The Canadian Urban Archetypes Project: a tool facilitating the integration of energy-related information into urban planning decision making

Introduction

The Canadian Urban Archetypes project investigates linkages between urban form, resident lifestyle patterns and associated energy consumption within selected Canadian neighbourhoods. Initiated by the CANMET Energy Technology Centre (CETC) within the federal government department of Natural Resources Canada, the project engages municipalities, utilities and local NGOs in developing a whole systems portrait of energy use within residential neighbourhoods. In all, 32 neighbourhoods in 8 Canadian municipalities are represented in the library of urban archetypes.

By creating case studies and developing a methodology for the quantification of energy-related information on the neighbourhood level, the Urban Archetypes project is a tool that addresses a significant gap in community energy planning practice in Canada. Municipalities seeking to reduce their energy footprint can refer to Urban Archetype case studies or replicate the methodology to asses existing neighbourhoods for energy behaviour and consumption patterns in the areas of transportation, residential building energy use and to a lesser degree in water and waste.

Community energy planning activities such as establishing baseline energy consumption of existing neighbourhoods can lead to multiple benefits associated with improved energy efficiency. For example, when residents rely less on fossil fuels, the economic efficiency of the community can be improved and resilience created against rising energy prices. By reducing the contribution of energy activities to Green House Gasses (GHGs), and Criteria Air Contaminants (CACs), energy planning also contributes to better environmental quality and human health.

At the time of writing, data collection and analysis associated with the Urban Archetypes project was still ongoing. Thus this paper begins by situating the project within the broader context of relevant Canadian research and urban planning practice. Short and long term objectives of the project are defined, followed by the identification of project proponents and partners. Research design and data collection sources and methods are described. Anticipated analysis and outputs are explained and the paper concludes with a course charted for the steps ahead, including the potential use of interactive maps to synthesize and communicate Urban Archetypes findings.

The Broader Context

Although land use, infrastructure and housing decisions play significant and differentiated roles in the overall energy demand of a community, energy has not been a factor in urban planning decision making in North America in the last 25 years.[1] This can be attributed to inexpensive fossil fuels, the availability of land on the urban fringe and the economic incentive associated with the development of greenfield housing. As a result, the relationships between urban form and energy end-use are typically not quantified on the neighbourhood level, nor the energy-implications of infrastructure decisions considered in planning processes.

To establish the broader context for the Urban Archetypes Project, a brief review is presented of definitions and relevant theories, statistics and research and existing federal programs and community energy planning activities. The section concludes by describing how the Urban Archetypes project builds on existing research and tools, addressing a significant gap in community energy planning knowledge in Canada.

Definitions and Relevant Theories

Three terms central to the Urban Archetypes project are urban form, resident lifestyle patterns and urban archetypes. Urban form is characterized by physical features of the urban environment such as land use and physical infrastructure, building typology and civil assets. Resident lifestyle patterns are described both through demographic variables and energy behaviours. An urban archetype is defined according to typical characteristics of the urban form and resident lifestyle patterns.

Community energy planning is a long term strategic planning process working towards a reduced energy footprint within the community.

An important concept for the discipline of community energy planning and the structuring of energy-related information on the community and neighbourhood levels is the hierarchy of energy related decisions. Originally outlined by Mark Jaccard et al. in a 1997 article,[2] following the hierarchy, landscape and infrastructure decisions have implications for energy use over the longest time frame and are therefore most important in terms of determining total energy inputs required by a community. Buildings are replaced less frequently than municipal services therefore have energy implications over a shorter, but still extended time frame. Equipment has the shortest service life and represents the scale where modifications or upgrades can happen most quickly. Water and waste do not fit in any one particular level of the hierarchy and so may be considered ancillary, but are nevertheless highly relevant energy-related decisions that take place within the urban environment. Taking a whole systems perspective on energy consumption within neighbourhoods involves considering energy-related decisions at all scales.

Infrastructure and Lane Use Patterns

- Density
- Mix of land uses
- Energy Supply Infrastructure

Production Processes, Transportation Modes and Buildings

- Choice of industrial processes
- Choice of transportation mode
- Building and site design

Energy Using Equipment

- Transit vehicles
- HVAC systems
- Appliances

Figure 1. The hierarchy of energy-related decisions. After M. Jaccard et al. (1997)

In his 1999 book *The Ingenuity Gap,* [3] Thomas Homer-Dixon argues that the increasingly complex problems faced by our society our can only be resolved through a combination of social and technical ingenuity. This is particularly true for energy planning, which sees technical decisions are made in the context of social processes. *Fueling the Future,* [4] a book inspired by *The Ingenuity Gap*, contains contributions from leading authors on energy strategy. The chapters describe among other things, soft energy paths, the potential contribution of energy-efficient housing and renewable energy technologies, although stops short of explicitly integrating these solutions on the neighbourhood level.

Statistics, Tools and Research

Statistical studies relevant to energy carried out by the Canadian federal government are often focused on specific technologies and energy end-use. These studies are important for informing technology choice and energy supply provision. Correlation of energy use described by these statistics to the neighbourhoods within which the energy decisions are made is not possible due to the scale on which the information is presented. For example, residential energy end-use statistics including the Survey of Household Energy Use [5] and the Comprehensive Energy Use Database [6] are available on the regional scale but not on the level of the community or neighbourhood.

Other national statistical studies pertaining to energy planning do exist for which data can be obtained on the community and neighbourhood scales. The Census for example asks about the mode of transportation individuals take to work. [7] This information is collected and disseminated to facilitate transportation planning by municipalities. With regards to household energy efficiency, data collected as part of the EcoENERGY Retrofit program (formerly known as the EnerGuide for Houses program) is available upon request on the neighbourhood scale.

A significant contribution to research on communities and neighbourhoods has been made by The Canada Mortgage and Housing Corporation (CMHC), an agency of the federal government. In 2003, CMHC produced a foundation paper on community energy management. Among barriers noted to community energy management was the lack of substantial information for urban planners.[8]

Two tools relevant to neighbourhood-level energy assessment developed by CMHC include an urban travel GHG calculator and a Lifecycle Tool for Costing Community Infrastructure Planning. Developed in 2000, the Greenhouse Gas Emissions from Urban Travel Tool [9] calculates greenhouse gas (GHG) emissions from personal urban transportation (i.e. cars and public transit). Excel-based software is used to compare GHGs from urban travel within nine neighbourhood scenarios, reflecting combinations of three neighbourhood designs (suburban type, medium density and neo-traditional) and three proximity contexts (inner area, inner suburbs and outer suburbs). While the methodology is robust, the tool was developed based on data exclusively from the Greater Toronto Area and thus does not reflect the diversity of urban forms and resident lifestyle patterns found across Canada.

The Lifecycle Tool for Costing Community Infrastructure Planning [10] also employs the concept of neighbourhood scenarios. Also an Excel-based spreadsheet, it allows communities to create their own neighbourhood scenarios consisting of identifiable development patterns. It quantifies in economic terms the life-cycle costs associated with those patterns over a 75 year time frame. While sustainable community planning and design concepts articulated in the tool are consistent with energy-efficiency, estimated energy consumption resulting from specified development patterns is not an output of the model.

The synthesis of multivariate energy-related information on the community scales involves working with datasets that are large, complex and inherently spatial in nature. A research initiative dealing with the visualization of such data sets is the former Sustainable Development and Knowledge Integration through Visualization (SDKI-Viz) program. Promoted by the Earth Sciences Sector of Natural Resources Canada, the transportation energy theme of the program investigated the use of remotely-sensed urban land use data to derive transportation energy consumption in large metropolitan areas. [11]The method of using maps for the integration and holistic communication of energy-related information is highly relevant; possibilities associated with mapping neighbourhood archetype case studies will be described in greater detail towards the end of the paper.

Programs and Community Energy Planning Activities

Two significant national programs that provide context for grassroots community energy planning activities and associated data collection in Canada are the Partners for Climate Protection Program (PCP) administered by the Federation of Canadian Municipalities and the Federal Gas Tax Fund administered by Infrastructure Canada.

The PCP program sets a series of 5 milestones for communities to achieve a specified level of GHG reductions. With 151 municipalities participating from across the country, the PCP program has been the largest impetus for community energy planning activities in Canada to date. Indicators collected to develop a portrait of the municipality's energy consumption include for example floor area, annual operating hours and number of occupants for buildings.[12] Because PCP data is collected on the municipal level, resulting statistics create benchmarks against which neighbourhood level analysis could be compared.

Another major national initiative pertaining to energy planning is the disbursement of funds collected through the Federal Gas Tax. Municipalities will receive a total of $11.8 billion CDN in gas tax funding running 2012 to support sustainable municipal infrastructure.[13] To access these funds, a municipality must develop an Integrated Community Sustainability Plan (ICSP), which includes a community energy plan. The opportunity to access infrastructure funding associated with the Gas Tax Fund is acting as a catalyst for community energy planning activities.

The Smart Growth movement promotes communities that are vibrant, complete and walkable, with varied housing choice and transportation options, serviced by green infrastructure.[14] These urban design principles foster energy efficiency and are being implemented by increasing numbers of urban planners and developers across Canada. In a workshop held in 2004 to identify the role Natural Resources Canada could play in supporting Smart Growth, the quantification of transportation and non-transportation energy conservation and emission reduction benefits of smart growth practices was identified as a high priority action item.[15]

The Urban Archetypes Project within the Broader Context

By developing case studies and a methodology for the quantification of residential energy use in a whole systems perspective on the neighbourhood level, the Urban Archetypes project both builds on and contributes to Canadian research and planning practice in the domain. By looking at all scales of the hierarchy of energy-related decisions, the project takes a whole systems perspective on energy use by residents.

And developing technical information for integration into urban decision-making processes is consistent with Homer-Dixon's ingenuity model.

The project is situated within existing statistical studies by leveraging, when available, datasets such as the that collected by the EcoENERGY Retrofit program for integration into Urban Archetype case studies. Unfortunately this was not possible in the case of 'trip to work' data from the 2006 census, as this information is not scheduled for release until 2008. Leveraging of Census data as well as other national energy end use datasets is a recommendation informing the further development of the Urban Archetypes methodology.

In the context of research and tools developed by CMHC, the urban archetypes identified by the project are expected to be consistent with the scenarios reflecting urban context and neighbourhood type described in both the GHG and Lifecycle Costing Tools. In analysis of the archetypes data, correlations found in CMHCs GHG calculator will also be tested in archetype neighbourhoods, thereby investigating whether the same correlations between urban form and GHG production found to be significant in the Greater Toronto Area also apply to a wider variety of Canadian urban contexts. Furthermore, the variables collected by the Archetypes Project are the same as many of those required as inputs for the Lifecycle Costing Tool. It and the Urban Archetypes methodology are therefore complimentary approaches, with Archetypes case studies and methodology assisting communities to understand the energy metabolism of their existing neighbourhoods and the Lifecycle Tool assisting communities in pricing infrastructure associated with different types of urban form.

The Archetypes case studies and methodology can similarly assist in neighbourhood-level quantification of energy consumption that could contribute to reporting for the Partners for Climate Protection Program or proposals for infrastructure projects proposed for Gas Tax funds. Inspired by the SDKI-Viz program, an anticipated method of communicating the complex energy-related yet inherently spatial information synthesized in the project is expected to be web-based interactive maps employing a high degree of cartographic visualization for knowledge discovery and sustainable development decision making.

The Canadian Urban Archetypes Project is therefore clearly situated within existing Canadian theory and research while addressing a significant gap with regards to the quantification of linkages between urban form, resident lifestyle patterns and energy consumption on the neighbourhood level. Being consistent with broader level concepts and existing studies means that data collected following the Urban Archetypes methodology can facilitate the comparison of neighbourhood-level data with municipal, provincial and national benchmarks.

Research Design

Purpose and Objectives

The purpose of the Canadian Urban Archetypes Project is to explore the linkages between urban form, resident lifestyle patterns and household energy consumption on the neighbourhood scale. The short term objectives of the project include:

- To identify the information required to create a whole systems portrait of energy consumption by residents at the neighbourhood scale;

- To build a library of neighbourhood case studies from across Canada, identifying similar neighbourhoods or archetypes in terms of their urban form and associated energy consumption;
- To provide data and information products to project participants such as municipal planning departments and utilities for integration into their decision making processes;
- To make a general case for or against certain development patterns or aspects of patterns based on the type and volume of energy consumption they support;

Longer term objectives for the Canadian Urban Archetypes Project can also be defined including:

- To contribute to the knowledge base on community energy planning by developing a methodology for quantification of energy-related variables on the neighbourhood level in a whole systems perspective;
- To build capacity amongst urban planners, utilities and the general public for understanding energy-related information and its role in urban planning decision making;
- To reduce energy consumption and the contribution of energy activities to negative externalities such as climate change and social injustices;
- To increase the proportion of energy derived from renewable sources and maximize multiple benefits such as community resilience to energy market fluctuations.

Project Proponents and Partners

The Canadian Urban Archetypes Project was initiated by the CANMET Energy Technology Centre (CETC) within Natural Resources Canada, the Canadian federal government department responsible for the sustainable development of Canada's natural resources. CETC is Canada's leading federal government Science and Technology (S & T) organization with a mandate to develop and demonstrate energy efficient, alternative and renewable energy technologies and processes. The specific project proponent within CETC is the Sustainable Buildings and Communities group (SBC). Its mandate is the research, development, and deployment of leading-edge energy efficient and renewable energy technologies for new and existing housing, buildings and communities.

Communities of different sizes and geographical regions were engaged in the project in order that a range of climates, energy sources and energy efficiency issues were represented. Communities with an active interest in energy efficiency issues were especially encouraged to participate, since their understanding of the information contained in the resulting case studies would accelerate the implementation of project findings within urban planning processes. The municipalities of Ottawa, Coquitlam, Regina, Whitehorse, Halifax, Calgary, Clarington and Lethbridge are participating in the project and have signed Memoranda of Understanding (MOU) to that effect.

Figure 2. Municipalities participating in the Canadian Urban Archetypes project

Canadian utilities can be publicly or privately owned and operate in either a regulated or deregulated context according to the province in which they are located. Utility partners were the electrical and natural gas utilities supplying municipalities participating in the Archetypes project. These included Enbridge Gas Limited, Hydro Ottawa Inc, ATCO Gas, ENMAX, SaskPower, SaskEnergy, Nova Scotia Power Limited, and the Yukon Electric Power Corporation. In communities where oil heating was prevalent, local oil delivery companies also contributed data. Utilities have traditionally been responsible for providing sufficient energy supply. Recently they have also undertaken initiatives to promote reduced energy consumption and, therefore, it was often the Demand Side Management (DSM) champion in the organization who was engaged. The Urban Archetypes project was seen by these individuals as an opportunity to obtain local research to inform the development of utility-led DSM programs.

Local Non Governmental Organizations, consultancies and students were engaged to conduct the door to door surveys to solicit information from neighbourhood residents. These organizations or individuals contributed a high degree of local knowledge to the project and found doing the research to be an educational experience. In Whitehorse the Northern Climate Exchange undertook the surveys; in Halifax it was The Ecology Action Centre and in Calgary, Sustainable Calgary. Academic partners were also engaged; these included Douglas College in New Westminster and the University of Ontario Institute of Technology in Oshawa, who facilitated the hiring of students to conduct surveys in Coquitlam and Clarington respectively.

Archetype Selection

Selection of neighbourhoods for study was undertaken in conjunction with participating municipalities to ensure maximum relevance of the work for them. Each neighbourhood identified as an archetype study area consisted of approximately 300 dwelling units and was of relatively homogenous built form. Depending on the size of the municipality, between 3 and 6 areas of distinct urban form were selected.

Characteristics considered in neighbourhood selection included the age of the development, its density, mix of uses and building typology. Transportation-related features considered included distance to the central business district, road network pattern, transit access and active transportation infrastructure. Demographic aspects such as income, age of inhabitants and whether residents were owners or tenants were also taken into consideration. By understanding these and other characteristics, neighbourhoods could be selected to represent a variety of types of urban form and resident lifestyle patterns in examples that could be compared and contrasted to test for correlation between these variables and associated energy consumption.

Examples of neighbourhoods for which data has been collected to date that exhibit distinct characteristics of urban form that in the analysis could be classified as archetypes include:

- ***Sandy Hill, Ottawa:*** Centrally located, grid-iron street pattern, large 1890s homes converted into apartments, close to rapid bus transit, some commercial and institutional mixed-use;
- ***Wolf Creek, Whitehorse:*** Ex-urban country residential, single family dwellings constructed in the 1990s, without transit service, single-use residential;
- ***Rundle, Calgary:*** Inner suburb, curvilinear street pattern, single family dwellings constructed in the 1960s, close to light rail, some commercial establishments.

Data Collection

Upon selection of specific neighbourhoods for study, the municipal planning department provided a list of addresses and maps depicting the study area. The list of addresses was the sample used to conduct the surveys and collect electricity and natural gas data from the utilities. Experience gained during the course of the project suggests that the list of addresses should also contain the six digit postal code information, enabling the results of the project to be mapped.

Data were collected to describe neighbourhood characteristics in three main domains: urban form, resident lifestyle patterns and energy consumption.

Domain	**Collected from**	**Collected by**
Urban Form Land use Physical infrastructure Civil assets	GIS Other municipal databases Site visits	Municipality
Resident Lifestyle Patterns Transportation patterns Heating and cooling Lighting and appliances Water and waste	Survey of area residents	Survey Crew (NGOs, Consultants, Students)
Energy Consumption Electricity Natural gas Home heating oil Energy efficiency	Utility records EcoEnergy database	Utilities Oil companies NRCan

Figure 3. Different data, from different places, collected by different partners.

Urban Form

To understand the urban form land use, physical infrastructure and civil asset variables were requested from participating municipalities. Examples include total area of the archetype, average lot sizes and setbacks, length of roads, length of bicycle lanes, number of dwellings, building typology and mix of uses.

It was found that the majority of land use and physical infrastructure data requested for the project were contained within GIS databases. Variables such as average property values were often obtained from other databases. Information not easily gleaned from any database in some communities included sidewalks and traffic calming measures and civil assets such as stop signs. In some cases, site visits had to be conducted to collect the data necessary data to describe the neighbourhood. Creating a portrait of a neighbourhood's urban form thus involves obtaining data from several sources.

Resident Lifestyle Patterns

Lifestyle patterns of the residents of the neighbourhoods involved determining demographics and energy behaviours. A door-to-door survey was used to collect information from residents and the survey was designed to be answered at the doorstep, without reference to anything detailed such as bills.

Questions in the survey followed the hierarchy of energy-related decisions, with transportation questions asked first, covering topics such as mode, destination and distance. Building questions were addressed second including age of the dwelling, heating source and equipment and which renovations had been done. Electricity consumption was investigated through questions on lighting and appliances and ancillary questions were asked on water and waste. Rounding out the survey were relevant demographic questions for categorization purposes such as number and age of occupants, income and dwelling ownership.

With a neighbourhood consisting of around 300 dwelling units in size, a sample of approximately 40 completed surveys was taken. This yielded a level of confidence of +/- 10-15%, considered sufficient for the purposes of the project. It struck a balance between the need for statistical validity and project budget and having a small sample size enabled the study to look to more communities across the country for examples.

Energy Consumption

Data on total and average household electricity, natural gas and oil consumption was obtained from the utilities. To respect the confidentiality of their customers, companies providing the information did not link individual household consumption to street addresses.

Challenges associated with obtaining consumption data each neighbourhood included addresses for which no records existed or addresses with inconsistent or unusually high readings. Records showing time of day consumption would be advantageous for more precise modelling of residential building energy consumption, and identification of peak demand periods in the neighbourhood.

EcoENERGY Retrofit program, formerly known as the EnerGuide for Houses Retrofit program consists of over 200,000 home energy audits completed across Canada from 1998 to 2006. This dataset provides additional insight into residential building energy efficiency, including thermal resistance values for attics, walls, floors and basements, heating source and furnace type and equipment efficiencies. Data were only available however for neighbourhoods where a sufficient number of audits had been carried out.

Analysis

At the time of writing, the analysis component of the Canadian Urban Archetypes Project is underway. In lieu of final results, methods and themes for conducting this analysis are discussed, with anticipated outcomes of the work described in the following section.

Urban planning research consultant, Dr. Ray Tomalty of C.O.R.P.S. Inc. is being retained to standardize the data sets, classify the neighbourhoods into archetypes and perform correlation analysis. First the array of variables collected in the different domains from various project partners are being separated into four main groups: demographic, urban form, energy behaviour, and energy consumption, with the latter two being further subdivided into transportation, residential building energy consumption, and water and waste. The results are summarized in tabular form, and correlation analysis is being conducted to identify linkages among the urban form and energy behaviour variables on the one hand, and urban form and energy consumption variables on the other. Demographic variables used as controls include income and education.

Once basic statistical tests are performed, the various neighbourhoods will be clustered into archetypes according to their urban form characteristics. Based on these common characteristics of form, an energy behaviour and consumption profile will be developed for each archetype that includes significant correlations between urban form, energy behaviour and energy consumption. It is expected that archetypes identified will be similar to the neighbourhood scenarios described in previous CMHC research.

Further to the work being done by Dr. Tomalty, vehicular transportation energy consumption will be calculated precisely for each neighbourhood according to the make model and year of vehicles. Results will include average annual fuel consumption, GHG and Criteria Air Contaminants (CAC) emissions as well as amounts spent on fuel. Additional work is also being done to model residential building energy consumption. Using information gleaned in the survey of area residents, along with available variables from the EcoENERGY Retrofit database, residential building energy consumption will be modeled using NRCan's established HOT2000 software.[16] This will provide a more precise portrait of typical household energy efficiency and total residential building energy consumption than could be obtained through statistical analysis alone.

This analysis of urban form and transportation energy consumption, combined with residential building energy modeling and ancillary information on water and waste, all based on neighbourhood-specific data will ensure that when complete, profiles generated by the Urban Archetypes project will reflect the total energy demand created by that neighbourhood and archetype.

The final piece of analysis will consist of recommending neighbourhood and archetype specific strategies and actions to reduce energy consumption or transition to renewable energy technologies. These will be categorized into infrastructure, building or equipment retrofits on the one hand, and options for initiatives to prompt changes in resident behavior on the other.

Outputs

The needs of key user groups were considered in defining outputs for the Urban Archetypes project. The two main user groups are those who would benefit from a general overview of the information and those who would find value in detailed technical information.

Municipal decision-makers and the general public are among those who would benefit from a general yet informative overview of the project's findings. For them, highlights of the analysis, accompanied by photographs and descriptions of the neighbourhoods, will be designed into a series of 4 - 6 page fact sheets. Two types of fact sheets will be created: those that compare and contrast the different neighbourhoods studied within the same municipality and those that compare and contrast neighbourhoods categorized as the same archetype from different municipalities. These fact sheets will be made available in hard copy and posted on the Internet.

Those who would benefit from more detailed technical information are urban planners, utilities representatives and other community energy planning professionals. For the experts, the raw data as well as the statistical analysis will be collated into one spreadsheet per community and made available upon request to relevant project participants, stakeholders and other interested parties such as students or professors. This data will be of use in performing more detailed technical analysis in a range of disciplines from transportation planning, to utility demand side management programs.

The development of interactive web-based maps suitable for depicting Archetypes data is also under consideration. Similar to how different users would benefit from different levels of information, it has also been recommended that maps be made available both for novice and expert map users.

Applications for Decision Making

Urban planning functions for which energy-related information could be useful are community energy plans, design charettes and development approvals.

Community energy plans are long-term strategic planning documents that seek to guide a community's energy supply and demand. The data and analysis resulting from the Urban Archetypes project can be used as baseline information for quantifying the energy consumption of a particular neighbourhood. Baseline energy consumption profiles of existing neighbourhoods could be entered into a community energy plan. This application is to be piloted in Halifax in the fall of 2007. If replicated, the archetypes methodology could also serve as a monitoring tool to detect changes in energy consumption as a result of a neighbourhood projects or program.

Other collaborative community planning processes into which Archetypes information could be integrated are design charettes. When animated by a skilled facilitator, archetypes findings could serve as tool to initiate dialogue on energy efficient urban. Design charettes can be used to plan greenfield development, as was done in the City of Whitehorse or used to revitalize an existing neighbourhood like the City of Regina did.

With regards to new construction, no quantitative data has been available to prompt developers to minimize resource consumption within new developments. Canadian mass-market construction has been slow to advance on the energy efficiency front, citing cost and customer unwillingness. By establishing energy efficiency targets as a part of an energy planning exercise, the municipal government can set benchmarks to guide developers in the development application process.

Next steps

The Canadian Urban Archetypes project, which began in 2004, is reaching a turning point in its activities: the data collection and analysis is nearing completion. This next phase will involve solidifying and disseminating the observations and conclusions developed to date. Further work might include the inclusion of additional communities and archetype forms. Another possibility is an investigation into linking the results to existing federal energy efficiency programs. A review of the project methodology may also be undertaken in conjunction with project partners to standardize and streamline the approach.

The preliminary finding that energy-related data within the public realm is found in different domains and held by different actors highlights the need for further action to synthesize and make available energy-related information for integration into decision making. That much of the data is spatial in nature and can be stored in spatial databases and depicted in map form for analysis and communication purposes, holds promise for the communication of this complex yet crucial information to diverse audiences.

By researching the urban form, resident lifestyle patterns and associated energy consumption in existing neighbourhoods, the Canadian Urban Archetypes Project is contributing to community energy planning capacity and in developing case studies and a methodology for the quantification of energy-related information in a whole systems perspective on the neighbourhood level is creating important decision making tool.

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