Council of Energy Ministers

Integrated Community Energy Solutions

A Roadmap for Action

September 2009

Cat. No. M134-7/2009E (Print)
ISBN 978-1-100-13117-7

Cat. No. M134-7/2009E-PDF (On-line)
ISBN 978-1-100-13118-4

Aussi disponible en français sous le titre :
Solutions énergétiques intégrées pour les collectivités – Plan d'action

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Introduction

Communities play a central role in the quality of life that Canadians enjoy. They also account for close to 60 percent of the nation's energy consumption. In recent years, communities have begun to identify significant opportunities for improving their energy performance through cross-cutting sector integration while enhancing quality of life and realizing financial benefits. This Roadmap for Action presents the role Canada's federal, provincial and territorial governments can play in working with communities and stakeholders to advance Integrated Community Energy Solutions.

Integrated Community Energy Solutions (ICES) have the potential to significantly improve community energy performance while contributing to the achievement of federal, provincial and territorial governments' energy efficiency and climate change objectives. These solutions capitalize on the cross-cutting opportunities and synergies available at the community level by integrating physical components from multiple sectors, including energy supply and distribution; transportation; housing and buildings; industry; water, waste management and other local community services; and land use and community form. Delivering the full potential of ICES also requires the creation of a supportive environment that governments can foster in two capacities: as investors in programs that stimulate actions and as policymakers and regulators who help shape the marketplace and reduce barriers to action.

Cross-cutting opportunities were introduced in *Moving Forward on Energy Efficiency in Canada: A Foundation for Action*, released by the Council of Energy Ministers in September 2007. In *Moving Forward*, Ministers recognized the vital role that governments can play in advancing energy efficiency in key sectors, including the built environment, transportation and industry. This sector-specific work is ongoing and needs to continue.

This document builds on *Moving Forward* to capture the additional potential of fully-integrated community solutions. The Roadmap represents the collaborative efforts of the provincial, territorial and federal governments, with important input from a wide cross-section of representatives from outside government, including non-governmental organizations and industry. The Roadmap also recognizes the essential role of municipalities, developers, energy utilities and providers, non-governmental organizations, industry, citizens and other stakeholders in bringing ICES to fruition.

ICES can be scaled to meet the needs of all types of communities, ranging from rural and small remote towns to medium-sized municipalities and large cities. ICES apply to new developments, existing neighbourhoods and even whole regions. In every case, the potential results are the same: improved energy performance, a sharply reduced carbon footprint, job creation, improved air quality, improved quality of life and many other benefits. As shown in this report, a growing number of early ICES successes from across the country offers examples upon which to build.

Picturing Canadian Communities in 2050

Imagine the year is 2050. Communities across Canada are now reaping the benefits of the Integrated Community Energy Solutions that they have been systematically implementing over the past 40 years. The federal, provincial and territorial governments have created a supportive environment, which municipalities, developers and other stakeholders have used to achieve an accelerated rate of implementation. By taking an integrated approach to energy supply and demand, communities large and small from coast to coast to coast have achieved extremely high levels of energy performance. These achievements have been critical to Canada's success in meeting federal, provincial and territorial climate change and energy efficiency targets, and they have led to exceptionally desirable communities for Canadians to live and work in.

In this vision of 2050, communities of all sizes approach energy supply and demand in an integrated and holistic way. A focus on energy efficiency and clean energy is fully ingrained in the ways that communities are planned, designed, built, operated and revitalized. As a result, municipalities and their citizens have realized abundant economic, environmental and social benefits. Attractive opportunities put private investment to work. The governance framework supports Integrated Community Energy Solutions (ICES) at every level.

Communities are also stronger. Reduced spending on energy means that more money stays in the local economy. Efficient local services enhance financial performance. Residents enjoy a higher quality of life. Industry and commerce are drawn to communities by their increased attractiveness.

By 2050, communities are making effective use of local energy sources ranging from on-site renewable energy to waste heat and organic waste, allowing optimal

Solar energy heats energy-efficient homes using solar thermal collectors, seasonal thermal storage and a district heating system. (Drake Landing Solar Community, Okotoks, Alberta)

use of the broader clean energy grids. District energy networks, in many cases, distribute thermal energy for heating and cooling, while smart electrical grids manage local energy supply and demand. Energy storage systems help to balance variations in supply and demand for heating, cooling and power.

Local industrial, commercial and agricultural enterprises approach energy in an integrated way, both within their own operations and with the community. Businesses take advantage of waste heat; use clean, renewable fuels as energy consumers; and capitalize on opportunities as energy producers.

Waste is reduced by the wide-scale use of reusable products and comprehensive recycling programs. Organic waste from households, local businesses and farms is collected, converted to biogas, injected into the gas grid and used as fuel for co-generating heat and power as well as for transportation. Residual waste is used to generate energy when appropriate.

In communities of the future, street orientation, building sites and building designs work together to enable the integration of active and passive renewable energy technologies. Through good design and effective retrofits, buildings of all ages exploit the latest energy-efficient technologies and integrate renewable energy technologies. They have high-performance thermal envelopes and, where appropriate, are connected to community energy systems. Residents and building mangers access real-time monitoring systems to optimize their use of equipment and their interface with district energy systems and the electrical grid.

Community members have access to safe, efficient and reliable transportation options, using the best mode for the needs of their trip. In smaller and rural communities, town centres are pedestrian- and bike-friendly, carpooling and mini-shuttles are well organized, and alternative fuel vehicles are commonplace. In larger communities, residents travel within and between neighbourhoods by using a mix of transportation modes. Pedestrian pathways and cycling lanes for shorter trips are seamlessly connected with powered transit through multi-modal hubs. Transit-oriented

Renewable air conditioning for office buildings is provided by cold seawater, coupled with cold storage in the rock mass underground. The Geo-Energy Vault allows visitors to see and learn about the otherwise hidden system.
(Alderney 5 Energy Project, Dartmouth, Nova Scotia)

building and industry development is focused near cores and nodes. Clean energy vehicle refuelling and recharging stations are conveniently situated. Community form makes goods and services available locally and keeps public spaces vibrant and accessible.

Across communities of 2050, people make informed energy decisions that are smart for them and smart for the planet. A knowledgeable workforce is supported by the tools, information, policies, programs and regulations they need. Planners, architects, community staff, developers and business leaders evaluate, design and implement ICES that make good sense economically and socially.

Local governments coordinate the implementation of ICES, based on strong business cases for their own operations and long-term value for the community. They are supported by federal, provincial and territorial policies and programs that work together to support long-term energy planning. Community energy objectives are set to ensure community benefits and to contribute to energy and emissions targets at the national, provincial and territorial levels. Established business models provide good value for private investment.

Heat-generating equipment to serve residential and local government buildings is housed in the community energy centre. (Centre in the Park, Strathcona County, Alberta)

Land-use regulations give preference to appropriate community form and mixed-use development with good transit access, while property value assessments reflect energy performance. Developers support their applications with energy studies that demonstrate both internal efficiency and community energy integration. Local governments leverage infrastructure investments to improve community energy performance. In larger communities, local governments have the necessary expertise in-house to ensure that ICES thrive. Small, rural and remote communities have access to service organizations and experts who understand their needs and can complement limited but informed staff resources.

Effective performance monitoring and reporting provides comprehensive and up-to-date energy information to designers and decision-makers. Standards for integrative technologies facilitate the broad deployment of successful solutions. Regulation and business models support established technologies and the demonstration, validation and commercialization of new technologies, preparing the ground for the next generation of ICES.

As a result of this sustained and systematic application of ICES, Canadian communities are among the most livable in the world. Their residents enjoy a healthy physical environment; a competitive economy; clean, reliable and affordable energy; and efficient community services. ICES have helped municipalities become stronger financially, enabled businesses to become more competitive and supported Canada in meeting federal, provincial and territorial energy efficiency and climate change objectives.

It is recognized that this vision of 2050 may not be fully realized by every part of every community, but by 2050, ICES concepts can be well-established and their benefits well-known. Each new and existing community may adapt these concepts to its own particular situation and use them to guide planning and operations. While communities may each move at their own pace, there are many incremental steps that can be taken right now to move toward the vision.

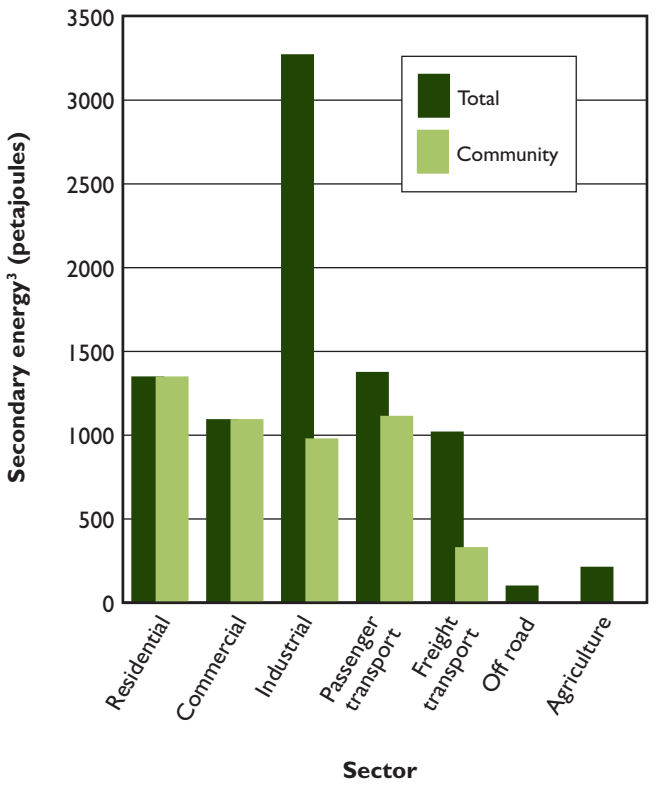
Assessing the Promise of Integrated Community Energy Solutions

Canadian communities account for an estimated 60 percent of national energy consumption. Since 1901, the proportion of Canadians who live in urban areas has grown from 38 percent to 80 percent, and by 2020, this figure could reach 85 percent. Meanwhile, the population is expected to grow to about 43 million by 2050, further increasing the impact on the environment. In this context, Integrated Community Energy Solutions offer great opportunities for improving the energy performance of communities, while enhancing quality of life and Canada's economic competitiveness.

Canadians live in more than 5400 communities. While the communities vary greatly in size and location, they all need energy for transportation, heating, cooling and lighting, as well as to power local industry and commerce.

It is estimated that communities accounted for about 60 percent of Canada's 2006 energy consumption (see Figure 1[1]) with a relatively equal breakdown among four key sectors: residential buildings, commercial buildings, industry and passenger transportation. The energy profiles of Canadian communities vary significantly on a per capita basis, as illustrated in Figure 2. Energy use from homes and buildings is generally consistent across communities, but there is significant variation in use by transportation and industry.[2]

Figure 1. Community Energy Use by Sector, 2006



[1] Figure 1 estimates are based on Natural Resources Canada Comprehensive Energy Use Data Base.

[2] Figure 2 energy statistics are based on community energy plans or local action plans for these communities.

[3] Energy used by final consumers within the specified sector, for all purposes.

As illustrated in Figure 3,[4] under a business-as-usual scenario, community energy use could be expected to increase by about 75 percent by 2050, compared with 2006. This change would lead to a large increase in greenhouse gas (GHG) emissions, therefore increasing the challenge of meeting GHG reduction targets.

Integrated Community Energy Solutions (ICES) have been identified as offering some significant opportunities to reduce GHG emissions. However, there is a shortage of studies that have attempted to quantify the full potential associated with their solutions. To address this gap, a collaborative called Quality Urban Energy Systems of Tomorrow (QUEST) commissioned a study that applied the National Round Table on the Environment and the Economy's modelling approach in the *Getting to 2050* study[5] to assess the potential of ICES for meeting climate change targets. The results, while preliminary, suggest that the potential energy savings and GHG emissions reduction of ICES are promising and "that stringent land-use policy to encourage densification, including constraints on the geographic footprint of cities, specification of densification corridors with fast and reliable transit, and reform of the property tax system to reflect marginal infrastructure building and maintenance costs, has the capacity to reduce direct and indirect urban emissions by approximately 40 to 50 percent in the long run."[6]

Figure 2. Energy use in Selected Communities

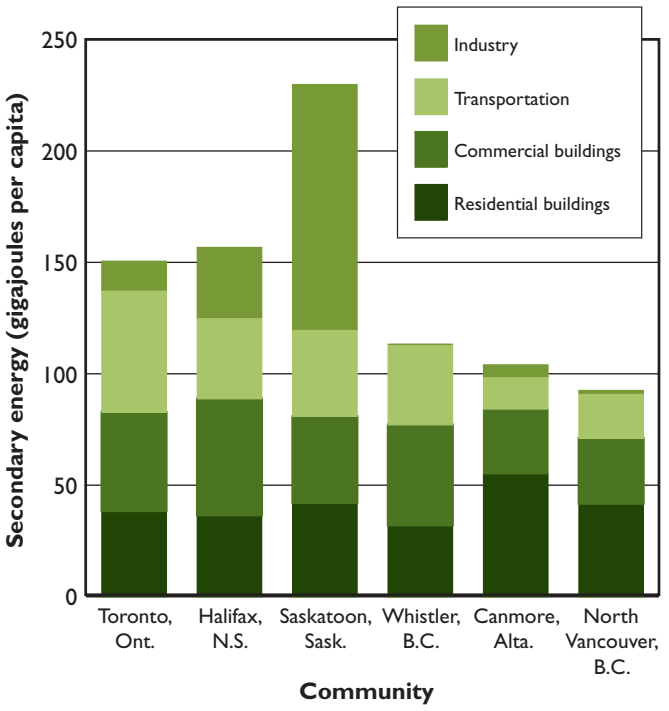
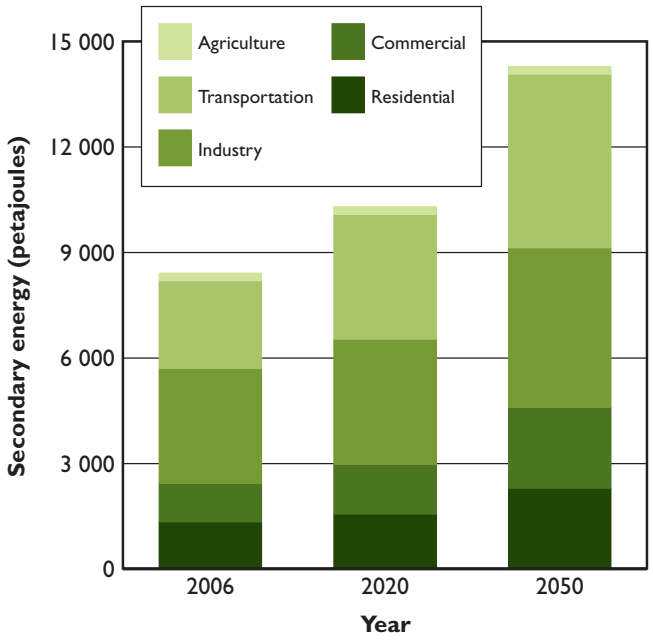


Figure 3. Forecasted Growth in Community Energy Use



[4] Figure 3 2006 estimates are based on Natural Resources Canada Comprehensive Energy Use Data Base; 2020 and 2050 estimates are based on *Scoping report: Exploration of the capacity to reduce GHG emissions by 2020 and 2050 through application of policy to encourage integrated urban energy systems*, prepared by MJKA, for QUEST. 2009.

[5] National Round Table on the Environment and the Economy. 2007. *Getting to 2050: Canada's Transition to a Low-emission Future.*

[6] MJKA. 2009. *Scoping report: Exploration of the capacity to reduce GHG emissions by 2020 and 2050 through application of policy to encourage integrated urban energy systems*, page 3. Prepared for Quality Urban Energy Systems of Tomorrow (QUEST).

The QUEST analysis was supported by a literature review to assess the potential for ICES in Canada. Highlighted were three Canadian studies that have estimated the potential community-level GHG reductions from aspects of ICES to be approximately 43 percent,[7] 47 percent[8] and 50 percent[9] of total community-level emissions. Findings from these studies and others included in the literature review also suggested that emissions reductions could be further augmented by taking advantage of waste, water and waste heat as energy sources.

Community-level studies support these findings. For example, the City of North Vancouver, British Columbia, completed its 100 Year Sustainability Vision in 2008. This initiative explored the feasibility of reducing the community's GHG emissions by 80 percent from 2007 levels by 2050 and eliminating them by 2107. This was a public, stakeholder-driven process that integrated building, transportation, infrastructure and technology options. A key finding was that close to one third of the targeted per capita reductions could be achieved through community form decisions alone. The study found that full realization could be achievable with complementary policies, technology investments, and greater collaboration among regional, provincial and federal governments.

The results of these studies point to a very significant potential. While work continues to better quantify and realize this potential, the message is clear: ICES could form an integral part of Canada's high-performance energy future and its GHG emissions reduction strategies.

District energy mini-plants, housed in select buildings, are added as the system grows.
(Lonsdale Energy Corporation, North Vancouver, British Columbia)

[7] M. Jaccard, L. Failing and T. Berry. 1997. "From equipment to infrastructure: Community energy management and greenhouse gas emissions reduction." Energy Policy, Vol. 25, No. 13, pages 1065–1074. Summary of a modelling project applying community energy management to four representative communities in British Columbia.

[8] Centre for Sustainable Community Development. 2004. *Demonstrating the economic benefits of integrated green infrastructure.* Report prepared for Federation of Canadian Municipalities. This report provides a compelling argument for municipalities to pursue integrated approaches to the development of services and infrastructure.

[9] Canadian Urban Institute (CUI). 2008. *Energy Mapping Study: Calgary.* CUI: Toronto, Onatrio. This study models the changes in building efficiency and requirements for renewable energy to achieve a 50 percent reduction in GHG emissions at the community level from 2005 levels, by 2050. This study also spatially depicts the energy outputs from various land-use scenarios.

Taking a Community Approach

Implementing Integrated Community Energy Solutions (ICES) requires contributions from a range of non-government stakeholders and local governments, supported by the federal, provincial and territorial governments. The ICES approach exploits synergies across multiple sectors through the use of building blocks. Adoption of ICES is affected by drivers influencing community energy use as well as barriers compromising implementation.

The built community environment encompasses multiple sectors that, in most communities, function largely independently of one another. Integrated Community Energy Solutions (ICES) exploit opportunities that come from treating the built community environment as a system.

By addressing the synergies that come from integrating sectors and taking advantage of cross-cutting opportunities at the community level, savings beyond those available in the individual sectors can be achieved.

Most importantly, the benefits of ICES investments go beyond more efficient resource use and reduced emissions. They include a wide variety of social, economic and environmental advantages, including more livable cities and a better quality of life for citizens, improved air and water quality, local economic stimulation and increased competitiveness, reduced exposure to fluctuations in energy prices and increased attractiveness to new investment.

Key Players and Their Roles

Advancing ICES requires the involvement of many players. Each has a critical role to play.

Local governments (including municipalities, regional governments and First Nations) are key actors because their zoning, policy and investment decisions have a huge influence on ICES development. They usually approve ICES installations and provide leadership at the community level.

Provincial and territorial governments are important players because they define the legislative frameworks under which municipalities operate. They are responsible for much of the regulation of the energy resources sector and can greatly influence the capacity of utilities and energy companies to actively support ICES. They also provide education and training opportunities, undertake research, create decision-support tools and make direct investments that can encourage ICES.

The Government of Canada, through various departments and agencies, can provide information, conduct research and development and play a coordination and facilitation role, helping the jurisdictions collaborate and avoiding duplication.

Developers and other private enterprises are critical implementers of ICES. With governments fostering a positive environment for ICES, developers and industry will find the business models, acquire the capacity and collaborate with local governments to make widespread ICES a reality.

Energy companies, utilities and regulators provide the energy supply and services that are essential to ICES. These solutions generate new opportunities and business models for utilities and competitive energy service providers, which energy regulators will wish to address. These players are critical to the ICES future because of their ability to attract investments and because of their ownership and oversight of integrated solutions using the conventional grid/fuel infrastructure, local energy production, renewable energy systems, storage, district systems and more.

Figure 4. Advancing Integrated Community Energy Solutions requires a supportive environment and integration across multiple sectors in the community.

Other ICES enablers work to create the environment where there is public support for ICES and the capacity to deliver. These include professional and industry associations, education organizations, and non-governmental organizations. Community members, through their choices as citizens and consumers, also play a central role in advancing ICES.

Sectoral Building Blocks

Within each sector, there are technologies and techniques that can contribute to realizing the cross-cutting opportunities that make up ICES. Bringing these building blocks together can result in synergies that achieve otherwise unattainable levels of energy performance. The building blocks in this section highlight some of the technologies and techniques within each sector that can enable communities to leverage these synergies as they build their own tailored solutions.

Energy Supply and Distribution. These systems can connect energy users with the best energy source for each job, combining on-site renewable sources and interconnection with grid distribution systems. Key elements include heat recovery and energy cascading, harnessing local renewable energy resource potential, district energy systems, decentralized energy systems, grid management initiatives and community thermal and electrical storage.

Transportation. Transportation services and transportation infrastructure can facilitate the efficient movement of people and goods by enabling residents and businesses to choose the best modes for each trip and by ensuring that goods move efficiently throughout the community. Opportunities include focusing development near cores and nodes; transit-oriented development; infrastructure for cyclists, pedestrians and alternative fuel vehicles; multi-modal hubs; and efficient freight transportation.

Housing and Buildings. Housing and buildings can provide highly livable and efficient shelter for people and businesses that is connected with appropriate energy sources. In this sector, high levels of energy efficiency, strategic integration of active and passive renewable energy technologies, optimized design for connection to local micro grids and low-exergy community energy systems that use waste heat and renewables can all contribute to ICES.

Industry. Businesses can be involved in ICES as energy consumers, energy producers and suppliers of waste heat. They can also supply organic waste and other opportunity fuels for the generation of clean energy. Additional opportunities include energy cascading and heat recovery, low energy/exergy facilities, strategic integration of renewable energy technologies and clean, renewable fuels.

Local Community Services. Community services can exploit opportunities for energy efficiency, heat recovery and efficient energy production. These opportunities include efficient infrastructure such as street lighting; pumping and treatment of water and sewage; waste management, including waste minimization; increased recycling; and energy production from both organic and residual waste. Another key element is efficient local government operations (e.g. buildings, fleets, snow removal and green space management).

Land Use and Community Form. While not under the purview of energy departments, land use and community form create the foundation of viable ICES. Over time, street patterns and shapes, population densities, community design and building types can be modified to establish supportive conditions for ICES.

Cross-Cutting Opportunities[10]

Improve efficiency. Reduce the energy input required for a given level of service.

Optimize community form. Use land-use decisions to reduce and concentrate energy demand, support efficient transit and facilitate the integration of renewable energy sources.

Increase complementary mixed uses. Locate activities to enable performance gains from the generation, distribution and transportation sectors.

Optimize "exergy." Match energy quality to the applications *(see sidebar)*.

Manage heat. Capture all feasible thermal energy and re-use it, rather than exhaust it.

Reduce waste. Use all available resources, such as landfill gas and municipal, agricultural, industrial and forestry wastes.

Use renewable resources. Tap into local solar, wind and geothermal energy.

Use grids strategically. Optimize electrical, fuel and thermal grid use from all sources and ensure reliability.

Exergy deals with quality of energy and using the right quality of energy for the right application.

For example, why burn fuel at high temperatures to heat a building when **cascading** residual heat from an industrial process or using low-temperature heat from solar systems can do the job?

ICES manage energy and exergy for optimal energy performance.

[10] Adapted from principles developed by the QUEST collaborative.

Solutions include an increased selection of businesses and services within walking or cycling distance, improved transit service and the systematic integration of active and passive renewable energy technologies.

An Enabling Environment. While policies, programs, regulations and tools do not form a sector in and of themselves, they contribute to the synergies necessary for achieving otherwise unattainable levels of energy performance in communities. More about the key enabling elements that can be used by federal, provincial and territorial governments can be found on page 20.

Forces Affecting ICES Implementation

It is recognized that a number of forces affect ICES implementation and need to be taken into consideration to ensure the effectiveness of collective efforts to accelerate the uptake. These forces include drivers that directly affect how energy is used in communities as well as barriers that impact the widespread adoption of ICES. In developing and implementing strategies to advance ICES, jurisdictions should consider these forces.

Drivers Influencing Energy Use in Communities

Energy and land availability. Community development patterns over the past several decades have been driven by the availability of low-cost energy and land resources. Higher energy and land prices will drive more efficient energy use, but price signals alone will not achieve the ICES vision because of their complex interaction with other drivers.

Technology. Modern energy and transportation systems have already displaced access to wood and water that were once key drivers of community size, shape and location. Other emerging technologies (including information technologies and renewable energy technologies) will shape communities of the future.

Demographics. By 2020, up to 85 percent of Canada's growing population and the vast majority of jobs will be located in major urban centres. In the past, urbanization led to urban sprawl and dependence on personal vehicles, but with appropriate government policies, communities of the future can evolve toward more efficient configurations.

Cycling and walking paths connect energy-efficient buildings served by a community energy system. (Centre in the Park, Strathcona County, Alberta)

Rural and northern communities. Even with rapid urbanization, roughly one fifth of Canadians still live in small rural and northern communities, many of them with resource-based economies. Even in small towns, there is sufficient density and opportunity for ICES. Further, new opportunities for renewable energy can strengthen local economies by creating jobs and reducing financial outflows for the purchase of energy.

Energy security. Energy is increasingly viewed as a strategic resource within communities, due to the risks and costs of service disruptions. This consideration makes a desire for secure and reliable energy an emerging driver of ICES that make communities less susceptible to system-wide failure.

Infrastructure renewal. Communities across Canada are in need of infrastructure renewal. The investments needed to replace aging infrastructure will create opportunities to facilitate the introduction of ICES.

Consumer preferences. Consumer choices have contributed to shaping today's communities. Consumer preferences are changing, and there is a strong move toward alternatives that are economical as well as beneficial to the environment and quality of life. ICES will give citizens new choices that can address consumer demand for energy efficiency, affordability and convenience.

Electricity generated from landfill gas is sent to the grid. The use of waste heat in a nearby new development is under evaluation. (Ecotricity Guelph Inc., Guelph, Ontario)

Climate change. Growing concern about climate change is driving interest in solutions that can achieve the deep reductions needed to stabilize global climate conditions. Communities have also started to consider how ICES can help them adapt to climate change, for example, by helping decrease vulnerability to extreme events through more resilient energy systems.

Barriers to Implementation of ICES

Decision making and inter-jurisdictional complexity. The complexity of decisions required at all stages of ICES planning, development and implementation challenges the existing decision-making structure. Decisions are technically complex, involve multiple stakeholder groups and cross departmental and jurisdictional boundaries. Few tools exist to support multi-stakeholder decision making.

Poor understanding of the ICES potential. There is little awareness among key stakeholders of the potential for ICES to help achieve national greenhouse gas (GHG) and energy efficiency goals. This is partly because best practices are not well documented, and the benefits are not adequately quantified. The business case for ICES implementation is also not well articulated.

Shortage of ICES experience and expertise. Canada has little experience with fully integrated ICES. The lack of on-going projects inhibits the development of the technical expertise needed to lead new projects or nurture the expertise that governments need to undertake financial, technical and strategic analysis of ICES.

Inadequate policy and regulatory support. Existing policy and regulation frameworks are not well suited to promoting ICES. Moreover, ICES initiatives may fall victim to uncoordinated or conflicting policies and regulations, or get caught in jurisdictional gaps. ICES proposals also face competition from other government priorities.

Limited support for research and development, demonstration and deployment. Current levels of funding for research and development, demonstration and deployment programming will not support the rapid transition necessary to deliver on the potential of ICES.

Limited integration of energy considerations in community planning. Provincial and territorial legislation and polices do not generally require community planning processes to fully address energy issues. Community energy plans are not required in most jurisdictions. The lack of mandatory community-specific GHG reduction targets weakens the signal for local authorities to fill this gap.

Shortage of accessible data and analysis tools. Locating and assembling the information needed to identify, evaluate, select and implement ICES can be costly and time-consuming. Relevant community-level data are often not available, and those that are collected are often not reported in a way that supports community energy planning. Moreover, the tools to identify and analyse opportunities for ICES are not available to all communities.

Demographic barriers. In several regions of Canada, many smaller communities are faced with a decline in population. Implementing ICES in these circumstances can be challenging because these communities may not have the resources to make significant changes.

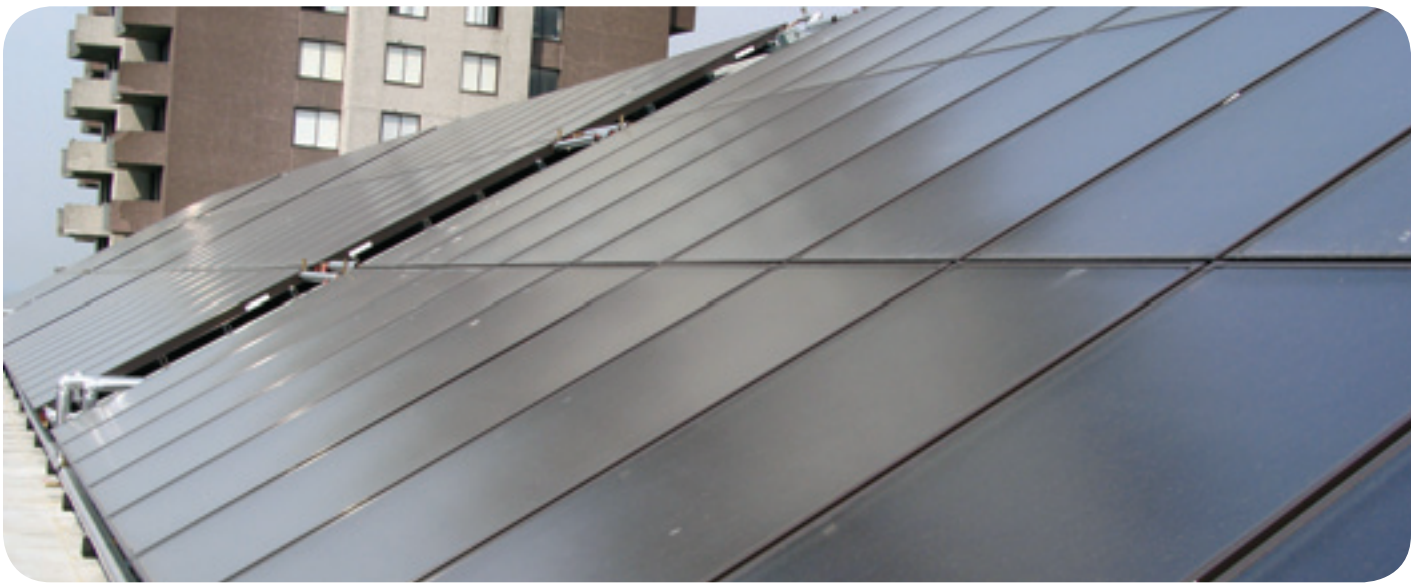
Cultural barriers. To succeed, the implementation of ICES will have to account for the cultural preferences of Canadians, ensuring that the features, advantages and benefits of ICES create positive consumer choice and transition, as appropriate.

Learning from Successful Communities

Across Canada and around the world, communities are beginning to take advantage of cross-cutting opportunities and are beginning to implement Integrated Community Energy Solutions (ICES). Governments at various levels are creating programs to support implementation, and numerous organizations are working to further develop these ideas. Collectively, these activities provide valuable learning about how a shift toward the wide-spread adoption of ICES can be carried out – including new technology solutions, decision-making processes and business models.

Canadian Examples

Canadian examples can be found in communities large and small, including existing neighbourhoods and new developments that are implementing Integrated Community Energy Solutions (ICES) with support from governments of all levels. Most of these examples are achieving integration across two or three sectors, and a few are addressing many sectors. These particular showcases have largely come to fruition as the result of leadership by champions who are exploring new ways to improve overall energy performance in communities. Beyond demonstrating and validating new technology and novel uses of existing technology, these examples are enabling the identification of barriers and the development of new approaches that nurture innovation.



Renewable heat captured through rooftop solar thermal collectors is distributed through the community energy system. (Lonsdale Energy Corporation, North Vancouver, British Columbia)

Small and Rural Communities

City of Dawson Creek, British Columbia, is a small community that has completed a comprehensive energy plan for the community and implemented such innovations as building audits and retrofits, light-emitting diode (LED) traffic lights, a solar-ready bylaw, training, energy program promotion and, potentially, local improvement charges.

Colonsay Sports Centre, Town of Colonsay, Saskatchewan, captures the waste heat from creating ice for the skating and curling rinks to heat the waiting room and the observation area.

Drake Landing Solar Community, Okotoks, Alberta, features R-2000* homes incorporating low-exergy systems, solar district heating, seasonal borehole thermal energy storage and short-term thermal storage. This is a technology pilot with multiple partners, including Natural Resources Canada, the Federation of Canadian Municipalities, the municipality, the builder, the developer and a private gas utility.

Hairy Hill Integrated BioRefinery, Vegreville, Alberta, is a technology pilot using anaerobic digestion to produce biogas from manure from a large feedlot. The biogas is in turn used to generate electricity and, soon, to manufacture ethanol.

Oujé-Bougoumou District Heating, Oujé-Bougoumou, Quebec, provides village-wide heating to efficient homes and buildings using wood waste (biomass) as the fuel source and hot water as the energy transfer medium. This technology forms part of the ongoing community revitalization and self-sufficiency efforts.

Thermal Park, Senneterre, Quebec, will be recovering waste heat from an existing cogeneration unit and redistributing it to farming, agri-food, agro-industrial and processing applications – including greenhouses. This approach will increase the diversity of the local economy, which is mainly based on the development of natural resources.

*R-2000 is an official mark of Natural Resources Canada. R-2000 is a system for building and certifying new homes to a higher energy efficiency standard, well beyond current energy codes.

Medium-Sized and Large Communities

City of Guelph, Ontario, is a medium-sized community with a community energy manager and a comprehensive community energy plan developed by a consortium and implemented through a number of initiatives led by various stakeholder groups, including landfill gas-generating electricity.

District Energy System, Charlottetown, Prince Edward Island, uses both sawmill waste and municipal solid waste to provide heat to more than 80 buildings and to generate electricity. Charlottetown has substantially reduced its dependency on imported oil, retained more energy dollars in the community, created new opportunities for sawmill operators and reduced greenhouse gas (GHG) emissions.

Dockside Green, Victoria, British Columbia, is a high-density, mixed-use harbour front brownfield re-development with a biomass gasification district heating system. The first-phase buildings have achieved Leadership in Energy and Environmental Design (LEED™) Platinum certification. The project was initiated under a municipal request for proposals and is serviced by a private multi-utility and partnerships with local industry.

Emerald Hills Urban Village, Strathcona County, Alberta, is a medium-density, mixed-use development with ongoing local government-developer collaboration through an integrated planning process.

Enwave Deep Lake Water Cooling, Toronto, Ontario, is a private district heating and cooling system that draws cold water from Lake Ontario to provide cooling in a high-density system that covers most of the city's downtown core and serves more than 140 buildings.

Lower Lonsdale Development, North Vancouver, British Columbia, is a mixed-use development with efficient new buildings and a district heating system using mini-plants (natural gas and solar thermal) that is operated by a public/private municipal utility.

Mole Hill, Vancouver, British Columbia, is a medium-density neighbourhood renewal project with building energy retrofits and strategic integration of individual ground-source heat pumps. It is an example of city-owned, affordable housing supported by community partnerships.

Municipal Energy Efficiency Program, Saint John, New Brunswick, includes energy retrofits to multiple municipal buildings, remote building energy monitoring, LED traffic lights, a photo-control time system for street lights, an energy-awareness program and energy management procurement procedures.

Sawmill Waste-to-Electricity Project, Middle Musquodoboit, Nova Scotia, is located within a sawmill plant, using biomass waste from its operations to provide the majority of the fuel for the facility's power and heat requirements. Surplus energy is sold to a local utility company.

National, Provincial and Territorial Initiatives

Arctic Energy Alliance, Northwest Territories, is a non-profit society with a mandate to help communities and other stakeholders work together to reduce energy and utility environmental impacts. It maintains a list of "Northerners Taking Action" to disseminate success stories.

British Columbia's *Local Government (Green Communities) Statutes Amendment Act* mandates GHG targets and establishes municipal authority to set energy requirements for new developments.

Building Canada is a federal government infrastructure funding program that includes the Gas Tax Fund, Green Infrastructure Funds and the Building Canada Fund, administered by Infrastructure Canada. The program requires the development of an integrated community sustainability plan in order to receive funding.

CanmetENERGY is the clean energy research and technology development centre of Natural Resources Canada. The centre leads and supports knowledge development in housing, buildings, renewable energy technologies, bioenergy, district heating, community planning, transportation and industrial processes.

The Community Energy Association provides communities in British Columbia with information and resources to support the development of community energy plans and community energy systems.

The EQuilibrium™ Communities Initiative will seek to improve community planning and develop healthy sustainable communities that are energy-efficient, economically viable and vibrant places to live. It will provide financial, technical and promotional assistance to sustainable community projects chosen through a national competition and showcase the talents and innovation of Canadian residential developers, planners, designers and municipalities. The initiative is being led and funded equally by Natural Resources Canada and the Canada Mortgage and Housing Corporation.

The Federation of Canadian Municipalities (FCM) Green Municipal Fund is a $550-million endowment from the Government of Canada to provide a long-term source of financing for municipal governments and their partners for the development of communities that are more environmentally, socially and economically sustainable.

Ontario's *Green Energy and Green Economy Act, 2009* will make it easier to bring renewable energy projects to life and provides certainty for renewable project developers by providing a best-in-class renewable energy feed-in tariff (FIT). The FIT is a mechanism that provides a standard price that promotes the development of community-based and large commercial renewable energy projects and pays proponents a market-viable price for their projects.

Partners for Climate Protection (PCP), managed by the FCM, is a Canada-wide partnership of municipal governments that encompasses GHG targets, energy profiles and community energy planning. PCP assists nearly 200 Canadian cities in adopting policies and implementing quantifiable measures to reduce local GHG emissions, improve air quality and enhance urban livability and sustainability.

Quality Urban Energy Systems of Tomorrow (QUEST) is a collaborative of key players across Canada from industry, the environmental movement, governments, academia and the consulting community that is building support for an integrated approach to land-use, energy, transport, water and waste management in communities and urban centres in order to address energy end-use and reduce GHG emissions.

International Examples

While complete ICES remain in the early stages of development around the world, many countries are actively involved in ICES-related research, development and demonstration projects, and some have long-term experience with certain ICES elements. Adapting the international lessons learned to the Canadian context has been critical to the success of a number of leading initiatives in Canada. These initiatives, in turn, are contributing to the growing international body of ICES knowledge. A number of international organizations have worked to disseminate information about best practices. Canada, by investing in ICES, will be well positioned to take advantage of growing domestic and international markets.

International Examples

The **International Energy Agency (IEA)** recognizes the potential of ICES and has created reports that provide comprehensive reviews of the current state of knowledge. The IEA is working on *Annex 51: Energy Efficient Communities: Case Studies and Strategic Guidance for Urban Decision Makers*. Its objectives are to inform planners and decision-makers about the principles of holistic energy planning and to provide methods and instruments for implementation. This work complements ongoing and completed work in a broad range of areas in energy conservation and energy technologies for buildings and community systems.

More than 1076 cities, towns, counties and their associations worldwide comprise **ICLEI – Local Governments for Sustainability**'s growing membership. ICLEI works with these and hundreds of other local governments through international performance-based, results-oriented campaigns and programs. A significant part of ICLEI's work focuses on community energy solutions. ICLEI partnered with the Federation of Canadian Municipalities to create the Partners for Climate Protection program in Canada.

In 2003, the **International Gas Union** conducted a competition that challenged countries to prepare a staged 100-year sustainable energy plan for a major metropolitan area. Canada's submission – which centred on Greater Vancouver (now Metro Vancouver) – resulted in Team Canada being awarded the Grand Prix at the International Competition on Sustainable Urban Systems Design in Tokyo in June 2003. It also resulted in Cities Planning for Long-Term Urban Sustainability, or cities^{PLUS}, a collaborative approach that has now been applied in 38 cities in 14 countries.

European initiatives incorporate some of the most advanced ICES concepts. For decades, Sweden has placed national priority on district heating systems, which now provide more than half of its residential space heating. Other examples are the BedZED in London, the United Kingdom; and the Western Harbourfront redevelopment in Malmö, Sweden. To accelerate work in this area, the European Commission has recently launched the CONCERTO initiative, which supports sustainable energy projects in 45 communities. The European Council and the European Commission are also active in developing policies and programs to support progress toward a sustainable built environment.

Making It Happen

Integrated Community Energy Solutions (ICES) promise to yield substantial improvements in energy performance and greenhouse gas emissions reductions. Federal, provincial and territorial governments could support ICES implementation through the use of various enabling tools, as appropriate to each jurisdiction, and through inter- and intra-jurisdictional cooperation.

Overarching Strategies

To support the adoption of Integrated Community Energy Solutions (ICES) in Canada, federal, provincial and territorial governments can pursue their own strategies, taking into consideration their specific circumstances. The following are overarching strategies that could guide the development of supportive environments for ICES.

Cooperate with other jurisdictions. In advancing ICES, federal, provincial and territorial governments could benefit from working together to establish coordinated and complementary strategies.

Lead within own jurisdiction. Energy departments could also play a leadership role within their own areas of influence while working collaboratively with other departments.

Adopt both a holistic and an incremental approach. The transition to ICES requires the development of solid holistic planning foundations on which to move forward. However, while these foundations are being established and even afterward, the implementation of ICES will be through incremental transformation of communities, one project, block, neighbourhood, facility or transit system at a time.

Empower local governments. Local governments have a leadership role to play in implementing ICES. Federal, provincial and territorial governments could facilitate this role by creating a supportive environment, which could address authority, capacity and resource challenges facing local governments.

Establish a market transformation framework. Facilitate the transition of communities across Canada with a comprehensive market transformation framework to realize the full potential of ICES.

A Three-Phase Transition Approach

Communities that are just beginning the process of implementing ICES can benefit from lessons learned by Canadian communities that have overcome the challenges associated with ICES implementation. International experience with ICES, especially in Europe, also demonstrates the feasibility of ICES and provides models for communities to follow.

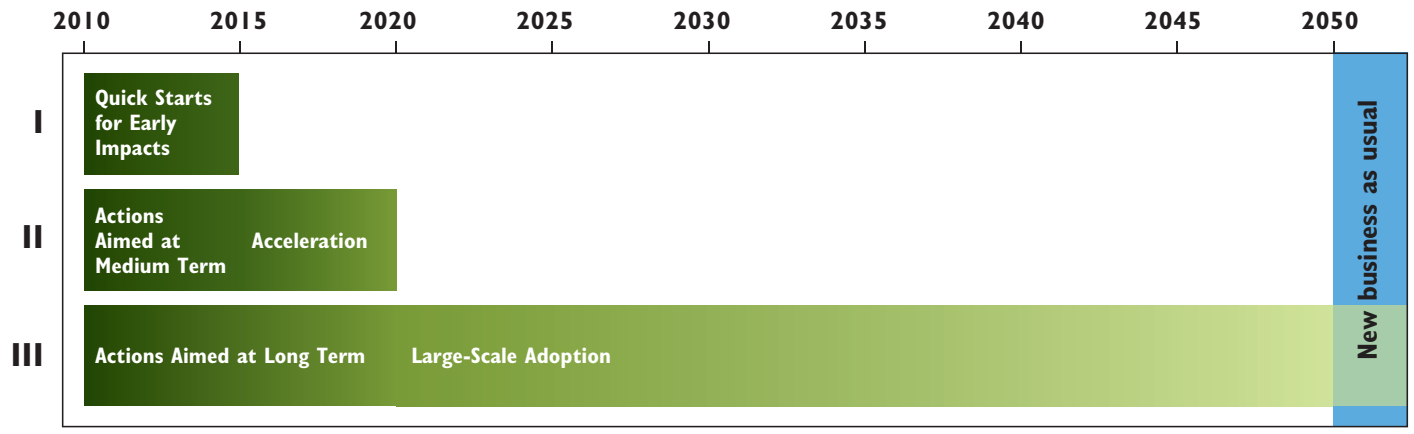
To facilitate the transition to a new business-as-usual environment where ICES are the norm, a three-phase approach is proposed. Tools described in the "Menu of Enabling Tools" (on page 21) may be included in these three phases by jurisdictions as they develop their own strategies. Examples are provided here to illustrate the proposed approach.

Phase I: Quick Starts for Early Impacts (2010–2015), in the short term, could begin with quick-start projects as well as large-scale demonstration and pilot projects that deliver early results, provide lessons learned and set the stage for future broader application of ICES. For example, more projects similar to those highlighted in this document may result when communities are encouraged to take advantage of existing programs and by adjusting other programs to increase support for ICES. This phase could also lead to a marked increase in the number of communities developing community energy plans or local action plans that incorporate a specific focus on ICES. These plans are essential to identifying opportunities, supporting the development of business cases for ICES projects and preparing for the acceleration called for in Phase II. Establishment of community level targets, like those required in British Columbia's *Local Government (Green Communities) Statutes Amendment Act,* could also help lay the foundations for future phases. Creation of a network of experts could support the development of information and best practices as well as the sharing of ICES expertise that could help all three phases.

Phase II: Acceleration (2010–2020) has a medium-term focus but could also start to establish the foundations necessary for the acceleration of ICES implementation. This acceleration is important if ICES are to make a significant contribution to the 2020 climate change and energy efficiency targets. Activities for this phase could include the development of programs, policy and regulations that support large-scale adoption of ICES and create a supportive environment for private sector investments; research to improve the quantification of the benefits of ICES and to prepare business cases; and increased support for research and development activities aimed at validating and improving existing technologies as well as the development of tools to support ICES decision making.

Phase III: Large-Scale Adoption (2020–2050) has a long-term focus but could also start now with actions to develop the next generation of ICES technologies, offering the prospect of new opportunities and facilitating the large-scale adoption of ICES. Activities for this phase could include policies and regulations that can be phased in over time; long-term funding covering all stages of the innovation cycle to support the development of the next generation of ICES methods and technologies; and ICES training programs and certification processes to facilitate rapid adoption of the next generation of ICES technologies.

Figure 5. A Three-Phase Transitional Approach



District heating pipes connect the thermal energy supply to customer buildings.
(Lonsdale Energy Corporation, North Vancouver, British Columbia)

Fostering and Enabling

To advance ICES, the enabling tools listed below are organized according to the Market Transformation Framework elements from *Moving Forward*.

Policies and Regulations. Policies and regulations for areas such as planning and land use, energy, buildings, and taxation shape how communities look and operate. Effective policies encourage local authorities and other decision-makers to integrate energy, land-use, transportation and infrastructure considerations.

Technology, Best Practices and Decision-support Tools. Reliable, high-performance technological solutions are needed to maximize the effectiveness of ICES and facilitate wide-scale adoption. The development and validation of new technology, including the tools that facilitate analysis of alternatives and guide decision-makers, are important. The results of pilot and demonstration projects verify performance and can be disseminated to increase knowledge of the available technologies, best practices and tools.

Information. High quality, community-level standardized energy measurement and information is important for understanding evolving energy use. It supports target-setting, decision making, communicating priorities to stakeholders, quantification, progress reporting and evaluating the success of ICES initiatives.

Capacity Building. Decision-makers, professionals and technicians require the capacity to understand, identify, evaluate and implement ICES opportunities. This includes access to the analytic capacity to evaluate costs and benefits and to the technical and process capacity to design and implement solutions.

Leadership Opportunities. Advancing ICES on a wide scale requires the active engagement of leaders at all levels of governments and across a wide range of stakeholder groups. These leaders could be supported in developing their visions of how ICES opportunities can be realized within their own organizations and at the community level. Working together, leaders can also develop networks and collaboratives to accelerate progress. Governments could also provide leadership by implementing ICES within their own facilities.

Market Stimulation. Market stimulation can accelerate ICES uptake and help to manage the transition to wide-scale implementation. Market instruments can include government support for early adopters and large-scale piloting, incentives, mechanisms to underwrite liability, long-term funding commitments for R&D activities, supportive energy rate structures and a commitment to support commercialization of proven technologies. Financial tools to understand and manage risk, promote market recognition and create increased perceived value by customers can all encourage the wide-scale uptake of ICES.

Menu of Enabling Tools

Experience in Canada and abroad has identified practical tools that the federal, provincial and territorial governments can use to realize the potential of ICES. A list of two dozen such tools is provided below, organized under each element of the Market Transformation Framework. Jurisdictions could prioritize and choose from this list to support their own strategies and to achieve their own short- and long-term objectives. They could also add tools specifically designed for their specific environments, as some of the tools described below may not be appropriate for all jurisdictions. The tools listed under each element could be used in combination to maximize contribution to the three phases of transition.

Policy and Regulation	Analysis to Support Policy Development	Support modelling work and review existing ICES initiatives to explore potential for replication. Document the drivers and rationale for ICES implementation and develop model business cases. Conduct economic studies of pricing mechanisms for ICES.
	Energy and Climate Change Plans	Recognize the role of communities in federal, provincial and territorial government strategies and plans, and coordinate related goals for 2020 and beyond. Ensure that community plans are in place to help deliver on these goals.
	Policy and Regulation	Undertake coordinated policy and regulation reviews to drive the development of a supportive environment for ICES. Examples are provisions for ICES in municipal acts, measures allowing utilities to encourage ICES, enabling local governments to designate areas for ICES promotion or to apply local improvement charges or tax reductions, setting efficiency requirements and interconnection standards for small community energy systems and developing and mandating interconnection standards for community power generation.
	Cooperation Across Jurisdictions	Explore ways in which regulations and policies can be better aligned to foster the adoption of ICES.
	Model Community Energy Guidelines	Develop a standardized framework that communities could reference when establishing requirements for achieving varying community energy targets, for example, by creating model energy guidelines for communities.
Technology, Best Practices and Decision-support Tools	Research, Development, Demonstration and Deployment	Provide long-term funding covering all stages of the innovation cycle to support both the current and the next generation of methods and technologies.
	Quantification	Develop standardized measurement methodologies for ICES initiatives, including standards for measuring energy flow, greenhouse gas emissions and other outcomes at the community level.
	Decision-support Tools	Develop a suite of tools and supporting data services for different community types that can be used at all stages in the decision-making process. Examples could include an EnerGuide for Communities labelling system (based on "Quantification," above), energy mapping tools, simulation tools, integrated planning processes and fully integrated Geographic Information Systems tools to enable spatial analysis of community energy profiles.
	Technology Validation	Develop programs and procedures for validating the effectiveness of ICES technologies to ensure that expected benefits are achieved from investments.
	Networking	Establish a network of experts to support the development of information and best practices and the sharing of ICES expertise.

Information	Decision-making Support	Collect and publish high-quality information to support decision making and energy planning as well as ICES business cases. This information could include community energy profile data and performance data from existing ICES projects.
	Outreach	Publicize success stories from existing ICES projects through information products and campaigns to educate stakeholders and promote market acceptance.
Capacity Building	Partnering	Partner with existing and well-established organizations to deliver webinars, workshops, conferences and site visits allowing exchanges of ICES experience that will develop or strengthen the capacity of key players to implement ICES.
	Certification	Support the establishment of ICES training programs for those involved in their development and implementation (e.g. planners, engineers, tradespeople) as well as the development of certification processes for these programs.
Leadership Opportunities	Leadership by Example	Demonstrate leadership by implementing and leveraging ICES within their own operations.
	Collaboration and Recognition	Support and recognize individuals, organizations and collaboratives that provide ICES leadership, such as local leaders, the Federation of Canadian Municipalities and Quality Urban Energy Systems of Tomorrow (QUEST).
Market Stimulation	Risk Management	Establish mechanisms to manage/reduce risks associated with ICES projects to compensate for technical complexity and long implementation cycles. Examples are underwriting liabilities for some projects and guaranteeing prices for energy purchases.
	Coordinate Existing Mechanisms	Coordinate/adjust existing government market instruments. Investigate how existing funding, financing and delivery mechanisms could be better coordinated and potentially adjusted to support ICES. For example, ICES funding options could be integrated into existing infrastructure renewal and fiscal stimulus packages.
	Incentives	Use fiscal incentives to improve the financial performance of ICES projects. Examples are tax credits and accelerated depreciation for ICES investments.
	Facilitate Energy Rate Structures That Support ICES	Set energy rate structures to support ICES through price premiums for ICES-generated energy, inclusion of ICES investment by utilities in their rate base and decoupling of profit from sales for energy utilities.
	New ICES Programs	Explore the development of new targeted programs (e.g. incentives, tax credits, financial mechanism to underwrite liability) to support the broad adoption of ICES, as a complement to sector-specific programs.
	Business Models	Encourage the development of business models that will facilitate the introduction of ICES, such as micro-utility ownership, municipal ownership, local distribution company ownership, community-owned cooperatives and public-private partnerships.
	Demand Management	Encourage development of utility demand-side management programs that focus specifically on ICES.
	Market Recognition	Build ICES market recognition through initiatives that recognize success stories and encourage incorporation of ICES in rating systems, such as the Canada Green Building Council's Leadership in Energy and Environmental Design (LEED™) for Neighbourhood Development rating system.

Conclusion

Integrated Community Energy Solutions can enable communities to dramatically improve energy performance, enhance quality of life and increase economic competitiveness, while contributing significantly to the achievement of federal, provincial and territorial energy efficiency and climate change targets.

Integrated Community Energy Solutions – A Roadmap for Action shows that capitalizing on synergies at the community level can improve energy performance and cut greenhouse gas emissions. The Roadmap follows in the steps of the Council's 2007 *Moving Forward* by stressing the importance of federal, provincial and territorial leadership and collaboration in obtaining these results. Supported by a stakeholder consultation process, it sets out a broad strategy for action and provides a Menu of Tools that federal, provincial and territorial governments can choose from, as they see fit, to complement existing sectoral energy efficiency activities.

While this document can help guide government efforts, success ultimately hinges on the engagement of many actors in local communities. The proposed three-phase approach is a framework for encouraging early action as well as medium- and long-term successes. The timetable recognizes the importance of establishing solid foundations and mechanisms to support accelerated uptake of Integrated Community Energy Solutions (ICES) to ultimately achieve large-scale adoption. It also recognizes the benefits of ongoing, incremental actions while holistic foundations are established. This approach could allow existing knowledge and expertise to produce results right away, while capacity continues to be built for transition toward the larger-scale implementation of ICES, contributing to Canadian communities' vibrancy, livability, environmental responsibility and prosperity.

Data gathered from a pilot plug-in hybrid electric vehicle support studies on impacts and opportunities. (City of Dawson Creek, British Columbia)

Energy-efficient buildings and higher density occupation reduce the infrastructure required for the biomass community energy system.
(Dockside Green, Victoria, British Columbia)

Appendix

Additional Examples of Integrated Community Energy Solutions

Small and Rural Communities

Haines Junction Geothermal Heat, Haines Junction, Yukon, is a joint project between the territorial and municipal governments to use the village's geothermal artesian well to heat the local convention centre. A feasibility study has been completed, and phased implementation is planned.

Plateau Subdivision, Iqaluit, Nunavut, is an area designated by the municipality for development of a sustainable Arctic subdivision. A feasibility study identified best practices and led to the creation of the *Plateau Development Scheme*, setting out approved development standards for a mixed-use community.

Revelstoke Community Energy Corporation, Revelstoke, British Columbia, is a municipal utility that combusts industrial wood waste from a lumber mill in a biomass boiler to generate low-pressure steam for industry and heat for local institutional and commercial buildings.

Village de la Gare, Mont-Saint-Hilaire, Quebec, is a high-density, mixed-use, transit-oriented development being built around a South Shore commuter train station outside Montréal. Facilities are grouped to encourage shoppers to travel on foot.

Medium-sized and Large Communities

Alderney 5 Energy Projet, Dartmouth, Nova Scotia, provides cooling to a 300 000-square-foot commercial and retail complex using the cold seawater in the Halifax Harbour. Cooling is provided directly by pumping the cold seawater into the building and supplemented by cool thermal energy storage for the eight weeks when the seawater is too warm.

Centre in the Park, Strathcona County, Alberta, is a medium-density, mixed-use community with a district heating system, operated by a municipal utility, that is connected to municipal and residential buildings.

Greenhouse Gas Reduction Strategy, Whitehorse, Yukon, is a plan accepted by City council in 2004 to reduce its greenhouse gas (GHG) emissions by specific targets. The City followed up in 2007 with the *Integrated Community Sustainability Plan* that encompasses every aspect of community development, including energy, and sets out a list of high-priority projects.

London Energy Efficiency Partnership, London, Ontario, is a municipality-led process for defining and evaluating energy-saving and renewable technologies for new residential construction in the London area.

Red River College, Winnipeg, Manitoba, has constructed an energy-efficient building at its Princess Street Campus that incorporates carbon dioxide and occupancy sensors with mechanical and electrical interconnection, and a 12.8-kilowatt building integrated photovoltaic array on the south facade curtain wall. Passive solar gain is accomplished by using large industrial-style windows with spectrally selective glass.

Regent Park Revitalization, Toronto, Ontario, is a high-density, mixed-use redevelopment with energy-efficient buildings and a district energy system. Regent Park is pedestrian-friendly and stresses efficient and affordable social housing through combined municipal and private development.

Town of East Gwillimbury, Ontario, has launched the Thinking Green Initiative, a municipal policy requiring energy-efficient new houses (ENERGY STAR®) and other buildings (Leadership in Energy and Environmental Design [LEED™] Silver) in this community.

National, Provincial and Territorial Initiatives

B.C. Community Energy and Emissions Inventory (CEEI) Initiative prepares community energy consumption and GHG emissions inventory reports for all local governments in British Columbia.

Federation of Canadian Municipalities' Sustainable Communities Mission takes delegations of municipal decision-makers on annual visits to leading sustainable community development projects in Canada and abroad. The Federation of Canadian Municipalities also hosts the bi-annual **Sustainable Communities Conference and Trade Show**.

Nova Scotia's Renewable Energy Standard establishes a minimum requirement for the proportion of electricity generated by utilities that comes from renewable sources. The initial requirement is 10 percent above 2001 levels by 2013.

Commitment, experience and preferences of community members shape the development of the Community Energy Plan and its implementation.
(City of Dawson Creek, British Columbia)