city is going to cover half of the cost (limited cap), working with the land developer, to build net zero energy homes.

Incentives can also include the fast-tracking the permitting process for more efficient buildings. Chicago's very successful, speedy permit program grants builders of LEED or Energy Star building permits within six weeks, shaving two months off the typical wait. Guelph is currently considering implementing the Ontario 2012 building code prior to 2012 as a voluntary recommendation with financial and/or accelerated application incentives. Markham, ON is organizing the development review as a one-stop shop for all development needs, including engineering, urban design, planning, and building. This allows for a more coherent project-development approach than does a departmental review process.

The British Columbia Community Charter and the Vancouver Charter both provide authority to exempt property from municipal property value taxes, another important fiscal tool to encourage revitalization with environmental, economic, or social objectives. Examples of revitalization objectives that would qualify for a tax exemption with respect to energy include: encouraging "green" building technology, including the installation of alternative energy sources; encouraging brownfield redevelopment; or redevelopment for community sustainability, residential intensification, and neighbourhood rejuvenation to minimize the need for new developments.[103]

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[100] 2006 Sustainable Community Award Winner, (http://www.sustainablecommunities.fcm.ca/files/Tools/Best_Practices_Guides/FCM-CH2M_BPG_2006[1].pdf – date accessed: June 2008).

[101] West Coast Environmental Law. *Urban Growth and Development, Smart Bylaws Guide, Part 3: Compact Complete Communities - Density Bonus – Quesnel* (http://www.wcel.org/issues/urban/sbg/Part3/compact/densitybonus/Quesnel.htm - date accessed: April 2008); West Coast Environmental Law. *Urban Growth and Development Smart Bylaws Guide – Compact Complete Communities – Density Bonus – Salmon Arm* (http://www.wcel.org/issues/urban/sbg/Part3/compact/densitybonus/SalmonArm.htm - date accessed: April 2008).

[102] 2006 Sustainable Community Award Winner (http://www.sustainablecommunities.fcm.ca/files/Tools/Best_Practices_Guides/FCM-CH2M_BPG_2006%5B1%5D.pdf – date accessed: June 2008). The official plan calls for use of the LEED Green Building Rating System, but compliance is currently voluntary, with an intention to make it mandatory.

[103] BC Ministry of Community Services. *Revitalization Tax Exemptions: A Primer on the Provisions in the Community Charter*, January 2008 (http://www.cserv.gov.bc.ca/lgd/gov_structure/library/community_charter_revital_tax_exemptions.pdf - date accessed: April 2008).

4.4 LEADING BY EXAMPLE

4.4.1 Overview

Municipalities can and have lead by example in a myriad of ways to foster energy sustainability. This sub-section profiles some of the important means by which the notion of leading by example is effectively implemented. They fall into the following categories:

Energy Management Programs for Municipal Facilities

The most immediate and visible means by which municipalities can lead by example is through programs dedicated to the reduction of energy operating costs in municipal facilities, including buildings and water and/or wastewater treatment operations, which often represent a significant portion of a municipality's total energy costs. And as further discussed in sections 4.5 and 4.6, municipalities should ideally have organizational structures and dedicated staff with a mandate to develop and deliver such programs. Municipalities can also lead by example in terms of use of innovative financing mechanisms, discussed in this section 4.5.

Energy Management Programs With Reach to the Municipality as a Whole

As noted, the energy use footprint associated with municipal operations is a small percentage of total energy use in a municipality. There is growing evidence in Canada of municipal programs extending reach to the broader community, offering a diverse offering of resources and actions.

Sustainable Energy Procurement

There are three major pathways by which municipalities can procure sustainable energy.

- *Procurement of energy efficient products*

  ENERGY STAR® is the easy, accessible source of information to help municipalities implement programs to procure energy-efficient products. The ENERGY STAR® symbol makes it easy to identify the most energy-efficient products in their class for a wide range of equipment categories. The ENERGY STAR® Purchasing Tool Kit provides ways to address common purchasing barriers such as lack of information, first-cost bias and life-cycle cost-analysis requirements and, specifically, provides: i) ENERGY STAR specifications for each product, ii) sample procurement language for tenders and contracts and iii) information resources on products. The EnerGuide label allows purchasers to compare the energy consumption of a wide range of equipment.[104]

[104] Office of Energy Efficiency (http://oee.nrcan.gc.ca/commercial/equipment/index.cfm?attr=20 – date accessed: May, 2008).

- *Procurement of energy efficiency building performance*

  This refers to the application of green-building/energy efficiency standards to contracting for new construction and renovations of municipal buildings. There are numerous certification options, the best known of which is currently LEED.

- *Procurement of electricity generated from low impact renewable energy sources*

  This refers to municipalities entering into electricity procurement contracts with utilities by which a specific percentage of the power is certified as green.

Ideal practice would be a comprehensive municipal government procurement strategy that addresses the energy dimensions of sustainability for each of the three procurement pathways and that commits to measurable targets in relation to each. The second of these categories is perhaps not traditionally viewed in the same procurement basket as the other two. But green procurement principles – including sustainable energy dimensions -- can and should be applied to construction design, processes, tendering and materials.

Sustainable Energy Supply

Municipalities can develop and own alternative energy systems such as district energy (further described in Section 5), and can provide green energy by way of cogeneration systems, PV and small wind systems, district heating, and industrial steam distribution.[105]

4.4.2 Current Practice and Trends

Several municipalities have implemented successful energy management programs for facilities that fall under municipal operations. An increasing number of municipalities are beginning to lead by example by applying "green" building standards to new municipal construction.

Municipal purchase of green power is still uncommon. It appears that only a few municipalities have explicit green procurement policies; notwithstanding a fair bit of interest and publicity over the years. Where they exist, green procurement policies tend to focus on products and services.[106] In this quite limited context, environmental performance considerations do reflect some sustainable energy dimensions including the reduction of greenhouse gas emissions and improved energy and water efficiency.[107]

[105] Guelph Community Energy Plan Consortium, *Community Energy Plan, Final Report*, April 2, 2007 (http://guelph.ca/uploads/ET_Group/admin/CEP_report_web.pdf - date accessed: April 2008).

[106] Examples: Metro Vancouver, Richmond, Calgary, Dawson Creek, Spruce Grove, Banff, Toronto, Jasper

[107] Hughes, Marja, *Green Procurement – Becoming a Way of Life*, prepared for Summit: Canada's Magazine on Public Sector Purchasing, September 2003 (http://www.summitconnects.com/Articles_Columns/PDF_Documents/200309_04.pdf - date accessed: April 2008).

4.4.3 Best Practice

Note: See Section 5 for more detail on implementation of specific projects/measures in municipal facilities.

Energy Management Programs for Municipal Facilities

Numerous municipalities across the country have successfully implemented energy management programs targeted to their operations. Most commonly, the evolution of these programs has been incremental employing the "success breeds success" approach to make the business case for further budget program and project allocations. Following are a few selected examples of best practice energy management:

- Yellowknife NT has introduced monitoring of the water supply and provision of constant heat injections to reduce the boiler demand and wear on the piping network; a permanent decrease in the parking garage temperature (from 17°C to 5°C); a sensor control system for parking lot plug-ins at the municipal garage; and lighting retrofit of all municipal facilities, including the installation of LED traffic lights. It is also worth mentioning that GNWT has incorporated green building practices into municipal facilities for years. As they are the biggest developer in the north, this has lead to an increased understanding and awareness of energy efficiency practices within the development community, something which is easing Yellowknife's move to implementation of City-wide mandatory efficiency standards.

- St. John's NL has implemented a retrofit project involving energy efficiency improvements in municipal buildings resulting in decreased operating costs, improved reliability, and a better working environment.

- The Toronto Community Housing Corporation (TCHC), which is the largest landlord in Canada (approximately 60,000 low-income rental units), has launched the Green Works Programs which includes a Utility and Energy Management Plan to reduce energy use and emissions. The TCHC initiatives include the Appliance Replacement Program, Building Renewal Program and the Compact Fluorescent Light Bulb Program.

Many Canadian municipalities are also attempting to institutionalize energy performance requirements for construction of new municipal buildings. For example:

- Richmond BC has adopted a target of LEED Gold for municipal buildings over 2000m2 and LEED silver for smaller buildings
- Calgary AB has adopted a target of LEED Silver for all municipal projects over 500m2.
- Waterloo and York ON require LEED Silver for all municipal projects over 500m2.

Others municipalities reference LEED standards in other ways. For example, Kingston and Newmarket ON require a LEED assessment at the design stage. As a result of municipal commitment to LEED standards, 21% of the LEED Canada certified buildings

have been municipal government facilities[108] The fact that LEED is becoming the marketplace standard for sustainable building performance more broadly illustrates that the municipal sector can help stimulate the market for sustainable energy innovation.

Energy Management Programs With Reach to the Municipality as a Whole

An increasing number of medium and large sized municipalities are establishing dedicated offices to address sustainability within both corporate and community operations. There is also a growing trend among municipalities to develop public-private partnerships in order to carry out specific municipal sustainable energy projects.

As per the profile in section 3.5, Guelph ON (with help from Guelph Hydro) formed a new CEP entity (CEP Inc.), with a City Energy Manger. CEP Inc. is governed by a board of directors that represent a broad base of energy users and providers in the community. The objective of CEP Inc. is to ensure the administration of the CEP. The City Energy Manager will be responsible for developing an overall, comprehensive implementation plan and coordinating efforts to achieve it. Guelph Hydro will be funding the first two to three years of CEP Inc.

As directed in its Community Energy Plan, Yellowknife created a CEP Implementation Advisory Committee, which is responsible for developing the implementation strategy and ensuring that it is carried forward. Furthermore, a new position within the government was formed, the Energy Coordinator, who is responsible for liaising between all departments and to assist in the implementation of the CEP.

The City of Greater Sudbury is a great example of a municipality that advanced an evolving sustainable energy policy and program starting with its internal operations and progressing to a collaborative approach beyond the boundaries of its own facilities. The process started with the Strategic Energy Plan, during which significant energy management investments were pursued in municipal facilities. Nearly 5 years ago, the city and local partners established the EarthCare Local Action Plan to become a sustainable community. Through this initiative, there are now 100 EarthCare "Partners" in all sectors and the city plays an active outreach and catalyst role in helping the partners meet their performance goals.

Peel Region ON established a "Corporate Energy Management Division", located within the Finance Department, with the core mandate "to manage energy use by the Region". Peel chose to build up internal capacity to carry out this mandate and is comprised of ten full time staff members who work with individual departments and divisions to identify improvements and establish energy efficiency standards and procedures. Areas of program focus include:

- Reducing energy consumption and the cost of energy to the Region of Peel

[108] Steve Dulmage, Education and Development Manager Canadian Green Building Council and Beth Sills, Principal-TriEdge – Research and Consulting, *Canada's First Green Building Toolkit for Municipalities*, Energy Matters 2007 Conference- March 27-28, 2007 - Mississauga, Ontario.

- Creating a culture of conservation within the Region through education and awareness initiatives
- Providing energy advisory services to the other Regional departments
- Metering, monitoring, bill verification, energy profiling and reporting
- Energy management opportunity analysis
- Assisting with the creation of energy efficiency standards."[109]

Sustainable Energy Procurement

The City of Calgary has a 20-year electricity supply agreement with ENMAX Power Corporation to increase the wind-powered green power proportion of its supply to 75% in a province where coal and natural gas account for 90% of generation.[110,111] The City is working with ENMAX to increase the proportion to 90% by 2012. Green power procurement is one of Calgary's six main tools for meeting its ambitious corporate GHG reduction targets of 50% reduction from 1990 levels by 2012.

Another municipal leader in the purchase of green power is the Town of Caledon ON, which buys Bullfrog Power (EcoLogo certified and carbon-free).[112] Metro Vancouver and the Alberta Urban Municipalities Association have also committed to green power procurement targets.[113,114] Under the Alberta agreement, Okotoks AB currently purchases 60% of its electricity from renewable sources and council has approved an increase to 100%.[115] Guelph ON is considering purchasing Bullfrog Power to cover the equivalent of demand from one or two City facilities, equivalent to 10% to 20% of municipal corporate electricity use.

The City of Toronto operates a broader green procurement policy with a focus on products. The City is extending the policy to construction design, processes, tendering and materials to address the nearly 40% of the annual $1 billion spent on purchasing each year in the construction sector. The Cities of Richmond, BC and Metro Vancouver also

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[109] Ontario Centre for Municipal Best Practices, *Best Practice Summary Report – Water and Wastewater, Energy Management Strategy*, October, 2006 (http://www.amo.on.ca/AM/Template.cfm?Section=Water_and_Wastewater_Energy_Management&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=105052 – date accessed: April 2008).

[110] City of Calgary, *The City of Calgary Climate Change Action Plan Target ↓50* , presentation at CCME Pollution Prevention Awards, June 15, 2007 (http://www.c2p2online.com/documents/Calgary_CPPR2007.pdf - date accessed: June 2008).

[111] Justin Duncan (Sierra Legal), *The Municipal Powers Report: Municipal By-laws and Best Practices for Community Health and Environmental Protection in Canada*, May 2007 (http://www.ecojustice.ca/publications/reports/the-municipal-powers-report/attachment - date accessed: June 2008).

[112] See the Bullfrog Power web site for elaboration of the green power purchase options (http://www.bullfrogpower.com/ - date accessed: June 2008).

[113] Metro Vancouver BuildSmart Product Directory (http://www.gvrd.bc.ca/buildsmart/Apps/ItemSelect.aspx - date accessed: June 2008).

[114] National Round Table on the Environment and the Economy, *Case Study on Renewable Grid-Power Electricity - Appendix A*, (http://www.nrtee-trnee.ca/eng/publications/renewable-power-grid-electricity/appendixA-renewable-grid-power-eng.html - date accessed: April 2008).

[115] Town of Okotoks, *Meeting Minutes*, April 23, 2007 (http://www.okotoks.ca/pdf/minutes/April23_2007.pdf - date accessed: April 2008).

have green procurement policies.[116] The City of Spruce Grove AB is also committed to ensuring that environmental costs (short and long term) are factored into all purchasing decisions.[117] The City of Vancouver incorporates emissions reductions into the City's service and supply contracts and it also has an energy efficiency purchasing policy to help the City meet its GHG reduction goals.[118]

Municipalities are also taking a leadership role on establishing energy performance standards for the construction of municipal buildings. Primarily using LEED as a platform, emerging best practice is the setting of LEED Gold or even LEED platinum as the standard for municipal buildings. Strathcona County, AB and several municipalities in Metro Vancouver (including the City of Vancouver, Richmond, and North Vancouver), have established LEED Gold rating as the target for municipal facilities. Under its new Community Energy Plan, Guelph, ON intends to require builders to seek "energy performance certificates" as third party verification of achievements of the required performance.

Sustainable Energy Supply

With respect to a municipal role in providing leadership on more sustainable energy production and distribution, there are now many examples in Canada of municipally-owned and operated renewable energy systems or advanced technology systems, including the community energy system in Revelstoke BC, and Markham District Energy ON. Fuller descriptions of technological best practices with respect to sustainable energy production and distribution are found in Section 5.

4.5 INSTITUTIONAL AND FINANCING ARRANGEMENTS

4.5.1 Overview

A systemic approach to energy sustainability, along the lines described in Section 3, requires long-term commitment to change management. Institutionally, this requires supportive organizational arrangements (e.g., a clearly defined responsibility centre in a position of influence within the municipal governance structure) and adequate, long-term resourcing.

The establishment of municipal energy utilities is an institutional approach that can support the business case for alternative energy systems within a city. Skill in setting up these utilities so that they are able to lead sustainability initiatives is needed in Canadian cities, and could be exported.[119] As an example of the kind of opportunities that exist in some jurisdictions, SaskPower (which has an Open Access Transmission Tariff system)

[116] Madeleine Plouffe, Existing *Green Procurement Initiatives*, (http://www.cec.org/files/pdf/ECONOMY/Green-Procurement_Initiatives_en.pdf - date accessed: April 2008).

[117] 2cg Waste Management Consulting Services, *Recycling Council of Alberta Green Procurement Research*, February 6, 2007. (http://www.recycle.ab.ca/images/stories/Download/RCA_GreenProcurement.pdf - date accessed: May 2008).

[118] City of Vancouver, *Corporate Policy* (http://vancouver.ca/policy_pdf/AF01301.pdf - date accessed: May 2008).

[119] Thomas Osdoba, City of Vancouver Sustainability Group *Canada and the Rest of the World, Ideas for Partnerships and Leadership*, March 2005 (http://www.sfu.ca/~ssbc/May6_Sustainable_Regional_Development_Background.pdf - date accessed: June 2008).

has adopted a comprehensive strategy to meet new load growth to the year 2010 using environmentally preferred power (EPP). This strategy is intended to encourage the development of power projects that have low environmental impact and reduce SaskPower's emissions profile, that use waste streams as a fuel source, and that establish the monetary value of small, environmentally friendly power sources. The municipal electric utilities in Swift Current and Saskatoon could undertake or bring on eligible EPP Projects located within their municipalities, connecting them to their grid.[120]

Regarding financing arrangements, in most cases, significant improvements in municipal energy sustainability are going to require major investments. Ideally municipalities would be able to benefit from broad economic instruments such as emissions trading, along with major federal and provincial financial incentives for renewable energy and demand reduction, and strategies and policies to fully engage investors and lending institutions. But in the absence of such higher-order initiatives, municipalities should seek out various kinds of partnership and financing arrangements with utilities, energy management firms and third parties.[121] Lowering return-on-investment "hurdle rates" can also support implementation of sustainable energy projects.

Municipalities could also establish their own revolving funds or endowment-style "in perpetuity" funds independent of annual municipal budgetary processes, to ensure a stable source of capital for key projects. This could be used to "top up" investments in alternative energy and energy efficiency projects that might not fully meet standard financial criteria, but that contribute to the municipality's other environmental and social goals.

Energy performance contracts (EPCs) are another approach that can help alleviate financial constraints for building energy retrofits. An EPC is an agreement with an Energy Service Company (ESCO) that enables building owners, including municipalities, to make energy efficiency upgrades without the usual associated financial risk. The ESCO undertakes all aspects of the retrofit on a turnkey basis. In some cases, the ESCO itself will undertake project financing, with repayment coming from the financial savings from the reduction in energy use; or will arrange third party financing.[122] The contract period can range from 5 to 10 years. Flat-fee payments tend to be structured to maintain a positive cash flow to the customer with whom the agreement is made.[123] However, given municipal access to capital at lower interest rates, municipal financing is now more common, with the ESCO guaranteeing set annual savings.

ESCOs typically offer the following: [124]

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[120] SaskPower, *Environmentally Preferred Power Program - Second Phase Public Overview*, February 2005.

[121] For a good review of financing models, refer to Messier-Middleton guide titled *CDM Financing*, prepared for the Ontario Power Authority, February 2008 (http://www.conservationbureau.on.ca/Storage/16/2127_CDM_Financing.pdf - date accessed: May 2008).

[122] BC Hydro. *Power Smart Program: Energy Performance Contracts* (http://www.bchydro.com/business/pspartner/pspartner20732.html - date accessed: April 2008).

[123] U.S. Department of Energy, Building Technologies Program (http://www.eere.energy.gov/buildings/info/plan/financing/contracts.html - date accessed: May, 2008).

[124] National Association of Energy Service Companies (http://www.naesco.org/resources/esco.htm - date accessed: May, 2008).

- Initial energy study
- Development and design of the project(s)
- Installation and maintenance of the energy efficient equipment involved
- Measurement, monitoring, and verification of the project's energy savings
- Assumption of risk via guarantee of energy savings.

Refer to Exhibit 4.3 for guidelines on using EPCs.

Exhibit 4.3: Guidelines from the US Department of Energy for Successful Use of Energy Performance Contracts

- Look for more than the low bid. Select an energy service company (ESCO) with a good track record that can provide other necessary services such as project design, installation and maintenance. Get references.
- Negotiate a contract that reasonably limits ESCO profit-making and establishes a win-win arrangement. Carefully weigh the pros and cons of shared savings versus fees for services and other contractual arrangements.
- Require the ESCO to take a "comprehensive approach" to energy conservation—bundling measures with rapid paybacks and measures with longer paybacks—rather than a "cream-skimming approach" (the practice of doing only easy, quick payback measures).
- Ensure the agreement does not allow the ESCO to sacrifice quality for energy savings.
- Ask your ESCO to incorporate extended product warranties and personnel training into the bid specifications.
- Organize an in-house project team to work with the ESCO to choose appropriate energy measures, prepare bid specs, pre-qualify prospective bidders, and perform other tasks when the contract is signed.
- Work with the ESCO to test new technologies in order to determine their performance and applicability.
- Design the project and coordinate construction in a way that minimizes disruption of the building's functions.
- Document both energy and non-energy benefits of your project and publicize its success

In several jurisdictions (e.g., Ontario, Saskatchewan, Alberta and the Yukon), municipalities have been granted “natural person” powers. This allows more scope to pursue different approaches and arrangements (e.g., public-private partnerships) within their areas of jurisdiction.

4.5.2 Current Practice and Trends

Municipal internal hurdle rates still typically emphasize short term benefits and discount or ignore long term saving. Tax incremental financing – whereby municipal infrastructure investments in a designated district can be recouped via a tax on the expected increased property values that will occur with redevelopment -- is rare in Canada but interest has been increasing.

Federal financing opportunities through Infrastructure Canada also bear mention. For example, Gas Tax Funds can be allocated to a municipality for the development of a community energy system. The Building Canada Fund will invest in municipalities for sustainable energy infrastructure that: increases availability and/or security of clean energy supply and renewable energy; improves air quality; and reduces GHG emissions.

Many municipalities use local improvement charges (LICs) to help cover the costs of infrastructure improvements on public property (roads, sidewalks, etc.) that benefit a given community or area in the municipality. The municipality pays for the improvement then assigns an LIC to each property deemed to benefit from the improvement. It has

been argued that LICs should be used by municipalities to finance improvements in residential and/or commercial building energy efficiency.[125] While there were no best practices related to energy found at the municipal level, the Yukon Government, which provides local services to all residents living outside of incorporated municipalities, started a LIC-based program in 1984 to assist residents living in rural areas to receive services by extending the electrical grid and landline telephone service to their properties. The program was expanded in 1998 to fund individual off-grid alternative energy power systems.

4.5.3 Best Practice

Public Funding of Programs and Projects

As noted previously, Guelph ON formed a new CEP entity (CEP Inc.), with a City Energy Manger. From the standpoint of program funding, Guelph Hydro will be funding the first two to three years of CEP Inc.

As noted previously, Yellowknife created a CEP Implementation Advisory Committee, which is responsible for developing the implementation strategy and ensuring that it is carried forward. The funding to implement the CEP is set up so that it is not part of the City budget, making it very difficult to cut in the event of a change in council. The fund is financed from Gas Tax funding and is divided between communications, Energy Coordinator, implementation fund and an energy efficiency fund. A certain amount is also earmarked for implementing energy savings opportunities that are identified in the facility energy audits to be carried out.

In Markham, ON some of the energy sustainability activities are funded through the budget of the town's development services commission as well as through municipal taxes, and development charges. The commission is organized as a one-stop shop for all development needs, including engineering, urban design, planning, and building. This allows for a more coherent project-development approach than does a departmental review process.

Okotoks has established the Eco-Efficiency Revolving Fund to support municipal energy efficiency retrofit projects and solar installations. This fund is continually replenished with energy savings from efficiency projects. The funds are used, in turn, for further municipal projects.

The Halifax "Alderney 5" project is an example of a public-private partnership that has made possible the demonstration of a renewable energy cooling system. Halifax is using this to showcase both the technology and the City's leadership and commitment in promoting and using environmentally and economically sustainable energy solutions.[126]

[125] Roger Peters et al, Pembina Institute, *Using Local Improvement Charges to Finance Building Energy Efficiency Improvements*, prepared for Climate Change Central and BC Hydro, May 2004.

[126] Halifax Regional Municipality, *Council Documents – Alderney 5 Energy Project*, July 18, 2007 (http://www.halifax.ca/council/agendasc/documents/070807ca1121.pdf - date accessed: April 2008).

Energy Performance Contracting

Several municipalities in Canada have successfully used energy performance contracting (EPC) to implement energy retrofit projects in municipal facilities. For example, the city of Burnaby used an ESCO to implement a more than $6 million in projects, encompassing 49 of the municipality's 150 facilities. Energy saving projects were "bundled" with lower return infrastructure projects. Under the terms of the EPC, the ESCO developed and implemented the measures and guaranteed the savings. The municipality used their own lower cost money for financing the project.[127,128] The City of Timmins also used an energy performance contract to improve the energy efficiency of municipal facilities after performing energy audits on 65 of the 94 city facilities. The city realised an annual operating cost savings of $50,000 in addition to the $480,000 annual utility cost savings guaranteed through the EPC.[129] Calgary, Vancouver, Ottawa and Toronto are some of the many other municipalities that have used EPC for their municipal energy retrofits.[130, 131]

4.6 STAFFING

4.6.1 Overview

Human resource (HR) issues play a very significant role in the municipal capacity to deliver on sustainable energy policy and commitments. Particularly in larger municipalities, along with having a funded energy management program, a dedicated energy manager position is considered to be essential to long-term success.[132] A long-term, protected energy management position and staff is necessary to provide the management and technical oversight to the full range of sustainable energy solutions that can be delivered in municipalities. This is an HR function that also cuts across departments and disciplines.

There is evidence that municipalities are increasingly aware of the importance of appropriate staffing with respect to energy management. While few municipalities currently have a dedicated energy manager, more and more are ensuring that staff members are aware of municipal energy policies, regardless of department or role. Some

[127] External financial support was modest relative to the total capital investment, although the funding and support provided by B.C. Hydro and NRCan was apparently nevertheless significant to the management committee that had decision-making authority over the project.

[128] Fraser Basin Council, in partnership with the Community Energy Association, *Energy Efficiency and Buildings: A resource for BC's Local Governments*, 2007.

[129] City of Timmins, Development Services Department, *Energy Savings Project: February 2004 to December 2007*, 2007 (http://portal.timmins.ca/files/TI/docs/ti_energy_presentation-2007.pdf - date accessed: July 2008).

[130] City of Calgary, *Climate Change Action Plan, Target ↓50*, July 2006 (http://www.calgary.ca/docgallery/bu/environmental_m/anagement/climate_change_program/target_50_climate_change_action_plan.pdf - date accessed: April 2008).

[131] Sean Pander, *Climate Protection Progress Report for the City of Vancouver*, August 31, 2007 (http://vancouver.ca/sustainability/documents/Progress2007.pdf - date accessed: April 2008).

[132] Gary Wilde, Manager, Corporate Energy Management, Peel Region, *Green Procurement and Sustainable Procurement*, Energy Matters 2007 Conference- March 27-28, 2007 - Mississauga, Ontario.

are also providing either voluntary or mandatory training in energy efficiency and conservation and sustainable processes, such as the Natural Step.

Staffing for energy sustainability can be scaled according to the size of municipality. It's not surprising that municipalities the size of Toronto can have large staffs to carry out these functions. However, for the smaller municipalities a regional approach can be taken, whereby a position is dedicated to a group of municipalities. There is even the concept of the "embedded" energy manager who stays on in a municipality for a fixed term and then moves on the next municipality.

Needs and opportunities exist in hiring and performance evaluation policies and approaches, through to training programs to keep staff up to date on skills and knowledge needed for sustainability. Ideal practice would include tying performance bonuses contracts and evaluations of senior managers to delivery on energy-related targets and/or evident success in integrating municipal sustainable energy objectives into program and project development and decision-making.

On the training front, ideal practice would include ongoing professional development to ensure that municipal inspectors and other officials involved in the development process are attuned to leading practices, and that they understand the associated systems and technologies sufficiently to minimize the likelihood of delays in approvals and permitting. Training and encouraging staff to serve an education and engagement function is also valuable. Well-trained staff can even afford a revenue-earning opportunity for municipalities, via consulting fees.

4.6.2 Best Practice

Both the Guelph and Yellowknife Community Energy Plans called for the development of a new staff position for oversight and facilitation of energy-related projects and liaison within the municipal government, and with external stakeholders. Yellowknife' Energy Coordinator has been integral in facilitating development of the implementation plan for the CEP. Guelph has recently hired an Energy Conservation Project Manager to develop and seek solutions to reduce the City's energy consumption and associated costs.[133] As described in section 4.5.3, some municipalities have established energy efficiency offices with related staffing implications. But smaller municipalities may hire an energy management or a consultant to help with planning and implementation.

Richmond, Whistler, and Halifax use best practices in ensuring that all City staff members are knowledgeable in terms of energy efficiency and sustainable development. Richmond achieves this by involving everyone in conservation, from the mayor down. They provide extensive staff training and rotate staff to different energy management projects, so they gain greater understanding of the importance of energy efficiency.[134] Halifax established a Sustainability Transition Team whose mandate includes "greening the corporate culture through the promotion of sustainability practices, policies, education

[133] City of Guelph, Newsroom, 2008 (http://guelph.ca/newsroom_display.cfm?itemID=75851 – date accessed: July 2008).

[134] BC Hydro, *City of Richmond – Excellence in Energy Management* (http://www.bchydro.com/rx_files/psbusiness/psbusiness51891.pdf - date accessed: April 2008).

and awareness throughout HRM".[135] Halifax also offers voluntary training in the Natural Step process, as does Whistler BC.

A key element of Toronto's Better Buildings Partnership, which initially focused on energy management within the city's own facilities, was outreach and training to city staff to increase awareness of the program and energy management opportunities. For example, noon-time "lunch and learn" sessions were held with city staff. Management best practice training was delivered to senior staff with responsibility in three main areas: finance, purchasing and legal.

The Government of Northwest Territories (GNWT) is a leading example in ensuring ongoing professional development with respect to leading energy practices and technologies. There are builders in Canada who have targeted zero net energy homes as a mass market product. One of the key barriers they have identified is building inspectors who don't understand the technology and, impose considerable transaction costs to the construction cycle. The Lethbridge residential construction project referenced above is a good best practices example, where the City and the developer are looking to address the transaction costs of the development.

4.7 COMMUNICATIONS, EDUCATION AND ENGAGEMENT

4.7.1 Overview

As indicated in section 3, ideal practice includes meaningful engagement of stakeholders (sometimes the whole community) from early in the planning phase. Especially for plans and programs whose success depends on high levels of acceptance, awareness and/or participation, use should be made of social marketing tools and techniques. Education is also often critical to engagement, and to necessary behaviour changes. Attention to ongoing engagement is key to the successful implementation of long-term strategies. Successful implementation of sustainable energy plans and programs usually depends on engagement of stakeholders and citizens.

4.7.2 Current Practice and Trends

There is a general municipal trend towards actively engaging citizens in planning and decision making activities. Community-wide understanding and buy-in on municipal policies and action can also promote changes in personal behaviour toward more sustainable energy use and conservation. On the other hand, there is generally insufficient attention being paid to educating residents in order to increase public awareness and acceptance of core sustainable energy conditions and values, including urban intensification and personal consumption.

4.7.3 Best Practice

Guelph uses an online, interactive tool, GuelphQuest (developed from Envision Sustainability Tools, Inc. MetroQuest), which allows people to choose different policy

[135] Halifax Regional Municipality, *HRM Sustainability Transition Team*, 2007 (http://www.halifax.ca/environment/documents/PSASustainabilityTransitionTeam.pdf - date accessed: April 2008).

scenarios and displays the potential results for a 30-year timeframe.[136] Also the Guelph Strategic Plan underwent a public consultation that took place with a wide array of individuals and groups through focus groups, telephone interviews, a youth challenge and surveys to get a sound understanding of what the City should be like in the future. Guelph has also followed through with initiatives to engage action, including distribution of 15,000 home energy kits (funded by Union Gas and Guelph Hydro) and real and virtual kiosks where residents can compare their energy and water use against the City average.

Both Calgary and Metro Vancouver have undergone a 100 year planning exercise, which engaged thousands of citizens. The citizens identified sustainability goals for various sectors, including energy and contributed to the development of short and long term targets to achieve them. Through this process, the citizens develop an ownership and personal commitment to the municipal and community-wide goals.

As previously mentioned, building on the leading-by-example initiatives such as LEED standards for municipal buildings, some municipalities have parallel policies to encourage voluntary uptake of the same standards by the private sector.[137] To date these rely more on information and moral suasion than on incentive programs. Some have provided assistance and information. For example, a LEED-compatible green directory was prepared as part of Metro Vancouver's BuildSmart and SmartSteps Programs, which enables designers to compare locally available products and services against sustainability criteria, including energy efficiency. [138]

Numerous municipalities, large and small, offer best practice examples of educational programs and resources aimed at individual residents. These include the Home$avers program in Edmonton AB, and the Craik Sustainable Living Project in Craik SK, both of which are profiled in Appendix D. Utilities operating at the municipal level can play an important partnership role in energy sustainability and, in this vein, Essex PowerLines, ON, piloted a project to engage employees in home energy efficiency improvements (via an energy savings kit and a requirement to complete a home energy audit survey).[139] Also worth mentioning is the fact that a number of municipal governments formally participated in Earth Hour 2008 by switching off lighting in municipal buildings and facilities.

4.8 MONITORING AND REPORTING

4.8.1 Overview

Setting targets and performance measures, monitoring progress, and reporting to council and citizens are all important to ensure transparency and promote confidence, learning and improvement.

[136] City of Guelph, *Guelph Quest*, 2008 (http://guelph.ca/living.cfm?subCatID=1615&smocid=2193 - date accessed: June 2008).

[137] The Sheltair Group, *Opportunities for Local Government Action in Energy Efficiency in New Buildings: Part 2 – Measures*, May 3, 2006.

[138] Metro Vancouver BuildSmart Product Directory

[139] Essex Powerlines serves Essex County, Ont., and is a subsidiary of Essex Power, a corporation formed in June, 2000 as an amalgamation of the former utility companies of Amherstburg, LaSalle, Leamington and Tecumseh.

4.8.2 Current Practice and Trends

Monitoring energy consumption and publicly reporting data is still considered a best practice versus a common practice. Municipalities that have invested in monitoring energy consumption (both electricity and natural gas) have reported substantial energy cost savings. Examples include York, Peel, and Durham Regions.[140]

4.8.3 Best Practice

Milestone 5 of the Partners for Climate Protection program involves monitoring progress and reporting results. As noted, of the 156 municipalities involved in the PCP program, only three have completed corporate milestone 5: Calgary, Edmonton, and Whistler. Each of these municipalities have developed and implemented a GHG emissions monitoring and tracking system. For example, Calgary has developed an automated computer data collection system, the greenhouse gas Emissions & Abatement Tracking (HEAT) system, which enables the annual reporting of corporate GHG emissions.[141] Whistler is the only municipality to have completed the community milestone 5 in which they have compiled a detailed 2006 inventory for community-wide emissions. They are sharing this report with the local government (including all staff members), NGOs, private sector, and the community at large to promote dialogue and highlight the current failure of the town to achieve the PCP targets thus far.[142]

York Region developed their own, online software tool, Energy and Environmental Management Systems (EEMS), to actively monitor, measure, and track the energy and environmental performance of municipal operations. The tool is able to capture all end uses, such as street and traffic lighting, water and wastewater treatment systems, fuel usage in buildings, power generation, heat and transportation. The EEMS tracks the energy consumption as well as savings, and calculates the associated emissions. The Region uses this system to identify opportunities for energy and cost savings.[143] The Town of Markham in York region also has its own performance measures approach for annual reporting on overall progress on community goals. It is directly related to previously mentioned checklist used in the development application process.[144]

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[140] Federation of Canadian Municipalities, *Best Practices Guide* (http://www.sustainablecommunities.fcm.ca/files/Tools/Best_Practices_Guides/FCM-CH2M_BPG_2005[1].pdf – date accessed: April 2008); Ontario Centre for Municipal Best Practices, *Best Practice Summary Report – Water and Wastewater, Energy Management Strategy*, October, 2006 (http://www.amo.on.ca/AM/Template.cfm?Section=Water_and_Wastewater_Energy_Management&CONTENTID=105049&TEMPLATE=/CM/ContentDisplay.cfm - date accessed: April 2008).

[141] The City of Calgary, *2003 Corporate Greenhouse Gas Emission Inventory*, January 2005 (http://www.sustainablecommunities.fcm.ca/files/Capacity_Building_-_PCP/2003_Corp_Emissions_Report_PCP_ICLEI.pdf - date accessed: April 2008).

[142] FCM/ICLEI Partners for Climate Protection Program - "Milestone Five", *SUMMARY REPORT of Whistler's 2006 Greenhouse Gas Inventory*, September 2007 (http://www.sustainablecommunities.fcm.ca/files/Capacity_Building_-_PCP/PCP_Members_Inventory_Action_Plans/Whistler_Sum_Report_of_GHGreductions.pdf - date accessed: June 2008).

[143] FCM–CH2M HILL, *Sustainable Governments and Sustainable Communities – A Best Practices Guide 2005*, 2005 (http://www.sustainablecommunities.fcm.ca/files/Tools/Best_Practices_Guides/FCM-CH2M_BPG_2005[1].pdf – date accessed: April 2008).

[144] Markham Centre, *Performance Measures Document: The Markham Centre Vision for Sustainability and Smart Growth*, January 2004 (http://www.markham.ca/markham/aspc/markhamcentre/PDF/MkmCtr_PM_0401.pdf - date accessed: May 2008).

Dockside Green's innovative and user-friendly performance measurement framework is briefly described in the profile on this project in Appendix C. Also refer to Appendix D for information on the monitoring and reporting approach for the Toronto Better Buildings Program.

4.9 SUMMARY TABLE

Exhibit 4.4 presents an overview of best practices presented in section 4 in relation to issues identified in section 2 (exhibit 2.1 provided an overview of key issues) and with respect to the applicability of issues identified to community size, region or province, and geographic location.

Exhibit 4.4: Overview of Best Practices in Municipal Governance and Management

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments
Decision Support Tools (Information Analysis)	*Assess baseline performance* • Use off-the-shelf software tools and/or customize tools *Set goals* • Performance indicators for specific measures *Create action plan* • extensive consultation process with professionals in the building design and construction	• Growing government and utility support • Municipal powers and governance • Lack of political will • Valuation	All	Yellowknife, NT Guelph, ON Toronto, ON Okotoks, AB Spruce Grove, AB Victoria, BC Markham, ON Vernon, BC	• An easy-to-navigate internet-based tool called See-it™, was used to develop the performance measurement framework for the Dockside Green redevelopment project in Victoria and is being used for reporting • As part of the Master Development Agreement, the City of Victoria requires the developer to provide annual and 5-year performance reports until Year 20 of

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments
	industry • cost benefit analysis is performed for all municipal projects • conduct full life-cycle costing and emissions analysis for all major capital projects and purchases *Implement action plan* • development application checklist to assess and evaluate applications on energy performance indicators • make high quality model contracts available *Evaluate progress* • Monthly verification reports to confirm the long-term benefits and effectiveness of projects • Project specific measurement and verification guidelines	approaches			the development. The City also committed to conduct its own audit to report on the impacts and outcomes of the development on the city and the environment.
Land Use Controls and Regulatory Tools	*Land use designations and controls* • Comprehensive development zone • Mixed use development • Neighbourhood specific minimum energy performance requirements • LEED neighbourhood development draft standards *Sustainability checklists* *Building performance standards*	• Infrastructure rehabilitation needs • Lack of political will • Municipal jurisdiction to set energy performance standards • LEED standards	All	Kelowna,BC Quesnel, BC Metro Vancouver, BC Whistler, BC Strathcona County, AB Burlington, ON Markham, ON Toronto, ON Montreal, QC Langford, BC Vancouver, BC Victoria, BC	• Planners establish unique zoning for the redevelopment site, enabling a municipality to negotiate detailed energy performance guidelines and specifications • The Vancouver Energy Utilization Bylaw established minimum energy performance requirements for all commercial and high-rise residential buildings • The LEED neighbourhood development standards are being piloted in Langford, B.C. and Oakville, ON.

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments
	• Building specific minimum energy performance requirements • ENERGY STAR® standards for new housing (e.g., EGH 80) • CBIP standards for new institutional/commercial buildings • Eco-industrial park			District of Sechelt, BC Cowichan Valley, BC North Vancouver, BC Vernon, BC New Westminster, BC East Gwillimbury, ON Yellowknife, NT Hinton, AB Ucluelet, BC	
Fiscal Levers and Incentives to Influence Development	*Reduce transaction costs* *Reduce financial risk to incent sustainable projects* • Density bonus to encourage increased density • Public private partnerships to co-fund projects • Incentive programs and grants *Penalize developments that don't meet energy sustainability requirements*	• Energy costs • Cost and revenue squeeze • Growing government and utility support • Transaction costs	All M, L, Urban	Ucluelet, BC Quesnel, BC Salmon Arm, BC Lethbridge, AB Vancouver, BC Markham, ON	
Leading by Example	*Energy management programs for municipal facilities* • Municipal energy management programs *Energy management programs with reach to the municipality as a whole* • *Sustainable energy procurement* • Energy performance standards for municipal buildings (one-	• Energy costs • Infrastructure rehabilitation needs • Green demographics • Valuation approaches • Siting wind developments	All	Yellowknife, NT St. John's, NL Toronto, ON Richmond, BC Calgary, AB Waterloo, ON York Region, ON Kingston, ON Newmarket, ON Guelph, ON	• Municipalities using LEED as a performance platform for targeting energy performance either for all municipal buildings or individual projects.

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments
	time or as applied to all new buildings) • Clean energy purchase • Green procurement policies *Sustainable energy supply* • Municipal district energy production / distribution	• LEED standards		Sudbury, ON Peel Region, ON Caledon, ON Metro Vancouver, BC Okotoks, AB Spruce Grove, AB Vancouver, BC Strathcona County, AB North Vancouver, BC Revelstoke, BC Markham, ON Ottawa, ON White Rock, BC Canmore, AB Port Hawkesbury, NS Airdrie, AB Kamloops, BC	
Institutional and Financing Arrangements	*Public funding of programs and projects* • Management and innovative funding arrangements • Local improvement charges (LICs) *Energy performance contracting*	• Energy costs • Cost and revenue squeeze • Growing government and utility support • Municipal powers and governance • Valuation approaches	M, L, Urban	Guelph, ON Yellowknife, NT Markham, ON Okotoks, AB Halifax, NS Burnaby, BC Calgary, AB Vancouver, BC Ottawa, ON Toronto, ON Yukon Government	• Gas Tax Funding • Revolving funds • LICs to assist rural areas

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments
Staffing	• Dedicated positions • Staff training	• Municipal powers and governance • Lack of political will	All M, L, Urban	Guelph, ON Yellowknife, NT Richmond, BC Whistler, BC Halifax, NS Toronto, ON Lethbridge, AB Government of NWT	• Dedicated positions • Staff training (including in the Natural Step process)
Communications, Education, and Engagement	• Educational programs and resources • Online, interactive development tools • Public consultation for planning	• Green demographics	All M, L, Urban	Guelph, ON Calgary, AB Metro Vancouver, BC Edmonton, AB Craik, SK	
Monitoring and Reporting	• PCP Milestone 5 • Monitoring tools • Regular reporting requirements	• Lack of political will • Valuation approaches	All M, L, Urban	Calgary, AB Edmonton, AB Whistler, BC York Region, ON Markham, ON Victoria, BC Toronto, ON	• PCP milestone 5 • Online software tool to monitor, measure, and track energy performance • Performance measurement frameworks (including reporting requirements)

5. OPERATIONAL PRACTICES AND TECHNOLOGIES FOR ENERGY SUSTAINABILITY

5.1 HOW THIS SECTION IS ORGANIZED

This section on operational practices and technologies focuses on the means by which municipalities implement and deliver sustainable energy solutions. The section is organized according to the two pathways for improving energy sustainability in municipalities introduced in section 1.3.5: i) energy management and ii) development/delivery of more sustainable forms of energy (cleaner and/or renewable sources).

Where pertinent, the discussion also makes a distinction between best practices that can be directly applied to municipal operations as well as best practices that can be applied in the community as a whole and substantially influenced by municipal governments. Many of the operational practices and technologies presented in this section are applicable regardless of the owner/developer of the building, facility or project.

The following matrix summarizes how section 5 has been organized to take all of these possibilities and experiences into account.

Exhibit 5.1: Matrix

Section	Topic	Where Located on the Sustainability Pathway	Applicability to Municipal operations vs Community as a Whole
5.2	Buildings	Energy management at the facility level	Both
5.3	Street lighting	Energy management at the facility level	Municipal operations
5.4	Municipal water and wastewater	Energy management at the facility level	Both (currently, municipal operations but with potential for community as a whole)
5.5	Renewable energy supply options	Energy supply options	Both
5.6	Waste biomass and biogas utilization	Energy supply options	Both
5.7	District energy, cogeneration and integrated systems	Energy supply options	Both
5.8	Project planning	Both	Municipal operations

As shown in the foregoing matrix, there are some best practice areas where the applicability of sustainable energy solutions is focused within municipal operations. To put this into context, Exhibit 5.2 provides an indicative profile of how municipal corporate energy costs are distributed across the following sectors: buildings, fleet, sewage and water and street lighting. Using the energy cost profile for the City of Kingston, Ontario, Exhibit 5.2 shows that roughly half of the annual energy operating costs of the municipality is attributed to building facility operations. Again, this profile is indicative, not definitive and it will vary, often according to the size and

location of municipalities. More rural located municipalities might exhibit a cost profile where vehicle fleet energy use represents a higher proportion of the total energy operating costs.[145]

There are literally hundreds of technologies and practices relevant to advancing energy sustainability in municipalities which, from the standpoint of market availability, can be categorized as follows:

- Applications that have been commercially available in Canada for some time.
- Applications that are commercially available elsewhere but which have achieved very little market penetration in Canada.
- Just emerging technologies and practices.

In this report the focus is largely on the first two categories but there is some attention to the category of emerging applications, particularly from the perspective of energy supply options. Each sub-section is organized to first introduce the relevant technologies and operational practices and then to provide specific best practice examples.

Exhibit 5.2: Distribution of Corporate Energy Costs for Kingston ON[146]

[145] The distributions between Kingston and the Regional Municipality of Halifax are similar, with Halifax having a somewhat higher proportion of energy expended in the buildings and vehicle sectors, and less on water/sewage. (Based on information from *Halifax Regional Municipality Community Energy Plan Task 7, Final Report*, November 2007.) In the Regional District of Nanaimo BC, by contrast, a much higher proportion is spent on the municipal vehicle fleet (52%) than on buildings (19%). (From Regional District of Nanaimo, *Partners for Climate Protection, Corporate & Community Climate Change Plans*, CAVI seminar, September 14 2007.)

[146] Steve Dulmage and Beth Sills, *The Step-by-Step Guide to High Efficient Buildings: Canada's First Green Building Toolkit for Municipalities* (http://www.peelregion.ca/finance/corp-energy/energy-matters07/pdfs/steve-dulmage-session.pdf - date accessed: June 2008), prepared for Energy Matters 2007, *3rd Annual Summit on Municipal Energy Management: Setting Direction for Sustainable Municipal Energy Strategies*, March 27-28, 2007, Mississauga, Ontario (http://www.peelregion.ca/finance/corp-energy/energy-matters07/ - date accessed: June 2008).

5.2 BUILDINGS BEST PRACTICES

This section on sustainable energy best practices for buildings is organized as follows.

- Subsection 5.2.1 focuses on technologies and systems for buildings
- Subsection 5.2.2 focuses on operational practices in buildings
- Subsection 5.2.3 presents some specific best practice examples from municipal facilities.

In considering the breadth and depth of these building solutions, it's important to note that there is typically very little difference between municipally-owned/operated buildings and buildings that generally fall into the commercial and institutional sectors in the community. For this reason, the focus of this section is on applications to buildings that are common to municipalities and the commercial and institutional sectors. The application of municipal best practice in new construction and building retrofit can help play a leadership role in advancing the application of best practices in these sectors.

The measures presented in these sections are indicative of current technical and economic best practice. They have been gleaned from a variety of authoritative sources, including recent studies undertaken for electric and gas utilities in Canada which have been commissioned to meet provincial regulatory requirements (refer to section 6 for an elaboration of some of these findings from these studies). Most of these measures will pass societal economic tests in most parts of the country. However, in the final analysis, economic and financial feasibility is always a function of case-by-case analysis affected by energy prices, availability of energy supply and energy sustainability measures and the government and/or utility interpretation of the avoided cost of supplying the energy.

5.2.1 Best Practice Sustainable Energy Technologies and Systems for Buildings

Exhibit 5.3 lists best practice energy efficiency measures suitable to commercial-institutional buildings. Exhibit 5.4 lists best practice sustainable energy supply options which can be integrated into a building to generate a local supply of energy to meet various heating and electricity service needs. For the most part, the measures listed in these tables can be applied to both new and existing buildings. However, the initial cost premium for application to existing buildings is almost always going to be higher.

Exhibit 5.3: Best Practice Energy Efficiency Measures for Buildings

Building System or End-Use	Measure
Building envelope	Highly efficient building envelopes/high-performance wall systems
	High performance roofing systems
	High performance glazing systems
	Air curtains
	Air sealing
	Green Roofs
	Thermal Storage
HVAC	Infrared heaters
	Adjustable speed drives
	Premium efficiency motors
	Advanced building automation systems
	Programmable thermostats and controls; individual controls
	High efficiency chillers (< 0.50 kW per ton)
	Near condensing and condensing boilers
	High efficiency packaged rooftop units and unitary equipment
	Air-to-air heat recovery
	Fuel switching
	Individual control of HVAC
Refrigeration equipment	Energy Star refrigerators and freezers
Domestic hot water	Low-flow faucet aerators and shower heads
	Grey-water heat recovery
	Condensing water heaters
	Tankless water heaters
	Fuel switching
Computer equipment	Energy Star computers and monitors
	Energy Star office equipment
	Energy efficient server technologies
Lighting	Standard T8 and T5 technology
	Next generation T8 and T5 technology
	Occupancy sensors and daylighting controls; individual controls
	Compact fluorescent lamps
	LED lamps
	Pulse start metal halide technology
	T5 high intensity fluorescent luminaires
Cross-cutting or whole building	Passive design for optimal solar exposure and day-lighting
	In-suite utility monitoring meters
	Building recommissioning
Additional Measures for Recreational Complexes	
Refrigeration	Low emissivity ceilings
	Advanced compressor and brine pump controls
	Refrigeration system heat recovery
Pools	Pool covers
	Dehumidifier heat pumps

Note: Use of recycled and local building materials, while not an energy efficiency measure per se, can reduce the "embodied energy" burdens of construction.

Exhibit 5.4: Best Practice Sustainable Energy Supply Options for Integration at the Building Level

Building System or End-Use	Measure	Potential Energy Impact
HVAC	Low temperature air-source heat pumps	50% – 60% heating energy savings relative to electric resistance.
	Ground-source heat pump (GSHP) systems	GSHP systems are typically designed to meet the majority of a building's heating and cooling energy requirement and 20% – 50% of the peak heating and cooling needs.
	Solar walls	These can heat ventilation air, reduce envelope losses, and satisfy some space heating requirements. Typically can get 3,000 MJ per m^2 of installed area, or 2.5% – 3% heating energy savings per m^2 (estimate from RETScreen).
	Solar heating for radiant floor heating	Typically sized to meet 30% – 50% of space heating energy needs.
Hot Water	Solar collectors: There are four main types of solar thermal collectors available: • Air • Glazed • Evacuated • Unglazed.	Typical residential installations use about 5 m^2 of collectors. Solar panels covering roughly half of an efficient office building's roof can satisfy most the heating requirements. The collector areas may range from 100-500 m^2.
Renewable Energy on the Customer Side of the utility meter	Rooftop solar photovoltaic (PV) systems: The conversion efficiency of PV panels is constantly increasing, with leading-edge technology in the area of 20% and future technologies expected to exceed 40% efficiency. Residential PV installations typically range from about 2-5 kilowatts of modules affixed to the exterior of the roof with a mounting system.	PV covering most of the roof of an efficient office can provide in the order of 15% of the buildings electricity requirements.

A few additional points are worth mentioning:

- It's important to note that energy retrofits in existing buildings can occur under many different circumstances which include: i) simple equipment replacements, ii) small, stand-alone energy retrofits and iii) energy retrofits that can be applied to floor by floor or whole building renovations. In some cases, it simply isn't practical to apply

certain measures to existing buildings (e.g., where there is not enough space to situate a ground source heat pump system).

- Recreational facilities, including ice arenas, are significant energy consumers in all municipalities, but disproportionately so in smaller communities. Consequently, energy management solutions in these types of facilities have a high replication potential. Exhibit 5.3 identifies best practice measures under the heading of recreation but many of the other measures in the table are also pertinent to this sector. This happens to be a sector where it's possible to work through peer associations to find shared approaches to energy management solutions, e.g. the Ontario Recreation Facilities Association.

- Best practice applications have resulted in cost-effective construction of buildings (commercial-institutional) whose overall energy performance is 40% to 50% better than the current model national energy code for buildings (MNECB). These practices applications typically include passive design to reduce energy service needs for both space heating and space cooling.

- It's encouraging to see that the cost premium of building advanced performance buildings is not prohibitive. As noted in section 2.3.2, LEED® is a performance-based approach that encourages innovation and creativity among the design-build community to attain required point ratings and certification. Exhibit 5.5 illustrates the estimated cost premium of going green among the current inventory of LEED buildings. With the exception of the Platinum rating level, the incremental cost of getting to fairly advanced levels of "green" is not prohibitive. As the volume of high performance building design grows, the design-build community will become even more adept at reducing the up-front costs. Of course, as was noted in section 2.2.4, the application of more appropriate valuation methods, such as life-cycle analysis, would render the issue of premium costs as moot in many cases.[147]

[147] The Canada Green Building Council (CaGBC) is initiating a series of pilot programs between now and 2010 to inform the next generation of LEED Canada. Among other things, the pilots will contribute to a growing database of measured and verified building energy performance, much needed to support the business case for LEED application.

Exhibit 5.5: The Incremental Cost of Green Buildings[148]

- It's also encouraging to see that best practice is starting to include significantly advanced performance building design and operation. By taking an integrated approach to design, construction, and renewable energy applications, it is possible to build facilities that approach what is referred to as " net zero energy" (NZE) performance. Conceptually, NZE performance refers to a building in which the operating energy use of the building will not result in the incremental energy consumption of non-renewable energy. In practice, NZE applications will rely on advanced design to significantly reduce the energy load and that the "gap" in required energy supply will either be met by purchased energy supply (e.g. from the grid and/or district energy system), on-site renewable energy or some combination of the two options. This can mean that renewable energy applications integrated with the building enable net supply to a district energy system or to the power grid to offset incremental purchases of energy supply.

- Exhibit 5.3 refers to "green roofs" (also known as roof top gardens) as a building envelope efficiency measure. These types of applications can reduce the water runoff

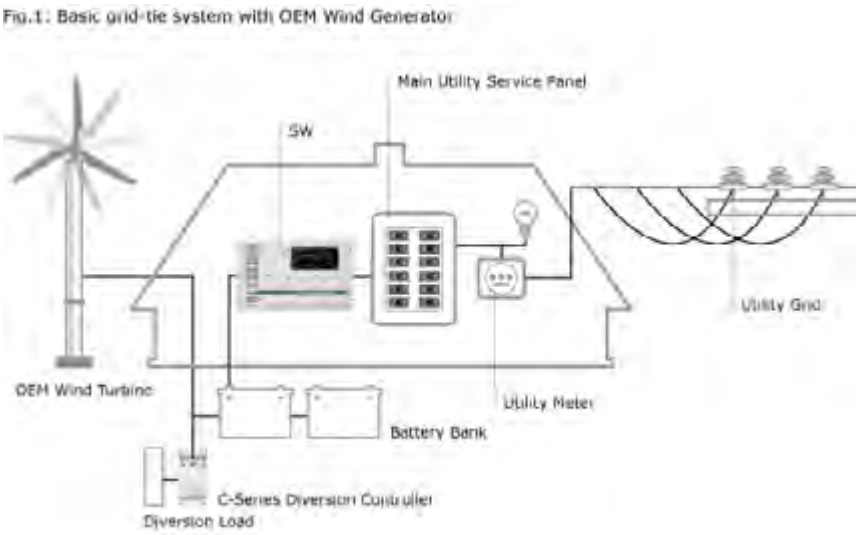
[148] Steve Dulmage and Beth Sills, *The Step-by-Step Guide to High Efficient Buildings: Canada's First Green Building Toolkit for Municipalities* (http://www.peelregion.ca/finance/corp-energy/energy-matters07/pdfs/steve-dulmage-session.pdf - date accessed: June 2008), prepared for Energy Matters 2007, *3rd Annual Summit on Municipal Energy Management: Setting Direction for Sustainable Municipal Energy Strategies*, March 27-28, 2007, Mississauga, Ontario (http://www.peelregion.ca/finance/corp-energy/energy-matters07/ - date accessed: June 2008).

rate and volume by up to 75%, filter pollutants from water and reduce the temperature of the water runoff, thereby reducing environmental impact.[149]

- Exhibit 5.4 refers to renewable energy solutions on the customer side of the meter that are becoming integral to the design of buildings that are on the leading edge of energy sustainability. The example noted in this exhibit refers to the integration of photovoltaics (PV) into cladding, roof membranes and glazing systems is emerging as an important trend in PV technology, which is likely to reduce costs and increase versatility of this technology. Residential PV installations typically range from about 2-5 kilowatts of modules affixed to the exterior of the roof with a mounting system. PV system applications for commercial applications have been in the 10-30 kW range but trends are towards larger systems capable of offsetting commercial building loads, and interconnections of 100 kW or larger are expected.

  What often gets overlooked in discussions of customer side renewable solutions is wind energy. Exhibit 5.6 illustrates how a residential customer side of the meter wind system application would be configured. This is certainly an option to consider in more rural municipalities.

Exhibit 5.6 Typical Residential Grid Connected Wind Turbine[150]



[149] Ken Church, Natural Resources Canada, Canmet Energy Technology Centre, *Community Energy Planning – 2007*, 2007, p. 228 (http://www.sbc.nrcan.gc.ca/documentation/communities/Community%20Energy%20Planning%202007.pdf – date accessed: June 2008).

[150] Xantrex, Residential Wind, About Small Wind Systems (http://www.xantrex.com/web/id/18/learn.asp - date accessed: June 2008). OEM is "original equipment manufacturer", "SW" refers to the inverter. "Diversion Load" refers to a resistance load used to dump excess electricity.

5.2.2 Overview of Sustainable Energy Operational and Behavioural Practices for Buildings

Best practice building operation and maintenance (O&M), as well as appropriate behavioural practices are essential to ensure that the energy performance of new or retrofitted facilities will be met and sustained over the useful life of the energy management applications. Exhibit 5.6 lists important O&M practices and Exhibit 5.7 lists best practice behavioural measures.

After 25 plus years of attention to energy management, one would assume that many of these practices are routine and firmly embedded in building operations. However, experience indicates otherwise. For a variety of reasons, there remain significant management best practice gaps resulting in potential energy performance opportunities associated with O&M and behavioural practices. One of the reasons why this circumstance persists is the lack of human resources dedicated to O&M; many organizations and companies have reduced the size of O&M dedicated staff to the degree where "breakdown maintenance" practice is the norm. To exacerbate the situation, many building operators and maintenance staff still do not have adequate training in which to operate increasingly complex building automation systems and, hence, the energy performance potential of those systems is underutilized.

One of the authoritative recent studies that puts this O&M potential into perspective, is the 2007, B.C. Hydro "Conservation Potential" study. For the commercial-institutional buildings sector, the study results showed that, overall, about a 12% economic savings potential could be generated from O&M measures, relative to the electricity reference case (business as usual) forecast over the study period.[151] Savings of this order of magnitude can generate enormous operating cost savings.

Exhibit 5.6: Best Practice Operational and Maintenance Practices

End-Use/Category	Measure
Operating and Maintenance	
Lighting	Add switching to reduce light levels and/or facilitate zone shut off
	Recommission timeclocks, photocells, and occupancy sensors
	Recommission central lighting control systems
	Reduce the use of "night lighting" during unoccupied hours
	Clean fixtures, or lower fixtures, or paint with lighter colour, and then delamp
	Use of a procedure for optimized control of lighting by security and cleaners
	Have cleaning staff work during occupied hours to eliminate use of lighting at night
Envelope	Envelope sealing: caulking, foam, weather-stripping
	Repair, adjust and recommission doors and windows
Heating and Cooling	Reduce HVAC system operation hours
	Eliminate simultaneous heating and cooling, and reheat

[151] Marbek Resource Consultants, *2007 Conservation Potential Review: The Potential for Electricity Savings through Technology Adoption, Behavioural Changes and Customer-Supplied Renewable Energies, 2006-2026: Residential, Commercial and Industrial Sectors in British Columbia*, prepared for B.C. Hydro, November 2007, Appendix B.

End-Use/Category	Measure
	Optimize outside air ventilation rates
	Use outside air for precooling and freecooling
	Setback or setup space temperatures during unoccupied hours
	Perform regular maintenance including coil cleaning, filter changes, adjust dampers, etc.
Domestic Hot Water	Shut off circulator pump during unoccupied hours to reduce distribution losses
	Reduce tank temperature
Refrigeration	Implement a refrigeration efficiency maintenance program
	Set thermostat at appropriate temperature
	Reset suction and head pressures
Plug Loads	Install timers to shut off coffee makers, water coolers, and other plug loads during unoccupied hours

Exhibit 5.7: Best Practice Behavioural Practices

End-Use/Category	Measure
Occupant Behaviour	
Lighting	Turn off task lights when not in use
	Use task lights instead of ambient lighting
	Reduce or eliminate unnecessary lighting
Space Heating/Cooling	Adjust heat up in summer, down in winter
	Use shades/blinds
	Use natural ventilation (summer)
	Keep entrance/warehouse doors closed
Refrigeration	Maintain proper temperature
Plug Loads	Activate power management features
	Shut off PC and/or monitor when not in use
	Switch off computer power bar when not in use
	Shut off idle equipment
Whole Building	Take stairs rather than elevator
	Change hours of activity

5.2.3 Selected Examples of Best Practices for Municipal Buildings

Existing Buildings

Following are a few among a multitude of examples of successful energy retrofits of existing municipal buildings.

- **Hay River NT:** The Northwest Territories Housing Corporation in Hay River installed four solar hot water systems on a 28 unit apartment complex. The total cost was $16,450 and the annual savings, payback and emissions reduction will be monitored to determine the success of the energy retrofit.

- **Norman Wells NT**: The Town of Norman Wells replaced older inefficient boilers and hot water heaters in the Fire Hall, Community Hall, Maintenance Shop, Arena,

and Staff Residence. The total cost was $75,000 and the annual savings are $4,700 with a payback of 5 years and an emissions reduction of 166 tonnes CO_2 per year.[152]

- **Burnaby BC**: The City of Burnaby implemented a comprehensive municipal energy retrofit using an energy performance contract (refer to section 4.5). Total project costs were $5.6 million, and guaranteed annual savings are $450,000. The implemented measures included: high-efficiency lighting; building envelope upgrades; thermal pool covers; automation (control system) upgrades and high-efficiency boiler and furnace upgrades. As a specific example, new reflective low-emissivity ceilings at the Kensington Arena save energy, improve lighting and provide a harder ice surface.[153]

- **Sudbury ON**: As part of the city's Strategic Energy Plan, Sudbury installed two passive solar walls on the Wanapitei and Sudbury sewage treatment plants. This energy retrofit was completed to reduce electricity-based space heating requirements in the plants and to improve air circulation. Installation of the solar walls cost approximately $30,000 each. The solar walls at the Sudbury and Wanapitei plants each generate annual savings of around $10,500 in electrical energy costs and reduce emissions by 27 tonnes of CO_2.[154]

- **St John's NL**: The Dr. Leonard A. Miller Centre (a health care facility) underwent a major energy retrofit by means of an energy performance contract. The total cost was just over $4 million, and based on combined energy and operational savings, the expected payback is slightly more than five years. The old heavy-oil boilers were replaced with three high efficiency boilers to burn No. 2 fuel oil, reducing oil consumption by 45%. Another key element of the energy retrofit was the installation of a direct digital control system to monitor and control all aspects of the centre's mechanical and electrical equipment. A new energy-efficient lighting system was also installed; specifically the centre's T-12 tubes and magnetic ballast fixtures were replaced with more efficient T-8 tubes and electronic ballasts.[155]

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[152] NWT Energy Conservation Program Overview, 2006/2007 (http://www.enr.gov.nt.ca/eps/pdf/ECP%20Overview.pdf - date accessed: June 2008).

[153] Fraser Basin Council and Community Energy Association, *Energy Efficiency and Buildings: A Resource for BC's Local Governments*, prepared for the Community Action on Energy and Emissions (CAEE) initiative, 2007 (http://www.greenbuildingsbc.com/Portals/GBBC/docs/FBC_Manual_final.pdf - date accessed: June 2008).

[154] Ontario, Ministry of Municipal Affairs and Housing, Resources for Municipalities, *Building Strong Communities: Ontario Case Studies for Cleaner Air*, 2004 (http://www.mah.gov.on.ca/Page1308.aspx - date accessed: June 2008).

[155] Natural Resources Canada, Office of Energy Efficiency, Energy Innovators Case Study, *Dr. Leonard A. Miller Centre Cuts Oil Consumption by 45 Percent*, April 2004 (http://oee.nrcan.gc.ca/publications/infosource/pub/ici/eii/m144-36-2004e.pdf - date accessed: June 2008).

New Construction

The following are some examples of new municipal buildings constructed to LEED Silver or Gold levels.

- **Kamloops BC**: The Kamloops Centre for Water Quality is the first water treatment facility and the Hillside Centre is the first patient care facility to be certified under LEED. Both have achieved LEED Gold. The Centre for Water Quality building was designed to reduce energy requirements by maximizing use of natural light, natural ventilation and energy efficient materials. It came in under cost.

- **Airdrie AB:** The Environmental Education Centre is a sustainable straw bale building that uses solar PV for all electricity needs, solar heating for a radiant floor heating system, solar walls, solar hot water, and a heat recovery system.

- **Waterloo ON**: The Emergency Medical Services Headquarters and Fleet Centre is a LEED Gold building. The building uses a variety of technology and operational best practices such as a highly efficient building envelope, improved ventilation system and lighting conservation measures. The building was also oriented to optimize a rooftop solar PV system.

- **Port Hawkesbury NS:** A new civic centre has been developed for LEED certification. It was designed with a translucent glazing wall system to provide daylight to the ice surface and harvest solar energy. The centre also uses an integrated heating, ventilating, air conditioning/refrigeration system that recovers heat from the ice surface to provide heat to the rest of the civic centre as well as to the adjacent high school.

Tohu Pavillion, Montreal
A Private Sector Case Example[1]

La Tohu is a non-profit organization for the circus arts. Its pavilion in Montreal, built between June 2003 and August 2004, houses a concert hall (840 person capacity). In addition to increasingly common energy-saving features, the building features a number of more unusual innovations.

- The building was situated to benefit from an existing power plant fuelled by landfill gas. The water used to cool the turbines runs through a network of coiled pipes in the pavilion, providing heating for the floor.

- Displacement ventilation is used in the theatre and reduces ventilation energy demand by 80%. The ventilation is driven by the stack effect (rising warm air) alone at times of low load, and assisted by fans during periods of high load.

- The building's heating and air conditioning needs are also partly met by a geothermal system. This system is twinned with an ice tray, cooled by a glycol loop, that can accumulate up to 10,000 kg of ice. The ice, effectively serves as cooling storage, which is important given the great variability in occupancy of the building.

- The air is also passively pre-conditioned in large, long ducts before being introduced into the interior space.

Refer to Appendix D (Section 2 in Leading by Example and Section 3 in Buildings) for additional examples of best practice at the building level.

5.3 MUNICIPAL STREET LIGHTING BEST PRACTICES

5.3.1 Overview of Sustainable Energy Technologies and Systems for Street Lighting

Municipalities have a solid track record in fostering energy efficient street lighting, which encompasses both street lighting and traffic lights/signals. Exhibit 5.8 lists some of the key best practice technologies and measures that have been shown to generate significant operating cost savings.[156]

Exhibit 5.8: Street lighting Technologies/Measures

Application	Measure
Street lighting	Electrodeless induction lighting
	Dimming controls
	LED lights
	PV lighting
	Control strategies
Traffic Signals	LED lights
	Dimming controls

In addition to these key technologies, there exist best practice control strategies that can significantly reduce street lighting energy use. For example, in Oslo, Norway there is a centrally managed street lighting control system. It comprises a monitoring and tracking network, data historian and a control centre that keeps track of lights that need to be fixed and automatically dims street-lights based on the basis of seasonal variations, local weather patterns and traffic density. Street lights at dawn, for example, don't have to be at full power to still do their job.[157]

5.3.2 Selected Energy Best Practice Examples in Municipal Street Lighting

Many municipalities have successfully implemented programs directed to improvement the energy performance of street lighting. For example:

- **Dawson Creek BC:** The community of Dawson's Creek is situated in the northern interior of BC and has a population of about 12,000 people. In 2006, the city conducted a retrofit program focused on municipal lighting as part of its long-term sustainability plan. All city street lights were replaced with low-voltage, high-pressure sodium lights, reducing energy consumption by 100 MWh per year and saving the city approximately $15,000 a year in energy costs. The 200 street lights that were installed are also "star-sky friendly", resulting in significantly reduced levels of overall light pollution. Furthermore, LED traffic lights were installed throughout the city, translating into substantial savings as well.[158]

[156] For example, a study performed by the town of Ann Arbor, Michigan, indicated that conversion to LED street lighting consumed 50% less electricity and paid back within 3.8 years. LEDs Magazine, "Lumecon, Relume to supply 1000 LED street lights to Ann Arbor", December 14, 2007.

[157] National Examiner, "Study: New street light technology could save energy, money", April 6, 2008.

[158] Sustainable Dawson Creek British Columbia, *Phase 1 – Community Energy Plan* (http://www.planningforpeople.ca/what_we_are_doing/energy_plan/phase_1/index.asp – date accessed: April 2008).

- **Calgary AB**: Calgary's "Envirosmart Streetlight Retrofit" focused on reducing streetlight electricity consumption in Calgary's residential areas. Over a 2 year period, about 37,000 residential streetlights were retrofitted with lower wattage lamps.

- **Becancour QC:** A street lighting retrofit project in Becancour will replace over 1,000 existing high–pressure sodium street lights with newly developed induction lamps. This will cut maintenance costs and waste, as well as reduce electrical consumption for street lighting by more than 35%. The new lamps are also to last for 100,000 hours, a nearly 420% improvement from the existing lights. The project will help to implement a newly developed technology in Canada that can be adopted by other municipalities and exported. [159]

5.4 WATER/WASTEWATER TREATMENT BEST PRACTICES

5.4.1 Background

This section focuses on best practices to reduce the energy operating costs of water treatment and waste water treatment facilities in municipalities. Energy represents the largest controllable cost of providing these services to the public and, in Canadian municipalities, this still represents a major opportunity for energy efficiency. One reason is that many of these facilities are old and were designed and built when energy costs were not a major concern. With large pumps, drives, motors, and other equipment operating 24 hours a day, water and wastewater utilities can be among the largest individual energy users in a community.

Exhibit 5.9 profiles electricity use intensities (kWh consumed per ML treated) for Canadian water treatment and waste water treatment facilities, based on a national water and wastewater benchmarking survey of utilities in Canada.[160] The profile shows a wide range in energy intensities.

Exhibit 5.9: Energy Consumption of Canadian Municipal Water and Wastewater Utilities

Sector/Treatment	kWh consumed per ML treated (2005 data)		
	Maximum	Minimum	Average
Water treatment	862	303	473
Primary wastewater treatment (WWT)	950	162	378
Secondary WWT & BNR[161]	1307	215	703

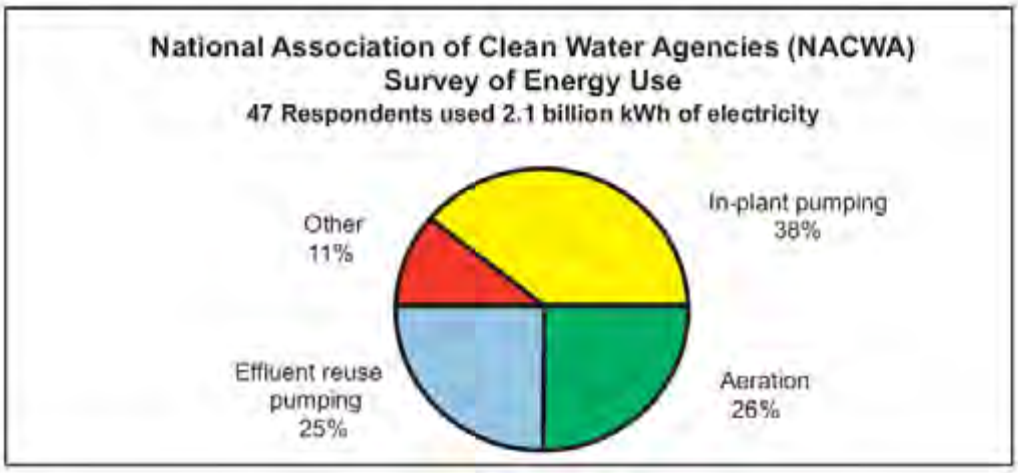
[159] FCM, *Enlisting Municipal Governments in a National Approach to Clean Air and Climate Change*, October 16, 2006, (www.fcm.ca/english/documents/envsub.pdf – date accessed: April 2008).

[160] Earth Tech Inc. (and NRC/IRAP), *National Water and Wastewater Benchmarking Initiative: 2007 Public Report* (http://www.nationalbenchmarking.ca/public/docs/NWWBI_Public_Report_2007_Aug8.pdf - date accessed: June 2008).

[161] Biological nitrogen removal

In the absence of Canadian energy end-use profiles for this sector, Exhibit 5.10 shows such a profile generated from a survey conducted in the U.S. Based on statistics from this survey, it has been estimated that energy costs in the water and wastewater treatment sectors account for as much as one-third of a municipality's total energy bill.[162] Pumping of water accounts for about 90% of energy use associated with potable water supply, whereas in wastewater treatment the majority of energy use is due to treatment processes.

Exhibit 5.10: Profile of Electricity Use in the U.S. Water Sector



The discussion of best practice energy efficiency measures for this sector is organized as follows:

- Section 5.4.2 profiles best practice measures designed to improve energy performance within the treatment facilities.
- Section 5.4.3 profiles management best practices designed to reduce demand and leakage.
- Section 5.4.4 profiles some municipal best practices.

5.4.2 Best Practice Energy Efficiency Measures for Water/Wastewater Treatment Facilities

Exhibit 5.11 lists best practices measures which can be implemented in municipal water and wastewater facilities to improve energy use performance and reduce peak demand and associated costs. Energy efficient treatment processes (e.g., fine bubble aeration) can be implemented when plants are upgraded or expanded.[163]

[162] US EPA and Global Environment & Technology Foundation, Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities, January 2008 (http://www.epa.gov/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf - date accessed: July 2008).

[163] Ontario Centre for Municipal Best Practices, Best Practice Summary Report, *OMBI General Energy Management Practices*, October 2006 (http://www.amo.on.ca/AM/Template.cfm?Section=What_s_New5&CONTENTID=105053&TEMPLATE=/CM/ContentDisplay.cfm - date accessed: June 2008).

Some technologies and practices to reduce demand are summarized in Exhibit 5.11 below.

Exhibit 5.11: Best Practice Energy Efficiency Measures for Water and Wastewater Facilities

Energy End Uses	Typical Base Case	Implemented Efficiency Measures	Approximate Simple Payback[164]
Pumps	Single or Two-Speed Motor	Variable speed drive	3 months to 3 years for 25-250 hp motors
	Standard Efficiency Motors	Premium efficiency motors	8 months to 3.3 years
	Poorly Sized Pumps	Pumps have a Best Efficiency Point (BEP) - testing and resizing/replacement of impellers can optimize operation	Not provided - called 'low'
Energy Management	Normal Operation	Time-of-use rates may allow for much cheaper electricity costs off peak. When applicable, system storage can be built up in off-peak times which allows for some pump shutdown during heavy peak times	Varies
	Poor Power Factor	Utility providers typically penalize customers for a low power factor- capacitor banks can be installed to correct this.	Varies depending on fees
	Single Electrical Meter	Sub-metering can find sections of plant that use more than normal. Can also spot irregularities and equipment malfunctions.	Varies depending on state of system
Other	Cogeneration (see section 5.7 for more information and best practices)	In large wastewater treatment plants, digester gas can be used in a gas turbine to create electricity for operation as well as process or space heat.	Typically high
Process	Mechanical or Coarse Bubble Aeration	Fine bubble aerator can increase oxygen uptake efficiency in wastewater - this requires less fan power.	
	Periodic Dissolved Oxygen Testing	Automated DO testing can reduce aerator load when it is not needed.	
	Management practices	Monitoring and adjusting aeration blowers to maintain only the necessary levels of dissolved oxygen	
	Heat recovery	Reclaiming and reusing heat in certain processes and WWTPs (e.g. digestion and incineration)	

5.4.3 Management, Operational and Maintenance Energy Efficiency Best Practices for Water and Wastewater Sectors

This sub-section focuses on management best practices which, together, can generate enormous energy performance improvements in this sector by a reduction of system

[164] Savings based on avoided cost for energy and water.

losses and demand management at the user end. Exhibit 5.12 profiles some of the key management best practice energy efficiency measures.

Exhibit 5.12: Management Best Practices to Improve Energy Performance in Water and Waste Water Treatment

Category	Best Practice Measure
Management information system	Source metering to enable input into the potable water system to be monitored
	District metering to enable pinpointing of areas with leaks
	Pressure control, which can reduce volume loss from existing leaks.
	Customer water consumption metering
	Installation of interval meters and bill validation
Maintenance	regular rehabilitation and replacement to maintain system integrity
Opportunity identification	energy audits and tracking hydro bills for monitor for abnormalities that may indicate equipment malfunctions

Regarding reduction of system losses, a recent survey of 65 Canadian municipalities known to have undertaken water conservation initiatives indicates that 66% had carried out leak detection and repair, 32% had installed or updated existing computerized water-use monitoring equipment and 15% had installed pressure reducing valves.[165] Based on a 2006 study, however, leakage management activities tend to be limited to repairing reported leaks and replacing mains. Very few Canadian municipalities are performing active pressure management or active leakage control to reduce leakage loss in potable water systems.[166] Halifax has emerged as a leader in this area and was the first Canadian utility to adopt the International Water Association/American Water and Wastewater Association (IWA/AWWA) water audit methodology for real loss reduction in its distribution systems.

5.4.4 Selected Best Practice Examples of Sustainable Energy Initiatives in the Municipal Water and Wastewater Sector

Best practice evidence shows that municipalities have made significant progress with dedicated programs and projects focused on improving the energy use performance and carbon footprint of existing water supply and wastewater treatment facilities.

The region of Peel in Ontario is a good example of an overall best practice management system to address energy operating costs in these facilities. The region's Corporate Energy group is working with the Water and Wastewater Treatment Division on the following key initiatives:

Energy Management Information System

- Installation of interval meters and bill validation
- Energy consumption and cost reporting

[165] USEPA, *Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities*, January 2008 (http://www.epa.gov/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf - date accessed: April 2008).

[166] Fantozzi et al., *Some International Experiences in Promoting the Recent Advances in Practical Leakage Management*, Water Practice and Technology, Vol. 1., 2006.

- Development of an energy budget forecasting tool.
- Communication networks and technologies review

Base and Peak Load Management
- IESO Operating Reserve Market study for backup power generators[167]
- Development of an energy management plan for Public Works
- Water and Wastewater Treatment long term backup emergency power and reservoir storage plan

Energy Efficiency
- Energy Audit of South Peel Water and Wastewater facilities.
- Energy optimization pumping strategy project for the water distribution system
- Sustainable energy supply
- Site visits for possible renewable energy projects

Exhibit 5.13 identifies additional best practice municipal examples in Canadian municipalities.

[167] IESO refers to Independent Electricity System Operator

Exhibit 5.13: Best Practices in Canadian Municipalities to Reduce Energy Operating Costs in the Water Sector

Technology / Practice	Example Municipalities	Program Description and Estimated Cost and Savings (if available)[168]
Efficient pre-rinse spray nozzles: A pre-rinse spray nozzle is a handheld device that uses a spray of water to remove food and grease from dishware, utensils, and pans before placing them in the dishwasher.	Region of Waterloo, ON[169] Toronto, ON[170] Welland, ON	Waterloo offers free equipment and installation as part of an ongoing pilot program, with 3 month paybacks from both water and energy savings. Toronto and Welland offer free spray nozzle retrofits in partnership with Enbridge Gas.
Elimination of "once through" cooling systems: Once-through cooling systems, or single-pass cooling systems, remove heat by transferring it to a supply of potable water and discharging it directly to the sewer. Equipment types may include air conditioners, refrigerators, coolers and ice machines.	Capital Regional District, BC[171]	CRD offers rebates for the replacement of once-through condensers and icemakers on a per ton replaced basis, with a1.5 year payback for small commercial systems.
Efficient Irrigation Systems: Irrigation can be made more efficient by installing timers or rain sensors, or by using a method that reduces evaporation, such as drip irrigation.	Capital Regional District, BC[172]	CRD offers rebates for automatic rain shut-off devices or rain sensors, and Irrigation Controllers with a 365-day calendar.
Large Customer Water use Monitoring: Monitoring of large customers for abnormal water usage for the purpose of leak detection in private distribution systems.	Halifax Water, Halifax Regional Municipality, NS	HRM offers a monitoring service for a monthly fee. Any action undertaken by the customer to remediate suspected leaks is done voluntarily by the customer.
Site Water Auditing: Water audits attempt to find instances within buildings (or landscapes) where water is being used inefficiently or unnecessarily.	Capital Regional District, BC	CRD offers free water use and efficiency audits to businesses in Greater Victoria and provides assistance with measurement and cost-benefit analysis of various measures to conserve water.

[168] Savings based on avoided cost of energy and water

[169] Region of Waterloo, Living in the Region, "Region Launches Restaurant Spray Valve Replacement Program" (http://www.region.waterloo.on.ca/web/region.nsf/0/02b9474f4ea5b2d485257037005215fe?OpenDocument – date accessed: April 2008).

[170] City of Toronto, *Spray 'N' Save program for restaurants* (http://www.toronto.ca/watereff/spray_and_save/index.htm - date accessed: April 2008).

[171] Capital Regional District, Water Services, For Your Business, Conservation, *The Case Against Once-Through Cooling Systems* (http://www.crd.bc.ca/water/conservation/ici/coolingrebate.htm - date accessed: April 2008).

[172] Capital Regional District, Water Conservation, Rebates, *Irrigation Rebate Program* (http://www.crd.bc.ca/water/conservation/rebates/irrigation.htm - date accessed: April 2008).

5.5 RENEWABLE ENERGY SUPPLY OPTIONS FOR COMMUNITY APPLICATIONS

5.5.1 Overview of Technologies

Renewable energy technologies (RETs) offer municipalities an environmentally sustainable means of providing electricity, heating, and cooling with little or no carbon emissions or other pollutants. Among the key challenges to achieving greater market penetration of RETs are: i) the premium up-front costs, ii) some forms of renewable energy (e.g., wind, sunlight) do not offer a consistent supply compatible with customer use patterns, [173]and iii) the emergence of the Not In My Back Yard (NIMBY) phenomenon. This sub-section focuses on RET applications at the community level and, as previously noted, additional discussions of RET applications are presented in sub-sections 5.2 (integration into building design) and 5.7 (integration into community energy systems).[174]

Exhibit 5.14 summarizes some key community-scale RET applications including their initial cost and the Levelized Unit Energy Cost (LUEC), which is a lifecycle cost performance unit that can be compared to the avoided cost of the energy source being displaced (e.g., centrally generated grid sourced electricity).[175] A more detailed description of these technologies can be found in Appendix E.

[173] They therefore require some form of storage or backup capable of providing the energy needed to either supplement the renewable source at peak times, and/or to replace it at times when little or no renewable energy is available.

[174] Municipal procurement of green energy was addressed in section 4.4.

[175] LUEC is defined as the discounted capital and operating costs per unit of discounted energy over the lifetime of the project. A discount rate of 10% was assumed.

Exhibit 5.14: Renewable Energy Supply Options for Community-Level Applications

Technology	Application	Initial Cost ($/kW)	LUEC (¢/kWh)	Potential Energy Impact
Small Hydro	Communities located near a source of moving water	$1,450 - $5,600	3.0 – 10.0	The 29 projects that were awarded purchase agreements by BC Hydro in 2006 will generate approximately 2,851 gigawatt hours of electricity annually (equivalent to the electricity consumed by 285,000 BC homes).
Photovoltaics (PV)	A PV "farm" can be developed for community-level applications. PV is very versatile in that it can be sized to allow a home or community to achieve Net Zero Energy status, using the electricity grid as storage at times when production exceeds consumption.	$4,500 - $10,000	34.5 – 46.0	PV is more cost-effective for reducing peak electricity demands or supplying electricity where existing electrical distribution infrastructure does not already exist. PV typically offsets 100 kWh of electricity for each m2 of installed area.
Wind	Typically better-suited for open space due to visual impact (also some noise)	$1,000 - $3,000	4.0 – 6.0	The wind turbine at Toronto's Exhibition place produces up to 1000 megawatt hours of electricity annually (enough to light 250 homes). The applications can also have multiple turbines as part of a wind farm to supply a community.
Solar Thermal	Versatile – larger scale system (water only) can be designed for community level Solar Thermal also integrates well with building envelopes.	$300 – $1,500 /m2	5.0 – 25.0	Solar thermal collectors can offset the use of conventional fossil fuel or electricity that would normally be used for heating water. Each m2 of installed collector area can offset up to 600 kWh(th) of energy.
Geothermal – Ground Source Heat Pump (GSHP)	Typically applied at a facility scale, but may be designed to serve a community.	$3,000 - $4,000/kW	10.0	Typical sized to meet the majority of the heating requirements of a facility (~80%) and 30 to 40% of the peak heating demand (i.e. backup heating system required). Typically, less cost effective if sized to meet 100% of energy needs and peak demand. GSHP can save approximately 70 – 80% of heating energy.

5.5.2 Selected Best Practice Examples of RET Community Level Applications

Below are some best practice examples of community level RET applications in municipalities.

- **Mayo YT:** Mayo, a community of 250 people, 300 km north of Whitehorse, sits atop a reservoir of geothermally heated warm groundwater. Like Whitehorse, Mayo currently uses low grade geothermal resources to keep its municipal water systems from freezing in the winter. The municipality is looking to expand its use of geothermal energy to help heat some buildings in the community by activating two geothermal wells that were drilled in the late 1980's.

- **Vancouver BC**: The Mole Hill project in Vancouver is a large-scale earth energy system involving the redevelopment of 27 municipal-owned houses.

- **Toronto ON**: As further described in section 5.7.2, Toronto uses cold water from Lake Ontario instead of conventional electric chillers to chill water at the Enwave cooling plant, which is then distributed to commercial buildings for air conditioning.

- **Toronto ON**: The Toronto wind turbine was a joint venture between Toronto Hydro Energy Services (an affiliate of Toronto Hydro Corporation with the City of Toronto as its sole shareholder) and the WindShare Cooperative. It was constructed in December 2002 and was the first wind turbine placed in the City of Toronto and the first in a downtown urban setting in North America. It is a 750 kW turbine and has the capacity to power 250 homes. Between December 2002 and February 2006, the turbine generated 2,864,768 kWh of electricity and displaced 815 tonnes of CO_2 emissions.[176]

5.6 ENERGY FROM BIOMASS AND BIOGAS WASTE

This sub-section discusses the use of waste biomass and biogas as forms of energy supply in municipalities. Waste biomass is sourced from a number of areas, including: forest industry residues, agricultural operations and municipal solid waste materials separated and processed to serve as combustion fuel. Energy supply from biomass is a particularly relevant option for rural municipalities in proximity to low cost supply of waste biomass. Liquid fuels such as bio-oil, ethanol, methanol and diesel can also be derived from biomass.

Biogas is methane produced from organic waste material. Facilities producing biogas include landfill sites, sewage treatment plants and anaerobic digestion organic waste processing facilities. Electricity produced from such sources has an initial cost in the order of $1,500 to $3,000 per kW, and an LUEC of 4 to 9 cents per kWh. Electricity produced from the recovery of this kind of waste energy is generally considered "clean" or "renewable".[177]

[176] Toronto Hydro Corporation, Initiatives, Wind Turbine (http://www.torontohydro.com/corporate/initiatives/green_power/wind_turbine/index.cfm - date accessed: June 2008).

[177] See for example: Draft for Discussion, *British Columbia's Clean or Renewable Electricity Guidelines*, December 2007.

5.6.1 Selected Best Practice Examples of Municipal Energy from Waste Projects

Note that most of the examples provided here involve use of biomass and biogas in cogeneration and/or district energy systems. These systems are further explained and illustrated in section 5.7 below.

Many municipalities, large and small, now use methane gas from landfill sites -- which would otherwise be released to the air -- to generate electricity. These include Kelowna, Calgary, Waterloo, and Montreal. Waterloo's LFG-fuelled generator has a power output of 3.7 megawatts, enough to provide electricity to about 2500 homes. Examples of other energy-from-waste projects include:

- **Victoria BC:** The Dockside Green project will use biomass gasification to provide heat and hot water to buildings in the development. The system will take wood waste - including wood construction debris, municipal tree trimmings and wood waste from local mills and woodworking shops – and convert it to low emission "syngas" which will fire the boiler.

- **Prince George BC:** The town has plans to build a new hot water community energy system which will utilize biomass, (such as wood impacted by the mountain pine beetle infestation), to decrease electricity and heating fuel consumption of downtown facilities.[178]

- **Hamilton ON**: Hamilton's cogeneration facility takes methane gas created by the wastewater treatment process and produces electricity and heat. It converts 32 per cent of the available energy in the digester gas to electrical energy (producing 13.6 kilowatt hours of electricity), and 48 per cent to thermal energy. It provides the City with a significant net financial benefit through electricity sales to the province and savings in natural gas costs for heating the wastewater facilities.[179]

- **Newmarket ON**: An anaerobic digestion plant processes 150,000 tons of biowaste and commercial waste each year. The plant produces 60,000 tons of compost and 5 megawatts of electricity, with enough surplus power for 3,000 homes.

- **Ottawa ON:** The cogeneration facility at the Robert O. Pickard Environmental (wastewater treatment) Centre converts 32 percent of the available energy in the digester gas to electrical energy and 48 percent to thermal energy.[180] This electrical power and heat is used to operate the Pickard Centre. Ottawa has implemented an energy management plan for the city's wastewater treatment plant to ensure that the

[178] As a point of interest, the new Central Energy Plant will be built to LEED standards.

[179] City of Hamilton, Public Works, *Together We're Caring for our Environment* (http://www.myhamilton.ca/myhamilton/CityandGovernment/CityDepartments/PublicWorks/PW+Environment.htm – date accessed: May 2008).

[180] City of Ottawa, *Cogeneration at the Robert O Pickard Environmental Centre* (http://www.ottawa.ca/residents/waterwaste/cogeneration_en.html - date accessed: May 2008).

facility remains in a lower cost electricity rate class by optimizing the use of digester gas as a fuel, maximizing cogeneration output. [181]

5.7 COMMUNITY ENERGY SYSTEMS

This sub-section profiles best practice community energy system applications which offer municipalities long-term, lower cost energy supply options using energy forms that have a lower overall environmental impact. The discussion of community energy systems comprises the following applications:

5.7.1 District Heating and Cooling

District heating and cooling, (generally referred to as district energy or DE) involves the generation and distribution (using a pipeline distribution system) of thermal energy for space conditioning at a community scale. The first DE system in Canada was built in London ON in 1880 to serve public buildings. The first commercial system in Canada was built in Winnipeg in 1924. Approximately 150 DE systems of varying sizes are currently in operation in Canada and over 5000 in the U.S.[182]

DE usually consists of one or more centralized heating and/or cooling plants connected to a network of underground pipes that distribute steam, hot water, or chilled water to the buildings on the network. Cooling can also be provided by local water bodies, as in Toronto where water is pumped from Lake Ontario.

5.7.2 Combined Heat and Power (Cogeneration)

Cogeneration or combined heat and power (CHP) is the simultaneous production of electrical and thermal energy from a single fuel.[183] When electricity is generated thermally (i.e., by burning fossil fuels or other fuels), between 50% and 65% of the fuel's energy value is released as heat to rivers, lakes, the ocean or the atmosphere.[184] The thermal energy applications in a pipeline distribution system can be for industrial process heating (e.g., paper drying, chemical processing, food processing) or space conditioning (heating or cooling).

Some district energy systems use CHP and sell energy to the grid while supplying heating to residential neighbourhoods. Thus, DE systems can involve the integration of electricity production and space conditioning, providing electric power and heat using 10 to 30 per

[181] The facility is categorized as a general commercial user, but it is operating close to the 5000 kW peak demand threshold that would categorize the plant as a large user; this would mean an increase of $155,000/yr for energy (delivery and administrative costs). Ontario Centre for Municipal Best Practices, *Best Practice Summary Report – Water and Wastewater, Energy Management Strategy*, October, 2006 (http://www.amo.on.ca/AM/Template.cfm?Section=Home&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=105048 – date accessed: April 2008).

[182] Enwave Energy Corporation. (http://www.enwave.com/heating.php - date accessed: May 2008).

[183] Strickland, Catherine and John Nyboerg, MJ Jaccard and Associates, *Cogeneration Potential in Canada - Phase 2*, prepared for Natural Resources Canada, April 2002.

[184] CogenCanada CHP Association (http://www.cogencanada.org/ - date accessed: May 2008).

cent less fuel than would be required to produce the same amount of electricity and heat separately.

5.7.3 District Energy and the Integration of Energy Systems

DE and CHP applications are increasingly being considered through the lens of what is referred to as integrated energy systems (IES). *In an integrated system approach to land-use, energy, transport, water and waste management, greater emphasis is placed upon achieving efficiency for the systems as a whole, and upon creating systems that are more resource efficient, adaptable, resilient and sustainable.*[185] An integrated energy system offers the means of bringing diversified energy services to municipalities through systems and technologies that:

- Distribute electricity generation and supply more efficiently than centralized electricity systems
- Optimize how energy quality of the fuel sources are best matched to energy service needs (cascading of energy use)
- Offer advanced, low carbon energy infrastructure that embodies reliability, resiliency, fuel flexibility and scalability (e.g., utilizing clean and/or renewable energy sources and/or converting community waste biomass, sewer heat, and landfill gas into energy assets)
- Are smaller in scale urban energy systems, distributed more widely, located closer to and within buildings, integrated with elements of buildings, and integrated with other infrastructure systems.

In an integrated energy system, the cascading of energy from high quality processes through multiple stages to low quality is made possible through spatial integration. Essentially, the heat generated from the production and use of electricity, or from industrial processes, can be used for low quality applications such as space heating. Thus, where available, it is preferable to design and connect buildings to use this low temperature waste heat. Useful energy can be derived from:

- Exhaust heat from any industrial process or from electric generation
- Industrial tail gas that would otherwise by flared, incinerated, or vented
- Recoverable heat from the process that is discharged though cooling water systems
- Pressure drop in any gas.

Technologies that can be integrated into industrial facilities to capture waste energy are briefly summarized in Appendix F. Linkages between industrial and municipal facilities for purposes of waste-energy recovery/use are possible, and may present particular economic advantages to small and rural municipalities, since major heat-generating facilities such as large industrial and electric power facilities are often located outside of

[185] CGA in conjunction with CaGBC, CEA, CEEA and Pollution Probe, *Integrated Energy Systems in Canadian Communities: A Consensus for Urban Action*, report produced from the results of the Quality Urban Energy Systems of Tomorrow - QUEST - workshop, March 2008, p. 4 (http://www.cga.ca/publications/documents/QuestWhitePaperEnglish-Final.pdf - date accessed: June 2008).

large cities.[186] Similarly, eco-industrial parks can use this concept for their design and operation.

Exhibit 5.15 profiles the range of technologies and fuels used in DE systems. The component technologies are becoming less mechanically complex and cleaner and more innovative. These trends bode well for municipalities and represent considerable economic and environmental benefits.

Exhibit 5.15: Common Technologies and Fuels Used for District Energy[187]

Plant type	Boiler/Generator/Technology	Possible fuel sources	Output
Heat only (hot water and steam) & CHP (Combined Heat and Power)	Combustion turbine	Natural gas, liquid fuels	Steam/electricity 5MW – 25MW
	Reciprocating engine	Natural gas, diesel, landfill gas, digester gas, biogas	Hot water 500kW – 7MW
	Micro turbine	Natural gas, hydrogen, propane, diesel	Hot water 25kW – 500kW
	Fuel cell Molten carbonate Phosphoric acid Proton membrane exchange Solid oxide	Natural gas, hydrogen	Hot water (steam for molten carbonate & solid oxide fuel cells) 1kW – 10Mw
	Stirling engine	Natural gas, landfill gas, propane, etc.	Hot water 1kW – 25kW
Chilled water	Lake/ocean water	Water	Cold water
	Chillers	Steam/hot water/electricity	Chilled water
Thermal storage	Incorporates one or more large storage tanks of hot or chilled water or ice linked to a district energy system. Mediums for storage can include steel storage tanks, aquifers and boreholes.		

5.7.4 A New Kind of District Energy System: Mini-grid Electricity Distribution Systems

An emerging area of research, development and demonstration (R,D&D) pertains to alternative electricity distribution systems. So-called mini-grids (sometimes called "micro-grids" or “isolated grids”) involve a set of generators and load-reduction technologies that enable the entire electricity demand of a localized group of customers to be met.[188] Generators in a mini-grid are also capable of serving their load independently.

[186] Owen Bailey and Ernst Worrel, LBNL, *Clean Energy Technologies-A Preliminary Inventory of The Potential for Electricity Generation*, 2005 (http://www.recycled-energy.com/documents/news/LBNL_clean_energy.pdf - date accessed: April 2008). A U.S. study indicates that these applications could produce a level of power equivalent to about 19% of the 2002 U.S. electricity consumption.

[187] Canadian District Energy Association, *The New District Energy: Building Blocks for Sustainable Community Development*, on-line handbook, January 2008 (http://www.toronto.ca/taf/pdf/ues_handbook.pdf - date accessed: May 2008). Cites James, Jamie et al (2006) and Edwards, G et al (2000) as source documents for table.

[188] US Department of Energy, Distributed Energy Program, Technologies, *Minigrids* (http://www.eere.energy.gov/de/minigrids.html - date accessed: April 2008).

By avoiding the cost of transmitting electricity from a distant central-station power plant or transporting fuel from a distant supply source, and by using a mix of generating and demand-side management technologies, a mini-grid gives the power supplier flexibility to meet a wider range of loads while improving the economics of meeting energy needs. The so-called power park (or premium power park) is a mini-grid application that could be offered as ultra-reliable, high quality electrical power to high tech industrial customers. Technologies to ensure uninterruptible power supply can include battery banks, ultra-capacitors, or flywheels.

Another mini-grid option is to design neighbourhoods to run entirely on direct current (DC). A high-voltage DC line would interface with the rest of the grid through high-tech DC-to-AC converters. DC systems are less vulnerable to power quality issues, and digital devices run on DC current. Use of DC would also allow distributed generation equipment to be connected directly with the mini-grid without using DC-to-AC converters at the power source.

5.7.5 Best Practice Examples of District Energy Systems

There are some interesting best practice examples of DE applications in Canadian municipalities which include the following:

- *Use of cleaner energy sources*: The North Vancouver, Windsor and Markham district energy projects use natural gas as a transition fuel for a lower carbon footprint. The University of New Brunswick in Fredericton employs a leading-edge technology, using a small-scale micro turbine that produces 100kW of electricity by burning natural gas. The heat generated by the production of electricity is reclaimed and used in the central heating plant steam production process to maximize efficiency.
- *Use of waste biomass*: Revelstoke, BC and Charlottetown, PE use wood waste for their district heating systems. Victoria BC's Dockside Green district energy system will also use waste wood.
- *Use of other clean/renewable energy sources*: Okotoks' AB Drake Landing uses solar energy; Toronto ON uses deep lake water for cooling. Hamilton ON and Ottawa ON have cogeneration facilities that uses digester gas (methane) created by the wastewater treatment process.
- *Scalability*: Many DE projects are designed to allow for expansion to service other facilities in the future, (e.g., the North Vancouver BC, Windsor ON and Markham ON systems).
- *Advanced system configurations*: The Toronto Exhibition Park trigeneration system uses the water supply systems to cool buildings and plans for the False Creek system in Vancouver involve sewer heat recovery.
- *Demonstration of new technologies*: e.g., Okotoks.

Some implemented or planned best practice applications are further elaborated below.

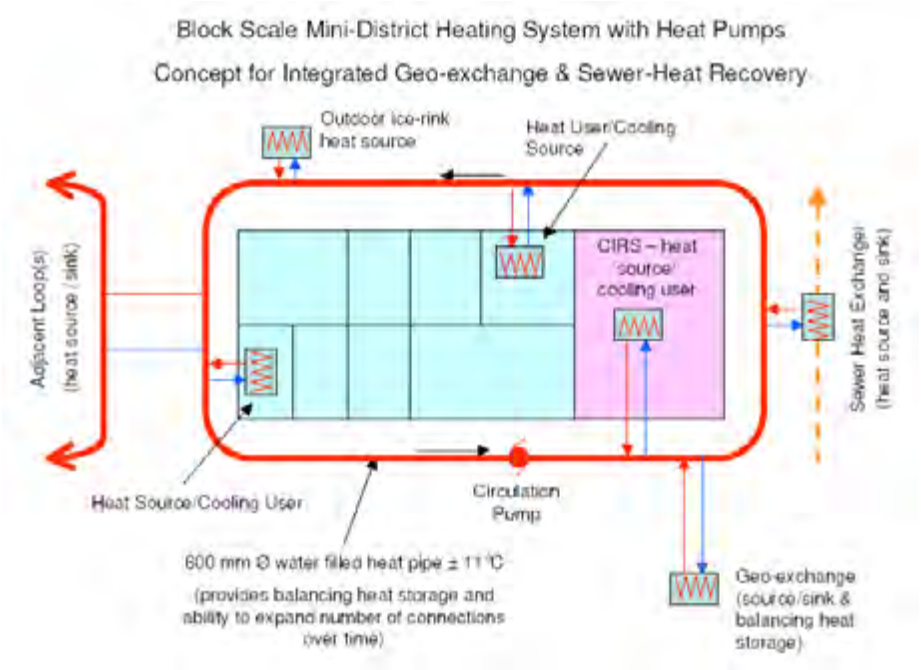
- **Vancouver BC**: Exhibit 5.15 on the next page illustrates the integrated energy system design for the Vancouver Southeast False Creek redevelopment.[189] As shown, the proposed energy system will comprises a mini district heating systems with ground source heat pumps and heat recovery from the sewer system.

- **North Vancouver BC:** The Council of North Vancouver, accepted study findings that indicated that a system of smaller plants distributed throughout the proposed service area would allow the CES to grow by segments as customers sign on. The Lonsdale Energy Corporation is mandated to install and manage a distributed district energy system to provide heating and domestic hot water to buildings in a specific section of the City. (See the sidebar for an important lesson learned.[190])

Lesson Learned in Planning the Lonsdale DE System

In the initial development of the Lonsdale Energy Corporation (LEC) district energy system in North Vancouver BC, design teams for the plant and the engineering teams working for the local developer did not come together. As a result, the new residential building controls failed to ensure efficient operation of the district energy system. Also the heating demand for residential buildings was overestimated, resulting in over-sizing of the system. LEC operators and management now work with local residential and commercial building development teams to plan the infrastructure and controls needed to connect to the system, and have created detailed design guidelines for developers.

Exhibit 5.15: Integrated District Energy System Design for False Creek Project



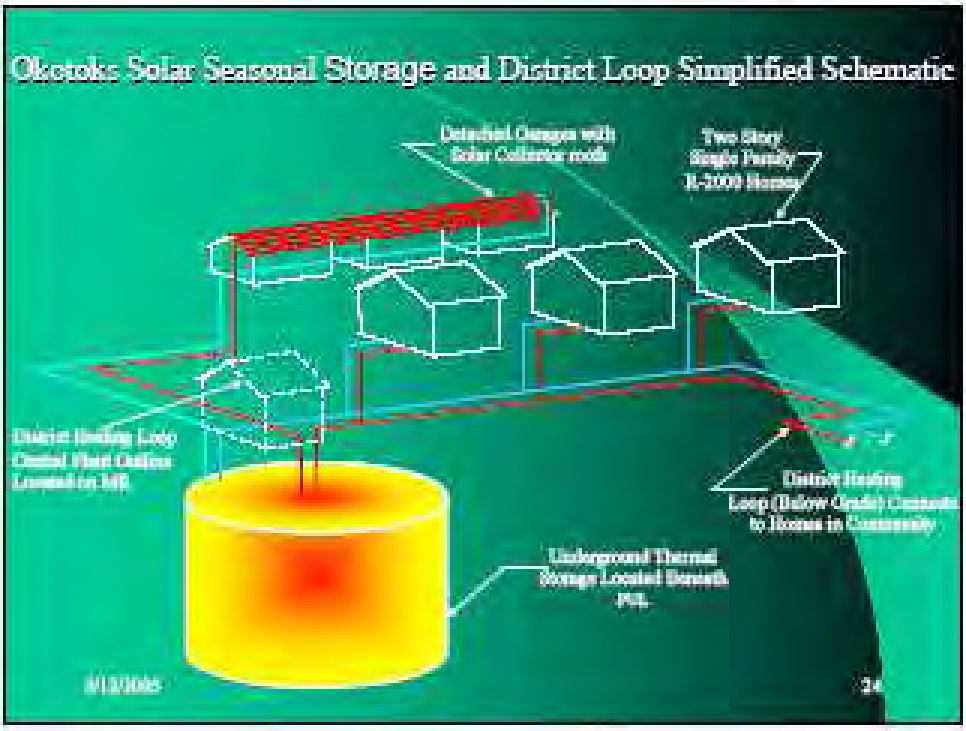
189 Robin Petrie, *City of Vancouver Energy Precinct*, presented at the 10th ACEA Conference, 2005.

190 Canadian District Energy Association, *The New District Energy: Building Blocks for Sustainable Community Development*, on-line handbook, January 2008 (http://www.toronto.ca/taf/pdf/ues_handbook.pdf - date accessed: May 2008).

- **Okotoks AB**: Exhibit 5.16 illustrates the leading edge example "Drake Landing" solar thermal storage and distribution system.[191] Drake Landing is designed to meet 90% of the space and water heating requirements from solar collectors which will collect heat during the spring, summer and fall and store the thermal energy in underground boreholes for extraction during the winter. A district-heating network will distribute the thermal energy.

- **Windsor ON**: The Casino district energy system is an example of adaptability and scalability of an integrated energy system. The energy equipment is located in the basement of the casino and provides heating and cooling via natural gas boilers and backup power with diesel generators. The district energy system began by meeting the needs of the casino and, over time, has helped the city meet the increasing demand for heating and cooling services of other building facilities, as the city expanded.

Exhibit 5.16: Okotoks Solar Thermal Storage and Distribution System



- **Toronto ON**: Toronto's tri-generation (electricity, heat, cooling) system is the largest in Canada, and the first one owned by a municipality. The system consists of a 1.6 MW natural gas-fired generator with heat-recovery and a hot water driven absorption chiller. The waste heat produced by the engine is recovered and supplied in the form of hot water to the absorption chiller which, in turn, provides cooling in the summer

[191] Bill Wong, *Solar Thermal Storage in a Residential District Heating System*, presented at the 10th ACEA Conference, 2005.

and augments the heating boilers in the winter.[192] The tri-generation system was completed in July 2007 and is the sole source of electricity and heat for the Direct Energy Centre at Exhibition Place while meeting most of the cooling requirements. This system is part of a larger plan to have the Exhibition Place reach energy-self-sufficiency by 2010.

- **Toronto ON**: The Deep Lake Water Cooling project uses water from Lake Ontario instead of conventional electric chillers to chill water at the Enwave cooling plant, which is then distributed to commercial buildings for air conditioning.

5.8 PROJECT PLANNING

This section has identified and discussed operational practices and technologies by which municipalities can implement and deliver sustainable energy solutions. As elaborated, there is an enormous diversity of opportunity and application for both demand and supply solutions at the facility and community scales. None of these applications by themselves will address all of a community's energy needs.

Energy sustainability requires a well planned and delivered approach encompassing many types of measures; this breadth and depth of possibility is captured well in the Guelph ON Community Energy Plan, as noted in section 3. To get the most out of these opportunities, municipalities can adopt some straightforward project planning steps which are summarized in Exhibit 5.17.

[192] Exhibition Place, Environmental Activities/Projects, *Trigeneration System in Direct Energy Centre*, October 2006 (http://www.explace.on.ca/green/Trigeneration.pdf - date accessed: June 2008).

Exhibit 5.17: Best Planning Practices for Projects

- **Understand current conditions:** As described in Section 4.1, it is important to understand baseline energy use as a basis for identifying capital and operating opportunities. Municipalities that have effective performance monitoring and tracking system for their buildings and facilities are already well positioned to understand baseline conditions. Municipalities may use in-house staff, out-sourced consultants, or some combination of the two to conduct these assessments.
- **Address project hurdle rates:** Also as discussed in section 4.1, municipalities can choose hurdle rates that enable a more comprehensive solution to energy use performance. Even extending simple payback thresholds to five years, can enable inclusion of measures that may be more costly in the short-term, but more effective over the longer term.
- **Link to infrastructure renewal:** Best practice evidence shows that energy projects -- particularly retrofit projects – can move forward when linked either directly or indirectly to infrastructure renewal, including building renewal. For some energy efficiency retrofits, there has been an explicit business case made that the financial savings stream can help support investments in capital upgrades. Opportunities for integrating energy with other dimensions of sustainability are found throughout this section, most explicitly in relation to water and wastewater.
- **Focus on replication opportunities:** Best practice projects often arise from programs where attention has been paid to facilities that have replication potential within a municipality, such as arenas and recreation facilities.
- **Explore innovative financing and contracting:** Municipalities have been market leaders in using energy performance contracting (EPC) services to design and implement major retrofit projects. These projects have generated cash streams that were subsequently used to finance additional measures. See section 4.5 for more on EPC.
- **Build a robust commercial agreement:** Best practice evidence shows it is prudent to build a robust commercial agreement template for the relationship between the municipality and out-sourced service providers. The quality of the commercial agreement defines the quality of the relationship.
- **Leverage existing government and utility programs:** Best practice evidence also shows that municipalities have successfully used financial incentives from government and utility programs. Given the plethora of such programs available today in all parts of the country, this is a prudent way to extend the reach of the municipality's investment in the project.

5.9 SUMMARY TABLE

Exhibit 5.18 presents an overview of best practices presented in Section 5 in relation to issues identified in Section 2 (Exhibit 2.1 provides an overview of key issues) and with respect to the applicability of issues identified to community size, region or province, and geographic location.

Exhibit 5.18: Overview of Best Practices in Operational Practices and Technologies

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments

Buildings	*Sustainable energy technologies and systems for buildings*
	• Energy efficiency measures, examples include:
	  • High efficiency building envelope
	  • High efficiency chillers
	  • Energy Star refrigerators
	  • Condensing water heaters
	  • Energy Star computer equipment
	  • T8 and T5 lighting
	  • Passive solar orientation
	• Energy supply options, examples include:
		• Energy costs
		• Infrastructure rehabilitation needs
		• Growing government and utility support
		• Valuation approaches
		• Siting wind power developments
		• LEED standards
			All	Hay River, NT
				Norman Wells, NT
				Burnaby, BC
				Sudbury, ON
				St. John's, NL
				Kamloops, BC
				Airdrie, AB
				Waterloo, ON
				Port Hawkesbury, NS
				Toronto, ON
				Arviat, NU
				Rivière-du-Loup, QC
					• Building best practices can be implemented for building retrofits as well as in the construction of new buildings.
					• New construction may include building to LEED Silver, Gold or Platinum standards.

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments

	• Ground source heat pumps
	• Solar walls
	• Solar collectors
	• PV systems
	Sustainable energy operational and behavioural practices for buildings
	• Operational and maintenance, examples include:
	  • Optimized control of lighting
	  • Envelope sealing
	  • Reduce HVAC operation hours
	  • Reduce tank temperature for domestic hot water
	  • Install timers for plug loads
	• Behavioural practices, examples include:
	  • Use task lights
	  • Adjusted space heating and cooling
	  • Shut off idle equipment
	  • Change hours of activity				

Municipal Street Lighting	• Street lighting, examples include:
	  • Dimming controls
	  • LED lights
	  • PV lighting
	• Traffic signals, examples include:
	  • LED lights
	  • Dimming controls
		• Energy costs
		• Infrastructure rehabilitation needs
		• Growing government and utility support
			All	Dawson Creek, BC
				Calgary, AB
				Becancour, QC
				Fort St. John, BC
				Yellowknife, NT
					• Street light retrofits are becoming more common within municipalities.
					• In addition to the high efficiency of newer lighting technologies, control strategies can be employed to reduce energy consumption even further. For example, real-time monitor and control systems can be used so that street lights are dimmed based on season, local weather, and traffic density.

Water and Wastewater	*Energy efficiency measures for water and wastewater facilities*	• Energy costs • Cost and revenue	All	Region of Peel, ON Halifax, NS	• Best practices include energy efficiency measures taken at the

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments

Treatment	• Energy efficiency measures for pumps, examples include:
	  • Variable speed drive
	  • Premium efficiency motors
	• Energy management, examples include:
	  • Time-of-use
	  • High power factor
	  • Sub-metering
	• Process, examples include:
	  • Fine bubble aeration
	  • Automated dissolved oxygen testing
	• Other sustainable energy examples include:
	  • Cogeneration
	Sustainable energy operational practices
	• Water sector, examples include:
	  • Off-peak pumping
	  • Use of available storage in distribution system
	• Wastewater sector, examples include:
	  • Continual monitoring and adjustment of aeration blowers
	  • Reclaim and reuse of heat in certain processes
		squeeze
		• Infrastructure rehabilitation needs
		• Growing government and utility support
		• Valuation approaches
				Region of Waterloo, ON
				Capital Regional District, BC
				Durham, ON
					point of the water and wastewater treatments plants, as well as measures taken to reduce water use, as this ultimately results in less water treatment and distribution required, thus reducing energy consumption.

Renewable Energy Supply Options	• Small hydro • Photovoltaics • Wind power • Solar thermal • Geothermal	• Energy costs • Cost and revenue squeeze • Infrastructure rehabilitation needs • Growing	All	Mayo, YK Vancouver, BC Toronto, ON Murdochville, QC Halifax, NS Whitehorse, YT	• At the community level, renewable energy technologies are often used to supply and/or supplement the energy required for community energy systems or district heating and cooling systems.

Category	Best Practice	Issue(s) Addressed	Applicability	Community Examples	Additional Comments
		government and utility support • Green demographics • Valuation approaches • Siting wind power developments			
Energy from Waste	• Biomass (e.g. forestry residue) • Biogas (e.g. landfill gas) • Waste heat (e.g. from industrial processes)	• Energy costs • Cost and revenue squeeze • Infrastructure rehabilitation needs • Growing government and utility support • Green demographics • Valuation approaches	All (Biomass is particularly relevant to rural or smaller communities)	Kelowna, BC Calgary, AB Waterloo, ON Montreal, QC Victoria, BC Prince George, BC Hamilton, ON Newmarket, ON Ottawa, ON	• Many municipalities are capturing methane gas from landfill sites or wastewater treatment plants to generate electricity. • Biomass is often used for district heating systems.
District Energy	• District heating and cooling • Combined heat and power (cogeneration) • District energy and integration of energy systems	• Energy costs • Cost and revenue squeeze • Infrastructure rehabilitation needs • Growing government and utility support • Green demographics • Valuation approaches	All	North Vancouver, BC Windsor, ON Fredericton, NB Markham, ON Revelstoke, BC Charlottetown, PEI Victoria, BC Okotoks, AB Toronto, ON Hamilton, ON Ottawa, ON Vancouver, BC London, ON Cornwall, ON Oujé-Bougoumou, QC	• District energy systems may use clean energy sources, such as natural gas, or renewable energy sources, such as waste biomass, solar thermal, or geothermal energy. • Cogeneration and trigeneration systems are also used in district energy systems. • Mini-grid electricity and mini heating distribution systems are emerging as successful district energy systems.

6. FINANCIAL IMPLICATIONS

In the best of circumstances, it would be helpful for municipal governments to have access to a rich and robust database of performance metrics for implemented sustainable energy projects in municipal operations and municipalities as a whole. Unfortunately, this type of information does not exist. There is an enormous paucity of robust performance data for these types of programs and projects. In view of these circumstances, this section is organized as follows:

- Section 6.1 presents some indicative performance metrics gleaned from the best practice and other municipalities profiled in the foregoing sections. At best, this information is more indicative than definitive.
- Section 6.2 provides a brief primer on the ways in which sustainable energy potential is commonly assessed. This is done to differentiate what is society's interest versus the private investment perspective.
- Section 6.3 addresses the notion that all cost-effective energy efficiency opportunities have been implemented; that there is little left to do that's cost-effective for municipalities. It draws on some recent studies to show the degree to which cost-effective potential remains.
- Section 6.4 revisits the fundamental challenges that municipalities face in making and selling the business case for sustainable energy investments.

6.1 SCAN OF INDICATIVE PERFORMANCE RESULTS

Exhibit 6.1 presents some indicative financial and other related performance results from implemented projects. Again, the absence of robust performance data sets makes it very difficult to draw conclusive patterns and outcomes from this experience.

As noted in Section 5, municipalities tend to accept longer paybacks on energy management investments than in the private sector and, in general, a simple payback target of $\leq$ 5 years is a common threshold. The longer payback threshold enables more depth and breadth to the scope of proposed energy management measures. The "fertile ground" offered by this type of investment horizon is one of the reasons why ESCOs were attracted to this market; longer-term contracts can be negotiated to foster comprehensive solutions affecting all major energy end-uses.

Exhibit 6.1: A Selection of Financial Performance Indicators

Energy End Use	Municipality	Project Name	Installed cost	Savings Value	Simple Payback
Water and wastewater	Peel			$8 million over two years	
Water and wastewater	Sudbury	Wastewater treatment Plant energy efficiency upgrades (included the installation of a solar wall)	$ 2 million		
Water distribution system	Durham	Energy Optimization Project		$310,000 over six years	
Water transmission system	Toronto	Transmission Operations Optimizer (TOO)	$5 million	$1.3 million (estimated yearly savings)	< 4 years
Wastewater treatment plant	Ottawa		$4.5 million	$1 million estimated electricity savings; $400,000 natural gas savings	< 4 years
Water purification plant	Ottawa			$100,000/ month (energy costs); $180,000 (in 2005 using natural gas)	
Wastewater treatment plant	Okotoks			$13,000	
Water reservoir	Okotoks			65% energy cost reduction	
Municipal buildings	Ottawa	Building Retrofit Program		$250,000/year	
Municipal buildings	St. John's	Municipal Building Retrofits		$625,000 average annual	
Municipal buildings	Peel			$4 million annually	
Municipal buildings (ex. facilities of transportation, waste and recycling, and fire department)	Calgary	Energy Performance Contracting (EPC) Program		$7 million/year (estimated)	
Municipal buildings (ex. library, ferry terminal, city hall)	Halifax	Alderney 5 Advanced Geothermal Energy Project	$3.6 million	$250,000/year (estimated)	21 year lease buy-out
Library and Town Office	Okotoks			53%, 55% annual energy cost reduction = $6000/year combined	
Cross cutting measures in municipal facilities	Ottawa		$5,167,000 (since 2003)	$2,161,899 (actual savings to end of 2007, for both energy and water)	
Streetlights	Dawson Creek	Municipal Streetlight Retrofits		$1200/month	
Streetlights	Calgary	EnviroSmart Streetlight Retrofit Program		$1.7 million/year (estimated)	

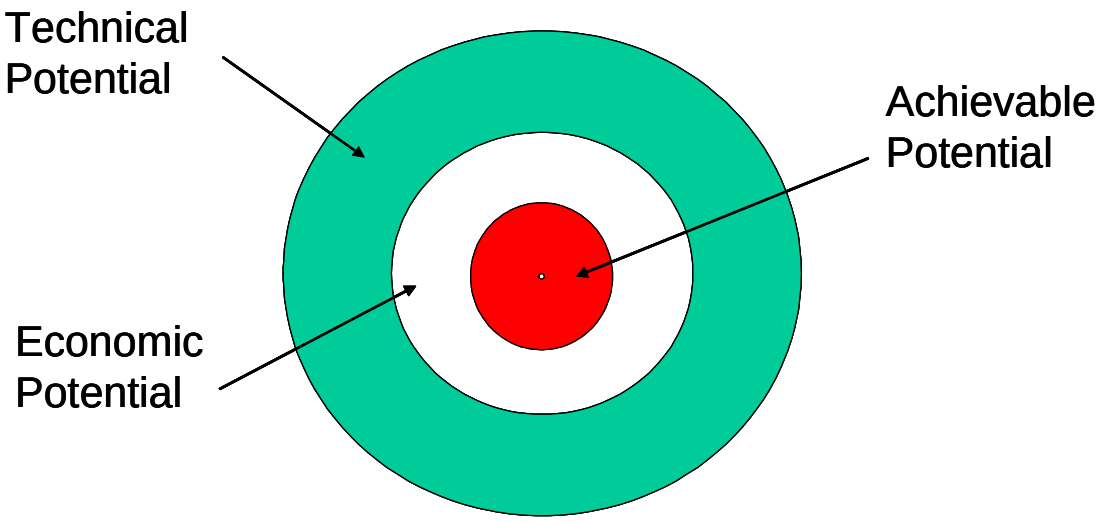
Energy End Use	Municipality	Project Name	Installed cost	Savings Value	Simple Payback
Traffic signals	Calgary	LED Traffic Signal Replacement Program		$670,000/year (estimated)	5 years
Density bonus	Ucluelet	OCP Density Bonus		$10 million (in cash, parkland, amenities)	
Redevelopment - mixed use	Montreal	Benny Farm		$640,000 over 15 years	

6.2 A PRIMER ON SUSTAINABLE ENERGY POTENTIAL

This sub-section provides a primer to the three main perspectives by which organizations typically assess the potential for sustainable energy solutions. It's critically important to understand these perspectives because the concept of potential is often misused or misconstrued, ultimately undermining informed discussions of what constitutes potential.

Exhibit 6.2 is a simplified depiction of three types of sustainable energy potential, technical, economic and achievable. Each of these perspectives is defined below.

Exhibit 6.2 Three Perspectives of Sustainable Energy Potential



Technical Potential:

This refers to the potential that could be attained if all technically feasible sustainable energy measures were implemented immediately regardless of cost-effectiveness. Technical potential is therefore considered as an upper boundary of what can be attained. The critical dynamic is that, over time, those measures that may not be presently cost-effective can pass to that threshold at some time in the future. So, it's important not to immediately discount these measures.

Economic potential:

This refers to the potential that could be attained if all the technically feasible sustainable energy measures that pass a societal economic test are adopted. From a municipal perspective, the decision of what to invest in should be determined from a societal lens, taking into account the full valuation of societal benefits and costs.

There are typically a variety of economic tests employed by government and utilities, most commonly, to assess the feasibility of demand-side management (DSM) programs and measures. At the most elemental level, the economic cost of delivering the sustainable energy performance, typically measured on a unit of energy basis, should be less than the marginal cost of the energy supply that is being displaced or deferred. As noted in section 2, the preferred method is to employ a life cycle analysis technique in order to fully capture the benefits and costs stream over the useful life of the measures. One of the most common economic tests is the Total Resource Cost (TRC) test, which is a societal measure of the net costs and benefits of a measure over its useful life. The TRC test is the most common test required by utility regulators in North America.

Achievable potential (also often referred to as the market potential):

This is a measure of how a target market responds to one or more market interventions designed to expand and accelerate market take-up of sustainable energy measures. The rationale for market interventions is to address one or more barriers and failures which impede market take-up of these measures to the level of what is economically viable, today and in the future, when market circumstances are expected to change. As shown in Exhibit 6.2, achievable potential is usually the smallest subset of overall potential, shown here to be represented as technical potential. From this perspective, municipalities should aim for an outcome in which as much of the technical potential as possible is achieved over time as based on the actual take-up of economic sustainable energy solutions in targeted markets.

All three of these perspectives are calculated as the difference between a reference case scenario of future energy demand and the energy demand following the modeling of the sustainable energy measures scenario.

6.3 WHAT SOME STUDIES TELL US ABOUT POTENTIAL

When we consider the “menu” of economic sustainable energy options, energy efficiency and DSM often comes to the forefront as a least cost solution. This sub-section is designed to dispel the notion that all cost-effective energy efficiency opportunities have been implemented; that there is little left to do that’s cost-effective for municipalities.

As a point of reference, in the past 3-5 years or so, utilities and governments in most parts of the country have commissioned comprehensive demand-side management (DSM) studies to assess the remaining potential in all sectors in their service territories. The output from these studies has driven the design of millions of dollars of DSM programs and, therefore, is a helpful source to reinforce the view that considerable economic potential for energy efficiency remains. The following examples have been gleaned from some of these studies with a focus on the economic potential in the commercial/institutional sector facilities.

- In Canada one of the key state-of-the-art analyses of DSM potential was recently completed by B.C. Hydro and is referred to as the "Conservation Potential Review" (CPR).[193] This study identified an electricity savings economic potential in the commercial/institutional sector of 28% relative to projected "reference case" electricity use in 2026 (a 20 year study time horizon).
- A recent study undertaken for Newfoundland and Labrador Power and Newfoundland Hydro generated an electricity savings economic potential estimate of 31% in the commercial/institutional sector by 2026.
- A study undertaken for Enbridge Gas Distribution Ltd generated a natural gas savings economic potential estimate of 14% in the commercial/institutional sector by 2014.

6.4 CHALLENGES IN ASSESSING SUSTAINABLE ENERGY POTENTIAL

As documented in this report, there are many best practice examples of sustainable energy projects in Canadian municipalities. Nevertheless, municipal investments in sustainable energy are sub-optimal, for a variety of reasons, some which are documented in section 2. With very few exceptions, municipalities use conventional calculation techniques to do the business case assessment for these projects and the valuation methods do not estimate the non-energy financial benefits stream. The challenges to municipalities moving forward, from a financial perspective, will be:

- Properly making and selling the case using full valuation,
- Access to internal budgets for capital and operating measures,
- Time and resources to investigate and possibly develop innovative financing approaches by which funds could flow to sustainable energy projects over the long-term and
- Overall, establishing the operating conditions whereby transactions costs of development and delivery can be reduced to make sustainable energy projects and programs attractive for investment.

[193] Marbek Resource Consultants, *BC Hydro 2007 Conservation Potential Review – Summary Report*, November 20, 2007, prepared for BC Hydro. (http://www.bchydro.com/rx_files/info/info54519.pdf - date accessed: April 2008). The objective of the CPR 2007 was to assess the potential energy and capacity savings over the next 20 years with an in-depth analysis of where, when, how and, at what cost these savings could be achieved. The analysis examined the potential impact of: changes in existing and emerging technologies, changes to operations and maintenance, changes in behavioural activities, changes in lifestyle, adopting renewable energy sources on the customer side of the meter and changes in fuel choice.

7. MOVING FORWARD

This section addresses the issue of "setting the bar for the future" by identifying current and possible future trends in the sector, and by outlining opportunities and threats to municipalities arising from these trends.

7.1 SUSTAINABLE ENERGY: TRENDS, OPPORTUNITIES AND THREATS

7.1.1 Summary of Trends

Trends have been identified throughout this report and will not be repeated in detail here. However, to provide context for the next section on opportunities and threats relating to municipalities moving forward, the following key trends are highlighted because of their particular significance.

- **Perfect Storm Conditions**: There has never been a better time to design and bring sustainable energy solutions to municipalities as we are in the midst of what can be construed as "perfect storm" conditions in which three particularly critical vectors have come into alignment.

  Corporate, institutional and public concern for action on the environment has never been higher, particularly for action on climate change. This concern is manifesting itself in many ways, all of which together contribute to a growing momentum to find and apply sustainable energy solutions. Governments and utilities offer today an array of financial and non-financial measures in support of sustainable energy solutions, some of which target municipalities directly and others which target the various constituencies of which a municipality is comprised.

  Oil prices continue to climb which brings energy use to the forefront of the public discourse and brings energy efficiency and other sustainable energy measures to the forefront of the discussion on solutions.

  Economic forces bring a third dimension to these conditions. On the one hand, the oil and commodity "boom" in provinces such as Alberta has fostered considerable population and economic growth in municipalities which, in turn, has generated increasing demand for energy services. On the other hand, in provinces such as Ontario and New Brunswick, the manufacturing and other key industry sectors are under growing threat from rising energy costs and the emergent strength of the Canadian dollar relative to the U.S. dollar. Municipalities in these provinces may necessarily approach sustainable energy solutions from the standpoint of economic survival. In short, the demand for sustainable energy solutions is expected to grow.

- **Small and Rural Communities Being Left Behind**: A plethora of best practice examples of sustainable energy applications have been documented in this report. They exhibit innovation, perseverance and dedication to achieving results. However, many of these best practice examples are being advanced by larger, urban municipalities. These solutions are not getting much uptake in the smaller, urban

municipalities. This is a trend that may continue in the short- to medium- term unless additional resources can be identified to help the smaller communities.

- **Cost squeeze and political inertia**: The scope and pace by which sustainable energy solutions can be implemented in municipalities will continue to be impeded by the combined forces of fiscal squeezes and political inertia. These issues have been elaborated in section 2 and repeated below in Exhibit 7.1. Provincial governments are transferring greater responsibilities to municipalities, but increased financial transfers do not often accompany these responsibilities. At the same time, there continues to be a lack of political will to implement the appropriate policies and actions in order to encourage and advance sustainable energy practices in municipal operations and the community. This is a trend that is likely to continue in the short- to medium- term.

7.1.2 Opportunities and Threats

Several trends affecting energy sustainability in municipalities have been identified throughout this report and, therefore, are listed here again in Exhibit 7.1 from the standpoint of opportunities and threats to achieving sustainable energy solutions in municipalities. It is important to reiterate that this list of opportunities and threats does not encompass all of the issues which municipalities face today in achieving environmental sustainability.

Exhibit 7.1: Overview of Key Issues for Sustainable Community Development – Energy Sector

Issue	Sub-Issue	Threat	Oppor-tunity
Cross-cutting			
Energy costs	Rising energy costs affect the costs of running municipal operations and affect the municipal economy. Investments in energy efficiency and alternatives are also part of the "green economy". There is an opportunity to attract dynamic businesses and professionals and which can even lead to direct business spin-offs for municipalities.	X	X
Cost and revenue squeeze	Provincial governments are transferring greater responsibilities (e.g., for transit operations, social services, affordable housing, environmental planning, and infrastructure provision) to municipalities, but increased financial transfers do not often accompany these responsibilities.	X	
Infrastructure rehabilitation needs	Offers some opportunities relating to the development of sustainable energy solutions in municipalities, particularly when the infrastructure rehabilitation opportunities occur in: i) urban core areas where roads and pipe upgrades require massive excavations and ii) where large brown-field tracts of land are considered for redevelopment.	X	X
Growing government and utility support	A tremendous and immediate opportunity for municipalities to leverage investments in sustainable energy projects via a plethora of government and utility programs.		X
Green Demographics	"Early adopters" can uncover the latent demand for the introduction of energy sustainability initiatives. Municipalities can then use this market shift to their advantage in order to advance energy sustainability solutions on a larger scale.		X
Municipal planning-governance-management for energy sustainability			

Issue	Sub-Issue	Threat	Oppor-tunity
Municipal powers and governance	Municipalities cannot create sustainable communities without the coordinated assistance of upper levels of government. Furthermore, municipal revenue sources are limited.	X	
Absence of enforceable national level sustainability standards and requirements for municipal top level plans.	Requirements for top level plans fall under provincial jurisdiction but vary significantly according to province. This makes it very difficult to characterize and target best practice to support energy sustainability in top level plans.	X	
Lack of political will	Lack of political will to implement the appropriate policies and actions in order to encourage and advance sustainable energy practices in municipal operations and the community.	X	
Valuation approaches	The business case for sustainable energy is undermined by two key factors: incomplete valuation of financial benefits; and outmoded methods and tools to conduct business case analysis (simple payback vs. life cycle costing).	X	X
Municipal jurisdiction to set energy performance standards	The scope for legally-binding municipal influence over building energy efficiency is for practical purposes quite limited in most jurisdictions.	X	
Transaction costs	Significant transaction costs for developers trying to implement energy sustainability projects because municipal and utility planning and permitting processes do not keep up with technological innovations. Furthermore, it is difficult for building inspectors to determine whether a proposed innovation provides protection to the public equivalent to that of prescriptive code requirements due to lack of information/education.	X	
Operational practices and technologies			
Siting large and small scale wind power developments	Lack of municipal permitting processes, approvals processes and zoning bylaws geared to wind development. Real and perceived issues relating to noise and setbacks.	X	
LEED certification and standards	Municipal opportunity to utilize an existing performance standard that is recognized as a legitimate standard in North America and one that is supported by program executors in both Canada and the states.		X

7.1.3 Preparing for Trends and Dealing with Opportunities and Threats

This section addresses the question of how municipalities can start to prepare for the anticipated trends, threats and opportunities, many of which have been documented in the preceding sub-sections. Given the unique circumstances of municipalities in Canada and the complexities associated with these issues, it would be a gross simplification to assume there is a clear and simple "magic bullet" path forward. It's going to be challenging.

It's beyond the scope of this assignment to provide a detailed "hand-book" for implementing municipal sustainable energy solutions. Rather, there are some high-level strategies that need to be employed which are briefly discussed below.[194] These strategies

[194] It is important to note that the strategies discussed draw from existing government and utility resources and documents. Organizations such as the Natural Resources Canada, including the Office of Energy Efficiency; the

place considerable emphasis on management best practices and on people. Sustainable energy will not be attainable unless organizational and human resource capacity building is considered as a priority solution.

- **Political and Municipal Corporate Commitment/Leadership**

The convergence of environment, energy and economic issues as described in this report represents a real and on-going threat to municipalities. It is often common to respond to short-term threats with short-term, one-off solutions. The political and corporate leadership in municipalities need to see beyond the immediate term and make a long-term commitment to energy sustainability in their operations and, eventually to seek energy sustainability in the community as a whole. The city of Guelph stands out as a leader in this regard.

Political and municipal corporate commitment means "getting in and staying in the game" for the long-term. It means treating the management of energy as a strategic business issue versus a purely or a predominantly operational issue. It means a commitment to continuous improvement and quality management.

Political and municipal corporate commitment is also manifested by: i) organizational and financial support for adoption of technical and management best practices and ii) support for dedicated staff and related competency development, to ensure a foundation for sustained energy performance improvements.

- **Planning and Organizational Accountability**

Achieving political and corporate commitment is, of course, just the first step towards implementing sustainable energy solutions in municipal operations. Sustainable energy management needs to be integrated with both short-term operational planning and long-term strategic planning that takes an integrated approach across departments and responsibility centres. It's also important to remember that energy sustainability solutions going forward need to necessarily link to solutions being considered to address the transportation and other dimensions of sustainability in municipalities.

The responsibility for managing energy use and costs must be formalized as part of the organization's management structure. This is done by assigning accountabilities and authorities to specific individuals within the facilities and measuring their personal performance against improvement goals.

- **Work Together to Build Economies of Scale**

At the outset, both smaller and rural municipalities are constrained from implementing elaborate planning and programs. One means of addressing this challenge is to have municipalities work together to build the economies of scale needed to support

U.S. Department of Energy and the U.S. Environmental Protection Agency offer a large and useful inventory of documents, tools and capacity building support.

sustainable energy planning and solutions. For example, community energy plans can be developed at the scale of regional municipalities. Municipalities can cost share projects that offer shared benefits (e.g., design and implementation of energy management information system).

- **Introduce Quality Management Procedures and Practices**

Municipalities can draw from existing resources to introduce best practices and procedures that reflect the "Plan-Do-Check-Act" framework found in existing international and national management systems for quality and environmental management (ISO 9001: 2000 and ISO 14001: 2004 systems) and more recently designed for energy management through the American ANSI/MSE 2000: 05, the "Management System for Energy". Exhibit 7.2 illustrates how a management system for energy necessarily comprises both managerial and technical elements.

Exhibit 7.2: Graphic Illustration of the Four Main Elements of the Energy Management Standard

The U.S. Energy Star program further elaborates how a management system for energy can translate into the fundamental elements of an energy sustainability program. The schematic depicts a closed loop construct whereby a municipality makes a commitment to implement energy management plans and actions, sets goals to drive the action plan with which performance improvements can be attained, monitors effectiveness, and feeds this back into the target setting and action plan process.[195]

[195] This is just one such depiction. There are others which convey the same concept, including the Canadian Dollars to $ense program, ANSI and programs in the U.K.

The Energy Star program has developed several sector specific guidebooks that lay out clear pathways for the development and implementation of sustainable energy programs.[196] Under the headings of "Plan, Do, Check and Act", these guidebooks are written to enable organizations in all circumstances (i.e., those who are advanced versus those who are just starting out) to use them. Fundamentally, this approach serves as a platform from which customized versions for Canadian municipalities can be considered. More specifically, these resources help organizations to[197]:

- Benchmark and track monthly and annual energy use;
- Identify and prioritize energy operations and issues that can increase efficiency;
- Identify energy efficiency objectives and targets;
- Define the performance indicator(s) to use to measure progress towards your energy targets;
- Establish energy management programs (i.e., action plans to meet goals);
- Monitor and measure the performance of established target(s);
- Document and communicate success; and
- Review progress periodically and making adjustments as necessary.

[196] Natural Resources Canada also offers organizations proven energy management tools and strategies to help measure current energy performance, set goals, track savings, and reward improvements.

[197] US Environmental Protection Agency, *Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities*, January 2008 (http://www.epa.gov/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf - date accessed: April 2008)

Exhibit 7.3: Fundamental Elements of the Energy Sustainability program

- **Leadership, Action and Winners**

The planning and organizational design/management dimensions identified above need not offset the benefits of taking immediate action. Using the old adage that "success breed's success", there are a number of areas where municipalities can begin to play a leadership role:

i) identify and implement projects that meet the municipality's hurdle rates, using lifecycle costing and corporate valuation measures that fully capture the benefits stream from these investments;

ii) introduce sustainable energy procurement policies and procedures;

iii) establish minimum energy performance targets for all new municipal facilities;

iv) for major greenfield or brownfield projects, including infrastructure rehabilitation, develop sustainable energy plans and work with the development community to design and implement projects that capture significant sustainable energy attributes.

7.2 OPPORTUNITIES AND PRIORITIES

The opportunities and priorities for municipalities to advance sustainable energy, as discussed below, are a matter of degree rather than anything that can be construed as radical changes in course. Given the current circumstances and best practices documented in this report, it's proposed that the opportunity areas be grouped into four categories focusing on:

- Baseline practices
- Capacity building
- Sustainable energy project priorities and opportunities
- Sustainable energy programs.

7.2.1 Baseline Practices

Certain key "baseline" practices and systems will support the adoption of management and technical best practices, improve the business case for sustainable energy and provide the metrics to help support decision-making and planning for adoption of sustainable energy solutions. Among other things, the business case for sustainable energy applications is being undermined by the lack of a robust evidence inventory of program and project performance. In the absence of performance data, it is very difficult to measure project and performance effectiveness.

The following baseline practices need to be considered by municipalities as priority baseline practices.

Energy Management Information Systems

The Natural Resources Canada (NRCan) handbook on Energy Management Information Systems (EMIS) states that the principal objective of an EMIS is "to support an organization's energy management program".[198] The successful development or enhancement of an EMIS is an important baseline practice for municipalities. An EMIS comprises three main components:

- meters/hardware/software,
- human resources at multiple levels of the organization and
- systems (information processing, analysis, reporting, communication).

[198] James Hooke, Byron Landry, and David Hart, *Energy Management Information Systems: Achieving Improved Energy Efficiency – A handbook for managers, engineers and operational staff*, published by the Office of Energy Efficiency of Natural Resources Canada (http://oee.nrcan.gc.ca/publications/industrial/EMIS/index.cfm?attr=24 – date accessed: June 2008).

Measurement and Verification (M&V)

The adoption of performance Measurement and Verification (M&V) is also an important baseline practice. Measurement refers to measuring energy savings while verification refers to a confirmation of the installation and operation conditions of a given project (i.e., were the planned measures installed?). In the absence of proper M&V, municipalities can't truly assess the performance of either capital or operational performance improvements.

The International Performance Measurement and Verification Protocol (IPMVP) is the internationally recognized savings verification tool to quantify energy and water savings with principles that are applicable to municipal facilities. [199] The IPMVP provides standard (M&V) terminology and defines four M&V options.[200]

Energy Performance Benchmarking

The adoption of energy performance benchmarking is a third example of an important baseline practice. Energy performance benchmarking comprises analysis and reporting to foster continual energy performance improvements through comparison with relevant and achievable internal and external norms and standards. An energy benchmarking analysis generates two important perspectives: i) an overview of how well a particular municipal sector or sub-sector (e.g., wastewater treatment plants) is doing in managing energy performance and ii) it enables specific facility participants in a benchmarking exercise to compare the performance of their own operation with the overall industry metrics.

Energy performance benchmarking aligns well to emerging municipal efforts to benchmark service. For instance, the Ontario Municipal CAOs Benchmarking Initiative (OMBI) is a groundbreaking collaboration of 15 Ontario municipalities that represent 75% of the population of Ontario. Led by the Chief Administrative Officers (CAOs) and City Managers in each participating municipality, the OMBI goal is to foster a culture of service excellence in municipal government.[201]

Sustainable Energy Valuation

The adoption of appropriate sustainable energy valuation techniques and methods are important baseline practices. Effective valuation will determine the value of the following benefits streams: i) energy savings, ii) productivity improvements, iii) asset maintenance and extended longevity and iv) carbon credits. When calculation oversights

[199] Measurement refers to measuring energy savings issues while verification refers to a confirmation of the installation and operation conditions of a given project.

[200] EETD Newsletter, *IPMVP – from a DOE-funded Initiative to a Not-for-Profit Organization*, Spring 2002, p. 3 (http://eetdnews.lbl.gov/nl10/IPMVP.html - date accessed: June 2008). The IPMVP may also be used by facility operators to assess and improve facility performance.

[201] Ontario Centre for Municipal Best Practices, *What's New*, 2008 (http://www.amo.on.ca//AM/Template.cfm?Section=What_s_New5 – date accessed: April 2008).

are corrected, the payback on sustainable energy investments often improves significantly. Estimates indicate that including the quantifiable non-energy benefits can increase the overall value of the investment by a minimum of 30% and possibly as high as four times the value of the energy benefits alone.[202]

Sustainable energy valuation should include, but not be limited to, the use of life cycle costing techniques and methods to value non-energy savings benefits streams. This baseline practice aligns well to emerging provincial efforts to advance techniques and performance relating to environmentally sustainable asset management. As defined by the Ontario government, "asset management is an integrated approach involving planning, engineering and finance to effectively manage existing and new infrastructure in a sustainable manner to maximize benefits, reduce risk and provide satisfactory levels of service to the users in an energy efficient and environmentally responsible manner".[203]

7.2.2 Capacity Building

In the context of this report, capacity building refers to training, awareness and other activities designed to develop and strengthen sustainable energy technical and management competencies. The best practice evidence shows that the leading municipal programs, including those targeted to both municipal facilities only and to the community as a whole, embody many best practice elements of capacity building. However, this is more the exception than the norm. The long-run return on investment associated with sustainable energy capacity building is considerable. Therefore, municipalities should implement and sustain capacity building to help create the conditions under which advanced performance solutions will be implemented and performance improvements sustained over the long term.

Two of the ways by which municipalities can foster the adoption of management best practices are to:

- Commit to an energy management organizational needs assessment that can be factored into the cost of every municipal project. This would be a way of introducing a systematic approach to ensure and assess the degree to which the municipality has introduced and is using the planning approaches and management tools elaborated in sections 3 and 4 of this document.

- Develop customized training that addresses corporate management best practices needs and gaps in the municipality, as determined from the organizational needs assessment.

[202] Marbek Resource Consultants, *Framework for Quantifying Non-Energy Benefits of Industrial Energy Efficiency Projects*, for the Office of Energy Efficiency, May 2006, p.5.

[203] Ontario Ministry of Public Infrastructure Renewal

Two areas of possible focus on capacity building are presented here.

- **Making and selling a business case for a sustainable energy investment**

One area where capacity building can pay off relates to the function of making and selling a business case for a sustainable energy investment. Taking into account that issues of valuation will be addressed eventually, capacity in this area could be developed through identifying appropriate decision analysis support tools and training staff on their use.

One of these tools, for example, which is gaining widespread international adoption, is the RETScreen Clean Energy Project Analysis Software. RETScreen is a unique decision support tool managed under the leadership and ongoing financial support of Natural Resources Canada's CANMET Energy Technology Centre – Varennes.[204] In RETScreen Version 4, the software's capabilities have been expanded from renewable energy, cogeneration and district energy, to include a full array of financially viable clean power, heating and cooling technologies and energy efficiency measures. Another useful tool is the Energy Star "Portfolio Manager", which is an interactive energy management tool that can be used to track and assess energy and water consumption. Energy Star recently added wastewater and drinking water treatment facilities to the suite of facilities that can be assessed using this tool.[205]

- **Sustainable Energy Program Design**

Section 7.2.4 below introduces the concept of sustainable energy programs in municipalities. To sustain the performance of these programs, municipal capacity building should be focused on the key elements of programming which typically include:

- Program design
- Staffing and budget management
- Day to day program management - this will also address in-house versus outsourced delivery of programs
- Financial oversight
- Monitoring, tracking and reporting
- Quality control and verification
- Program implementation- will include approach to outreach, marketing, advertising; engagement of channel partners; use of installation and incentive mechanisms
- Program evaluation- approach and resources allocated
- Program adjustment and re-design-how monitoring, tracking and evaluation results incorporated into program re-design etc.

[204] Natural Resources Canada, RETScreen International (http://www.retscreen.net/ang/home.php - date accessed: June 2008).

[205] EPA will also be releasing a best practices guide that will provide examples of how energy-efficient technologies and practices can reduce energy use and save money.

7.2.3 Sustainable Energy Project Priorities

The profile of best practices elaborated in section 5 illustrates that there is a large array of system and component level applications to bring energy sustainability solutions to existing and new facilities and developments in municipalities. The purpose of this sub-section is to highlight some of the sustainable energy project types which could be considered by municipalities interested in leading edge technologies and practices.

Exhibit 7.4 lists recommended project priorities and briefly discusses the application and implications.

Exhibit 7.4: Sustainable Energy Project Priorities

Project Category	Application and Impact
Performance requirements and measurement	Municipalities could consider a societal economic test, to determine the viability of a project. Municipalities could also consider projects that include a measurement and verification plan in the project scope and cost.
Sustainable Neighbourhoods and Communities	Municipalities could consider projects that bring sustainable energy solutions to the development of new communities. This can encompass both greenfield and brownfield developments.
District energy/integrated energy systems.	Municipalities could consider projects that foster, within the structure of integrated energy systems: • Use of waste energy • Use of waste biomass • Use of other clean/renewable energy sources • Build in the potential for scalability to allow for expansion to service other facilities in the future • Advanced system configurations, such as trigeneration systems • Support performance verification and measurement tools to help document the performance of these applications
Renewable Energy Applications	Municipalities could implement RET applications at three levels: i) facilities, ii) groups of facilities and iii) community. One of the key areas of priority is projects with practices and procedures designed to eliminate or reduce the transaction costs of RET development (e.g., municipal approvals for siting wind energy systems).
New Construction (all facilities)	Focus on building projects where the whole building energy performance is deemed to be "best practice", to be updated on an ongoing basis.
Existing Water-Wastewater Treatment	Focus on energy performance improvement in: • Water treatment • Primary wastewater treatment • Secondary wastewater treatment • End-use performance improvement • Management best practices (e.g., active pressure management or active leakage control)
Existing building facilities	Focus on building projects where the deemed energy performance is determined to be "best practice", to be updated on an ongoing basis.

7.2.4 Programs

A municipal focus on sustainable energy programs would address the reality that "change management" has to occur to sustain a pathway that will lead to sustainable energy in Canadian municipalities. As opposed to a project, a program is a means of bringing solutions to a target marketplace over a period of time necessary to sustain change.

In the final analysis, municipalities are seeking to foster some form of market transformation. A market transformation program is one that is specifically designed and fielded for the purpose of changing the way a market operates so that energy savings are achieved at a market level (e.g., within municipal facilities; commercial buildings, multi-unit residential buildings). These efforts are designed to increase the adoption of energy efficient products, services, or practice and are causally related to market interventions. Much of the experience of market transformation programs has centred on efforts to transform markets associated with specific products (e.g., lighting, cooling and heating systems). More recently the market transformation programs have begun to focus on affecting the way that transactions occur between buyers and sellers of energy management services (e.g., application of performance contracting).

Through the lens of market transformation, sustainable energy programs become the vehicle by which municipalities can begin to foster change in the sectors that extend beyond the jurisdiction of their own facilities. As noted in sub-section 7.2.2, a concerted capacity building effort focused on program development and implementation is a necessary element in supporting sustainable energy programs.

APPENDIX A

List of Contacts

Contact List

Name	Position & Organisation	Location & Contact Info	Related Websites
Study Contact			
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Jesse Row	Director, Sustainable Communities Group, Pembina Institute	jesser@pembina.org 403-269-3344 x110	http://www.pembina.org/
Harry P. Cleghorn	President, Cleghorn & Associates Ltd.	cleghorn@igs.net 613-384-0169	
Gay Drescher	Director of Development Services, Town of Rothesay	GayDrescher@rothesay.ca 506-848-6600	
Exemplary Community Profiles			
Dave Robertson	Operations Manager, Town of Okotoks	drobertson@okotoks.ca 403-938-8922	http://www.okotoks.ca/
Janet Laird	Director, Environmental Services, City of Guelph	janet.laird@guelph.ca 519-822-1260 x2237	http://guelph.ca/index.cfm
Jonathan Westeinde	Managing Partner, Windmill Development Group	jonathan@windmilldevelopments.com 613-820-5600 x158	http://www.windmilldevelopments.com/index.html
Lynn Strathdee	Development Coordinator, City of Victoria	lstrathdee@victoria.ca 250-361-0536	http://www.victoria.ca/cityhall/currentprojects_dockside.shtml?zoom_highlight=Dockside+Green
Mark Henry	Energy Coordinator, Engineering Division, City of Yellowknife	mhenry@yellowknife.ca 867-920-5697	http://www.yellowknife.ca/home.html
Richard Morris	Manager, Energy Efficiency Office, City of Toronto	rmorris@city.toronto.on.ca 416-392-1452	http://www.toronto.ca/bbp/index.htm
Richard Quayle	Municipal Manager, Town of Okotoks	municipalmanager@okotoks.ca 403-938-8902	http://www.okotoks.ca/
Steve Hanhart	Community Planner, Town of Okotoks	shanhart@okotoks.ca 403-938-8903	http://www.okotoks.ca/

APPENDIX B

Resources

(Sustainable) Energy Resources:

Arctic Energy Alliance
http://www.aea.nt.ca/

Canada Green Building Council
http://www.cagbc.org/

Canada Mortgage and Housing Corporation – Research Highlights
http://www.cmhc-schl.gc.ca/en/inpr/rehi/index.cfm

Canada Mortgage and Housing Corporation – Sustainability
http://www.cmhc-schl.gc.ca/en/inpr/su/

Canadian District Energy Association
http://www.cdea.ca/

Canadian Energy Efficiency Centre
http://www.energyefficiency.org/

Canadian Renewable Energy Alliance
http://www.canrea.ca/

Canadian Urban Institute
http://www.canurb.com/home.php

Canadian Wind Energy Association
http://www.canwea.ca/

Centre for Energy
http://www.centreforenergy.com/ET.asp

Cities^{PLUS}
http://www.citiesplus.ca/index.html

COGENCanada CHP Association
http://www.cogencanada.org/index.htm

Community Energy Association (British Columbia)
http://www.communityenergy.bc.ca/

Community Research Connections, Sustainable Community Development – Case Studies
http://www.crcresearch.org/casestudies/home

Energie-Cites EU
http://www.energie-cites.org/news5.html

FCM-CH2M HILL Sustainable Community Awards Best Practice Guides
http://gmf.fcm.ca/FCM-CH2M-Awards/

Federation of Canadian Municipalities-Green Municipal Fund
http://gmf.fcm.ca/Home/

Federation of Canadian Municipalities– InfraGuide
http://gmf.fcm.ca/Infraguide/

Federation of Canadian Municipalities– Partners for Climate Protection
http://gmf.fcm.ca/Partners-for-Climate-Protection/

Green Building Finance Consortium
http://www.greenbuildingfc.com/Home/IndustryResources.aspx

International Council for Local Environmental Initiatives (ICLEI)
http://www.iclei.org/

Local Renewable Initiatives
http://www.iclei-europe.org/index.php?id=3506

National Association of Energy Service Companies
http://www.naesco.org/

Ontario Centre for Municipal Best Practices
http://www.amo.on.ca/ocmbp

Ontario Power Authority
http://www.powerauthority.on.ca/

Recycled Energy Development
http://www.recycled-energy.com/

Smart Growth Canada
http://www.smartgrowth.ca/

Smart Growth Canada Network – Community Energy Planning
http://www.smartgrowth.ca/cep_e.html

Sustainable Cities: PLUS Network
http://www.plusnetwork.icsc.ca/index.php

Urban Land Institute
http://www.uli.org//AM/Template.cfm?Section=Home

US Department of Energy, Energy Efficiency and Renewable Energy – Building Energy Software Tools Directory
http://www.eere.energy.gov/buildings/tools_directory/

West Coast Environmental Law, Smart Bylaws Guide
http://www.wcel.org/issues/urban/sbg/

World Alliance for Decentralized Energy
http://www.localpower.org/

Sustainable (Energy) Planning – Canadian Examples:

Calgary Climate Change Action Plan Target ↓50
http://www.calgary.ca/docgallery/bu/environmental_management/climate_change_program/target_50_climate_change_action_plan.pdf

City of Guelph, Community Energy Plan
http://www.guelph.ca/living.cfm?smocid=2127; http://guelph.ca/uploads/ET_Group/admin/CEP_report_web.pdf

City of London, Official Plan
http://www.london.ca/Official_Plan/table-of-contents.htm

City of North Vancouver – Lonsdale Energy Corporation
http://www.gvrd.bc.ca/sustainability/casestudies/Lonsdaleenergy.htm

City of St. John's, Community Objective
http://www.stjohns.ca/cityservices/planning/pdfs/communityobjective.pdf

City of St. John's, Local Action Plan
http://www.stjohns.ca/cityservices/environment/pdfs/Climate%20Change%20Plan.pdf

City of Surrey, Official Community Plan
http://www.surrey.ca/Doing+Business/Land+Development+and+Building/Plans+and+Policies/Official+Community+Plan/default.htm

City of Vancouver – EcoDensity Planning Initiative
http://www.vancouver-ecodensity.ca/index.php

City of Vancouver – Southeast False Creek
http://vancouver.ca/commsvcs/southeast/index.htm

City of Victoria – Dockside Green
http://www.victoria.ca/cityhall/currentprojects_dockside.shtml

City of Yellowknife, Community Energy Plan
http://www.yellowknife.ca/__shared/assets/Yellowknife_Community_Energy_Plan_20063640.pdf

City of Yellowknife, CEP Implementation Strategy
http://www.yellowknife.ca/__shared/assets/CEP_Implementation_Plan_April_20075539.pdf

District Municipality of Ucluelet, Official Community Plan
http://www.ucluelet.ca/District/communityPlan.php

District of Squamish, Energy Pathways
http://www.district.squamish.bc.ca/cityhall/departments/energy_pathways.aspx

Halifax Regional Municipality, Climate SMART
http://www.halifax.ca/Climate/index.html

imagineCALGARY
http://www.imaginecalgary.ca/

Markham Centre
www.markhamcentre.com/

Metro Vancouver – GVRD 100 year plan
http://www.citiesplus.ca/cdsubmission/content_main/a1_full.htm

Metro Vancouver – Livable Region Strategic Plan
http://www.gvrd.bc.ca/growth/lrsp.htm

Town of Okotoks – Drake Landing
http://www.okotoks.ca/sustainable/Energy/perspective.asp; http://www.dlsc.ca/

Whistler 2020
http://www.whistler.ca/content/view/154/203/;
http://www.whistler2020.ca/whistler/site/homepage.acds?instanceid=1930792&context=1930501

Sustainable Energy Programs:

BC Hydro – Power Smart Program
http://www.bchydro.com/business/

City of Dawson Creek – Sustainable Dawson Creek
http://www.planningforpeople.ca/index.asp

City of Edmonton, Home $avers Program
http://www.co2re.ca/publications/

City of Ottawa, EnviroCentre
http://www.envirocentre.ca/english/home.html

City of Port Coquitlam, Sustainability Checklist
http://www.city.port-coquitlam.bc.ca/__shared/assets/Sustainability_Checklist2040.pdf

City of Toronto – Better Buildings Partnership
http://www.toronto.ca/bbp/index.htm

City of Toronto, Energy Efficiency Office
http://www.toronto.ca/energy/programs.htm

City of Toronto, Toronto Atmospheric Fund
http://www.toronto.ca/taf/

City of Vernon, Smart Growth Checklist
http://www.vernon.ca/services/pde/documents/smart_growth_development_checklist.pdf

Energy Star for Local Government
http://www.energystar.gov/index.cfm?c=government.bus_government_local

Metro Vancouver – BuildSmart Program
http://www.gvrd.bc.ca/BUILDSMART/

Metro Vancouver – SmartSteps Program
http://www.gvrd.bc.ca/smartsteps/

Ontario, Ministry of Energy, Community Conservation Initiatives Program
http://www.energy.gov.on.ca/index.cfm?fuseaction=conservation.community

Town of Craik, Craik Sustainable Living Project
http://www.econet.sk.ca/sk_enviro_champions/craik.html; http://www.craikecovillage.ca/

Town of Markham, Performance Measures
http://www.markham.ca/markham/aspc/markhamcentre/AboutMarkham_Site/perform.asp

Federal/Provincial Funding Opportunities:

Federation of Canadian Municipalities, Green Municipal Fund
http://gmf.fcm.ca/Home/

Infrastructure Canada
http://www.infrastructure.gc.ca/ip-pi/index_e.shtml

Legislation of note (with regards to energy planning):

British Columbia – Community Charter
http://www.qp.gov.bc.ca/statreg/stat/C/03026_00.htm

Ontario, Provincial Policy Statement 2005
http://www.mah.gov.on.ca/Page1485.aspx

Town of East Gwillimbury – Planning Report - Energy Star Municipal Policy
http://www.eastgwillimbury.ca/Environment/Thinking_Green_Initiatives/Energy_Star_.htm

Related Studies and Reports:

Alex Lantsberg, *Sustainable Urban Energy Planning: A Roadmap for Research and Funding*, prepared for the California Energy Commission Public Interest Energy Research Program, June 2005.

Amory Lovins, *Soft Energy Paths: Towards a Durable Peace*, Friends of the Earth International, 1977.

Arctic Energy Alliance, *Community Energy Planning: A Guide for Northern Communities*.
http://www.aea.nt.ca/files/COMMUNITY%20ENERGY%20PLANNING/Guide_NorthernComm.pdf

Arctic Energy Alliance, *Community Energy Planning Toolkit*, November 2006.
Available to download from AEA website (http://www.aea.nt.ca/library.aspx).

Association of Municipalities of Ontario, *Municipal Energy Conservation Template*, June 2007.
http://www.amo.on.ca/AM/Template.cfm?Section=Aerts_and_FYIs&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=148922

Canadian District Energy Association, Canadian Urban Institute, Toronto Atmospheric Fund, supported by Infrastructure Canada, principal authors Brent Gilmour and John Warren (Canadian Urban Institute), *The New District Energy: Building Blocks for Sustainable Community Development*, on-line handbook, January 2008.
http://cdea.ca/resources/UES%20Handbook%20Final%2021-01-08.pdf/view

CGA in conjunction with CaGBC, CEA, CEEA and Pollution Probe, *Integrated Energy Systems in Canadian Communities: A Consensus for Urban Action*, report produced from the results of the Quality Urban Energy Systems of Tomorrow - QUEST - workshop, March 2008.
http://www.cga.ca/publications/documents/QuestWhitePaperEnglish-Final.pdf

Fraser Basin Council and Community Energy Association, *Energy Efficiency and Buildings: A Resource for BC's Local Governments*, prepared for the Community Action on Energy and Emissions (CAEE) initiative, 2007.
http://www.fraserbasin.bc.ca/publications/documents/caee_manual_2007.pdf

Ken Church, Natural Resources Canada, Canmet Energy Technology Centre, *Community Energy Planning – 2007*, 2007. http://www.sbc.nrcan.gc.ca/documentation/communities/Community%20Energy%20Planning%202007.pdf

National Round Table on the Environment and Economy, *Getting to 2050: Canada's Transition to a Low-emission Future*, January 2008.

Saskatchewan Energy Management Task Forces, *Technical Guide: A Guide for the Selection of Energy Efficient Technologies*.
http://www.emtfsask.ca/pdfs/gdenefftech.pdf

US EPA and Global Environment & Technology Foundation, *Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities*, January 2008.
http://www.epa.gov/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf

APPENDIX C

Exemplary Community Profiles

Profiles of some leading communities

Although many communities have adopted sustainable energy objectives, leading examples of successful approaches at the planning level include: Guelph, Yellowknife, and Okotoks. On a building or facility level, leading examples include Victoria's Dockside Green and Toronto's Better Buildings Partnership.

The practices of these communities, which are referred to throughout the main body of this report, are profiled in detail in Exhibits C1-C5.

Exhibit C1
Profile of Guelph, Community Energy Plan

Guelph, ON Exemplary Community Profile: Energy	
Overview of Why This Community is Exemplary	While still in very early stages of implementation, Guelph's Community Energy Plan (CEP) has aggressive targets, a broad scope, strong partnership arrangements, and practical support at the political level, as evidenced by Council directions to ensure engagement of City staff and timely reporting on progress.
General Community Description	• Type of municipality: Urban • Population: 114,943 Density: 1325.5 per km^2 Dynamics: Growing 8.3% (2001 to 2006) • Primary economic base: Mixed
Jurisdictional Issues/Context	• Municipalities in Ontario do not have jurisdiction to modify the Ontario Building Code, so cannot establish more stringent efficiency requirements than called for in the Code. • Guelph is considering implementing the 2012 Ontario building code prior to 2012, but in the absence of enforceable powers to do so, will likely need to use incentives. • Ontario's Places to Grow Act, through its focus on densification, is in sync with the vision and goals of the CEP.
Conditions and Challenges Relevant to Sustainable Energy	• The natural gas utility is privately owned and operated (Union Gas). • The electricity distribution system (Guelph Hydro Electric Systems Inc, GHESI) is municipally owned and operated. • GHESI can develop new businesses (separate from its electricity distribution business) for energy generation. For example, its company Ecotricity recovers gas from Eastview landfill to generate electricity. • GHESI, which has its own board of directors, is the main partner of the CEP and has been very supportive.
Vision, Scope, Objectives, and Anticipated Benefits of Plan/Approach - Community Energy Plan (CEP)	Vision "Guelph will create a healthy, reliable and sustainable energy future by continually increasing the effectiveness of how we use and manage our energy and water resources." [206] The driving force was/is the mayor, who initiated the process during her first term in office and continued to be involved as a community member in the Consortium following her election defeat. She was returned to office in the subsequent election, and remains a key proponent. There has also been consistent support for the CEP from Council, as well as from the Mayor who held office between terms of

[206] Garforth International llc, *City of Guelph Community Energy Plan*, prepared for Guelph Community Energy Plan Consortium, April 2007 (http://guelph.ca/uploads/ET_Group/admin/CEP_report_web.pdf - date accessed: April 2008).

the current Mayor.

Scope of Plan

- Addresses energy use not only in municipal buildings and services (transportation, water), but also City-wide.
- Addresses energy supply (including generation), including renewable energy and district energy systems.

Key Objectives[207]

While the City is projected to grow rapidly over next 25 years, the intention is to meet the increased energy demand via improved efficiency. Other goals include meeting one quarter of Guelph's total energy requirements with local renewable resources and using cogeneration for 30% of the city's electricity requirements. The CEP also aims to:

- Attract investment
- Provide a variety of reliable, competitive energy, water, and transport services
- Reduce energy use and GHG emissions below the global per capita average
- Ensure energy and water use per capita is below that of comparable Canadian cities

Some priorities are: energy and water efficiency for buildings, vehicles, and industry; use of heat from electricity generation and existing industrial processes; incorporation of renewable energy sources; teaming with existing electricity and gas networks to avoid wasteful duplication of assets.[208]

Relationship to Other Major Municipal Policies/Plans

"Essentially, the CEP forms the basis for land use planning and building design for the City".[209] The CEP is Council's top priority as identified in the new Strategic Plan, and since goal number 5 of the CEP directs that all publicly funded investments visibly contribute to CEP objectives and targets, it is now a significant driver of initiatives throughout the bureaucracy. Efforts to ensure integration between the CEP and the Official Community Plan (which is currently being updated) are also underway, to ensure that land use and community design approaches are oriented towards energy efficiency. Other key plans, including the Local Growth Management Strategy, and Guelph Hydro's Conservation and Demand Management Plan are also being aligned with the CEP.

Anticipated Outcomes

Guelph believes the CEP will contribute to a more sustainable future for the City via: improved energy efficiency, cost-savings, economic competitiveness (based on increased attractiveness for investment and services, and solutions that can be marketed beyond Guelph).[210] Greater energy security is also anticipated, with some independence from the provincial distribution system via CHP and district energy

[207] Garforth International llc, *City of Guelph Community Energy Plan*, prepared for Guelph Community Energy Plan Consortium, April 2007 (http://guelph.ca/uploads/ET_Group/admin/CEP_report_web.pdf - date accessed: April 2008).

[208] Ibid.

[209] City of Guelph, Environmental Services, *Community Energy Plan - Update Report to the Community*, November 2007 (http://guelph.ca/uploads/ET_Group/CEP/110907_Community%20Energy%20Plan%20–%20Update%20Report%20to%20the%20Community.pdf - date accessed: April 2008).

[210] Ibid

Guelph, ON Exemplary Community Profile: Energy	
	systems.
Defining Features and Key Operational Elements of Plan/Approach	• Development of the plan by a Consortium: City administration, academia, businesses, utilities, community groups. • Completion of a baseline study of energy use and associated emissions across the entire City. • Identified benefits to six stakeholder groups: residents, businesses, city administration, financial institutions and builders-developers.[211] • Aggressive and measurable goals. • An action-oriented plan with short-term "scale" projects to achieve immediate, meaningful progress. • A strongly engaged Council which directed that: "Six cross-departmental teams of staff be directed to work with our partners and other stakeholders to implement the directions provided in the Community Energy Plan, and undertake feasibility studies leading to action plans relating to scale projects, and to report back to Council and partner agencies during the third quarter of 2007."[212] • A modified municipal organizational structure to support implementation. • Use of public-private partnerships to finance and implement CEP plans and projects.
Implementation and Current Status	Status of implementation • A new entity, CEP Inc is being formed with representation from many of the original consortium participants. Numerous feasibility studies have been initiated in the areas of cogeneration, district energy systems, renewable energy, and high energy efficiency building standards. • University of Guelph is looking at cogeneration involving on-site use of the heat and sale of electricity back to the City. • The design of two proposed greenfield developments is being aligned with CEP goals in terms of overall plans and specific energy technologies (e.g. district energy and CHP systems are being considered). • The CEP is stimulating many project concepts beyond the original 6 scale projects. For example, a solar PV company is exploring construction of a solar power facility on municipal land, to sell power back to the grid. Steps taken to ensure any necessary behaviour-change/compliance • Guelph is reviewing the development approval process to consider tools/incentives to encourage/promote energy efficient growth. • Guelph has implemented awareness campaigns both internally and within the community, including rebate programs. For example, 15,000 home kits were distributed by Guelph Environmental Leadership, which included such features as low-flow showerheads, kitchen and bathroom aerators, pipe insulation, Teflon tape, energy efficient light bulbs, etc. This was funded through Union Gas and Guelph Hydro, while the kits were distributed by volunteers. • The City has established a real and virtual kiosk for educational purposes, where residents can compare their energy and water use against the city average. Costs of implementation • CEP development was $150,000 (not including staff time). Source(s) of funding

[211] City of Guelph, Environmental Services, *Community Energy Plan - Update Report to the Community*, November 2007 (http://guelph.ca/uploads/ET_Group/CEP/110907_Community%20Energy%20Plan%20–%20Update%20Report%20to%20the%20Community.pdf - date accessed: April 2008).

[212] Ward 2 Guelph, *Council Voting Record April 23, 2007* (http://ward2guelph.wordpress.com/2007/06/06/council-voting-record-april-23-2007/ - date accessed: June 2008).

Guelph, ON Exemplary Community Profile: Energy	
	• Half of the cost of CEP development was funded from FCM, half from the partners. • CEP Inc. is to be funded for the first few years by Guelph Hydro. <u>Steps to ensure long-term viability</u> • The Director of Environmental Services was directed to work with Guelph Hydro to develop a protocol for ensuring overall project coordination, reporting back to partners on progress, future partnership options, advocacy and engaging the community. • Efforts/process developed to ensure integration between CEP and other plans. • The CEP goals speak to everyone regardless of political orientation. For example, Goal #5 states that "All publicly funded investments will visibly contribute to meeting the four CEP goals" – By phrasing it as such, they have inherently ensured that all departments would be involved in implementing the CEP through any and all spending decisions made. • The Consortium has disbanded though some of the members will carry on working with CEP Inc., the new CEP entity, which includes the City Energy Manager position. • CEP Inc. - Guelph Hydro and the City worked together to develop the terms of reference for the new CEP Inc., which will be governed by a board of directors representing energy users and providers in the community, to run the CEP, market CEP to businesses, liaison between public/private sector investments and the City for potential CEP projects, and to measure and report on the status and results achieved by the CEP. Currently, a business plan is being developed for CEP Inc. • Guelph Hydro will be funding the first two to three years of CEP Inc. • The energy services entity will monitor and report on the GHG emissions, energy use, and potable water use. • Two new positions will ensure long term resourcing: 1. City Energy Conservation Project Manager 2. Position in Facilities Management Dept. to look specifically at energy use/reduction in municipal buildings. Furthermore, there will always be a budget allocation in the Planning Dept. for energy efficiency projects. • The City is currently considering implementing the Ontario 2012 building code prior to 2012. With no ability to enforce the code before 2012, it would likely be implemented on a voluntary basis with financial and expedited permit processing incentives. Similar programs are established in other municipalities.
Key Barriers and How They Were Addressed	• Part of the CEP initiative was to determine the baseline energy use data for the entire City, requiring a partnership/cooperation between the City and the utility companies (Union Gas and GHESI). There was concern regarding confidentiality of customer data, which caused delays in completing the baseline study. However, these concerns were addressed and the study was completed. • Current staff workload and complement do not provide adequate resources to proficiently implement the CEP.[213] • Maintaining proper resources and management to develop and implement the CEP was a challenge, especially with so many people, departments, and organizations involved. The hiring of a CEP Manager will address this challenge, as the manager will be responsible for developing an overall implementation plan, through all departments, and coordinating efforts to achieve it. • Another challenge was financing. As it was a community project (not a City Hall project), the development of the CEP was not included in the budget (a budget was only included when the completed CEP was passed by council). Because of this, cost-sharing issues had to be resolved between all parties involved.
Lessons Learned	• Even though the CEP was a community plan, it was essential to have both the City and the utilities on board. • Council must be on board because the CEP affects all departments. • Ensure there is an accountability mechanism, so that people and departments are held accountable when a poor "green" decision has

[213] City of Guelph, Environmental Services, *Community Energy Plan - Update Report to the Community*, November 2007 (http://guelph.ca/uploads/ET_Group/CEP/110907_Community%20Energy%20Plan%20–%20Update%20Report%20to%20the%20Community.pdf - date accessed: April 2008).

Guelph, ON Exemplary Community Profile: Energy	
	been made.
Moving Forward and Upcoming Trends	• There are currently approximately 30 projects on the go, which has far exceeded the initial 5 to 6 scale projects recommended in the CEP. • Further projects and plans include, for example, purchasing hybrid vehicles for the municipal fleet, using biodiesel in the fleet, purchasing clean/green power from Bullfrog Power, constructing cogeneration facilities, developing large areas of land (green, grey, and brownfields) according to CEP goals. • Concern is that more staff and financial resources will be required to properly implement the CEP and associated projects and to better coordinate between all the departments involved to drive the CEP forward. This should be addressed with the formation of CEP Inc. and new staff positions. • The City has changed the conditions of hiring and performance reviews to reflect their VIEW system (Values Integrity Excellence and Wellness). The CEP is indirectly linked to this as striving for excellence with respect to the City requires the inclusion of the CEP vision and goals. • The first anniversary of the CEP is coming up this year and they will run a campaign to increase stakeholder and public understanding of the goals and vision of the CEP as well as the implementation plans and projects. They will be performing a survey (to become annual to assess progress) of citizens regarding their knowledge and understanding of the CEP. The City uses an internal communications employee and external consultant for social marketing aspects of public engagement.
How Does Current Approach/Practice Differ from Previous (and/or from other municipalities)?	• The staff and council now have a basis for which to make "green" decisions. For example, previously, there would be much discussion over excess funding (additional $200,000 to $300,000) required to purchase biodiesel for the bus fleet. However, with the CEP in place, the decision is clear on whether or not Guelph should support green energy.

Exhibit C2
Profile of Yellowknife, Community Energy Plan

Yellowknife, NWT Exemplary Community Profile: Energy	
Overview of Why This Community is Exemplary	Yellowknife has quickly developed and embraced a Community Energy Plan and clearly defined an Implementation Strategy. They are involving various levels of government, stakeholders, and the general public to ensure an overall understanding and buy-in of the goals and vision of the plan. The City has ensured that the commitment to reducing energy consumption will move beyond municipal facilities to the other sectors by incorporating the CEP goals into regulations and bylaws.
General Community Description	• Type of municipality: Northern, Rural by Statistics Canada definition • Population: 18,700 Density: 177.7 per km^2 Dynamics: Growing 13.1% (2001 to 2006) • Primary economic base: Mining, Government
Jurisdictional Context	• Through the Northwest Territories Municipal Act, building energy standards can be controlled at a municipal level. • The Government of Northwest Territories (GNWT) is the biggest developer in the north. GNWT have adopted the Commercial Building Incentive Program (CBIP) for all of its new buildings in NWT, meaning that all new buildings must be 25% more efficient than the Model National Energy Code for Buildings (MNECB). • Through public consultation, the CBIP standard will be applied to all new buildings, public and private, in Yellowknife in 2009. • Currently, there are only voluntary energy standards in Yellowknife, such as EGH-80, for the residential sector. • In 2010, the EGH-80 standard will be mandatory for all new residential development.
Conditions and Challenges Relevant to Sustainable Energy	• Private electricity utility (Northland Utilities) and Crown corporation (NWT Power Corporation). • NWT Power Corporation runs hydroelectric generators (~95%)[214] and diesel-electric power backup (when there is low flow). • Burning heating oil for homes and buildings is a major contributor to overall GHG emissions for Yellowknife. • Space heating accounts for 70% of the energy profile and 80% of GHG emissions. For this reason, alternate sources of energy for space heating is of main concern, some possibilities include hydro and geothermal.
Vision, Scope, Objectives, and Anticipated Benefits of Plan/Approach	• Yellowknife joined PCP in 1997 (they have completed corporate and community milestones 3), which led to the CEP planning process. • A CEP Committee was created in 2005, resulting in the Community Energy Plan (CEP). • The CEP Committee vision is to "use an ongoing CEP process and consider economic, social and environmental costs and benefits, to strive to meet or exceed the standards of climate protection excellence, as set out by the FCM's Partners for Climate Protection Program."[215] • The members of the CEP Committee include representatives from public institutions (including the local and provincial government and school board), non-profit groups, businesses and industry, power utilities, and the general public. • There was pressure from community groups and the general public for Yellowknife to move toward a CEP. After which, a politician took up the cause. This lead to the creation of the CEP Committee, which developed the CEP. The CEP Committee has now evolved into the CEP Implementation Advisory Committee, as recommended within the CEP to ensure both its constant evolution and implementation.

[214] Yellowknife Community Energy Planning Committee, *Yellowknife Community Energy Plan*, July 2006 (http://www.yellowknife.ca/__shared/assets/Yellowknife_Community_Energy_Plan_20063640.pdf - date accessed: April 2008).
[215] Ibid.

Yellowknife, NWT Exemplary Community Profile: Energy	
	Scope and Key Objectives of Plan/Approach • The CEP targets to reduce corporate and community GHG emissions through a combination of reduced energy use, increased energy efficiency, and renewable energy. The plan covers: Long term planning; Building and fleet efficiency; Alternative fuels and renewable energy; Transportation; Green financing and public-private partnerships; and Community engagement. • The CEP was passed by Council, but it gave little indication of who would be responsible for implementation and how it would be carried out. This was left to Administration and the new position of Energy Coordinator. The new position had to be defined on the go and was continually evolving as to how and where the position would fit in to the whole picture. • The Administration unofficially tasked Public Works to develop the implementation strategy. Governance Platform to Drive the Plan • The CEP Implementation Strategy was developed by assigning each recommendation from the CEP to the appropriate City department. Each department then worked with the Energy Coordinator to develop a detailed implementation strategy for the recommendation, complete with tangible targets and timelines. Policy instruments, financial incentives and regulations are outlined in the CEP and the CEP Implementation Strategy.[216] • The newest council has also worked the CEP into their Strategic Objective. Cost and timeframe for development of strategy and plan • Funding for the CEP and the Implementation Strategy came from the Government of Canada, GNWT, the City of Yellowknife, and FCM GMF. • The total cost of developing the CEP was $220,000, half of which ($110,000) was from an FCM Grant. • This process took one year to complete. The subsequent implementation strategy took three months to complete. Relationship to Other Major Municipal Policies/Plans • CEP is tied into the Smart Growth Redevelopment Plan, as the Smart Growth Plan adopted the 21 sustainable planning principles that were defined in the CEP. Anticipated Outcomes • Implementation of the CEP should lead to municipal emissions reduction by 20% and energy use by 10%. • The completion of a municipal energy audit including cost benefit analysis.

[216] City of Yellowknife Administration, *Implementing Yellowknife's Community Energy Plan*, prepared for City Council, March 2007 (http://www.yellowknife.ca/__shared/assets/CEP_Implementation_Plan_April_20075539.pdf - date accessed: April 2008).

Yellowknife, NWT Exemplary Community Profile: Energy	
	• No quantitative analysis is done on environmental and social benefits.

Defining Features and Key Operational Elements of Plan/Approach	• Energy use and GHG emissions are considered in the City's decision-making process. Energy/emissions and LCC sections were added to Council Memoranda. Feedback thus far has indicated that the new sections are not always completed, therefore to follow up, feedback from CEP Implementation Advisory Committee will be required.
	• An essential component to a successful CEP and implementation is the inclusion of long and short term GHG reduction targets for both city operations and community.
	• Transparency and accountability has been well established, through for example, the public committee to advise and report.
	• Designated Energy Coordinator to work with all departments for integrated approach.
	• Leading by example in municipal operations via policies, programs and projects. For example, lifecycle costing for new buildings and fleet purchases; retrofits and use of renewable energy in municipal facilities; municipal fleet replacement with fuel efficient vehicles; driver training for efficient operation; and creation of an internal renewable energy and efficiency funding mechanism.
	• Measures to promote action in community-at-large: incorporation of Sustainable Energy Planning Guidelines in Planning and Development processes; by-law for new building energy standards for commercial, residential, and equipment; advocating with GNWT for green financing and alternative fuel availability; and measures to reduce heating oil use in residential sector.[217]
	• Partnerships/collaboration in developing and implementing plan:
	  • Committee members and/or CEP working group: Northland Utilities, NWT Power Corp, general public (including residents and businesses), school board, Ecology North, GNWT, Arctic Energy Alliance
	  • Funding: Government of Canada, City of Yellowknife, FCM GMF, GNWT
	  • CEP is based on 10 studies each performed by different private-sector consultants

Implementation and Current Status	Status of implementation • The CEP Implementation Strategy is still on target regarding the timeframe, 95% of listed items are moving ahead. • Report on implementing the CEP is going to council on March 4th, 2008. This will be a public document and used to apply for PCP milestone 4. • There are 32 sub-recommendations in the CEP. These are used as a benchmark to determine if the City has achieved what they set out to. • City is not currently measuring/analysing specific GHG and energy reductions, as most aspects of CEP are still in planning stages, including the energy audit. • Examples of specific projects: • Performing a heat recovery study for sewers. • Conducting a large geothermal feasibility study at a local mine that is closed. This would be used for a district heating system. The study costs $350,000 and is to determine how large the resource is and how to use it in existing and expanding communities for district heating. This Brownfield remediation/redevelopment would then influence urban design and community development. A closed mine usually means a dying community, however Yellowknife has expanded to other economies (ex. government of the North) and is still growing. • A complete energy profile (community and municipality) was carried out in 2004. There will be a follow up profile in 2010.

[217] Yellowknife Community Energy Planning Committee, *Yellowknife Community Energy Plan*, July 2006 (http://www.yellowknife.ca/__shared/assets/Yellowknife_Community_Energy_Plan_20063640.pdf - date accessed: April 2008).

Yellowknife, NWT Exemplary Community Profile: Energy	
	Steps taken to ensure any necessary behaviour-change/compliance • The City is working with GNWT to implement incentive programs for both the commercial and residential sectors. GNWT is taking the lead on this. • There is a communications plan in place to engage and educate the community about the CEP and associated goals. The hope is that this will encourage wide spread buy-in to the CEP. • The City targets of reducing emissions by 20% and energy use by 10% in municipal facilities has become a decision making criteria, and is considered in day-to-day operations. • For example, the council was putting pressure on the City to purchase a wood pellet boiler for the community centre district heat system. The administration reviewed the economics and emissions reduction and found that using this boiler, the municipal emissions would be reduced overall by 19%, and therefore, an easy decision was made. • As stated previously, the City is also implementing mandatory energy efficiency standards for the commercial and residential sectors above and beyond the MNECB. Costs and benefits of implementation The $500,000 CEP annual budget is financed from Gas Tax funding and is broken into four line items: • Communications - $25,0000 – Internal/Community • Energy Coordinator - $75,000 - Internal/Community • Implementation Fund - $35,000 – Internal/Community • Energy Efficiency Fund - $365,000 – Internal (for City emission reductions only)[218] (is now closer to $400,000/year) Additional funding may be available associated with the Smart Growth Redevelopment, bringing the total to $600,000. Steps to ensure long-term viability • The Energy Coordinator is responsible for liaising between all departments. The CEP Implementation Advisory Committee is responsible for developing the implementation strategy and ensuring that it is carried forward. • Funding is set up so that it is not part of the City budget, therefore it is very difficult to cut if council changes. A certain amount is also earmarked for implementing energy saving opportunities identified in the energy audit. • Administration is on-board and CEP philosophy is becoming entrenched in lingo and mind set.
Key Barriers and How They Were Addressed	• Developing and implementing a CEP is more than just putting in place some plans, policies, and programs. It is a change of mind set and behaviour. • Change process takes time and is often a struggle. There are no/few immediate results. It is important that this is understood, otherwise, the slow process may be seen as a barrier. There is always going to be resistance, but as long as things are moving ahead and there is receptiveness from the start from any party involved, results can be seen and this should be viewed positively, regardless of the speed.
Lessons Learned	• Essential to have top lead in Administration on board. • CEP is a good first step. Because it is an evolving process, it doesn't have to be perfect the first time around. The important step is passing a CEP into council, so that it gets into the public and administration radar, people start using the lingo and the mind set is slowly adapted.

[218] City of Yellowknife Administration, *Implementing Yellowknife's Community Energy Plan*, prepared for City Council, March 2007 (http://www.yellowknife.ca/__shared/assets/CEP_Implementation_Plan_April_20075539.pdf - date accessed: April 2008).

Yellowknife, NWT Exemplary Community Profile: Energy	
	• Important that it is a team process, with a clear leader, and everyone else on board. • Goals need to be defined including why these are the goals and how they are going to be reached. • Important to have an energy profile done on the entire community. • Setting GHG targets was a debate that could have gone on a long time. There were two schools of thought: 1. goals have to be achievable and 2. goals are something to shoot for (not necessarily realistic). Yellowknife experienced that if people could not see how to get there, how to achieve these goals, they would not support it. • Advice is to broaden the goals in the CEP, to have a bigger impact and understanding in the general public.
Specific Best Practices	Changes to the Building Code: • Applying the CBIP standard to all new buildings, public and private, in Yellowknife in 2009. • In 2010, the EGH-80 standard will be mandatory for all new residential development.
Moving Forward and Upcoming Trends	• Next step is to start the implementation planning process and to implement it. • CEP will also continually evolve and the move will be toward implementing the same practices, policies, etc. through out the community. • The City is working currently on internal efforts, before deciding on how to use energy in the community, which is a long term vision/goal for the CEP.

Exhibit C3
Profile of Okotoks, Sustainable Okotoks

Okotoks, AB **Exemplary Community Profile: Energy**	
Overview of Why This Community is Exemplary	Okotoks has proven its commitment to sustainability through capping growth based on carrying capacity of its watershed. There is also a strong commitment to sustainability in infrastructure planning/design/upgrades and in approaches to accommodating new development. In this respect, Okotoks has become a solar leader within Canada, building the first solar powered subdivision, Drake Landing.
General Community Description	• Type of municipality: Urban (Satellite Community to Calgary) • Population: 17,145 (~ 20,000 as of Dec. '07) Density: 924.4 per km^2 Dynamics: Growing 46.7% (2001 to 2006) • Primary economic base: Approximately 55% commute to Calgary; local jobs in service and light manufacturing • Built environment: Mostly residential (of which, 39% non-traditional housing, 33% multi-unit)[219], Aiming for 22% commercial/industrial (not there yet).
Jurisdictional Context	• Alberta Municipal Act does not give municipalities jurisdiction over building codes (in terms of energy efficiency). New buildings, public and private, only have to meet the MNECB standards. • Currently Okotoks would not consider lobbying the provincial government for the right to control building codes.
Conditions and Challenges Relevant to Sustainable Energy	• Okotoks participates in the Alberta Urban Municipalities Association (AUMA) Energy Aggregate Program. The Town and the community pay a premium for certified renewable energy sources, including mostly wind and hydro. • The Town now purchases 80% of its energy from renewable sources[220] from AUMA (AUMA provides all program participants with a guaranteed 20% certified renewable sources, but Okotoks had asked when they started 8 years ago that the energy they purchase through AUMA be 60% renewable sources, and they are working towards receiving 100% renewable energy sources). • Natural gas is used for heating in the Town.
Vision, Scope, Objectives, and Anticipated Benefits of Plan/Approach	<u>Vision</u> • Sustainable Okotoks was driven by grass-roots within the community. It trickled up to the politicians, who were prepared to listen and started thinking outside the box and take action. • There is no overall vision or plan for the energy sector specifically. Energy supply and consumption is mentioned in passing in the MDP. Despite the lack of a defined sector specific plan, Okotoks has taken and continues to take action within municipal facilities regarding energy efficiency and renewable energy. • Okotoks incorporates solar technologies and renewable energy policies into its sustainable initiative portfolio for several reasons, such as general altruistic aspiration, to establish a solar foundation, demonstrate the technologies potential and use as an educational tool, and Alberta has a high incidence of solar radiation.[221] <u>Commitment</u> • Okotoks joined PCP in 2000, committing to reduce emissions, though no milestones have been completed to date. • It is the council's commitment to reduce the Okotoks carbon foot print.

[219] Town of Okotoks, *Okotoks MDP Report (2004-2006)* (http://www.okotoks.ca/pdf/devserv/planning/G3_MDP_Rev04-06.pdf - date accessed: April 2008).

[220] Town of Okotoks, *Sustainable Okotoks – Air - Perspective* (http://www.okotoks.ca/sustainable/Air/Perspective.asp - date accessed: April 2008).

[221] Town of Okotoks, *Sustainable Okotoks – Energy - Perspective* (http://www.okotoks.ca/sustainable/Energy/perspective.asp - date accessed: April 2008).

Okotoks, AB Exemplary Community Profile: Energy	
	Scope and Key Objectives of Plan/Approach • Purchase clean power, incorporate solar technologies into municipal facilities, and educate the public. • Okotoks incorporates energy efficiency and renewable energy projects into municipal facilities before attempting to convince the general public to do the same. They use their facilities as demonstration projects to educate the public. Anticipated Outcomes • Community-wide reduction in GHG emissions. • Reduce overall energy consumption. • Municipal cost savings. • A cost benefit analysis is performed for all municipal projects. However, because the council's goal is to reduce the Town's carbon footprint, projects are reviewed on a case by case basis. In this way, payback is not the most important criteria, as project contribution to reduction of the carbon footprint plays an important role. For example, the new 3kW PV system for the recycling depot has a long payback of 20 years, though the project is going ahead.
Defining Features and Key Operational Elements of Plan/Approach	• Partnerships - For the major neighbourhood level project (Drake Landing), the project itself was conceived by NRCan and Okotoks partnered with FCM, the Province of Alberta, Climate Change Central, EnerWorks, ATCO Gas, United Communities, and Sterling Homes[222] to see the project through to completion.
Implementation and Current Status	Status of project implementation • All municipal buildings have had energy efficiency retrofits. • Municipal facility retrofit examples: VFD installed at water reservoir and WWTP; lighting and furnace retrofit at recreation centre; lighting retrofit at Town office and library; solar in-floor heating and rooftop PV at recycling depot; SHW at ice rink and pool; solar wall at operations centre; and natural gas replaces gas for the zamboni. • For the municipal retrofits, real time data is available at the community recreation center as a public display. It shows what percentage of energy required was fulfilled by the solar installation for each facility. • Drake Landing construction is complete and is currently being monitored. • The most recent status report was the Early Performance Data from April 2007,[223] which showed that all subsystems were operational, 40 of the 52 houses were connected to the district heating system, and a prediction of system performance indicated that a solar fraction of 90% would be achieved in year 5 of complete system operation. Steps taken to ensure any necessary behaviour-change/compliance • To date, the Town of Okotoks is taking on a leadership and demonstration role. They have not put in place any regulations or bylaws associated with energy use or emissions for the general public. • The Town is currently looking into a possible evolution of the Eco-Efficiency fund toward the public domain, providing financial incentives, such as rebates. They are seeking advice from EPCOR, as the Town wants to ensure that this is done wisely avoiding free riders, and thus they are proceeding with caution.

[222] Town of Okotoks, *Sustainable Okotoks – Energy - North America's First Solar powered Subdivision - Drake Landing* (http://www.okotoks.ca/sustainable/Energy/perspective.asp - date accessed: April 2008).

[223] The Drake Landing Solar Community Project, *Early Results* (http://www.dlsc.ca/reports/EPD_March_April_2007.pdf - date accessed: April 2008).

	• Due to the Drake Landing project, the development industry is familiar with R2000 standards and requirements, and may embrace this philosophy, standard for further developments. • Okotoks also distributes a tri-annual community survey. This allows the citizens to voice their opinions/concerns, and council can then adjust the programs to meet citizen wishes. <u>Costs of implementation</u> • Drake Landing was a $20 million dollar project. The feasibility study for it was $294,000. • Municipal projects varied in cost depending on project. For example, the Solar System at the Recreation Complex was $64,927 and the Recycling Depot Solar System was $50,898.[224] <u>Source(s) of funding</u> • Okotoks received funding (grants and loans) from FCM GMF for both the feasibility study and implementation of the community district solar heating system (at Drake Landing). • Alberta Capital Finance Authority. • For the municipal energy efficiency retrofit projects and solar installations, Okotoks has established the Eco-Efficiency Revolving fund, which is continually replenished by the energy (and thus cost) savings themselves. <u>Steps to ensure long-term viability</u> • Funds/resources integrated into each department to ensure continuity/availability of funds. • Municipality regards itself as a corporation. • Town is a shareholder within the corporation of Drake Landing. • Eco-Efficiency Revolving Fund is continually replenished with energy savings from efficiency projects. The funds are used in turn for further municipal projects.
Key Barriers and How They Were Addressed	• Economic – "…estimated unit cost of heating energy at Drake Landing, once you subtract the added costs associated with building the first-ever demonstration version, is 10 cents per kilowatt-hour at best - more than triple the three cents per kilowatt-hour Albertans currently pay for natural gas. Stripped of Drake Landing's grants and subsidies, a solar-thermal system would only be built with the backing of a major utility company, which isn't likely to do so as long as its customers are looking at a 300% premium on their heating bills. This truly is a demonstration project," ATCO's Bruce Littke admits. "And there aren't any plans today to move it beyond a demonstration project.""[225] • There is no firm government policy regarding energy production/distribution/use, it's more reactive at this point. • Provincially, take a "wait and see" approach in terms of addressing energy sustainability. This makes it difficult for municipalities to address energy sustainability. • Power supply will likely be an issue for Alberta with all the growth taking place. They will eventually be importing power and there is much uncertainty as to how the government will handle this. • Remains a tough argument for renewable energy because these sources still remain at a higher cost.

[224] Robertson, Dave, *Solar Projects Summary Report*, prepared for NRCan, 2001.

[225] Alberta Venture, *Not Your Average Bedroom Community*, Volume 9 Issue 7 (http://www.albertaventure.com/abventure_4703.html?&doc_id=6316&content=false - date accessed: April 2008).

Okotoks, AB Exemplary Community Profile: Energy	
	• When Okotoks started all their energy projects, they thought that there would be a carbon credit system up and running, so they were putting a value on their reduction credits. Eventually, the Town wants to be able to identify GHG reductions and barter the credits, if there is ever a national or international program for this.
Specific Best Practices	Practices reviewed for current report • District renewable energy in new development – Drake Landing • Municipal energy retrofits – Municipal Solar Initiative • Purchase of clean power – AUMA Energy Aggregate Program • Financing mechanism – Eco-Efficiency Revolving Fund
Moving Forward and Upcoming Trends	• Use of a "development agreement" where demonstrated energy efficiency, reduction in carbon footprint, and reduction in water use would be a requirement to obtain a development permit for increased density. For every 10% increase in density, a 20% decrease in water use must be demonstrated through the proposal and will be monitored over time. Projects: • Building a new municipal center with 1kW PV system, solar hot water, gray water re-circulation, etc. • 3 kW PV system for recycling depot, which will reduce depot conventional energy consumption by 25kW/day on average.

Exhibit C4
Profile of Dockside Green, Victoria

Dockside Green, Victoria, BC Exemplary Community Profile: Energy	
Overview of Why This Community is Exemplary	Dockside Green is the first certified LEED Neighbourhood Design, consisting of 26 LEED Platinum buildings. A district energy system fuelled by wood waste from the local region will be used to heat buildings and produce hot water. The location of the development is a former industrial site.
General Community Description	• 15 acre Brownfield site • 1.3 million square feet of development space • 26 buildings for residential, commercial and light industrial uses
Jurisdictional Context	• The City of Victoria published a RFP to develop the Dockside Brownfield lands. Proposals were judged on their environmental, economical and social considerations. • Under the BC Municipal Act, municipalities do not currently have direct power to set building energy standards. However, the Town of Ucluelet has recently petitioned the BC government to change the Municipal Act to allow municipalities the power to set energy standards for buildings.
Conditions and Challenges Relevant to Sustainable Energy	• The City of Victoria is presently serviced by natural gas. • The biomass district energy cogeneration plant will be owned and operated by Vancity, Corix, Terasen Gas and Windmill West.
Vision, Scope, Objectives, and Anticipated Benefits of Plan/Approach	Vision • The vision of Dockside Green is to be a GHG neutral development with no net emissions from a building energy perspective. The development will use a triple bottom line accounting strategy incorporating environmental, economic, and social principles. • The City (specifically a City planner) insisted on this vision approach in the RFP. Key Objectives of Plan/Approach • All 26 buildings will be LEED Platinum certified; energy efficient appliances and individual meters are included in each unit. • Biomass energy cogeneration to produce heat that will be used to heat buildings and domestic hot water needs. The biomass will consist of wood waste recovered from local mills and woodworking shops, as well as tree trimmings and deadfall from the Victoria region. Relationship to Other Major Municipal Policies/Plans • The City rezoned the land and modified the OCP to reflect design guidelines and land use designations. • Created a comprehensive district by-law for the site. Anticipated Outcomes • Demonstration project and community awareness - The City of Victoria chose the Dockside Green proposal because they wanted to showcase a development that pushed current development standards with regards to triple bottom line accounting and also demonstrated various renewable energy systems.
Defining Features and	• The Dockside Green project has a planned total of 1.3 million ft^2 of mixed residential, office, retail, and light industrial space.

Dockside Green, Victoria, BC Exemplary Community Profile: Energy	
Key Operational Elements of Plan/Approach	• Remediation costs were factored into cost of development. Windmill is encapsulating some of the contaminated soil on site. • A district heating system that is based on wood waste will be implemented.[226] A thermochemical gasification process that creates a synthetic gas that can be burned to produce heat will be used. The boiler will supply the majority of Dockside heating requirements with some peak load supplied by the backup/peaking gas boilers. Individual buildings will be charged for heat generated by the system for building heating and domestic hot water needs. Excess heat will also be sold to offsite customers, further displacing natural gas use. As a result, Dockside Green is expected to be GHG negative from a building energy perspective. • Dockside is being designed and built to be the first LEED Platinum development in North America.[227] All buildings are being designed to be 47% more efficient than the Model National Energy Code for Buildings (i.e. 53% of the MNECB value). The design approach focuses first on passive design, such as shading and day lighting. To address passive design, the first two phases include an average R17 value on wall systems, R22 to R25 roof insulation, and low e double glazed windows. Finally, energy efficient appliances and an in-suite utility monitoring meter are being installed in all units. • Photovoltaic panels will be placed on buildings to harvest electricity from the sun. As well, solar lights (using locally developed technology) will be used for bus shelters, street lighting and traffic signals. The Dockside Green Sustainability Centre will be one area that will highlight the different technologies that are being used and tested on site. • A Performance Measures Framework was developed for the Dockside monitoring program, working down from vision to themes to topics to goals to indicators – e.g., "energy" is a topic in the "environment" theme and has as one of its goals to reduce GHG emissions. Indicators include annual residential per capita GHG emissions. The chosen indicators can be measured, recorded and monitored. An easy-to-navigate internet-based tool called See-it™, was used to develop the framework and is being used for reporting.
Implementation and Current Status	Status of implementation • First phase of the development, the Dockside Wharf neighbourhood, has been constructed and the first building is scheduled to open in early 2008. This portion of the development is to be completed by early 2009. The second phase of the development is currently being built. Steps taken to ensure any necessary behaviour-change/compliance • Reporting mechanism – As part of the Master Development Agreement, the City of Victoria requires the developer to provide annual and 5-year performance reports until Year 20 of the development. The City also committed to conduct its own audit to report on the impacts and outcomes of the development on the city and the environment. Costs of implementation Costs borne by the City: • City bought property from the province for $1. • City funded costs of an initial assessment of the site. • City is co-funding development services coordinator position with developer. The City had a minimum break-even policy, with any land revenues in excess of costs to be put back into community amenities (amenity reserve fund).

[226] The Sheltair Group, *Dockside Green Performance Indicators*, prepared for the City of Victoria, March 2007 (http://www.victoria.ca/cityhall/pdfs/currentprojects_dockside_indctr.pdf - date accessed: April 2008).

[227] Windmill West and VanCity, *Dockside Green: Energy Conservation* (http://docksidegreen.com/sustainability/eco-friendly/energy-conservation.html - date accessed: April 2008).

Dockside Green, Victoria, BC Exemplary Community Profile: Energy	
	Source(s) of funding • Funding for the district energy system was provided by a loan from VanCity Capital to Vancity, Corix, Terasen Gas, and Windmill West. Steps to ensure long-term viability • The city and developers collaboratively developed a Master Development Agreement (MDA) for the project based on city's design guidelines and policies, and the proposal. The MDA covers the approaches (e.g., TDM) and includes targets/performance measures for sustainability. • The MDA has allowed Council to see from day 1 how the project was going to develop, and to control changes. • The developers created a penalty clause between themselves and the City of Victoria of up to $1 million dollars ($1 per buildable sq. ft.) payable to the Municipality should they not obtain the LEED Platinum designation for each building.
Key Barriers and How They Were Addressed	• Building and engineering department personnel have had to wrap their heads around new approaches and technologies and determine how to accommodate them within existing codes and requirements. • Provincial government staff have assisted (e.g. reviewed practices to verify that they meet code requirements for fire, mechanical, electrical, etc.). • Some of the technologies themselves have been a challenge. For instance, biomass gasification is being substituted for the original cogeneration approach and vehicles that meet original specs are not readily available. • Skill sets in the design-build industry and among the city staff were not tuned to this type of project. It was necessary to re-educate these individuals in order to alter their mindset. • The planner who worked on the project from the start identified educating the development field and the public as the main barriers to green sustainability.
Lessons Learned	• In the initial planning stages, it might have been more effective to put more of the detail on requirements into the by-law versus the master development agreement. This would have allowed for greater clarity and more detailed specifics. • The project team found that it was necessary to simplify both the master agreement and the future monitoring process for the municipality. • The city played a leadership role in bringing parties together to reduce risk and transaction costs. These parties included provincial agencies (with regard to provincial regulations), community associations, and utilities.
Specific Best Practices	Practices reviewed for current report • Dockside Green is a pilot project for LEED Neighbourhood Design certification standards.
Moving Forward and Upcoming Trends	• Has created new expectations regarding future development – e.g., more amenity spaces, more environmentally-appropriate technologies. • Development community seems to be responding reasonably well. Nothing as extensive as Dockside, but the markers have moved.
How Does Current Approach/Practice Differ from Previous (and/or from other municipalities)?	• The city of Victoria purchased the majority of the Dockside lands from the province in 1989 and was already in possession of the remaining project land.

Exhibit C5
Profile of Better Buildings Partnership, Toronto

Better Buildings Partnership (BBP), Toronto, ON Exemplary Community Profile: Energy	
Overview of Why This Community is Exemplary	Initiated in 1996, the Better Buildings Partnership (BBP) is a cooperative public-private program that focuses on promoting and implementing retrofits in all buildings in the city of Toronto, excluding single-family dwellings. The BBP program also includes a related electricity conservation program that offers incentives for reductions in electricity demand that are achieved through the retrofits. Due to its success, the program has become a model for other communities.
General Community Description	• The city of Toronto covers an area of 630 m^2 and has a population of 2.6 million people.
Jurisdictional Context	• The City of Toronto has committed to reducing GHG emissions by 20%, relative to 1988 levels. • Toronto Hydro is the largest municipally owned utility in Canada and the second-largest in North America.
Vision, Scope, Objectives, and Anticipated Benefits of Plan/Approach	Vision • The vision of the Better Buildings Partnership is to improve the environmental and economic sustainability of buildings in the city of Toronto. This initiative is part of the city's plan to reduce GHG emissions by 20%, relative to 1988 levels. Key Objectives of Plan/Approach • Environmental targets include reduced energy use, peak loads, and pollutant emissions. • Economic goals focus on new jobs and enhanced demand for technologies. • Social targets include improved awareness of sustainability issues and technical skills development. • The electricity conservation program is seeking to reduce the city's electricity demand by 70 MW, or about 1%. Relationship to Other Major Municipal Policies/Plans • The BBP is aiming to be the primary coordinator for the different sources of funding that are available to building owners in the region. This includes federal, provincial, municipal, and utility-level programs. Anticipated Outcomes • The overall impacts of the program include GHG and building operating cost reductions, employment creation, and positive economic impacts for the entire region.
Defining Features and Key Operational Elements of Plan/Approach	• The main program coordinator is the City of Toronto's Energy Efficiency Office. However, Enbridge Gas Distribution Inc., Toronto Hydro, the Toronto Atmospheric Fund, and an evolving list of Energy Management Firms (EMFs) are also involved in the planning and implementation of the program. • In addition to energy efficiency and water-related retrofits, the program also encourages the introduction of general building renewal improvements, including structural and aesthetic enhancements. The focus on "building renewal" is fairly unique among energy retrofit programs and it has been very successful since it further encourages improvements in the economic vitality of buildings. • Project payback periods are not to exceed ten years and generally range from three to ten years. • The electricity conservation program, which began in 2006 and is scheduled to run till 2010, offers incentives of up to $400 per kW of peak demand reduction, or up to $0.05 per kWh of annual energy savings. The incentive is limited to 40% of total eligible costs.
Implementation and Current Status	Status of implementation • As of 2006, projects had been completed on 625 buildings (45 million ft2), resulting in GHG reductions of 195 kT, operational savings of $19 M, and an economic impact, based on energy savings and job creation, of $161 M.

	Steps taken to ensure any necessary behaviour-change/compliance • The BBP program design involved an extensive consultation process with professionals in the building design and construction industry. Costs of implementation • Program funding for 2008-2012 amounts to $62 M, with $6 M budgeted for 2008 and a ramping up of funding thereafter. Source(s) of funding • Building owners enter contracts with EMFs, the city, or financial institutions. These contracts generally allocate a specified portion of the energy savings from the project to one of the project partners for the duration of the contract length and address issues such as timeline, project financing, and long-term monitoring. • The city provides interest-free loans of up to 20% of project cost. Current funding for this revolving loan program amounts to $12 M. • Financing is also provided by Enbridge Gas Distribution Inc., at interest rates that reflect its commitment to promoting energy efficiency through its involvement in the BBP program. • Grants through the electricity conservation program are offered through the city of Toronto, in cooperation with the Ontario Power Authority. Measurement and reporting • Monthly verification reports (on energy and water consumption, GHG emissions reductions, etc.) are required in order to confirm the long-term benefits and effectiveness of individual projects. More detailed reports must also be produced twice a year. • Reports are submitted to the city and information that is gathered is entered into the city's program tracking system to monitor the results of program. • Measurement and reporting costs are included in the feasibility studies for potential projects. Steps to ensure long-term viability of program • The city of Toronto's Energy Efficiency Office is a permanently funded department that handles a number of initiatives dealing with energy efficiency. • The establishment of a revolving loan fund. • Robust long-term agreements between project stakeholders.
Key Barriers and How They Were Addressed	• Having too many bidders for a given retrofit project can be potentially harmful since the cost of preparing proposals can be high. To address this issue, the BBP program implemented a system whereby it limits the number of companies that are eligible to bid for each project to 3 or 4. • The program encountered difficulty in obtaining political support in its initial stages. The support of well-known public and political figures was vital in this stage of development. • Program awareness was found to be a challenge. This was addressed by a thorough marketing campaign and by ensuring that the program remained centralized rather than branching into several smaller programs.
Lessons Learned	• It is vital to obtain long-term political support in order to implement a successful program. • A robust measurement and reporting system allows program administrators to gauge the status of potential projects and track their long-term performance. The performance of the program as a whole can also be assessed. • It is essential for program participants to be bound by high-quality contracts. The BBP program addressed this need by making model

	contracts available on their website. It was found that these files were frequently accessed and this resulted in a streamlined application process with all of the stakeholders' interests being adequately protected. • The program only funded energy retrofit projects initially. However, it was found that participants were more interested in general building renewal. The program has thus evolved to have more of a building renewal focus and now even encourages general building improvements to be incorporated into projects. About 20% of the funding went to non-energy related retrofits initially and this figure has steadily increased.

Moving Forward and Upcoming Trends	• The program is poised to expand into three sub-programs (in mid-2008):
	  • The retrofit portion will essentially be an extension of the program up until this point, focusing on existing buildings
	  • The new buildings portion will focus on energy efficiency improvements in buildings that are going to be constructed in the near future
	  • The renewable energy portion of the program will target the integration of renewable energy systems into new and existing buildings
	• Due to its success, the BBP program has had a large impact on external policy and programs. For instance, the Toronto BBP program was inspired and aided in the development of a similar program in London, England. Officials in Ottawa are also looking to implement a similar program. In addition, the program motivated much of the content that is currently in the city of Toronto's energy action plan.
	• In 2007, the city of Toronto submitted a proposal to the Ontario Power Authority (OPA) to expand the BBP program.

APPENDIX D

Best Practice Profiles

Profiles of some best practices

The main body of the report refers to a number of best practices in Planning for Municipal Energy Sustainability, Municipal Governance and Management Practices, and Operational Practices and Technologies. Some of these best practices were explained in detail, while others were mentioned in passing in order to keep the report manageable. The best practices profiled below include elaborations of some of the best practices within the main body of the report as well as additional best practices that are not included within the text of the main body.

1. PLANNING FOR MUNICIPAL ENERGY SUSTAINABILITY	
Type of Best Practice	**Case Examples**
Top Level Municipal Plans Refer to section 3.3.1 for additional examples. *(London, St. John's)*	• **Surrey, BC – Official Community Plan** This extensive plan, originally adopted in 1996 with a major review in 2002, is an example of the kind of integrated, systems-level approach outlined in section 3.1 of the report. It is strongly rooted in sustainable development principles and objectives and has policies to promote energy conscious planning and design, along with fairly detailed implementation guidelines. It addresses land use, street planning, buildings and landscaping and energy supply, distribution and storage. It also calls for implementation measures to build energy efficient communities to be integrated into Neighbourhood Concept plans, and in the review of development applications and other permitting; and for a review of by-laws to ensure support for energy efficiency, conservation and renewable and low-impact energy production. • **Ucluelet, BC – Official Community Plan** Ucluelet's OCP includes guidelines to promote promoting compact development and Smart Growth calls for specific actions in the energy sector, such as the use of alternative development standards and the use of the LEED Green Building Rating System. (It is apparently the first community in North America to implement a LEED standard for all new development.)[228] • **North Vancouver, BC – Official Community Plan** The OCP of North Vancouver is based on smart growth principles and includes Sustainable Development Guidelines. Energy efficiency and greenhouse gas reduction are identified as top energy-planning objectives. It has led to the establishment of district energy systems and the use of LEED guidelines in building developments. • **Salmon Arm, BC – Official Community Plan** Policy statements in the OCP encourage alternative energy sources for new and existing buildings. The measures are currently voluntary, but planners have indicated that the OCP statement could be the foundation for future changes to the municipality's zoning, subdivision and servicing, and development cost charges by-laws.[229] • **Whistler, BC -- Whistler 2020** Whistler 2020 is a long-range strategic plan, implementing The Natural Step (TNS) philosophy for all municipal operations. During the course of planning, a Sustainable Energy Vision was prepared, identifying long-term opportunities to apply TNS conditions to energy management. • **Calgary, AB – ImagineCALGARY**

[228] Partly for this reason, it won a B.C. Energy Aware Award in the Community Planning and Development category.

[229] Fraser Basin Council. *Community Action on Energy Efficiency – Local Government Policy Tools*, Final Report, June 2007.

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	ImagineCALGARY, a 100 year plan, developed with the help of over 18 000 citizens, identified long term goals for the city to meet its needs for energy, water, and transportation, through short term (10 & 30 year) targets. Planning initiatives include policies and programs, such as a sustainable building policy and the green electricity policy. • **Strathcona, AB – Strathcona County Municipal Development Plan** Approved in May 2007, this plan addresses the need for compact development form, and explicitly commits to promoting renewable energy (including the promotion of alternative utilities such as innovative heating and energy systems - e.g., ground source heating). It also specifies that proponents of new urban areas must use a systems approach that considers a range of sustainability issues, including the energy efficiency of buildings, infrastructure and waste management.
Energy "Master" Plans Refer to section 3.3.2 for additional examples. *(Guelph, Yellowknife, Kamloops, North Vancouver, Whistler)* Refer also to the exemplary community profiles for Guelph and Yellowknife in Appendix C. As discussed in section 3.3.2, a number of other Canadian communities have developed actions plans under the Partners for Climate Protection program.	• **Banff, AB – Local Action Plan** Banff's local action plan addresses energy management and GHG emissions and was integrated into the corporate ISO 14001-compliant environmental management system. The plan was developed to encourage the community (including the municipal and private sectors) to take action in order to reduce energy consumption. It also incorporates a monitoring and evaluation strategy to track progress. • **Dawson Creek, BC – Community Energy Plan** Dawson Creek has a community energy plan consisting of two phases: municipal operations and community-wide and energy consumption. This plan has lead to many city lead energy conservation initiatives. • **Regina, SK – Corporate GHG Emissions Reduction Commitment and Community GHG Emission Reduction Action Plan** The City of Regina planned and implemented numerous initiatives to meet its corporate GHG emissions reduction target, and has also prepared a community-wide plan. Corporate initiative have included energy efficiency and electrical system enhancements in municipal buildings, street lighting retrofits, energy efficiency improvements to the local water supply systems such as installing variable-speed pumps, and sewer and wastewater system improvements. • **Sudbury, ON – Community Energy Plan** Sudbury's CEP includes activities to increase the energy efficiency within the corporation (i.e. municipal buildings); a Community Energy Efficiency Strategy; and a Community Energy Supply Strategy. Drivers for the CEP include reduced municipal and community costs for energy, as well as the economic benefits associated with energy dollars spent locally. Other drivers included reduced local environmental impacts and reduced GHG emissions from burning cleaner energy. A community-wide energy efficiency program (part of EarthCare Sudbury) targets to achieve savings of $5 Million annually in the community. A second long-term goal is to supply 50% of community energy needs from local renewable sources, including wind power, small-scale hydro, landfill utilization, and geothermal sources.[230] • **Halifax, NS – Community Energy Plan** The Halifax Regional Municipality's Community Energy Plan evolved from a partnership initiative with Natural Resources Canada to develop a national template for Community Energy Plans. HRM's plan pilots this template. Based on eight key goals, the CEP lays out a map for meeting "true" energy needs, via energy efficiency and increased reliance on cleaner, less polluting energy, and renewable energy sources. It focuses on corporate

[230] Holland Barrs Planning Group and Marbek Resource Consultations, *Integration of Air-Quality Related Planning Processes*, prepared for the BC Ministry of Water, Land and Air Protection, May 2004.

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	'house in order' actions as well as on promoting community-wide action, and puts a strong emphasis on the role of urban development and design.
"Sector" or "Secondary" Plans and Strategies Refer to section 3.3.3 for additional examples. *(Victoria – Dockside Green)* Refer also to the exemplary community profile for Dockside Green in Appendix C.	• **Langford, BC – LEED Neighbourhood Development (LEED-ND)**[231,232,233] The district of Langford, a community of over 22,000 people within the Greater Victoria area, is developing LEED neighbourhood development draft standards which are to be tested in the pilot project community of Westhills, the third largest LEED-ND project in Canada, and the largest west of Ontario. The 517 acre, $3-billion plan is to include up to 6,000 units for 12,000 to 15,000 people and up to 5 million square feet of commercial space. The development, to be completed over the next 20 years, is to feature only energy efficient LEED-certified buildings. The construction of infrastructure is underway and property sales are to commence in mid-2008. • **Vancouver, BC – South-East False Creek Development Project**[234,235] The South-East False Creek (SEFC) area of Vancouver comprises about 80 acres of former industrial land near downtown, of which 30 acres is privately owned. A sustainable development project was initiated for this land in 1996. The development plan foresees the construction of a community with 6,200 residential units, for a total of 6.5 million ft^2 of residential space and a community of up to 12,000 people. Part of the development will be constructed for the 2010 Olympic Games, as the Olympic Village, and will serve as accommodations for Olympic athletes. (This portion of the development accounts for about 20 acres. Building of the remaining portion will commence after the Games, with completion expected by 2018.) The SEFC project will include a district heating system for space and water heating. A number of other sustainable energy initiatives will be implemented in this system, including sewer heat recovery, solar thermal energy systems, and high-efficiency natural gas boilers for supplemental heat. Minimum building standards have also been set for all of the buildings in the SEFC development. All buildings will be built to a minimum standard of LEED™ silver, with a goal of LEED™ gold for the Olympic Village, and LEED™ platinum for the community centre. Since LEED is a post-construction certification Bruce Maitland, a lead program administrator until 2005, suggests using a "parallel-LEED" approach of mandating standards that are higher than those to be met. • **Lethbridge, AB – BuiltGreen™ Community**[236,237,238] The city of Lethbridge is constructing a new 158 acre residential community, called Sun Ridge, based on the sustainable building principles and practices embodied in the BuiltGreen™ program. The associated standards address details such as building materials, ventilation, indoor air quality, water conservation, and waste management. Construction of

[231] Journal of Commerce, *Langford lands massive "green" development*, June 16, 2007 (http://www.joconl.com/article/id23620 – date accessed: April 2008).

[232] Westhills, *Westhill Vision*, 2008 (http://www.westhillsbc.com/vision – date accessed: April 2008).

[233] Government of British Columbia, *Leadership in Energy and Environmental Design - June 2007* (http://www.cserv.gov.bc.ca/LGD/intergov_relations/smart_development/leed.htm – date accessed: April 2008).

[234] City of Vancouver, *Southeast False Creek*, 2008 (http://www.city.vancouver.bc.ca/commsvcs/southeast/ – date accessed: April 2008).

[235] Turner, D., *Managing the Future of Development*, April 2005 (http://www.sfu.ca/dialog//undergrad/pdfs/0601-DerekTurner.pdf – date accessed: April 2008).

[236] City of Lethbridge, Environmental Services, *Innovative BuiltGreen™ Alberta Community in Lethbridge*, (http://www.lethbridge.ca/NR/rdonlyres/6907D502-F9F1-4763-8941-2B68D3AB2356/5328/EnviroscopeMarchApril.pdf – date accessed: April 2008).

[237] Built Green, *Success Stories* (http://www.builtgreencanada.ca/content.php?id=313 – date accessed: April 2008).

[238] Sunridge, *Sunridge* (http://www.sunridgecommunity.ca/ – date accessed: April 2008).

Sun Ridge began in 2005. The community will include 224 single-family units, 2 multi-family units with a total of 130 units, and a commercial site which will be built on about 65 acres. All buildings in the community will meet a minimum of BuiltGreen™ Bronze standards. Financial incentives are offered to home buyers who upgrade to even higher building standards. The community will also include alternative energy sources (passive and active solar systems, photovoltaics, geothermal heating, green roofs, etc.).

- **Oakville, ON -- The North Oakville West Secondary Plan**

This is the largest LEED Neighbourhood Development pilot with a total size of 5,400 acres. There is considerable emphasis on compact, mixed-use development but in addition, alternative and renewable energy options and district energy, as well as energy efficiency, feature prominently in the draft plan.

- **Montreal, QC – Redevelopment of Benny Farm**[239,240,241242]

Benny Farm is an 18-acre development in Montreal's Notre-Dame-de-Grâce neighbourhood. The site, consisting of 384 units, was originally developed in 1946-1947 to provide housing for WWII veterans and their families. The buildings slowly degraded as veterans moved on or passed away. The 2003 redevelopment plan for the Benny Farm site called for the renovation of 35-40% of the buildings and the demolition and reconstruction of the remainder. The new development will consist of special housing, low-cost housing and newly constructed condominiums as well as a medical clinic, a community recreation centre, and a daycare. A non-profit, community-run utility company, called Green Energy Benny Farm (GEBF), oversees the ownership and management of the project. To maintain the affordability, the project focuses on keeping the utility costs as low as possible. The development plans include: a district heating system with geothermal wells and heat pumps for space heating and use of evacuated tube solar panels for water heating. High-efficiency gas boilers will be installed and/or renovated and will act as backup systems. Simulations have shown that energy savings of 40-50% will result from this system, as compared to a boiler-only system.

[239] Pearl, Daniel S., *Greening the Infrastructure at Benny Farm* (www.holcimfoundation.org/Portals/1/docs/CA_booklet.pdf – date accessed: April 2008).

[240] L'œuf, *Benny Farm - Notre-Dame-de-Grâce*, 2006 (http://www.loeuf.com/en/bennyfarm/index.php – date accessed: April 2008).

[241] Canada Mortgage and Housing Corporation, *Redeveloped Benny Farm Brings 60-Year-Old Garden City Back to Life*, (http://www.cmhc-schl.gc.ca/en/inpr/graw/hoawpr/upload/111810_2.pdf – date accessed: April 2008).

[242] Benny Farm Redevelopment (http://www.bennyfarm.org/en/home.php - date accessed: June 2008).

2. MUNICIPAL GOVERNANCE AND MANAGEMENT PRACTICES TO SUPPORT ENERGY SUSTAINABILITY	
Type of Best Practice	**Case Examples**
Decision Support Tools (Information Analysis) Refer to section 4.1.3 for additional examples. *(Yellowknife, Guelph, Toronto, Okotoks, Spruce Grove, Victoria)*	• **Markham – Performance Measures Document** The Markham Centre Advisory Group obtained public input regarding key objectives for Greenlands, Transportation, Built Form, Green Infrastructure and Public Spaces, and prioritized these objectives. Performance measures were identified for each objective, and application checklists were prepared. Performance indicators were then established for each measure to enable an easily understood rating system to evaluate how each development proposal meets or exceeds standards and expectations. Staff use the Application Checklist to provide an initial assessment of each new development application and evaluate the application in terms of the performance indicators. The Citizen Advisory Group reviews the application. The Developer presents its plans to the Advisory Group to obtain comments, recommendations and feedback and modifies the application to incorporate the recommendations. A public meeting is held with public notice given. A staff report is brought forward to the Development Services Committee, and ultimately to Council, for approval. This report outlines the application's progress towards community values, goals and performance targets.[243] • **Vernon – Smart Growth Checklist** All applicants for Official Community Plan amendment, zoning bylaw amendment, subdivision, development permit or development variance permit must complete a Smart Growth checklist.[244]
Land Use Controls and Regulatory Tools Refer to section 4.2.3 for additional examples. *(Kelowna, Quesnel, Metro Vancouver, Whistler, Strathcona County, Burlington, Markham, Toronto, Montreal, Langford, Vancouver, Victoria, District of Sechelt, Cowichan Valley, North Vancouver, Vernon, New Westminster, Yellowknife, Hinton)*	• **East Gwillimbury, ON – Energy Star Standards for Residential[245]** In April 2006, East Gwillimbury, a town with a population over of over 21,000 in the York Region, acted on its commitment to environmental stewardship, the first pillar of its 2005 strategic plan, by mandating that ENERGY STAR® standards be applied in all new housing developments (over 10 buildings) in the town. ENERGY STAR® homes use 30 to 40 per cent less energy than regular buildings and reduce greenhouse gas emissions by about three tonnes per home per year. The town estimates that its policy, the first of its kind in Canada, will prevent 97,000 tonnes of greenhouse gas emissions between 2007 and 2016. The new standard will also reduce the burden the town places on Ontario's energy system. Finally, homeowners benefit by having homes built to better standards and by saving on their energy bill. Typical energy efficiency measures implemented in ENERGY STAR® homes include insulation and window upgrades, more efficient HVAC systems, and the installation of qualified appliances. • **Ucluelet, BC – OCP Review[246,247]** Ucluelet, located on the west coast of Vancouver Island, has instituted an innovative award-winning community plan to support sustainability. With respect to energy, this includes an intention to mandate the LEED Green Building Rating System.

[243] Markham Centre, *Performance Measures: Turning the Markham Centre Vision Into Reality* (http://www.markham.ca/markham/aspc/markhamcentre/AboutMarkham_Site/perform.asp – date accessed: April 2008).

[244] City of Vernon, *Smart Growth Development Checklist* (http://www.vernon.ca/services/pde/documents/smart_growth_development_checklist.pdf – date accessed: April 2008).

[245] Town of East Gwillimbury, *What are Energy Star® Qualified Homes?* (http://www.eastgwillimbury.ca/Environment/Thinking_Green_Initiatives/Energy_Star_.htm – date accessed: April 2008).

[246] Eggertson, Laura, *Ucluelet mayor balances community needs and development*, March/April 2007, prepared for Forum Magazine, Federation of Canadian Municipalities (http://www.fcm.ca/english/publications/profile9.pdf – date accessed: April 2008).

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Type of Best Practice	**Case Examples**
Fiscal Levers and Incentives to Influence Development Refer to section 4.3.3 for additional examples. *(Quesnel, Salmon Arm, Vancouver, Markham)*	• **Ucluelet, BC – Density Bonus Program**[248,249] Ucluelet has also implemented a system that allows for higher density buildings while maintaining high sustainability standards. Developers that are looking to build condos or other buildings that require a higher density than community zoning allows must provide community amenities such as parkland or cash towards a planned new community centre. • **Lethbridge, AB – Build Green Program** For the Build Green program, which involves 220 homes, the city is going to cover half of the cost (limited cap), working with the land developer, to build net zero energy homes.
Leading by Example Refer to section 4.4.3 for additional examples. *(Yellowknife, Toronto, Richmond, Waterloo, York Region, Kingston, Newmarket, Guelph, Sudbury, Caledon, Okotoks, Spruce Grove, Vancouver, Strathcona County, North Vancouver, Revelstoke, Markham)* Section 3 of this Appendix has many additional examples of municipalities leading by example.	• **St. John's, NFLD – Municipal Buildings Retrofit Program**[250] In 1995 and 2001, the City of St. John's implemented energy retrofits in all of its municipal buildings in partnership with Vestar, an energy service company. The project led to reductions in operating costs and improvements in equipment reliability (reducing the need for emergency service), operating practices, and staff skills. The project also improved the environment in several ways. It reduced greenhouse gas emissions, improved air quality and enhanced conditions for workers through improved lighting, heating and humidity levels in the city's buildings. Annual energy savings now amount to approximately $625,000, with an estimated annual reduction of 1 kt of GHG emissions, or about 1/3 of the total building emissions. • **Calgary, AB – Green Power Initiative**[251,252] The city of Calgary is trying to reduce its corporate GHG emissions to a level 50% below 1990 levels by 2012. Several innovative initiatives have been implemented in order to accomplish this goal. For instance, the first phase of the plan included a wind-powered light rail transit system. Since 2001, Calgary's CTrain transit system has purchased 100% of its electricity from wind-generated sources, reducing GHG emissions by 26 kt annually. Methane gas capture systems were also installed at its wastewater treatment plant. Annually, this installation produces 11 million kWh and reduces GHG emissions by 10 kt. Furthermore, Calgary instituted a building retrofit program for its municipal buildings. This program was completed in 2004 and used energy performance contracting to reduce annual GHG emissions by 30 kt. The city

[247] FCM-CH2M Hill Sustainable Community Awards, *Municipal Governments and Sustainable Communities: A Best Practices Guide 2006*.

[248] Eggertson, Laura, *Ucluelet mayor balances community needs and development*, March/April 2007, prepared for Forum Magazine, Federation of Canadian Municipalities (http://www.fcm.ca/english/publications/profile9.pdf – date accessed: April 2008).

[249] FCM-CH2M Hill Sustainable Community Awards, *Municipal Governments and Sustainable Communities: A Best Practices Guide 2006*.

[250] City of St. John's, *GHG Emissions Reduction Strategy: City of St. John's Local Action Plan, 2006-2010*, (http://www.stjohns.ca/cityservices/environment/pdfs/Climate%20Change%20Plan.pdf – date accessed: April 2008).

[251] City of Calgary, *Green Energy*, May 18, 2006 (http://content.calgary.ca/CCA/City+Hall/Business+Units/Infrastructure+Services/Green+Energy.htm – date accessed: April 2008).

[252] Federation of Canadian Municipalities, *Strategic Commitment to the Environment by Municipal Corporations*, July 2003 (http://sustainablecommunities.fcm.ca/files/Infraguide/Environmental_Protocols/Strategic_Comm_Environm_Mun_Corp.pdf – date accessed: April 2008).

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Type of Best Practice	**Case Examples**
	has also mandated that all new municipal facilities have to meet a minimum of the LEED Silver standard. Four new municipal facilities have already been designed to this standard. Calgary has also instituted lighting retrofit programs to replace traffic lights and about 37,000 residential streetlights with more efficient lighting technology. A municipal Ecofuel Biodiesel project has focused on fuelling 77 city vehicles with a blend of fuel whose biodiesel content ranges from 5-20%. The latest development of Calgary's Green Power Initiative has seen the signing of a 20-year agreement with ENMAX Energy Corporation, Calgary's wholly owned utility subsidiary. Beginning in 2007, a minimum of 75% of the electricity that the utility has been supplying to municipal buildings has been from renewable energy sources. The city has the option of increasing the renewable energy share to 90% by 2012. This agreement has supported the development of an 80 MW wind farm which was completed in 2007. • **Peel Region, ON – Municipal Buildings Program**[253,254] Corporate Energy, a division of Peel's finance department formed in 2003, is working to manage the energy use of municipal buildings within the Peel region. In order to accomplish this, Corporate Energy works with other departments to monitor their energy use with "real-time" energy-tracking technology, help set energy efficiency standards, implement renewable energy technologies, and promote energy conservation. Some of Corporate Energy's activities include energy efficiency audits, building retrofits, exploring opportunities for renewable energy, and implementing demand reduction programs. In addition, Corporate Energy obtains contracts with utility suppliers in order to help stabilize energy costs, invests in R&D pilot programs related to renewable energy, and manages a public outreach program related to energy sustainability. As of 2006, Corporate Energy had successfully reduced energy costs for the Peel Region's municipal buildings by $4 M annually. This economic success highlights the division's success in implementing innovative energy management practices, conserving energy, reducing energy costs, and contributing to the health of the environment. • **Metro Vancouver, BC – Green Buildings Program** The Greater Vancouver Regional District (now Metro Vancouver) implemented a Green Buildings Program, which provides technical education and research to the building industry. They integrated provincial standards with the LEED guidelines and industry needs in order to educate all those involved in the industry, as well as to support and promote sustainable building practices. The evaluation portion of the program involves monitoring the new facilities for energy performance and emissions. Vancouver has also mandated that all new municipal facilities over 500 m2 meet LEED Gold certification. • **Ottawa, ON – City Building Retrofits and Energy Audits** This program has been active for 6 years. Its objective to reduce energy operating costs in city owned and leased buildings and facilities. This target market

[253] Region of Peel, *Corporate Energy* (http://www.peelregion.ca/finance/corp-energy/ – date accessed: April 2008).

[254] Ontario Centre for Municipal Best Practices, *Best Practice Summary Report October 2006* (http://www.amo.on.ca/AM/Template.cfm?Section=Home&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=105052 – date accessed: April 2008).

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Type of Best Practice	**Case Examples**
	encompasses roughly 800 buildings with about 2000 utility accounts. The program has focused on the identification of project opportunities and then allocating the budgetary and service resources to ensure implementation. Initially, FCM funding was used to cover 50% of the cost of conducting energy audits of 49 City buildings. These analyses informed the first 2-4 years of the program. The resulting project generated savings of 2,913 MWh and 15,000 m^3 of water usage over two years. Although the project was transacted through an energy performance contract, the City financed the capital investment (it was not third party financed). The program essentially survives from year to year since program managers must sell the "business case" for annual budget allocations. This is done on the basis of past performance and proposed projects that fall within the city's hurdle rate, currently set at a simple payback of 5 years. The annual budgets have ranged from $500,000 to $1.5 million. Success factors for the project include the city's willingness to provide budget support, the on-going evolution of the technical and cost performance of technologies and the City staff awareness of these opportunities, and project hurdle rates that enable a more comprehensive approach to identification of opportunities and solutions. In addition, project administrators found that it was vital to be familiar with their facilities. This need was easily addressed since the city has an effective performance monitoring and tracking system in place which provides utility metrics for all buildings and facilities. • **White Rock, BC – LEED Operations Building** New operations building that received a LEED Gold rating. • **Canmore, AB – LEED Civic Centre** Civic Centre built to a LEED Silver rating. Uses Canmore's water supply system to cool the building in place of a conventional air conditioning system. • **Waterloo, ON – LEED EMS Headquarters** LEED Gold rated building for the Emergency Medical Services Headquarters and Fleet Centre. The building was also oriented for optimal use of a rooftop solar PV system. • **Port Hawkesbury, NS – LEED Civic Centre** New civic centre is pursuing LEED certification. It was designed with a translucent glazing wall system to provide daylight to the ice surface and harvest solar energy. The centre also uses an integrated heating, ventilating, air conditioning/refrigeration system that recovers heat from the ice surface to provide heat to the rest of the civic centre as well as to the adjacent high school. • **Airdrie, AB – Sustainable Education Centre** The environmental services department, located in the Environmental Education Centre, is a sustainable straw bale building using solar PV for all electricity needs, solar heating for a radiant floor heating system, solar walls, solar hot water, and a heat recovery system. • **Kamloops, BC – LEED Municipal Buildings** Two LEED Gold Certifications, both are the first LEED certifications of their respective building types in Canada. The Kamloops Centre for Water Quality is the first water treatment facility and the Hillside Centre, an adult psychiatric facility, is the first patient care facility to be certified under LEED.

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Type of Best Practice	**Case Examples**
Institutional and Financing Arrangements Refer to section 4.5.3 for additional examples. *(Guelph, Yellowknife, Markham, Okotoks, Burnaby, Calgary, Vancouver, Ottawa, Toronto)*	• **Halifax, NS - Alderney 5 Energy Project**[255] Project construction and a related feasibility study are being funded by a sustainable community reserve, Nova Scotia's Department of Energy, FCM's Green Municipal Fund, Environment Canada, and NRCan's Energy Innovator and TEAM programs. The project is also being financed by a local private partner, High Performance Energy Systems, and project administrators are looking towards Sustainable Technology Development Canada (SDTC) for possible funding. The total building cost is estimated at $3.6 M and construction was to commence in September 2007 and be completed one year later. It is estimated that the project will reduce annual energy costs by a third, or about $250,000. It is also expected that over the first 20 years of the projects, $830,000 of capital costs related to HVAC system replacement will be avoided. In addition, there will be an annual reduction of 0.9 kt of GHG emissions and the use of 900 kg of CFC-based refrigerants will be eliminated. The Halifax Regional Municipality is to lease the system from its private partner for the first 20 years of operation, after which it will take ownership.
Staffing Refer to section 4.6.2 for additional examples. *(Guelph, Yellowknife, Whistler, Halifax, Toronto, Lethbridge)*	• **Richmond, BC – Staff Training** The City of Richmond won the 2007 Power Smart Excellence Awards - Excellence in Energy Management Award. Richmond involves all staff in conservation, from the mayor down. The City provides extensive staff training and rotates staff to different energy management projects, so they gain greater understanding of the importance of energy efficiency. In addition, top managers from many departments participated in BC Hydro's Energy Management Assessment and over the last year have explored ways to improve their city's energy management practices.
Communications, Education and Engagement Refer to section 4.7.3 for additional examples. *(Guelph, Calgary)*	• **Metro Vancouver, BC – Green Buildings Program (BuildSmart)**[256,257] The BuildSmart program, launched in 2001, was initiated as part of the Greater Vancouver Regional District's (GVRD) Sustainable Region Initiative, which was itself started in 2000. The program provides technical education and assistance to the building industry in order to help facilitate the design, construction and management of green buildings. The BuildSmart program has integrated LEED guidelines with provincial and municipal standards and industry needs and is using them to educate builders, architects, engineers, general contractors and municipal staff about the benefits associated with sustainable building practices. The BuildSmart website features in-depth technical guides, publications, and tools, as well as a directory of more than 650 sustainable and locally-available building products. It also offers useful links, links to professional services, and a description of the LEED Green Building Rating System. The BuildSmart program employs 3.5 full-time staff and had registered 45 LEED buildings in 2005. In 2004, it was estimated that the program had reached 8% of industry professionals in BC through its 51 events. The number of LEED registered and certified buildings had also been found to double every year since 2001 so that they represented 6% of the total institutional and commercial construction market.

[255] Halifax Regional Municipality, *Alderney 5 Energy Project* (http://www.halifax.ca/council/agendasc/documents/070807ca1121.pdf – date accessed: April 2008).

[256] Hughes Condon Marler: Architects, *Local Government Green Building Programs*, prepared for the Regional District of Nanaimo, 2005 (http://www.rdn.bc.ca/cms/wpattachments/wpID1046atID1014.pdf - pgs. 5-9 – date accessed: April 2008).

[257] Metro Vancouver, *BuildSmart* (http://www.gvrd.bc.ca/buildsmart/ – date accessed: April 2008).

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Type of Best Practice	**Case Examples**
	• **Edmonton, AB – Home $avers Program**[258,259,260] The Carbon Dioxide Reduction Edmonton (CO2RE) initiative developed the Home$avers program in partnership with NRCan and has delivered it in partnership with Home Depot, beginning in 2004. Using statistics from NRCan, CO2RE produced a series of booklets that provide energy efficiency information specific to Edmonton homes. Information is available online on issues ranging from water and electricity management to insulation, windows, ventilation, and heating systems. Residents who have participated in Home$avers have also had the chance to win an eco-products shopping spree at local Home Depot stores. CO2RE is now developing a membership database that will allow it stay in touch with residents and track energy efficiency improvements across the city. As of 2007, the CO2RE program had achieved a 30% recognition rate, established a membership of 10,000, and distributed almost 150,000 Home$aver booklets and $170,000 in energy efficiency rebates. It also contributed to an annual GHG emissions reduction of 3.7 kt. • **Craik, SK – Sustainable Living Project**[261,262] Craik, a community of less than 1,000 located between Regina and Saskatoon, formed the Craik Sustainable Living Project (CSLP) in 2001. The program focuses on sustainability issues such as land use, food production, water conservation, energy generation, and recycling. The program also places a large emphasis on fostering knowledge and community involvement. One program initiative, which was completed in 2004, involved the construction of an innovative 6000 ft^2 multi-purpose building in order to showcase "green" technologies and environmental practices. From its recycled timber posts and beams and straw-bale walls, to its passive solar and geothermal heating system, the CSLP Eco-Centre is a model of sustainability. The facility has environmental education and general meeting areas and will generate its own revenue by leasing space. The building also features a rainwater capture system, a solar PV system, composting toilets, environmentally friendly interior finishing techniques, and a host of other environmentally friendly practices. The Eco-Centre will form an integral part of CSLP's Eco-Village project, which involves the construction of 14 energy-efficient alternative homes next to the Eco-Centre. Construction of the Eco-Village began in 2006. The project also offers an education and outreach program on an array of sustainability issues.

[258] CO2RE, *Publications & Resources*, 2008 (http://www.co2re.ca/publications/default.htm – date accessed: April 2008).

[259] Alberta Emerald Foundation, *Emerald Awards - City of Edmonton*, (http://www.emeraldfoundation.ca/emerald_awards/past_recipients/2007/city_of_edmonton/view – date accessed: April 2008).

[260] FCM-CH2M Hill Sustainable Community Awards, *Municipal Governments and Sustainable Communities: A Best Practices Guide 2005*.

[261] Saskatchewan Eco Network, *Saskatchewan's Environmental Champions: Craik Sustainable Living Project*, (http://www.econet.sk.ca/sk_enviro_champions/craik.html – date accessed: April 2008).

[262] FCM-CH2M Hill Sustainable Community Awards, *Municipal Governments and Sustainable Communities: A Best Practices Guide 2005*.

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Type of Best Practice	**Case Examples**
Monitoring and Reporting Refer to section 4.8.3 for additional examples. *(Calgary, Edmonton, Whistler, York Region, Markham, Victoria)*	• **Toronto, ON – Better Buildings Partnership**[263,264,265] Initiated in 1996, the Better Buildings Partnership (BBP) is a cooperative public-private program that focuses on promoting and implementing retrofits in all buildings in the city of Toronto, excluding single-family dwellings. In addition to energy efficiency and water-related retrofits, the program also encourages the introduction of general building renewal improvements. In order to confirm the long-term benefits and effectiveness of individual projects and the program as whole, monthly verification reports (on energy and water consumption, GHG emissions reductions, etc.) are required. More detailed reports must also be produced twice a year. Reports are submitted to the city and information that is gathered is entered into the city's program tracking system to monitor the results of program. Measurement and reporting costs are included in the feasibility studies for potential projects (See detailed profile of BBP in Appendix C for more details.)

[263] City of Toronto, Toronto Works and Emergency Services, *Better Buildings Partnership Procedure Manual*, March 16 2004, (http://www.toronto.ca/bbp/pdf/bbp_procedures_manual.pdf – date accessed: April 2008).

[264] City of Toronto, *Better Buildings Partnership – Existing Buildings* (http://www.toronto.ca/bbp/index.htm – date accessed: April 2008).

[265] Personal communication with Richard Morris, BBP Program Coordinator, February 12, 2008.

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Best Practice Description	**Case Examples**
Buildings – Technologies, Systems, Operational and Behavioural Practices Refer to section 5.2.3 for additional examples. *(Hay River, Norman Wells, Burnaby, Sudbury, St. John's, Kamloops, Airdrie, Waterloo, Port Hawkesbury)*	• **St. John's, NFLD – Miller Centre and Municipal Retrofit Program** St. John's retrofit project involved energy efficiency improvements in municipal buildings resulting in decreased operating costs, improved reliability, and a better working environment. • **Toronto, ON – Green Works Programs**[266] Toronto Community Housing Corporation (TCHC), which Toronto is the sole shareholder, is the largest landlord in Canada with approximately 60,000 low-income rental units. TCHC is committed to implementing a comprehensive Utility and Energy Management Plan to reduce energy use and emissions. Initiatives currently being implemented by the TCHC include an Appliance Replacement Program, a Building Renewal Program, and a Compact Fluorescent Light Bulb Program. The Building Renewal Program, started in 2005, will see an investment of up to $100 million over four years. The first phase of the program includes buildings that were chosen because of their higher than average utility costs and poor building conditions. This phase will renovate more than 100 buildings in 19 housing developments, containing about 7,500 residential units. Although the focus will be on energy and water-related retrofits, the overall program focus is on building renewal. The second phase of the program was to begin in 2007. In its first phase, the Compact Fluorescent Light Bulb Program is aiming to replace over 200,000 incandescent bulbs with compact fluorescent bulbs that use about 75% less energy. The TCHC has also implemented programs targeted at improving recycling rates, increasing the amount of community green space and public gardens, and decreasing water consumption by 20%. The water usage targets will be met though a water conservation initiative that includes replacing old inefficient toilets. • **Toronto, ON – Tridel Developments' Integrated Energy Projects**[267] Tridel, a Toronto-based condo developer, has been integrating several innovative technologies into its buildings in order to maximize their energy efficiency and market them to environmentally-conscious home owners. This includes installing integrated energy management systems in order to optimize loads and step down equipment or lighting when it is not in use. Tridel has also been installing high efficiency boilers, ENERGY STAR® appliances, and compact fluorescent lights into its buildings. Other energy efficiency measures include the installation of individual energy meters and the design of air handling systems that recover energy from stale air before it is exhausted. • **Arviat, NU – Public Housing Project**[268] The Nunavut Housing Corporation (NHC) has developed an innovative solution for the construction of cost-effective and energy efficient public housing. With its new 5-Plex Public Housing Project, the NHC uses a number of creative strategies and new technologies to reduce costs, without sacrificing comfort. For instance, to reduce shipping costs, lightweight steel studs replace conventional studs. Additional insulation and enhanced air sealing also significantly improve the energy performance of the units. A shared, central heating utility and Heat Recovery Ventilator (HRV) for

[266] Toronto Community Housing, *Green Works Programs* (http://www.torontohousing.ca/key_initiatives/our_green_plan/green_works_programs – date accessed: April 2008).

[267] Tridel Naturally Better, *Energy Efficiency* (http://www.naturallybetter.ca/building/energy.asp – date accessed: April 2008).

[268] Canada Mortgage and Housing Corporation, *Nunavut Housing Corporation 5-Plex* (http://www.cmhc-schl.gc.ca/en/inpr/graw/hoawpr/upload/111826_2.pdf – date accessed: April 2008).

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Best Practice Description	**Case Examples**
	the entire 5-Plex help dramatically lower monthly heating bills, while improving air quality. In 2005, the NHC built 14 5-plexes at a cost of $1.4 M each, providing 70 new homes for aboriginal families. The size of each of the units is 840 ft^2. • **Rivière-du-Loup, QC – Energy Efficient Arena Construction**[269] Centre Premier Tech arena's steel structure, as well as its dehumidification, refrigeration, and lighting systems, have all been innovatively implemented. The refrigeration system allows facility operators to optimally adjust the temperature in order to obtain an outstanding ice surface quality. The arena recovers heat from this system and uses it to heat the spectator stands and the facility's hot water supply. The arena also employs waterless urinals. The centre's energy management system was designed to meet energy needs during peak hours and conserve energy whenever possible. The arena saves energy by using low-emission lighting that is adjustable to three intensities depending on the activity taking place. A reflective canvas is also fixed to the ceiling of the arena in order to maximize lighting effectiveness and minimize heat projection onto the ice. CANMET and Hydro-Québec are continuing to monitor the building's energy performance and will provide recommendations for improvement to the systems in the near future. The facility was constructed at a cost of $8 M and was completed in 2004.
Municipal Street Lighting Refer to section 5.3.2 for additional examples. *(Dawson Creek, Calgary, Becancour)*	• **Fort St. John, BC** The City has replaced all traffic signals and street lights with LED lights. • **Yellowknife, NWT** City efforts that have improved energy performance included a lighting retrofit of all municipal facilities, including the installation of LED traffic lights.
Water and Wastewater treatment Refer to section 5.4.4 for additional examples. *(Region of Peel, Halifax, Waterloo, Capital Regional District)*	• **Region of Durham, ON – Energy Optimization Project**[270] The region used power monitoring meters as part of an Energy Optimization Project for the Water Distribution System of Pickering, Ajax, Whitby, Oshawa and Courtice. Accurately measuring electricity consumption allowed the region to verify the utility billing. The estimated savings over six years (2001-2006) was approximately $310,000. Real Time Power Monitoring was been developed as part of the Energy Optimization Project for the Water Distribution System. The Optimization Project objective was to minimize operation costs by using a high lift pump schedule which effectively utilizes optimal reservoir storage filling and drainage strategies. In order to accurately measure the actual electricity consumption at each water facility in the lake based system, the Region of Durham installed a total of 54 power monitoring meters at the three water supply plants in Ajax, Whitby, Oshawa and nine pumping stations. All meters within each water supply plant were daisy-chained and connected to the existing Ethernet hub so that users could access the metering records through the internet.

[269] Genivar, *Centre Premier Tech, Rivière-du-Loup* (http://www.genivar.com/fr/realisations/realisation.asp?noRealisations=993&noMarche=16 – date accessed: April 2008).

[270] Ontario Centre for Municipal Best Practices, *Best Practice Summary Report – Energy Management with Metering and Billing Control/Verification*, October 2006 (http://www.amo.on.ca/AM/Template.cfm?Section=Home&CONTENTID=105049&TEMPLATE=/CM/ContentDisplay.cfm - date accessed: June 2008).

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Best Practice Description	**Case Examples**
Renewable Energy Supply Options Refer to section 5.5.2 for additional examples. *(Vancouver, Toronto)*	• **Mayo, YT – Geothermal Energy Project**[271,272] Mayo, a community of 250 people 300 km north of Whitehorse, sits atop a reservoir of geothermally heated warm groundwater. The community is currently using low grade geothermal resource to keep its municipal water systems from freezing in the winter. The municipality is looking to expand its use of geothermal energy to help heat some buildings in the community by activating two geothermal wells that were drilled in the late 1980's. This project failed for a number of reasons, including incompatibility issues between the heat pumps that were installed and the building space heating systems. There are now cost-effective solutions to these problems. As such, the city hired a consultant to assess the rehabilitation potential of the geothermal wells in 2005. This project is still in the planning stages but its goals are to reduce Mayo's dependence on high-cost fossil fuels, to prove the long-term viability of converting fossil fuel based systems to heat pump systems, to raise awareness of geothermal technology and its potential in the North, and to reduce greenhouse gas emissions. • **Murdochville, QC – Mont Miller Wind Farm**[273] Hydro-Québec wanted to diversify the type of energy they were able to provide to customers through the supply of wind power. Northland Power, together with 3Ci inc., a Quebec wind power developer, met Hydro-Quebec's needs by developing an independent 54 MW wind farm in the Gaspésie region, near the town of Murdochville and connected it to the grid. The project was sold to Northland Power Income Fund prior to construction. Through its wholly owned subsidiary, Northland Power manages and operates the facility under a long-term agreement. • **Halifax, NS - Alderney 5 Energy Project**[274] The Alderney 5 complex in Halifax encompasses several facilities, including a library, a ferry terminal, and the city hall. The target of the Alderney 5 energy project is to reduce the $750,000 annual utility costs associated with these facilities by replacing their old and redundant heating and cooling systems. The plan calls to the construction of a small district energy system that will connect all of the buildings with heating and cooling pipes. The existing boilers will be converted to natural gas and two new high efficiency boilers will be installed. A seawater cooling system will also be used to cool the facilities in the summer months. In the winter, the seawater intake system will be used to "charge" a cold storage borehole field. This borehole field will consist of 100 boreholes, each of which will be 4 ½" in diameter and 600 feet in depth. Heat will be removed from the surrounding rock mass by pumping sea water through heat exchangers and piping cold fresh water through the borehole field. The project is also to include a lighting retrofit program that will reduce lighting operating costs by 50% and minimize the cooling load required during summer months. The project construction and a related feasibility study is being funded by a sustainable community reserve, Nova Scotia's Department of Energy, FCM's Green Municipal

[271] Government of Yukon, *Yukon Energy, Mines, and Resources – Geothermal Energy* (http://www.nrgsc.yk.ca/geothermal.html – date accessed: April 2008).

[272] *Yukon Development Corporation and the Energy Solutions Centre: 2005 Annual Report* (http://www.yukonenergy.ca/downloads/db/576_YDC_ESC_2005.pdf – date accessed: April 2008).

[273] Northland Power Inc., Wind Turbine Farms (http://www.northlandpower.ca/index.taf?z=4&p=103&l=&_UserReference=DD90D9F799FF023444875381 – date accessed: June 2008).

[274] Halifax Regional Municipality, *Alderney 5 Energy Project* (http://www.halifax.ca/council/agendasc/documents/070807ca1121.pdf – date accessed: April 2008).

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Best Practice Description	**Case Examples**
	Fund, Environment Canada, and NRCan's Energy Innovator and TEAM programs. The project is also being financed by a local private partner, High Performance Energy Systems, and project administrators are looking towards Sustainable Technology Development Canada (SDTC) for possible funding. The total building cost is estimated at $3.6 M and construction was to commence in September 2007 and be completed one year later. It is estimated that the project will reduce annual energy costs by a third, or about $250,000. It is also expected that over the first 20 years of the projects, $830,000 of capital costs related to HVAC system replacement will be avoided. In addition, there will be an annual reduction of 0.9 kt of GHG emissions and the use of 900 kg of CFC-based refrigerants will be eliminated. The Halifax Regional Municipality is to lease the system from its private partner for the first 20 years of operation, after which it will take ownership. • **Whitehorse, YK – Geothermal Energy for Municipal Water Systems** The city uses low grade geothermal energy in the form of warm groundwater, to prevent municipal water systems from freezing in the winter.
Energy from Waste Refer to section 5.6.1 for additional examples. *(Kelowna, Calgary, Montreal, Victoria, Prince George, Hamilton, Newmarket, Ottawa)*	• **Waterloo, ON – Landfill Gas Power Plan**[275,276,277,278] The Waterloo municipal waste landfill covers an area of 178 acres and is owned by the regional municipality of Waterloo. Landfilling at this site commenced in 1972 and is expected to be completed in 2026, with a total capacity of 12 million tonnes. The site is currently at about half of its capacity. A gas collection and flaring system was installed in 1995 and was to have over 85 gas wells by 2003. The regional municipality of Waterloo installed this system at a cost of $3.9 million. The landfill gas that is captured contains 53% methane. In 1999, the construction of a 3.7 MW landfill gas fuelled electrical power generating facility was completed on the site. Plant features include gas conditioning and power generation using efficient reciprocating engine technology. The site also reduces odours and virtually eliminates the release of methane gas, a powerful greenhouse gas, from the landfill site. This plant was built by Toromont Energy at a capital cost of $7.5 million and has resulted in GHG emissions reductions of 148 kt per year. However, the utility company is considering expanding the power plant to a generating capacity of 8 MW. It is estimated that the landfill will continue producing methane at levels adequate to maintain this maximum capacity for another 50 years. Waterloo and Toromont Energy will also explore how to use the waste heat produced in the generating station. A number of lessons were learned throughout the implementation of this project. It was found that a team approach and a clear plan are both critical. It was also found that municipal and private sector partners can combine their strengths in a relationship of shared risk and reward. In addition, project administrators indicate that

[275] World Bank, *Case Study: Region Of Waterloo LFGTE – Project Annex To Handbook For The Preparation Of Landfill Gas To Energy In Latin America And The Caribbean - Annex H*, November 2003 (http://www.bancomundial.org.ar/lfg/gas_other_project_002.htm – date accessed: April 2008).

[276] Couturier, Guy, J., *Waterloo Landfill Gas Project*, prepared for Toromont Energy Ltd. (www.ghgregistries.ca/files/projects/prj_1383_651.pdf – date accessed: April 2008).

[277] CanREN, *Bioenergy: Toromont Energy Ltd.*, 2003 (http://www.canren.gc.ca/renew_ene/index.asp?CaID=47&PgID=1110 – date accessed: April 2008).

[278] Environment Canada, *Waste Management – Waterloo Project*, 2006 (http://www.ec.gc.ca/wmd-dgd/default.asp?lang=En&n=70F5EB5B-1 – date accessed: April 2008).

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Best Practice Description	**Case Examples**
	environmental benefits are built on the foundation of a viable long-term business. Further, it was found that a staged approach to site development is the preferred approach since it reduces the amount of risk that the developer is exposed to and that project partnerships should be structured so that each of the partners is operating in their area of expertise.
District Energy Refer to section 5.7.5 for additional examples. *(Windsor, Fredericton, Victoria, Okotoks, Toronto, Ottawa, Vancouver, London)*	• **North Vancouver, BC –District Energy System Project**[279,280] The Lonsdale Energy Corporation (LEC) was established in 2003 by the city of North Vancouver in partnership with Terasen Gas. Its current goal is to install and manage a distributed district energy system to provide heating and domestic hot water to buildings in the Lower Lonsdale development area. By 2013, a total of 25 buildings, including over 2,000 residential units and representing three million square feet of mixed commercial and multi-unit residential space, will ultimately be connected to the system. The network will utilize five "mini-plants" with high efficiency gas boilers. This approach helps keep the cost of the district heating system down and relieves the need for separate large electrical or boiler rooms and the associated system management in each building. The project has received $8 million in government and private sector funding. The Federation of Canadian Municipalities is supporting the project with a $2 million low-interest loan and a $2 million grant while Terasen Gas and the municipality are each providing $2 million. One-third of the targeted space, or approximately one million square feet, were to have been connected to the system by early 2007. The project is unique in Canada, has generated considerable interest from other municipalities and is strongly supported by the Community Energy Systems Group within the CANMET Energy Technology Centre (CETC) at Natural Resources Canada. The plan has garnered several awards, including the Energy Efficiency Award for Industry from NRCan and the Community Excellence Award for Leadership and Innovation from the Union of British Columbia Municipalities. • **Markham, ON – District Energy Capital Expansion Project**[281,282] Markham's Smart Growth downtown, also known as Markham Centre, is the largest greenfield urban planning project in North America with a planning area of 988 acres and upwards of 15 million square feet of residential, commercial and institutional buildings. Markham Centre will be home to over 25,000 residents and 17,000 employees. Markham District Energy Inc. (MDEI) and the town are working towards having over 90 per cent of the developed space of Markham Centre connected to the community energy system. When fully developed, it is anticipated that the district energy system will achieve an overall efficiency gain of 50 percent, resulting in a corresponding 50 percent reduction of CO2 emissions. The existing MDEI production facility, which has been running since December 2000, is the first of four planned facilities. It has a combined heat and power (CHP) plant (a

[279] Metro Vancouver, *Lonsdale Energy Corporation* (http://www.gvrd.bc.ca/sustainability/casestudies/Lonsdaleenergy.htm – date accessed: April 2008).

[280] Corix Utilities, *Case Study - North Vancouver – Lower Lonsdale District Energy System Project* (http://www.corix.com/utilities/documents/CU_CS_NorthVan.pdf – date accessed: April 2008).

[281] Town of Markham, *Creating More Energy - Official Groundbreaking Markham District Energy Plant Expansion* (http://www.markham.ca/Markham/Departments/NewsCentre/News/070531_Expansion.htm – date accessed: April 2008).

[282] Markham District Energy Inc. (http://www.markhamdistrictenergy.com/ – date accessed: April 2008).

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	natural gas cogeneration facility with heat recovery technology -- 3.5 MW electrical and 3.2 MW thermal capacity) plus additional high efficiency natural gas boilers (10 MW capacity) and absorption chillers (1.5 MW capacity). The current capital expansion project is expanding the distribution system with infill of the existing system and installation of chilled water storage technology and efficiency upgrades. The capacity of the CHP plant is to be expanded by 5 MW, for a total electrical capacity of 8.5 MW. Completion of this project is slated for June 2008. This is the first time in Canada that private townhouses will be connected to a municipality's district energy system. • **Revelstoke, BC – District Heating System** Revelstoke uses wood waste from the local forestry industry to produce energy, which is used by the sawmill as well as by the district heating system. • **Charlottetown, PEI – Community Energy System**[283] Three small district heating plants were constructed in Charlottetown between 1981 and 1985 with the support of the PEI Energy Corporation, a provincial crown corporation. The first plant burned municipal solid waste to provide space heating to a local hospital. The second plant burned woodchips to provide both space and water heating to nearby government buildings and large private buildings in the downtown area. Another woodchip system, based at the University of Prince Edward Island, was used to heat university facilities, as well as private buildings. In 1995, these systems were purchased by Trigen Energy Canada, who connected and expanded the resources of the independent systems. The expanded district energy system became fully operational in 1998. The City of Charlottetown's district heating and cogeneration plant now heats 84 buildings. The system includes a 15 km hot water distribution network. Its customers are the provincial government, the Queen Elizabeth Hospital, the University of Prince Edward Island, the Atlantic Veterinary College, two malls, larger commercial buildings, retail stores, apartment buildings, and a few private residences. Each building is equipped with a compact heat transfer system that is sized for the building's needs. Energy costs from the district heating system are about 10% lower than heating oil costs, and annual GHG emissions are reduced by an estimated 48.9 kt. Further, Charlottetown has reduced its dependency on imported oil with 45% of the energy being generated by municipal waste and 45% being generated by sawmill waste. The system has also resulted in increased local employment for the construction and maintenance of the network. It is estimated that for every dollar spent on biomass fuel, 70 cents stay in the local economy, compared with 10 cents for every dollar spent on oil. In addition, the use of municipal waste has reduced the required landfill requirements by 90%. As one of the first large district heating systems in Canada, the Charlottetown system encountered several barriers. For instance, the European piping that was slated to be

[283] CanREN, *Charlottetown District Energy System* (http://www.canren.gc.ca/renew_ene/index.asp?CaID=47&PgID=956 – date accessed: April 2008).

[284] NRCan, CETC, *Cornwall, Ontario - District Heating System* (www.nrcan.gc.ca/es/etb/cetc/pdfs/cornwall_district_heating_system_e.pdf – date accessed: April 2008).

[285] CanREN, *Oujé-Bougoumou District Heating System* (http://www.canren.gc.ca/renew_ene/index.asp?CaID=47&PgID=975 – date accessed: April 2008).

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Best Practice Description	**Case Examples**
	used for the project was not certified by North American standards. Oil prices also began to decline in the mid-1990's and the provincial government that was in power at the time was looking to reduce expenses and get rid of debt. This led to a lack of support for the system, which is why it was ultimately sold to a private investor. • **Hamilton, ON – Community Energy System** Hamilton Community Energy CHP plant provides electrical power to the City and distributes hot water to buildings through an underground piping network. • **Cornwall, ON – Hot water District Heating System**[284] In 1995, Cornwall, a community of nearly 50,000 people in Eastern Ontario, successfully constructed the first municipally owned hot water district heating cogeneration system in Canada. The system uses two high efficiency natural gas reciprocating engines to generate 7 MW of heat that is distributed to 14 buildings through a buried 4.5 km distribution network. The buildings receiving hot water through this system include a hospital, schools, recreational buildings, a municipal library, a senior citizens' residence, an apartment building, and a government office building. The system also generates 5 MW of electricity, or about 4% of the city's electrical energy. The combined production of heat and power has reduced fuel consumption by close to 30%. The local utility, Cornwall Electric, has lowered its dependency on outside energy suppliers while creating local jobs for the construction and maintenance of the plant. The Cornwall system has a thermal efficiency that approaches 90% in winter months • **Oujé-Bougoumou, QC – Wood Waste District Heating System**[285] The Oujé-Bougoumou Cree Nation, a community of 650 people located about 1000 km north of Montreal, uses wood waste to fuel a district heating system that supplies both heat and hot water to all the buildings of the village. This includes over 135 housing units and 16 public buildings. The system was commissioned in 1992 and was initially comprised of a 1.2 MW biomass boiler and a 1 MW oil boiler. A second 1.7 MW biomass boiler and two additional oil boilers were added, beginning in 1998. The total capacity of the biomass and oil boilers is now 2.9 MW and 4.5 MW, respectively. The system has resulted in a reduction in residential operating costs and in job creation within the community. Annual GHG reductions as a result of the system amount to approximately 2.3 kt.

APPENDIX E

Renewable Energy Technologies

RENEWABLE ENERGY TECHNOLOGIES

Small Scale Hydro

Hydropower releases the potential energy stored in water resting at altitude. For run-of-the-river microhydro power systems, a portion of a river's water is diverted to a water conveyance – channel, pipeline, or pressurized pipeline (penstock) – that delivers it to a turbine or waterwheel at a lower elevation. The moving water rotates the wheel or turbine, which spins a shaft. The motion of the shaft can be used for mechanical processes, such as pumping water, or it can be used to power an alternator or generator to generate electricity.

In terms of suitability for decentralized generation there are three sizes that may be considered: micro hydropower (up to 100 kW), mini hydropower (up to 1 MW), and small-scale hydro (up to 10 MW). Conversion efficiency is typically about 90% and generation cost is typically in the range of 3.0 to 10.0 cents per kWh. Factors to consider are: distance from the power source to the location where energy is required, stream size (including flow rate, output and drop), and a balance of system components – inverter, batteries, controller, transmission line and pipelines. All these factors will influence the size of the system and the appropriate application. Unlike solar and wind, the size and flow of small streams may restrict future site expansion as the power demand increases. In many locations stream size will fluctuate seasonally. During the summer months there will likely be less flow and therefore less power output. They are a good match for winter electricity peaking areas.

Micro, mini, and small scale hydro, can be slightly different than other renewable energy technologies in that it can be suitable for supplementing an existing grid, or, if feasibility studies show a sufficiently constant flow of water, as the sole source of electricity for a facility or community.

Photovoltaics

Generally arranged into modules, PV cells can be designed to match a wide range of electrical needs. Efficiencies for commercial PV cells range from 7-17%. The most significant barrier to the widespread adoption of PV is cost, with electricity generation costing between 34.5 and 46.0 cents per kWh. PV is also an inconsistent source of power, since it is dependent on the availability of sunlight. PV is therefore typically best suited to supplement a central grid or used in conjunction with some sort of electrical storage such as batteries.

Solar thermal

Solar thermal energy is a technology for harnessing solar power for practical applications from solar heating to electrical power generation. Solar thermal collectors, such as solar hot water panels, are commonly used to generate solar hot water for domestic and light industrial applications. There are also solar thermal electric power plants; that is, solar power plants that generate electricity by converting solar energy to heat, to drive a thermal power plant.

Solar thermal energy also refers to the use of technologies that heat air using solar energy. A common product is a perforated plate collector consisting of metal cladding with small holes over the entire surface. In this configuration, outdoor air moves through the holes where it is

heated behind the metal plate, and then sucked into the building as make-up air. Solar air heating technologies currently cost less to install and are more cost effective than solar water heating technologies.

Wind

Wind energy is one of the lowest-priced renewable energy technologies available today, costing between 4 and 6 cents per kilowatt-hour, depending upon the wind resource and project financing. Turbines range in size from around 35 kW to 3000 kW. Conversion efficiency ranges between 25 and 40%.

Wind power must compete with conventional generation sources on a cost basis. Depending on how energetic a wind site is, the wind farm may or may not be cost competitive. Even though the cost of wind power has decreased dramatically in the past 10 years, the technology requires a much higher initial investment than fossil-fuelled generators.

Although wind power plants have relatively little impact on the environment compared to other conventional power plants, there is some concern over the noise produced by the rotor blades, aesthetic (visual) impacts, and sometimes birds have been killed by flying into the rotors. Most of these problems have been resolved or greatly reduced through technological development or by properly siting wind plants.

Biomass

Biomass combustion is a carbon-neutral process because the resulting CO2 was previously captured by the plants being combusted. At present, biomass co-firing in modern coal power plants is the most cost-effective biomass use for power generation. Due to feedstock availability issues, dedicated biomass plants for combined heat and power (CHP), are typically of smaller size and lower electrical efficiency compared to coal plants (30%-34% using dry biomass, and around 22% for municipal solid waste). In cogeneration mode the total efficiency may reach 85%-90%.

Biomass integrated gasification in gas-turbine plants (BIG/GT) is not yet commercial, but integrated gasification combined cycles (IGCC) using black-liquor (a by-product from the pulp and paper industry) are already in use.

Technologies and cost of power and heat generation from biomass depend on feedstock quality, availability and transportation cost, power plant size, conversion into biogas (if any). If sufficient biomass is available, bio-power and CHP plants are a clean and reliable power source suitable for base-load service.

Biomass Gasification

When biomass is heated with no oxygen present or only about one-third the oxygen needed for efficient combustion (amount of oxygen and other conditions determine if biomass gasifies or pyrolyzes), it gasifies to a mixture of carbon monoxide and hydrogen – synthesis gas or syngas. Like natural gas, syngas can also be burned in gas turbines, which is a more efficient electrical generation technology than steam boilers to which solid biomass and fossil fuels are limited.

Biogas: Anaerobic digestion, landfill gas (bio-methane) and wastewater treatment

In the absence of oxygen, organic matter such as animal manure, organic wastes and green energy crops (e.g. grass) can be converted by bacteria-induced fermentation into biogas (a 40%-75% methane-rich gas with CO2 and a small amount of hydrogen sulphide and ammonia). Anaerobic digestion is also the basic process for landfill gas production from municipal solid waste. It has significant potential, but it is characterized by relatively small plant size. Anaerobic digestion is increasingly used in small-size, rural and offgrid applications at the domestic and farm-scale.

The rising cost of waste disposal may improve its economic attractiveness. In modern landfills, methane production ranges between 50 and 100 kg per tonne of municipal solid waste (MSW). In general, some 50% of such gas can be recovered and used for power and heat generation. After purification and upgrading, biogas can be used in heat plants, stationary engines, fed into the natural gas grid, or used as a transport fuel (compressed natural gas). Large-size plants using MSW, agricultural wastes and industrial organic wastes (large-scale co-digestion) need some 8,000-9,000 tonnes of MSW per year per MW of installed capacity. Some 200 such plants are in operation or under construction world-wide using more than 5 million tonnes of MSW.

Exhibit A indicates the applicability of various technologies to different landfill site sizes, and provides a range of capital costs and operations and maintenance (O&M) expenses.

Exhibit A
Typical Costs for LFG Utilisation Systems

Utilisation System	Typical Output	Typical Site Size	Capital Costs ($/kW)	O&M Costs ($/kWh)
Reciprocating Eng.	50 kW-5 MW	1-8 million tonnes	$1,900-$1,300	$0.021-$0.016
Steam Turbine	1 MW-50 MW	>6 million tonnes	$4,000-$1,000	$0.04-$0.015
Gas Turbine	1 MW-10 MW	3-12 million tonnes	$2,500-$1,800	$0.015-$0.013
Microturbine	25 kW-500 kW	scalable	$2,450-$1,500	$0.015-$0.013

Source: Landfill Gas Study, Sperling Hansen & Ass., 2002, pp.4-1 to 6-4 (note: SHA obtained the costs from varying sources from different years. Although not stated, it is assumed that these prices are in $2002).

Another form of anaerobic digestion can be found in wastewater treatment plants. These plants release biogas through the decomposition of organic matter. The biogas (mostly methane) can be captured and used to provide energy services either by direct heating or through the generation of electricity. Anaerobic digestion destroys pathogens and this method is used to generate biogas in many treatment plants. Typically the biogas is burned to produce heat to maintain the temperature of the digester process. Excess gas is then flared (Oregon State Energy Office 2004). This process destroys pathogens resulting in cleaner water and more benign solids.

Plasma Gasification

In plasma gasification, fuel or waste is fed to a reactor vessel where electrically generated plasma at a temperature of 20,000°C is present. When the fuel or waste is exposed to the plasma it is heated to a very high temperature (>2,000°C), which causes the organic compounds in the fuel or

waste to dissociate into simple molecules such as hydrogen, carbon monoxide, carbon dioxide, water vapour and methane. These simple molecules, that are all gases, are allowed to continuously flow from the reactor to gas cooling and cleaning equipment. The gas from the reactor has a low to medium calorific value, and is therefore suitable as the fuel for a gas fired power generation unit. When used as a fuel for power generation, more power is usually produced than is consumed by the gasifier. Therefore, electrical power can be exported for sale, or used for onsite purposes. For high calorific value wastes and fuels the power exported can be four times that consumed by the gasifier.

Geothermal

The idea behind geothermal energy is to take advantage of the ground's relatively stable temperature to heat or cool buildings. Heat is 'exchanged' between the ground and the building by using standard pump and compressor technology. Recent advances in geothermal technologies could help take advantage of large sources of energy. Heat extraction from municipal water supplies, deep lake water cooling, counter seasonal geothermal storage for heating and cooling and improved heat transfer technologies are being further developed, demonstrated and implemented.

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APPENDIX F

Industrial Waste Energy

OVERVIEW OF SOME PRINCIPLES AND TECHNOLOGIES RELATED TO USE OF INDUSTRIAL WASTE ENERGY

Energy-intensive industrial processes require large volumes of raw material at ambient temperatures, add large quantities of fossil energy and/or electricity to raise the temperature and transform the raw materials, then release three streams: gases still containing combustible materials; exhaust heat; and finished goods. Much of the exhaust energy can be recycled to produce useful heat and/or power.

In many cases, this energy can be captured and reused within the industrial facility itself. But technologies with which industrial and electric power waste heat can be utilized can also benefit rural and smaller communities in proximity to these energy sources. The following are some examples of how electricity (or thermal energy) can be generated from "recycled" energy.[286]

[286] Owen Bailey and Ernst Worrel, LBNL, *Clean Energy Technologies-A Preliminary Inventory of The Potential for Electricity Generatio*n, 2005 (http://www.recycled-energy.com/documents/news/LBNL_clean_energy.pdf - date accessed: April 2008).

Technology	Description	LUEC[287] (¢/ekWh)	Assumptions
Pressure Power Recovery	Recovery of energy when reducing pressure in steam or gas distribution systems.	2.8 - 5.2	4000 annual running hours, installed cost of $600/kWe and operating cost of $0.011/kWh - 5500 annual running hours, installed cost of $2,000/kWe and operating cost of $0.009/kWh
Organic Rankine Cycle	Similar to steam turbine system except driving fluid is organic and operates at a lower temperature.	4.6	6500 annual running hours, installed cost of $2,000/kWe and operating cost of $0.01/kWh
Flare Gas Recovery	Recovery of methane through recovery compressors.	3.4	8500 annual running hours, installed cost of $1,400/kWe and operating cost of $0.015/kWh
Advanced Cogeneration	Iron and steel plants can power their generating systems with a combination off-gas turbine/steam turbine system.	1.9	8500 annual running hours, installed cost of $1,090/kWe and operating cost of $0.004kWh.
Fuel Cells in the Chlorine-Alkaline Industry	Fuel cells generate direct current electricity and heat by combining fuel and oxygen in an electrochemical reaction. This technology avoids the intermediate combustion step and boiling water associated with Rankine cycle technologies, or efficiency losses associated with gas turbine technologies.	4.9	8500 annual running hours, installed cost of $3,000/kWe and operating cost of $0.008/kWh
Black Liquor Gasification	Increases the electricity production within the pulp mill. The technology is called black liquor gasification-combined cycle (BLGCC)	2.1	8500 annual running hours, installed cost of $1,070/kWe and operating cost of $0.006/kWh
VOC Control	Ability to generate electricity and useful thermal heat with a gas turbine, using the VOC containing gases enriched with natural gas.	9.0	5870 annual running hours, installed cost of $4,000/kWe and operating cost of $0.01/kWh

As indicated in the table, with the cost of energy generated through waste or recycled energy as low as approximately 2.0¢/kWh can be very attractive compared to virtually any conventional fuel source, in addition to the environmental benefits.

[287] Based on Discount Rate of 10%, 20 year service life