EVIDENCE OF THE CITY OF GUELPH

Exhibit 1

Tabs 7, Schedules 1 & 2

EB-2025-0058

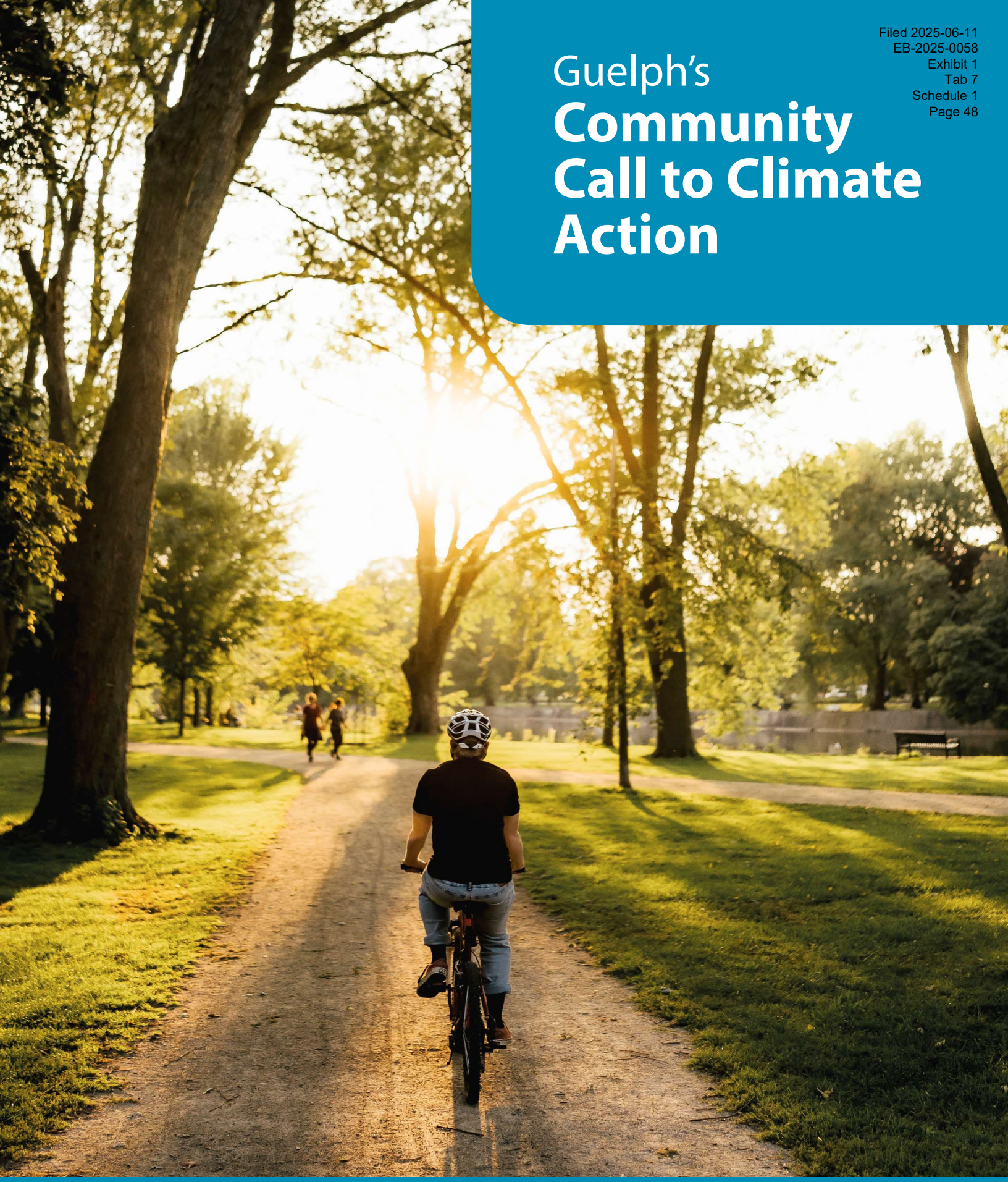
June 11, 2025

EXHIBIT LIST

EXHIBIT	TAB	SCHEDULE	PAGES	CONTENTS
1	1	1	1-2	Certificate of Evidence
1	2	1	3-13	Minutes of Committee of the Whole Meeting – November 5, 2024
1	3	1	14-25	Minutes of Guelph City Council – November 26, 2024
1	4	1	26-29	A copy of Bill 219 “No Free Ride for Fossil Fuels Act, 2024
1	5	1	30-32	Correspondence from Mike Schriener dated March 13, 2025 - Re: Intention to Reintroduce Bill 219
1	6	1	33-46	Copies of all correspondence between Enbridge and the City of Guelph from May 10,2024 to January 31, 2025
1	7	1	47-55	City of Guelph Climate Pledge
1	7	2	56-204	City of Guelph Community Energy Plan
1	7	3	205-414	Meeting Minutes of The City’s Commitment to Achieve 100% Renewable Energy by 2050
1	8	1	415-451	Economic and Tourism Strategy 2022-2026
1	8	2	452-470	Future Plan; Strategic Plan 2024-2027
1	8	3	471-500	Indigenous Relations Framework
1	8	4	501-560	Provincial Policy Statement 2024
1	8	5	561-954	City of Guelph Official Plan

TAB 7
Schedule 1

Guelph's Community Call to Climate Action



CITY OF Guelph
Making a Difference

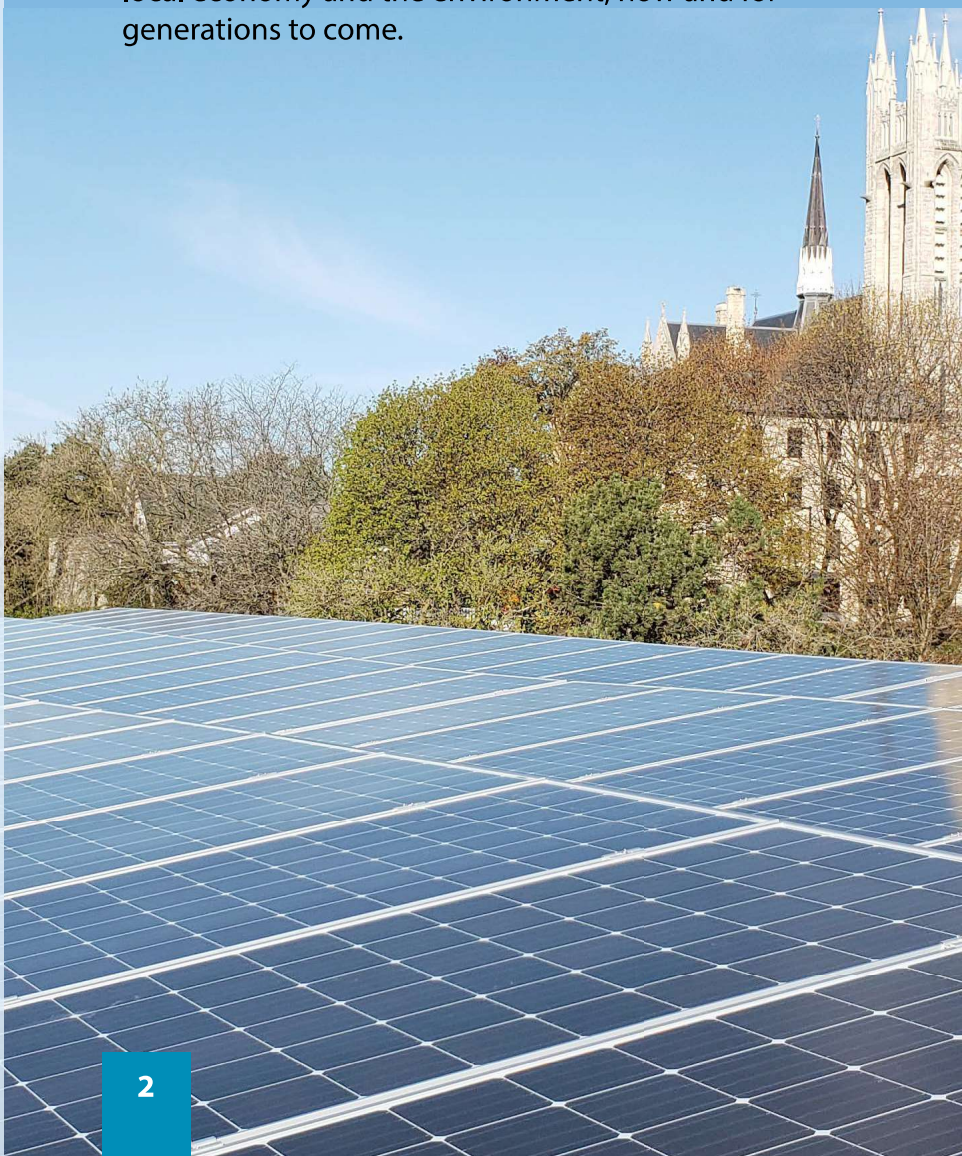
Understanding the Community Call to Climate Action

Climate change is caused by having far too much greenhouse gas (GHG) in the atmosphere. These GHGs are primarily because of human activity and burning fossil fuels for energy. Energy plays a large part of our everyday lives – powering our homes and appliances, running our local shops and businesses, and moving us around Guelph and beyond. While energy will continue to play a key role in our lives and our future, **we must understand the connection between energy and climate change so we can use energy in a better way.**

The Community Call-to-Climate Action will support everyone in Guelph:

- Better understand GHG emissions from energy use
- Identify ways we can reduce GHG emissions
- Help the Guelph community focus our collective climate action

Although Guelph is small compared to the rest of the world, we each release more GHG emissions than the global average. To help reduce GHG emissions, we all need to do our part—including here in Guelph. It will improve the well-being of our residents, our local economy and the environment, now and for generations to come.



How Climate Change impacts all of us

? How does climate change impact you?

Climate change is not a distant problem. It affects absolutely everything, around the world and our daily lives right here in Guelph.

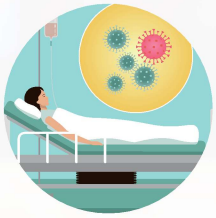
Lower farm yields

Rising food costs

More conflicts over limited resources

Extreme weather events causing property damage

People being displaced



Increased disease due to warmer temperatures

More invasive pests

Productivity loss

Higher insurance premiums

Water shortages

Poorer air quality

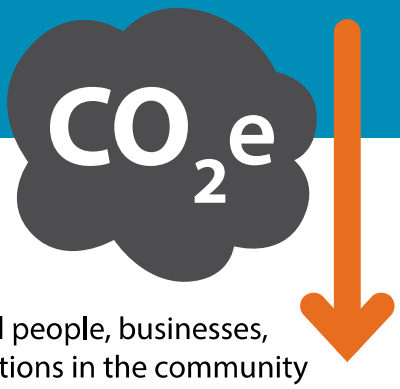
Climate anxiety

Youth disenfranchisement

More flooding

Our Community Climate Target

The City of Guelph is fighting climate change through its commitment to the United Nations Race To Zero campaign.



Encourage all people, businesses, and organizations in the community to help conserve energy and reduce GHG emissions.

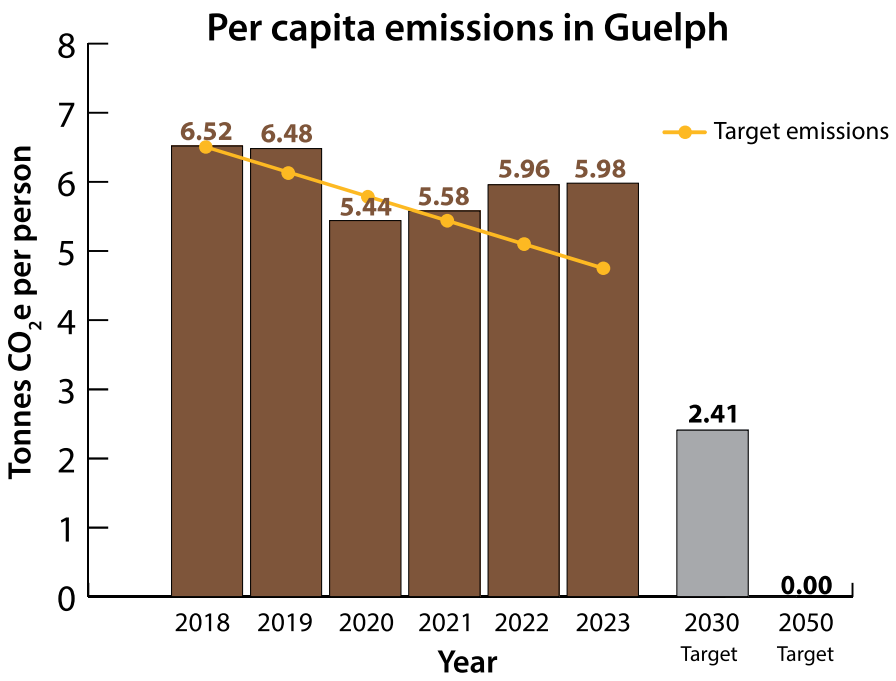
Guelph's
Race to Zero
Community GHG Emissions

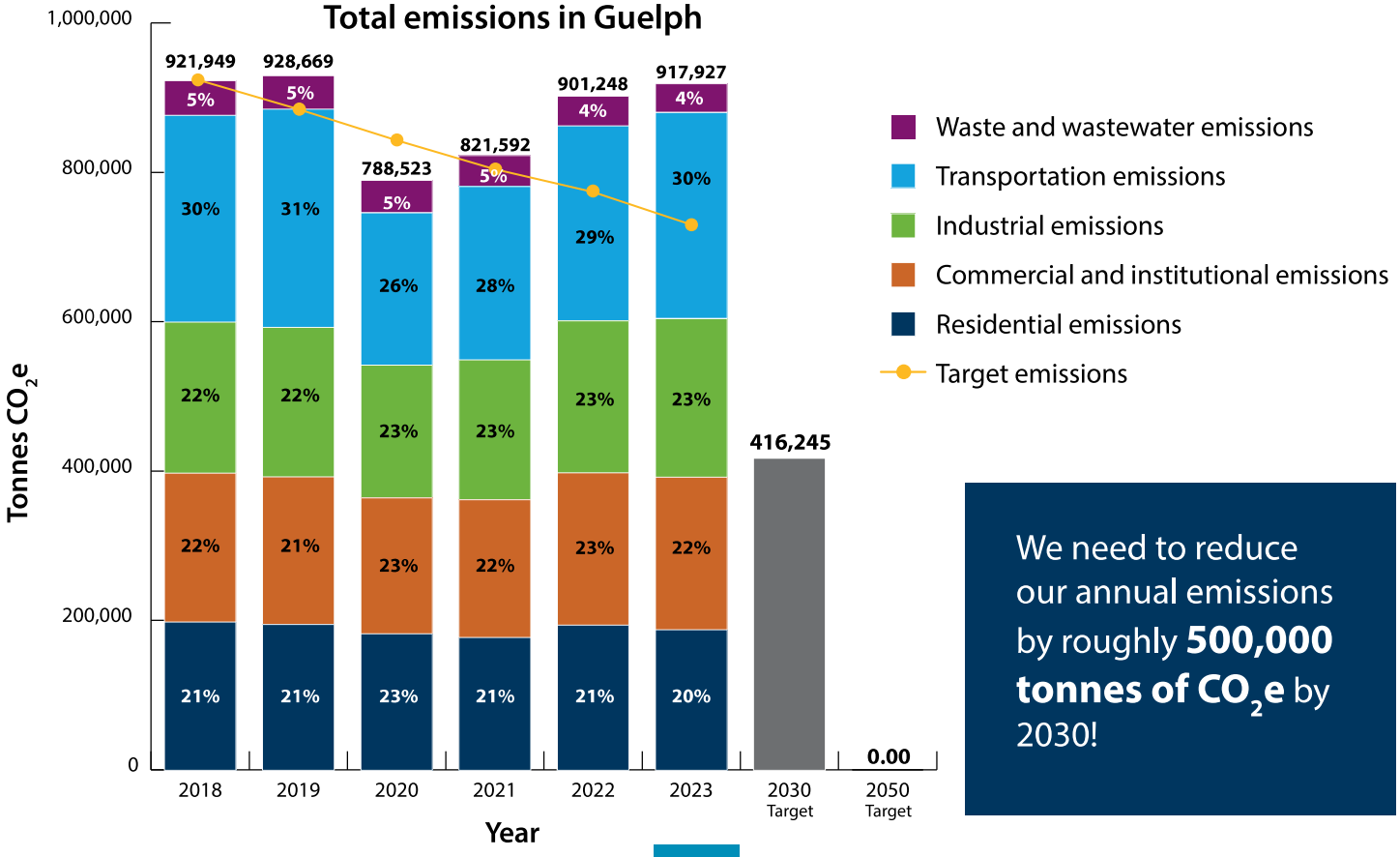
63%
reduction per capita
in GHG emissions by 2030 against the 2018 baseline

Work together to become a
net zero carbon community
by 2050

Our progress against targets

Tracking community GHG emissions helps us know how things are going and what must be done. Although some progress has been made over the years, more action is needed now to reduce GHG emissions and fight climate change.





We need to reduce our annual emissions by roughly **500,000 tonnes of CO_2e** by 2030!

Ways we can act to reduce community GHG emissions

Here are key focus areas where we can better manage our energy use and GHG emissions as we live, work and play in Guelph.

Energy efficient and low-carbon buildings

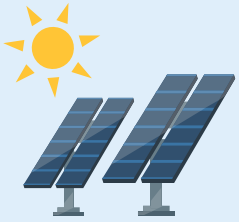
- Transition building heating systems to recover waste heat and use energy efficient heat pumps
- Carry out deep energy retrofits for existing buildings
- Make new buildings more energy efficient and meet standards for low-carbon design

Decarbonized business operations

- Reduce energy consumption and reduce fossil fuel use by industrial, commercial and institutional businesses in their operations

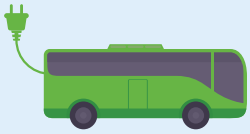
Renewable energy

- Increase solar generation on buildings and parking lots
- Explore large-scale renewable energy projects within Guelph



Sustainable transportation

- Expand the network of safe and accessible streets and trails to promote walking, cycling and rolling
- Advance local and inter-regional transit to be a better option than personal automobile use
- Adopt more electric vehicles



Circular economy

- Reduce waste by consuming less and more sharing and reusing
- Use low embodied carbon construction
- Recover energy from waste

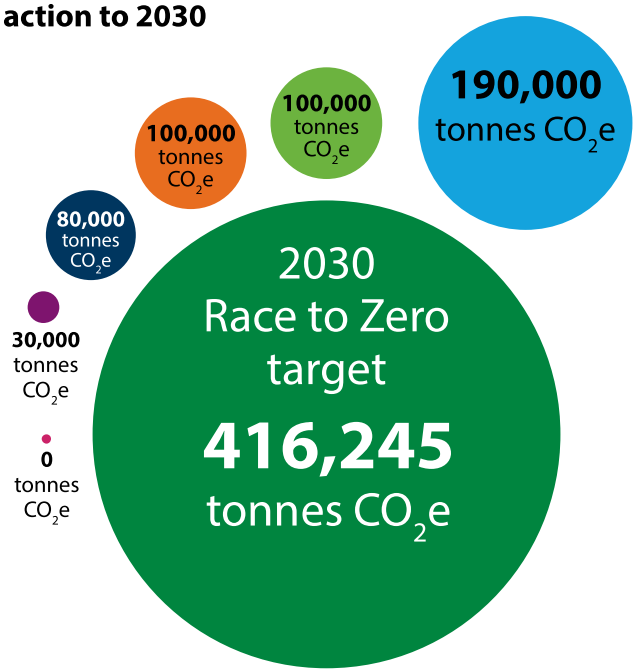
Natural environment

- Preserve greenspaces by increasing densification and mixed-use neighbourhoods where residents can live, work and play
- Protect and expand carbon sequestration through trees, wetlands, soils, and other nature-based solutions

What do we need to do?

We need real action by all, and we need to act now. These are the priority climate actions that will help us reach our 2030 Race To Zero targets and fight climate change.

Carbon reduction potential of each priority climate action to 2030



Homeowners:

- Have **40,000** homes in Guelph change their heating systems to low carbon heat pumps

Builders and Developers:

- Design and build **all** new buildings that are more energy efficient and be net zero carbon

Vehicle owners:

- Replace **60,000** internal combustion vehicles with sustainable transport modes or electric vehicles

City:

- Manage and maintain fugitive emissions from waste management and wastewater treatment to reduce emissions by **30,000** tCO_2e

Companies:

All industrial companies in Guelph must work together and focus resources to reduce sector emissions by **100,000** tCO2e

All commercial and institutional companies in Guelph must work together and focus resources to reduce sector emissions by **100,000** tCO2e

Answer the Community Call to Climate Action

We need climate action now!

Support each other to get priority climate actions done in the community.

Live, work, and play in ways that reduce community GHG emissions.

Only by coming together as a community and all of us doing our part to use less fossil fuels to reduce GHG emissions, our collective actions will add up to what is needed to achieve our Race To Zero targets and fight climate change.

Need more information and ideas on how to take climate action?

Read the Guelph's Community Call to Climate Action Backgrounder.

CITY OF Guelph
Making a Difference

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COMMUNITYENERGY PLANNING

Garforth International llc
Energy Productivity Solutions

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CITY OF Guelph
Making a Difference

Community Energy Plan

Garforth International llc
Energy Productivity Solutions

Owens Corning

MVV Energie

Remmer Consulting

Final Report dated 3rd April 2007

Prepared For
Guelph Community Energy Plan Consortium

ACKNOWLEDGEMENTS

The team preparing the recommended CEP would like to acknowledge the efforts made by the following groups, individuals, and organizations that have made invaluable contributions to the development of the Community Energy Plan.

[redacted]

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[redacted]

Workshop Participants

The Consortium would also like to acknowledge the many other participants at a number of briefing sessions and workshops held through 2006 from many organizations and companies including the University of Guelph, students from the City's High Schools, local industry, small and medium enterprises, environmental organizations, the architectural and construction industry, and last but certainly not least a large number of individuals who participated at community workshops.

The following photo from the last community workshop showing citizens actively and

[redacted]

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CITY OF GUELPH
COMMUNITY ENERGY PLAN

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APPENDICES

1. DEFINITIONS AND ABBREVIATIONS

This is a summary of some of specific terms and abbreviations used in the report. It is not exhaustive. In many cases, terms are defined in the body of the text and are not repeated here. A good detailed list of energy related terms and usages can be found on the Natural Resources Canada website.[1]

Term	Definition
Baseline	Estimation of the present (2005) energy and water use and greenhouse gas creation
Biomass	Vegetation such as wood, agricultural waste, catering waste etc with the potential to be used as a fuel
Building Code	Legally required construction standards
Built Infrastructure	General term referring to all the homes, commercial and institutional buildings and industrial buildings in the City
Carbon dioxide (CO_2)	The commonest form of greenhouse gas. Over 90% of manmade greenhouse gas emissions are from the use of energy.
CEP	See Community Energy Plan
CEP Consortium	Group in Guelph guiding the development of the CEP representing multiple parts of the community
CHP	See cogeneration
$CO_{2(equiv)}$	Greenhouse effect of the other five greenhouse gases identified in the Kyoto Treaty expressed in equivalents of carbon dioxide. (see www.unfccc.org)
Cogeneration	Generating electricity in such a way that most of the heat produced is usefully used
Combined Heat and Power	See cogeneration
Commercial Buildings	Nonresidential buildings generally owned or operated by for-profit entities
Community Energy Plan	Plan to guide the long term efficiency of energy and water use in Guelph for the coming two to three decades
Cooling Degree Days	A measure of how hot a location was over a period, relative to a base temperature. In this report, the base temperature is 18.0°C and the period is one year. If the daily average temperature exceeds the base temperature, the number of cooling degree-days for that day is the difference between the two temperatures. However, if the daily average is equal to or less than the base temperature, the number of cooling degree-days for that day is zero.
Daylighting	Designing buildings to maximize the use of natural daylight to reduce the need for electricity
District cooling	Cooling services delivered via district energy systems
District energy	Systems that deliver heating or cooling to energy consumers in the form of chilled or hot water, or (in older systems) steam.
District heating	Heat services delivered via district energy systems

[1] See http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/data_e/glossary_e.cfm?attr=0

Electrical Conversion Losses	The difference between the energy value of the fuel used to make electricity and the energy value of the electricity itself.
EU	European Union
Fossil Fuels	Combustible material obtained from below ground and formed during a geological event.
GDP	See Gross Domestic Product
Geothermal systems	Systems that use the relatively constant temperature of the ground a few meters down to cool buildings in summer and heat them in winter.
GHG	See Greenhouse Gases
Golden Triangle	Term referring to the area bounded by Kitchener, Waterloo and Guelph
Greenhouse Gases	A greenhouse gas absorbs and radiates heat in the lower atmosphere that otherwise would be lost in space. The main greenhouse gases are carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbons (CFCs) and nitrous oxide (N_20). The most abundant greenhouse gas is CO_2 - Carbon dioxide.
Gross Domestic Product	The total value of goods and services produced by a country during a given year.
GWh	Gigawatt-hour – unit of electrical energy equals the use of 1 thousand million watts of electrical energy in one hour
GWh_e	Gigawatt-hour-equivalent - unit of energy from any source equivalent to one kilowatt-hour of electricity. Used to get a standard measurement for comparison of different forms of energy
Heating Degree Days	A measure of how cold a location was over a period, relative to a base temperature. In this report, the base temperature is 18.0°C and the period is one year. If the daily average temperature is below the base temperature, the number of heating degree-days for that day is the difference between the two temperatures.
Institutional Buildings	Nonresidential buildings generally owned by public administration, education, public or private healthcare facilities and other not-for-profit entities.
kWh	Kilowatt-hour – unit of electrical energy used as the basic billing unit and equals the use of 1 thousand watts of electrical energy in one hour
kWh_e	Kilowatt-hour-equivalent - unit of energy from any source equivalent to one kilowatt-hour of electricity. Used to get a standard measurement for comparison of different forms of energy
Kyoto Treaty	International Treaty ratified by Canada and most other industrialized countries with mandatory targets to reduce man-made greenhouse gases primarily through reduced use of fossil fuels
LEED	Leadership in Energy and Environmental Design - A voluntary system for rating buildings based on their environmental performance including energy and water use. Originally developed by a non-profit group – US Green Buildings Council.
Light vehicle	Vehicles with a weight less than 3,855 kg and includes motorcycles, cars, SUV's and pickup trucks
MWh	Megawatt-hour – unit of electrical energy equals the use of 1 million watts of electrical energy in one hour
MWh_e	Megawatt-hour-equivalent - unit of energy from any source equivalent to one megawatt-hour of electricity. Used to get a standard measurement for comparison of different forms of energy
Per Capita or /capita	For each person in the total population being considered

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Potable Water	Water that has been treated and delivered via public distribution and is considered safe for human consumption
Rainwater Harvesting	Systematically gathering rainwater to use for non-potable applications and to minimize the need to manage as storm water runoff
Smart Growth	Approach to developing areas of a cities to use minimum resources, to maximize social interactions with a balanced mix of demographics
SMART Meters	Energy meters (heat/electricity/cooling) capable of gathering energy use patterns, applying different tariffs depending on time of day and use level, and capable of being integrated into wider information and control systems
Solar Heating Systems	Systems that collect the heat of the sun to warm buildings or make domestic hot water
Solar Photovoltaic Systems (PV)	Systems that convert the light of the sun into electricity either for use locally or for delivery to the wider grid
Sustainability	Meets the needs of the present generation without compromising the ability of future generations to meet their own needs
tonne	Metric Ton equal to 1000 kilograms – mostly used in this report as a measure of greenhouse gas emissions

2. EXECUTIVE SUMMARY

For over two centuries, the ready availability of low cost energy has allowed the world's industrialized countries to achieve unprecedented levels of well being and prosperity. Recent dramatic increases in costs and price volatility are putting the spotlight globally on how effectively we use energy. The rapid growth of China and India is putting further pressure on the world's energy supplies and climate. Despite its plentiful energy resources, Canada is increasingly exposed to the full force of the global energy market pressures and can look forward to energy costs trading upwards combined with pricing uncertainty.

The evidence is growing that the human use of energy is causing greenhouse gas emissions that are beginning to have significant effects on the climate. Recent opinion polls indicate that this is now viewed as the most critical issue for most Canadians, underlined by the renewed political commitment to meet international greenhouse gas emissions targets.

Over half of the world's population lives in cities, and in Canada that proportion is closer to 80%. Of all the energy used in Canada, over half is for buildings, homes, and transportation within cities. Homes and buildings use over 30% of all energy in the country and consume more than half of all the electricity. Cities are increasingly recognizing that the quality of life and competitiveness will in part be driven by how effectively they manage the use of their energy and water resources.

Guelph's leaders recognized the growing importance of effective management of energy and water to the economy and environment, and in 2004 formed a Consortium to proactively develop a community energy plan. The Consortium represents all facets of the community including the administration, academia, business, the gas and electric utilities, and other community groups. In 2006, the Consortium decided to formalize a long-term Community Energy Plan (CEP) which would guide the city's energy future for years to come. The CEP team had a balanced mix of local and global expertise ensuring the plan incorporated the best elements of urban energy management from around the world.

Guelph, with its current population of 115,000, plus an additional 18,000 students during the academic year, is a thriving town well situated in the "Golden Triangle", an area to the west of Toronto that is attracting significant growth. Guelph's population is expected to grow to 180,000, probably within its current boundaries, supported by significant commercial and industrial development.

In rough numbers, the growth will add about 20,000 homes and somewhere between 400,000 and 500,000 square meters of non-residential construction, along with significant industrial growth.

To support this growth, the city has made a commitment to implement an energy plan that will ensure the long-term competitiveness and environmental performance of the city. The Guelph CEP was developed to be much more than an inspirational statement. It was created very much with implementation in mind. For this reason the team looked at success stories from the USA, Canada and Europe to adopt the best ideas that had clearly worked elsewhere. All of these success stories underlined the need to take a long-term, multi-decade view and to have community leadership that ensured long-term, consistent implementation of the basic strategies year after year. Another key element was to see the energy supply of the city as an integrated whole.

The overall vision of the CEP is simple:

Guelph will create a healthy, reliable and sustainable energy future by continually increasing the effectiveness of how we use and manage our energy and water resources

This vision is supported by five goals that focus on the CEP's role in attracting quality investment, in ensuring reliable and affordable energy, in reducing environmental impacts, in enhancing Guelph's competitiveness, and in aligning public investment with the CEP. Each has recommended long-term measurements detailed in the plan.

- ***Guelph will be the place to invest, supported by its commitment to a sustainable energy future***
- ***Guelph will have a variety of reliable, competitive energy, water, and transport services available to all***
- ***Guelph energy use per capita and resulting greenhouse gas emissions will be less than the current global average***
- ***Guelph will use less energy and water per capita than comparable Canadian cities***
- ***All publicly funded investments will visibly contribute to meeting the other four CEP goals***

Successful delivery of these goals brings tangible financial and other benefits to residents, local business, the city administration, developers and builders, banks and investors, and the energy suppliers.

Guelph was an early pioneer in the development of community energy solutions by being a key player in developing municipal energy distribution in Ontario 100 years ago. Taking the lead for the next 100 years is entirely consistent with this tradition. Today the city covers about 86,000 km2. The population of 115,000 is estimated to grow by at least 2% per year to approximately 180,000 by 2031. Residential growth will be from a mixture of redevelopment in some older areas, and new development on greenfield sites. Industrial and commercial developments are planned in six areas around the city.

Today, Guelph uses a total of 6,030 gigawatt hours of equivalent energy (GWh_e) from fuels of all types, or 52.45 megawatt hours of equivalent energy (MWh_e) for every inhabitant of the city. If the heat wasted in the production of electricity for the city is included, the total rises to 8,475 GWh_e or 73.71 MWh_e /capita. This is the energy directly consumed in the cities buildings, vehicles, and industries, and does not include energy used in ships, airplanes, long-haul freight or other transportation. In general, the Guelph CEP focuses on the energy directly used in the city as this can be more easily influenced by community action. In 2005 a total of 19.2 million cubic meters of water was pumped and treated. Lost water totaled approximately 14 percent of all water pumped. The average daily water demand was 52,579 cubic meters.[2]

[2] http://guelph.ca/uploads/ET_Group/waterworks/Waterworks_Summary_Report_2005.pdf

This use is comprised of 230-250 litres per equivalent population per day for household use, with the balance being used by commerce and industry.

Guelph's climate, with over 4,352 heating degree days compared to only 180 cooling degree days, puts a high demand on space heating, and the plan addresses the heating alternatives in some detail.

The CEP was developed using the following priorities:

- Maximize the energy and water efficiency for buildings, vehicles and industry
- Maximize use of heat generated in electricity generation and existing industrial processes
- Incorporate as many renewable energy sources as feasible
- Team with the existing electricity and gas networks to avoided wasteful duplication of assets

Cities that systematically implement these principles year after year typically have energy levels at least half of the current levels of Guelph, with all the associated economic and environmental benefits that this brings.

On the first priority, efficiency, detailed assessments were made of the present 33,000 homes and 1.7 million m^2 non-residential buildings by age and energy use. The needs for the future industrial energy use and transport fuels use were similarly assessed.

Following these priorities, the CEP recommendations are:

Use efficiency to create at minimum all the energy needed to support the growth of the residential sector

It is feasible to add about 20,000 homes with no net increase in energy needs and this is the recommended target. Ontario recently passed stringent new energy efficiency building codes that will be fully in force by 2012. The CEP is recommending that the city explore incentives and other approaches to immediately implement the full code. This alone, combined with energy efficiency requirements on major residential renovations creates all the energy needed for growth.

From 2012 onwards, the CEP is recommending a steady annual improvement in energy efficiency of about 1% per year, which by 2031, would be a level that aligns with global best practice from Scandinavia and Germany.

Use efficiency to create all the energy needed to support the growth of the commercial and institutional sectors

Similarly, all the energy needed to support the entirety of the growth of commercial and institutional buildings energy needs can be met by the same combination of immediate implementation of the new codes and efficient renovation.

Adopt an energy performance labeling scheme for buildings as a voluntary initiative for the city, teamed with Natural Resources Canada and a local mortgage bank, to act as a pilot for the whole of Canada to gain about 5% incremental delivered efficiency

The CEP is recommending that all new and existing buildings have an Energy Performance (EP) Certificate that guarantees the building's energy consumption in normal operation at the

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time the building is sold or even rented. There is no Canadian EP Certification at present. It is the subject of much discussion at a Federal level in Canada, and the recommendation is to offer Guelph as a national pilot.

The recommendation is to model around an emerging approach being discussed in Canada that is an amalgam of the Canadian Energy Guide and the European Union approach.

The experience in other jurisdictions is that this stimulates somewhat higher quality buildings and a certain amount of "efficiency competition" between developers.

Add to Guelph's attractiveness for quality industrial investment by offering world class tailored energy services and achieve annual investment growth rates higher than the underlying population growth, with no overall increase of the primary energy needed to serve the first fifteen years of growth.

Increasingly, industrial investors are looking at energy services as a key part of their decision on where to invest. The CEP is recommending developing tailored energy services for selected industrial development areas that not only deliver gas and electricity, but also selectively deliver other energy forms such as compressed air, process steam heating and cooling, etc.

Meet Guelph's growing transport requirements while reducing the transportation energy use by 25%, using sensitive urban design, effective alternative transport options, and encouraging vehicle efficiencies.

Transport fuels collectively represent 30% of all the energy used in Guelph, and account for a huge 45% of all the greenhouse gas emissions caused by the city. The CEP recommends a multi-pronged approach that includes various measures to encourage more efficient vehicles, urban design that reduces vehicle journeys, and focused attention on appropriate competitive mass transit.

Many of these measures were already being developed in detail in Guelph's wider transport and urban planning. The CEP is underlining the importance of their success to meeting the overall energy and climate change goals.

Incrementally create energy distribution architecture in Guelph that will allow the majority of the city to be served with fuel choices that optimize cost, availability, and environmental impact long into the future.

Over the coming years major changes will happen in energy and environmental legislation, fuel availability, the viability of emerging alternative energy technologies and their relative costs. To be able to achieve maximum benefit from these changes, the CEP is recommending a stepwise development of district heating networks covering the higher density areas of the city to supply space heating and domestic hot water. These networks also provide an efficient and economic way to distribute heat from a variety of existing and new energy sources.

In evaluating benchmark cities such as Mannheim or Copenhagen, we find that a common feature of these very efficient and reliable energy and water systems was the existence of all energy services being supplied by a single company. This avoids the inefficient use of primary fuel, and allows a rational integration of alternative energy sources. The CEP is recommending this approach.

Within fifteen years, at least a quarter of Guelph's total energy requirement will be competitively sourced from locally created renewable resources

The challenge around climate change will increasingly turn the focus on renewable fuels as a viable and essential way to reduce greenhouse gas emissions. Currently the economic value of greenhouse gas reductions is zero, but this is likely to change as various market mechanisms come into force.

The CEP is strongly recommending a target to install the equivalent of a "Thousand Roofs" of solar photovoltaic electricity.

The heat demand of the area makes it a natural fit for integrating bio-mass heat sources combined with district heating to provide about 10% of the base load heat needs through the winter. The local wind quality makes energy from turbines marginal under the current technology. Last but not least, the growing need to find environmentally acceptable ways to manage municipal waste merits a rigorous assessment of the waste-to-energy potential.

Target – At least 30% of Guelph's anticipated electricity requirements will be associated with Combined Heat and Power (cogeneration) by 2031.

As the city's energy evolves to include more district energy, it begins to include small and medium scale combined heat and power installations. Today Guelph's 1,627 GWh annual electricity use in reality uses 4,074 GWh_e of fuel, the difference being lost as heat, creating non-productive costs and significant greenhouse gas emissions. By implementing CHP within larger developments, much of this heat can be effectively captured and used, creating major cost and environmental benefits. The CEP recommendation is to proactively seek CHP projects with a total electric capacity in the 75 to 100 MW range with a comparable level of heat recovery.

Guelph will reduce the magnitude of the summer grid electrical peak by at least 40% by 2031 to avoid the need for investment in new electrical infrastructure to serve the growth of the city

One of the consequences of growing prosperity and the norms of new construction is the increasing use of air-conditioning, even though climatically there is relatively little need. The result is very high electrical demands for a few hours a day during the summer months. This peak drives substantial investments in underutilized generation, transmission and distribution assets by the electric utility.

The cumulative effect of many of the preceding measures including efficiency, cogeneration, heat recovery and solar PV will moderate and reduce the peak.

Guelph will systematically create an integrated energy metering, billing and management network across the entire city to allow cost-effective management of all energy forms

The energy breakthroughs foreseen by the CEP arise as a result of seamless integration of energy efficiency along electrical, gas and district heating networks, with a flexible and, over time, changing mix of renewable and non-renewable energy sources. Such an approach requires a high degree of management and data sharing across the different parts of the system to deliver maximum benefit. The recommendation is to establish a common data management and metering architecture within the city.

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Guelph will implement large area high-efficiency Scale Projects that accelerate progress towards a successful implementation of the CEP by creating early success and developing a deep pool of community expertise

All too often, CEPs fail to deliver due to a lack of sufficient scale and early success. The Consortium was committed to make sure that did not happen in Guelph. As a result, the CEP is recommending implementing neighborhood energy plans in relatively large, but bounded areas of the city.

The plan is calling for the early identification and implementation of Scale Projects. Some specific ideas are included as part of the CEP, and include various business and industrial areas, the greenfield mixed use developments targeted for the south of the city, the University of Guelph Campus as a whole, and the revitalization of the St. Patrick's Ward. These are offered as viable examples of potential Scale Projects.

The CEP also recommends elements that will ensure long-term successful implementation. Many Federal, Provincial and local programs exist and the CEP is recommending the city maintain information and offer assistance to capture as many of these resources as possible. The Consortium clearly recognizes that some of the measures proposed will require adjustment or interpretation of regulatory or other legal constraints, and is committed to clear these kinds of market barriers wherever possible. Since many of these challenges will be of interest beyond Guelph, the CEP is suggesting that Guelph can be a national prototype as these market and regulatory structures emerge. A high priority in this area will be to establish the market framework of a municipal energy service organization that is structured to ensure the highest reliability, least cost and least environmental impact energy services of all types.

Guelph's elected officials, business community, financial institutions, neighborhood groups, utilities, architects, developers, construction industry, academia and the city administration are clearly committed to the vision, goals, recommended actions and progress of the CEP as a key measure of Guelph's overall success in becoming a world class city in which to live, work and play.

In support of this, the CEP is recommending community and neighborhood groups be instrumental in ensuring Scale Projects are sensitively implemented and the energy and environmental goals are fully achieved. The CEP also presents an amazing opportunity for the University of Guelph and other colleges to build on the city's commitment to the CEP by developing specialist areas of study, training and research such that Guelph will become a center of excellence on the theory and practice of sustainable urban development.

The goals that the CEP has established are intentionally very aggressive and are generational in nature. The CEP is strongly recommending the city put in place a regular reporting system to track the progress towards the goals and to share best practices with the community, both through conventional and electronic media, and as a regular topic at City Council Meetings.

Guelph is already blessed with a number of commercial, non-profit and general interest groups as well as individuals working towards sustainability, energy efficiency and alternative energy in some way. The CEP made a first step to create an inventory of some of these resources, and this should be the basis of a developing resource database.

Despite the anticipated growth of the population and increase in economic activity, the overall fuel use required by the city to deliver all its energy service will actually decrease from today's total of 8,475 GWh_e to 6,135 GWh_e in 2031. This represents a decrease of greenhouse gas

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emissions, currently at an estimated 16 tonnes per inhabitant, to about 7 tonnes. This is still some distance from the ambitious goal, but at a level that is clearly putting Guelph among the top energy performers in the world.

At the same time, Guelph will take its place as one of the most competitive and attractive cities in Ontario and Canada, with a core energy productivity expertise that will be sought out around the world.

3. ENERGY CHALLENGES OF THE 21ST CENTURY

3.1. Global Overview

The ready availability of reliable, clean, low cost energy has allowed the industrialized countries of the world, including Canada, to achieve unprecedented levels of prosperity and well-being. Energy systems have been the catalyst that has allowed our cities to develop to be stimulating and productive places to live.

	Urban Population as a % of total population			Urban Population annual growth rate (%)	
	1970	1995	2015	1970-1995	1995-2015
Least Developed	12.7	22.9	34.9	5.1	4.6
All Developing	24.7	37.4	49.3	3.8	2.9
Industrialized	67.1	73.7	78.7	1.1	0.6
Low HDI	18.2	27.4	38.6	4.1	3.7
Medium HDI	23.0	37.7	52.7	3.9	2.8
High HDI	52.8	70.9	78.5	3.3	1.7

Source: UNDP, Human Development Report 2000

Figure 3.1 Evolution of City Populations

Today, more than half of the world's population lives in cities. In the industrialized world, eight out of every ten people are city dwellers. As the 20th Century closed, all the comfortable assumptions around the cost, availability and impact of energy use were being challenged. The brunt of meeting those challenges will fall on the city leaders of the world.

There have been recent dramatic increases in the costs of coal, natural gas, and oil, accompanied by high levels of price volatility. In the past, such increases were usually followed by relatively fast declines. It is unlikely this will happen this time around. Cities, consumers and businesses would be wise to plan for steadily increasing primary energy prices.

As industrialization spreads around the world, countries like China and India are becoming major energy users, absorbing the fuel reserves that previously moderated global prices.

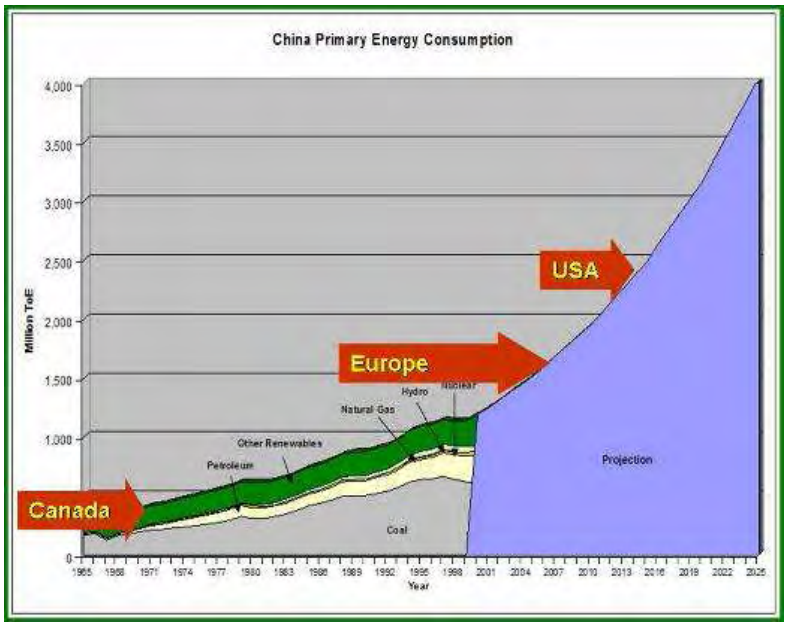

Figure 3.2 China's Energy Demand Forecast[3]

(See Appendix 8 for Full Size)

By 2020, China alone will be using more energy than the USA, with India's needs rising almost as fast. Even with these recent increases, Chinese and Indian energy use per head is still less than 10% of Canadian levels, showing the likelihood for sustained increases in demand.

Prices are also driven by the increasing cost of exploration, extraction and distribution of primary fuels and electricity. There is debate about how many decades or centuries of oil, gas and coal supplies are available. The consensus is for the global oil reserves to peak in the next two to four decades; that coal will be available for some centuries; and natural gas may peak within the current century. Fuel availability is only one aspect; the cost of getting it to the final consumer has dramatically increased in the past twenty years, a trend that is likely to continue.

On the environmental front, the human use of energy has caused dramatic increases in the levels of greenhouse gases in the atmosphere over the last century, a trend that is accelerating. Today, the level of the most common greenhouse gas, carbon dioxide, is already double the pre-industrial levels and is expected to double again within the current century unless significant measures are taken. At least 90% of manmade greenhouse gases come from the use of coal, oil and natural gas.

3 Sources – BP Statistical Review of World Energy June 2004 / US Dept of Energy International Energy Outlook 2004 / Projection based on IMF GDP Growth Rate forecast of 5% pa

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Figure 5. Atmospheric temperature and carbon dioxide concentration as measured from the Vostok ice core from Antarctica. On the right of the diagram are shown projections of carbon dioxide concentration for the 21st century. The temperature measured by the ice core is an average for the polar region. Changes of global average temperature are about half of those in the polar average.

gure 3.3 Greenhouse Gas and Surface Temperature[4]

(See Appendix 8 for Full Size)

ouse gas concentration over the last 160,000 years, the current levels evels that could be reached by about 2050. Historically there has been a h surface temperature and carbon-dioxide concentration. The consensus at atmospheric warming is accelerating, giving raise to significant

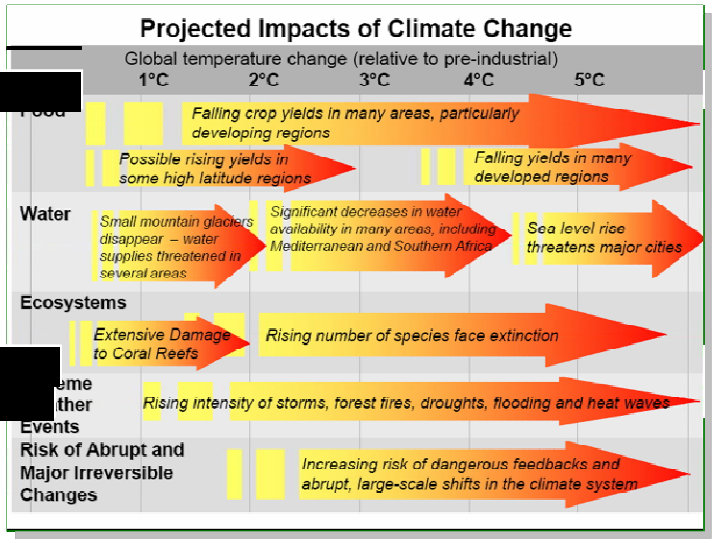

Figure 3.4 Impacts of Global Warming[5]

(See Appendix 8 for Full Size)

Figure 3.4 summarizes the impacts of global warming, including the disappearance of glaciers and ice fields, rising sea levels threatening coastal regions, an increase in the frequency and intensity of weather events and significant impacts on agriculture and species. This growing awareness of climate risk is changing legislation and management of energy around the world, a trend that is likely to accelerate.

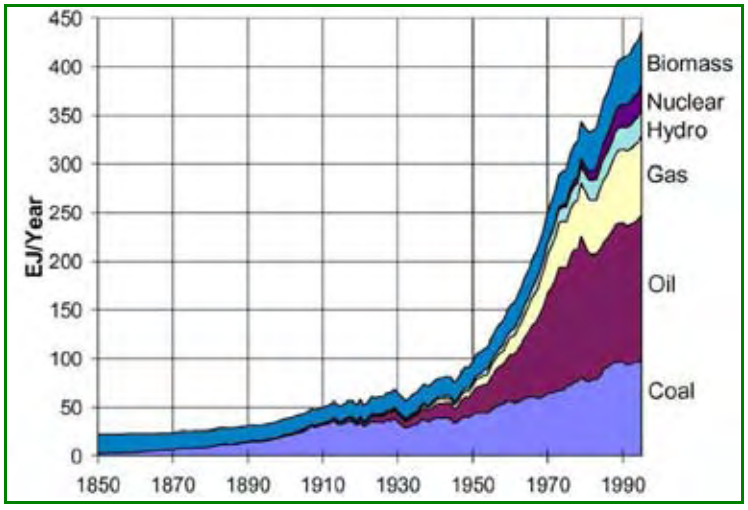

Figure 3.5 Global Evolution of Fuel Use

Figure 3.5 shows the energy use over the last 150 years, and graphically illustrates the challenge the world is facing to continue to meet the growing demand for energy services. Taken globally, we are facing a future with rising energy costs with rapidly accelerating pressure on supplies and distribution channels. There will be growing pressure from cost, legislation and environmental degradation to radically improve energy efficiency and to seek renewable, zero-carbon fuels and technologies that can reduce the climate impacts.

Closely related to energy is the challenge to ensure a low-cost, clean supply of water that will need to be addressed at many levels.

3.2. National Energy Overview

Canada is a country blessed with large quantities of natural energy resources from coal, oil, uranium, and natural gas. In the past, this has buffered Canada from the worst of the occasional price shocks. This is becoming less true as globalization of energy markets accelerates and global demand rises. The days when Canadians could look forward to low energy prices as a certainty are numbered.

Canada's size and climate, combined with very low historic energy prices, has resulted in one of the highest per capita energy uses in the world (see box). Every Canadian uses 6.4 times as much energy compared to the global average, a quarter more than the USA, and well over twice that of the European Union.

Country	Energy Index
Total World	***1.0***
Canada	***6.4***
USA	5.1
EU 25	2.6
Sweden	3.5
Germany	2.6
China	0.5
India	0.2

The relative average per capita energy use of some selected regions around the world. This shows the energy use of each region's inhabitants relative to the energy used on average by all the world's inhabitants.[1]

In comparison with Sweden, a country with not dissimilar challenges of climate, size, lifestyle and economic mix, the average Canadian is consuming 80% more energy per capita than the average Swede.

The challenges of meeting China and India's growing demand for energy is radically highlighted by the twenty-to-one ratio in energy use per head.

Aside from the obvious environmental challenges raised, these large differences in energy use have a major impact on the economic competitiveness of Canada. Canada needs over 130% more energy to produce a dollar of economic output compared to Germany. As energy prices globalize, this discrepancy has significant and growing impacts on the competitiveness of the national economy.

The overall growth of the Canadian population and the economy is also putting strains on the existing energy supply systems, especially around electricity, a further factor that will require the country to rethink its energy use patterns.

Canada is experiencing some of the clear early warning signs of climate change, with accelerated melting of glaciers and ice fields. The national debate around the appropriate way to tackle climate change is very energetic at the moment, including whether to stay committed to the obligations of the Kyoto Treaty that call for Canada to reduce greenhouse gas levels by 6% relative to 1990 levels by 2012 to a level of about 563 Million Metric Tons (tonnes) of carbon dioxide equivalent. This target is far from being achieved at present with Gross 2004 emissions at about 758 Million tonnes, or 27% above 1990 levels. On a per capita basis, Canadians emit 23.7 tonnes of greenhouse gases compared to 23.9 Tonnes in the USA, and 9.3 tonnes in the European Union. The Swedish emissions are 7.8 tonnes/capita.[6]

The current forecast from the Canadian Government is for a steady increase in greenhouse gas emissions rising to 897 Million tonnes of CO2 equivalent, and increase of more than 50% above

[6] Kyoto Treaty Text and greenhouse gas data from UNFCCC website - http://unfccc.int/2860.php and Environment Canada http://www.ec.gc.ca/pdb/ghg/inventory_report/2004_report/ts_1_e.cfm

the Kyoto Treaty 1990 reference year. Carbon dioxide emissions directly attributable to domestic energy use in Canada in 2004 are at a level of 18.4 tonnes/capita and this level will be used through the rest of the document.

As the most populous province, Ontario is a major source of greenhouse gases. Figure 3.6 summarizes Canada's total greenhouse gas emissions by province.

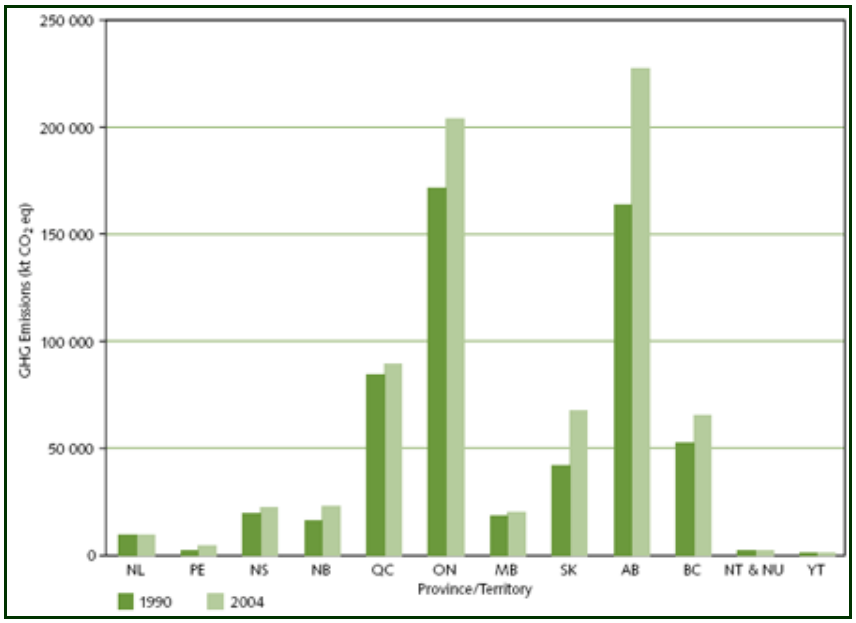

Figure 3.6 Greenhouse Gas Emissions by Province

At 16.4 tonnes/capita, Ontario is somewhat less than the national average, primarily due to the generating and industrial mix. However, this is still about twice the Swedish level and some 75% higher than the EU average.

In terms of water use, Canada uses 1.6 cubic meters of water per year per person; three times as much as the average German, four times as much as the average Swede, and eight times as much as the average Dane. Only the USA has a higher per capita water use than Canada. An often overlooked fact is the amount of energy that is used to prepare and process water.

The National Energy Board has launched a consultative process to develop an "Energy Futures Report" that will be available at the end of 2007[7].

Whatever the details, the future directions are clear. To compete on a global scale, the Canadian economy must become substantially more energy and water efficient. Reducing the climate change impacts of energy use will feature strongly in the national scheme of things moving forward.

3.3. City Level Challenges

With 80% of the industrialized world's citizens already living in cities, and the major growth in the rest of the world being in the urban environment, it is the cities that must lead the efforts

[7] http://www.neb-one.gc.ca/energy/EnergyFutures/2006/index_e.htm#introduction

around ensuring clean, reliable, safe and economic supplies of energy and water in the face of the growing challenges.

Homes and buildings are responsible for over 30% of all energy used in Canada, and proportionally more of all the energy used in most cities. They also account for over 55% of all electricity used. Personal transport accounts for a further 16% of all energy used in the country, most incurred in the urban environment. Freight transport represents 12% of Canada's energy use, much of it within cities, or associated with delivering the goods and services that allow the city to function. Collectively, cities are the major users of energy. Industry uses a further 38% of all energy. With Canada's high levels of activity in mining, metals, pulp and paper, forestry and similar industries, most of the industrial use is outside of most major cities.

The low cost of energy in both Canada and the USA has encouraged the development of cities that are very different from city structures of the past. They cover very large areas with low population density. Cities are zoned with distinctive areas for homes, commercial offices, industrial areas, shopping and entertainment. This layout and density encourages widespread use of cars and discourages the use of cost-effective public transport. The widespread use of cars necessitates wide drivable roads and parking, further reducing the density. Similar patterns have emerged in some of the urban development in Asia, and even in some suburban development in Europe. This approach to urban development is very energy intensive, especially considering that the USA and Canada have had some of the lowest energy efficiency in buildings in the industrialized world, and the rising energy prices and volatility. It is easy to see why achieving significant breakthroughs in energy use in North American cities is becoming a high priority to city leadership.

3.4. Supplemental Reading on Sustainable City Experiences

For the reader interested in further background as to how different cities are responding to creating cleaner, more energy efficient cities, the following examples provide a wealth of ideas and approaches. This is a limited list and interested parties can find more examples by doing a search on the web or at the local library on the subject.

United Cities and Local Governments

This is a global organization that shares broad items of interest to cities around the world http://www.cities-localgovernments.org/uclg/index.asp

Energie Cites

A European organization focused on promoting sustainable energy approaches. Now it has a widening membership beyond Europe. http://www.energie-cites.org/

Natural Resources Canada

This Federal agency has some excellent material on managing energy in the community http://www.sbc.nrcan.gc.ca/communities/communities_e.asp

Sustainable Communities

This USA based organization has a broad range of material and links to a variety of city initiatives in the USA and elsewhere. http://www.sustainable.org/

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Mayors' Asia-Pacific Environmental Summit

This is an annual conference organized by mayors around the pacific rim to discuss urban environmental and sustainability challenges
http://www.environmentalsummit.com/

An underlying theme of all these cities' goals is the vital contribution that sustainable, clean and economic energy and water services add to the overall attractiveness and competitiveness of the city. The reverse is clearly true; expensive, unreliable and polluting energy and water systems will ultimately become a deterrent to investors, inhabitants and tourists.

4. GUELPH'S CHALLENGES

4.1. Managing Growth Pressure

Guelph is a compact city with a 2005 population of about 115,000, plus an additional 18,000 students residents during the academic year[8], located about 100 km from Toronto's Central Business District. It covers an area of about 86 square kilometers. It is located in one of the strongest economic growth regions in Canada, and North America.

In addition to its proximity to Toronto, Guelph has many aspects making it an attractive place for potential investors and residents. It is home to the University of Guelph, and a wide range of manufacturing, high tech and service industries. It is well located for transportation, is an agricultural hub, and is in the "Golden Triangle" which is attractive to many incoming investors.

Combined, these characteristics are putting significant growth pressure on Guelph.

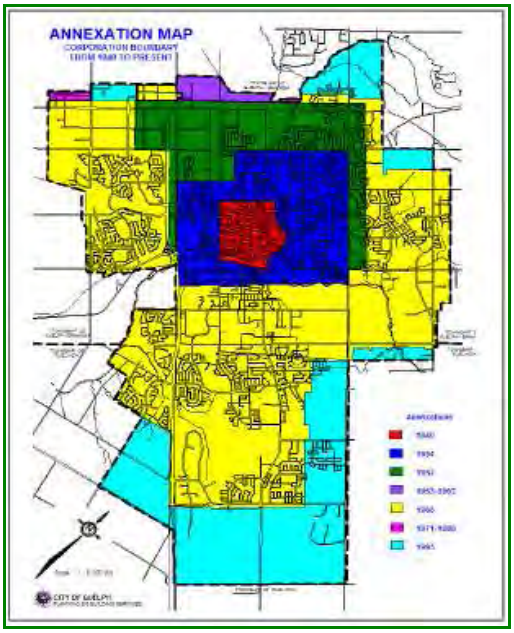

Figure 4.1 Guelph Growth 1940 to Present Boundary

Guelph has already experienced significant growth over the last 50 years to its current boundaries. The population is expected to further increase to around 180,000 by 2031 along with significant industrial and commercial investments.

[8] For per capita indexing the student population has not been included.

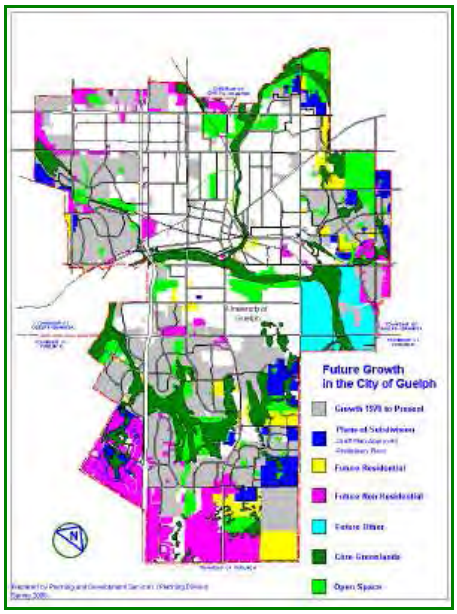

Figure 4.2 Designated Growth Areas

Future growth is expected to occur within the existing boundaries, following the basic principles of "Smart Growth" and provincial "Places to Grow" legislation. These include selective intensification, increasing the efficiency of infrastructure, and ensuring valuable heritage features, public spaces and significant natural features are retained.

4.2. Long-term Competitiveness

Guelph is committed to economic development and growth that will ensure the long-term competitiveness of the city as a safe place to invest, work, and live. This has multiple dimensions including attracting high-quality long term employment opportunities, offering a full range of world-class education, a range of housing for all income levels, supported by public services of the highest quality at competitive costs. Among these must be reliable, clean and economic energy and water services, the area specifically addressed by this Community Energy Plan.

4.3. Quality of Life

Guelph is committing itself to being a role model for Canada and the world in offering a distinctive quality of life at many levels through active involvement of all sections of the community, including the city administration and political leadership. This will include ensuring that Guelph remains a center of excellence for scientific and technical innovation through its university, commerce and industries. The city will retain its distinctive character built on over 175 years of history, including maintaining a conscious connection with the agricultural community. It will actively capitalize on the benefits offered by the ethnic and cultural diversity within the city. The city will be recognized as a center for arts and culture of all genres. Last, but certainly not least, Guelph is committed to being a community where the highest levels of sound environmental stewardship guide all of its decisions.

4.4. Community Response to the Energy Challenge of Growth

The combination of managing growth and adhering to sound environmental principles is particularly challenging when it comes to providing energy and water services of the highest quality, lowest cost and with the least environmental impact. This was recognized by a number of leaders in Guelph who started addressing this issue as early as 2003, and then in the fall of 2005 formally founded a Community Energy Plan Consortium with the aim of leading the city and its constituents to a more sustainable energy future. By late 2005, the Consortium had carried out a number of public input meetings and workshops. In mid 2006, the Consortium reinforced its efforts to develop a Community Energy Plan for the city by awarding a contract to Garforth International llc.

Since that time, the roster of organizations represented by the Consortium has grown and now includes:

The consulting team includes members with expertise in building efficiency, renewable energy, integrated municipal energy and water systems, and overall strategic energy management. The team was chosen in part because it included members with clear experience that included European municipal energy and water practice from Mannheim, Germany[9], a city widely recognized as a benchmark in terms of providing low impact, high quality services.

As a major part of the process, a number of public meetings were held to provide information and gain input. The input process culminated with the public forum held in the River Run Center, with over 100 participants. In all, an estimated five hundred people have participated in these meetings and have made their interests, visions and concerns known. They have thus been a part of the creation of the CEP Preliminary Draft recommendations. (See Figure 4.3)

[9] See Section 11 – Scale Projects and www.mannheim.de.

Workshops/Presentations/Milestones	Date
Initial Community Workshops (5 sessions)	***Dec 5&6, 2005***
RFP awarded	***06-Jun***
Kick-off Meetings – Consortium, UoG, City, School Boards, GHI	***Jun 6 to 9***
Community Presentation # 1 – GDA Focus Group	***22-Jun***
Community Presentation # 2 – Industrial Focus Group	***05-Jul***
Consortium review of CEP work in progress	***23-Aug***
Community Presentation # 3 – City Council + Guelph Hydro	***06-Sep***
Community Presentation # 4&5 – Students / Energy and Environmental	***10-Oct***
Community Presentation # 6 – University of Guelph	***15-Nov***
Community Presentation # 7 - Small and medium Enterprise / Public Sessions	***14-Nov***
Community Presentation # 8 – Public Forum	***15-Nov***
Draft CEP	***08-Jan***
Consortium Review of Recommended CEP	***12-Jan***
Formal presentation to City Council (date to be aligned with council agenda)	***TBD***

Figure 4.3 Timetable - Workshops/Presentations/Milestones

Throughout the process the Consortium met at least once a month to review and guide the progress.

The last step of this phase of the process is to finalize the Community Energy Plan Preliminary Draft Report with the Consortium and present it to the City Council for receipt prior to communicating the CEP to the wider community. Clearly the CEP must be seen in the context of any legal and formal regulatory framework.

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5. VISION OF A SUSTAINABLE ENERGY FUTURE

5.1. Community Energy Plan Vision

Energy Vision for Guelph

Guelph will create a healthy, reliable and sustainable energy future by continually increasing the effectiveness of how we use and manage our energy and water resources.

Throughout the development of the Community Energy Plan, the Consortium took a global perspective to benchmark their decisions from around the world. The decision on the choice of overall Vision was no exception. Energy and sustainability visions from the UK, Sweden, and Canada[10] were discussed and elements incorporated into the final selected Vision.

The Consortium recognized the importance of a Vision around energy and water that would not be changed year to year, but would survive in intent, spirit and wording literally from one generation to the next.

5.2. Sustainable Energy Goals

Goals in Support of Guelph's Energy Vision

1. Guelph will be the place to live and invest supported by its commitment to a sustainable energy future
2. Guelph will have a variety of reliable, competitive energy, water, and transport services available to all
3. Guelph energy use per capita and resulting greenhouse gas emissions will be less than the current global average
4. Guelph will use less energy and water per capita than comparable Canadian cities
5. All publicly funded investments will visibly contribute to meeting the four CEP goals

The Consortium was very clear in the intent to create a plan that was not only visionary, but was also firmly rooted in the need to be actionable, with goals that were clearly, and easily measurable. Goals were selected bearing in mind that they meet the following criteria:

- They clearly support the economic, social and environmental benefits of the Community Energy Plan
- They are structured such that they can survive unchanged for years or decades
- They highlight clear benefits for residents and investors in the city
- They must be easy to explain, understand and measure

These goals and the associated detailed measurements are covered in more detail in Section 9 of the CEP. In general, if there was conflict between being precise, but difficult to measure or

[10] Among others – London, UK; Vaxjö Sweden; Mannheim, Germany; Yellowknife, Canada; Berlin, Germany, Copenhagen, Denmark.

communicate, or being directionally correct and easy to measure and communicate, the Consortium elected to go with the latter position.

5.3. Benefits for the City of Guelph

As Guelph delivers on its energy plan, a wide range of benefits will accrue to various communities within the city. These are wide-ranging and interconnected. All contribute to the long term health and prosperity of Guelph.

5.3.1. Benefits for the Residents

- Domestic energy and water costs will be consistently lower than neighboring cities
- Air quality, in relation to lowered greenhouse gas emissions, will be substantially better than in a business-as-usual approach
- Supply reliability will be less vulnerable to disturbances in specific fuel supply chains
- Residents will be less vulnerable to abrupt pricing changes caused by market volatility
- The satisfaction in knowing these benefits are achieved with significantly reduced impact on the planet

5.3.2. Benefits for Guelph's Businesses

- All of the same benefits as for the resident
- Opportunity to receive energy services tailored more closely to the specific needs of the business
- By reducing greenhouse gas, the risks of possible future costs around climate change regulation are reduced
- Availability of talented labor attracted by Guelph's commitment to a sustainable future
- Opportunity to create products, services and solutions aimed at supporting Guelph's implementation of the CEP – and the opportunity to market these beyond Guelph

5.3.3. Benefits for the City Administration

- As an operator of the city facilities, all of the same benefits as for business
- Enhanced tax base from quality commercial and industrial investors and their employees
- Opportunity to attract investment clusters around products, services and solutions aimed at serving sustainable community energy and water plans
- Reduced risk of becoming *"just one more Toronto dormitory"*

5.3.4. Benefits for Financial Institutions

- Enhanced collateral value of residential and commercial property due to reduced energy and water operating cost allowing extended mortgages or financing
- Reduced financing risk of residential and commercial property due to reduced exposure to energy and water market volatility.

5.3.5. Benefits for Developers and Builders

- Ability to capture premium market prices as a result of enhanced collateral value of efficient property

- Development of community based district energy services may reduce construction costs of individual homes and buildings[11]

5.3.6. Benefits for Canada and the Planet

- Being a leading example that Canada has the potential and commitment to create innovative community responses to the global challenges of energy and water
- Creating a replicable model that can be proliferated across Ontario and the nation
- Being a tangible example of how Canada can reverse its deteriorating performance[12] in meeting its global environmental commitments

5.3.7. Benefits for Energy Service Suppliers

An integrated community energy approach creates new opportunities and benefits for energy service suppliers to both the city and the surrounding region. An, almost inevitable, fallout of the successful implementation of a Community Energy Plan is some degree of reshaping the commercial frameworks that provide energy supply services and energy efficiency services to the city. The precise form of these changes will evolve over time, and it is premature to jump to final conclusions at this stage of the development of the Community Energy Plan. Whatever the form, the benefits that the CEP creates for future energy service providers will include some combination of the following:

- Improved return on generating and distribution assets due to increased range of energy services and improved primary fuel efficiency
- New market opportunities through the sale of energy efficiency management services and equipment
- Greater understanding of end-customer energy needs
- Managing future risk of cost or regulatory impacts resulting from greenhouse gas reduction policies
- Developing integrated municipal energy services management expertise that itself becomes a marketable product

[11] See CEP Section 10 – Strategy on District Energy & Section 11 – Scale Projects

[12] See "Canada vs. The OECD: An Environmental Comparison" – University of Victoria – 2001 as an example of an assessment of Canada's global environmental ranking

6. PROFILE OF GUELPH

6.1. General Background

Guelph is a unique Ontario community in Wellington County. It is known for historical architecture, a wonderful mix of urban amenities and dedication to the arts. It is in one of the fastest growing regions of Ontario, commonly known as the 'Greater Golden Horseshoe". This growth is both an opportunity and a potential threat to Guelph in the 21st Century.

Guelph is a city with a clear community commitment to economic development and sustainability which can sometimes be seen as being in conflict with each other. The Community Energy Plan is a significant opportunity to add support to an ongoing "philosophy that seeks to balance economic, social and environmental perspectives"[13].

This community has continually shown its receptiveness to innovation from its founding in 1827. John Galt of the Canada Company created a bold vision and a plan for Guelph. To quote a local historian: "So spectacular was the result, that, for a time, [Guelph] rivaled Niagara Falls as a tourist destination, and both wealthy travelers and government officials came to view the fruits of Galt's grand design."[14] The City has continued to thrive through most of its history.

6.2. Historical Role in Community Energy

It is appropriate that Guelph is taking a lead in developing a Community Energy Plan for the next 100 years, having been a key player in the development of communal energy distribution in Southern Ontario. In 1903, Guelph was one of the first Ontario municipalities to take over the privately owned local gas and electricity provider. It was the first municipality in Ontario to own its utility debt-free.

The leadership of the city was also instrumental in creating the Hydro Electric Power Commission of Ontario bringing hydro-electricity from Niagara Falls in 1906.

6.3. Present Day Profile

The city covers 85.89 km^2 within Wellington County[15], approximately 100 km west of Toronto, surrounded by fertile agricultural lands including many organic farms. This close connection to agriculture is reflected in existence of both the Ontario Agricultural College and the Ontario Veterinary College, on the campus of the University of Guelph. Guelph is also home to the Ontario Ministry of Agriculture, Food and Rural Affairs.

Guelph is in the "Greater Golden Horseshoe", a technology and growth hot spot. This region is targeted by the Ontario Government's "Places to Grow Act" as a high growth area. The median

[13] City of Guelph, http://guelph.ca/documen.cfm?noheader=1&smocid
[14] History of Guelph, Johnson, 1977
[15] 2001 Community Profiles, http://www12.statcan.ca/english/profil01/CP01/Details/Page.cfm?Lang=E&Geo1=CSD&Code1=3523008&Geo2=PR&Code2=35&Data=Count&SearchText=Guelph&SearchType=Begins&SearchPR=35&B1=All&Custom=

age of the population is 35.4 with 80% of the population above 15 years old, mostly between the ages of 25 – 54[16].

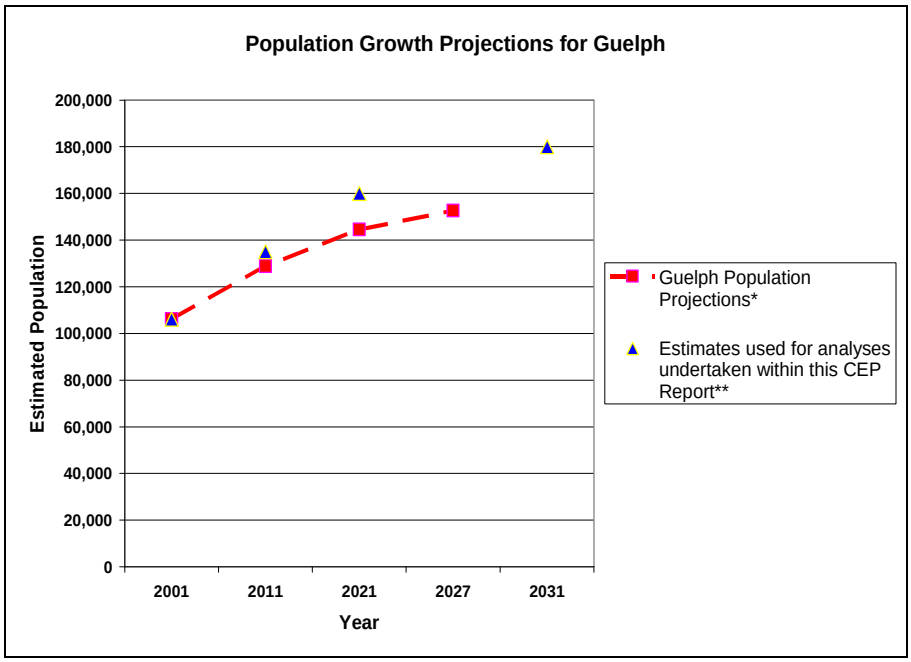

Figure 6.1 Population Growth Projections for Guelph

The population has grown by 10.8% between 1996 and 2001, faster than the Ontario average of 6.1%. In 2006, the growth rate was 2.3%.[17] **Estimates based on achieving Places to Grow goals of approximately 180,000 in population by 2031.

For this report, the 2005 population is estimated at 115,000, with 2031 predicted to be 180,000, representing a 2% growth per year. Some estimates are anticipating a higher rate of growth.

Population density was 1,250 inhabitants per square kilometer in 2001.

Population statistics for Guelph, including overall population estimates, are understood to exclude the approximate 16,000 students (2005) studying at the University of Guelph.[18] A large proportion of these students, perhaps 90%, leave Guelph over the summer period from May to September, the time when census data is generally collected.

[16] 2001 Community Profiles, http://www12.statcan.ca/english/profil01/CP01/Details/Page.cfm?Lang=E&Geo1=CSD&Code1=3523008&Geo2=PR&Code2=35&Data=Count&SearchText=Guelph&SearchType=Begins&SearchPR=35&B1=All&Custom=

[17] City of Guelph, Growth Management Workshop, May 2006

[18] Gillian Maurice, Sustainability Coordinator, Physical Resources, University of Guelph

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The following statistics are based, unless otherwise specified, on the 2001 census data[19] as per below:

- Population density was 12.25/km^2.
- Most of the population uses their private cars for transportation, making this a major component of overall energy use:
    - About 7% of the Guelph population shares passenger transport to work.
    - About 15% of the population uses public transport, bicycle or walks to work.
- The student population is a heavy user of public transport compared to the average Guelph citizen. Student use of public transport is encouraged through the inclusion of reduced fare bus pass fee as part of their overall student fees.[17]
- The average income for Guelph is in line with provincial levels:
    - Median household income was $56,000 in 2001, slightly higher than the Ontario average.
    - Median household income has risen to $74,600 in 2006.

In summary, Guelph is a diverse, medium-sized community reflective of the overall profile of Ontario.

6.4. Economic Development

One of Guelph's greatest assets is a capable, productive, and well educated workforce. It is situated in one of the fastest growing economic regions of North America and is close to major markets. Guelph is well served by most means of industrial and commercial transport including rail. These items help to make Guelph attractive to investors, as well as making it an attractive place to live, work and play. There is a large availability of public and private sector industrial and commercial lands[20] including:

- Hanlon Business Park – City Owned
- Hanlon Creek Business Park – Private/Public Partnership
- Northwest Industrial Area – Mature Area
- Southern Industrial Area – New Development
- University of Guelph's Research Park – Start-up Innovation Incubation
- York Road Industrial Lands – Emerging New Development Area

Commercial and retail opportunities abound, as exemplified by recent expansion of the Stone Road Mall, and the growing retail development to the south. The availability of reliable and competitive energy services is a key factor for industrial and commercial investors, a key aspect addressed in the Community Energy Plan.

Altogether there are over 1000 registered businesses operating in Guelph with most employment being in manufacturing and educational services. Retail and health are closely tied

[19] http://www.statcan.ca/menu-en.htm

[20] City of Guelph, Guelph Land and Building Profile, 2004

for third and fourth in terms employment. In 2001, approximately 61,280[21] jobs existed, a number expected to grow to 98,000 by 2031.

6.5. Crossroads in Development

The citizens of Guelph were consulted in mid-2006 regarding their opinions concerning growth. While being generally supportive, concerns were voiced on managing the impacts of growth. Although the general outlook is positive, it is important to the citizens that the essential and individual character of the city be maintained. As discussed later in this report, the Community Energy Plan brings major contributions to achieving this goal.

Guelph is at a crucial development stage, with the population is expected to increase by as much as 60% within the next two to three decades. This has triggered in-depth reviews of many aspects of municipal operations:

6.5.1. "SmartGuelph Principles"

Laid out in 2003, these principles[22] serve as a framework for strategic planning. Guelph is targeted to grow, preferably without annexation, within the Province of Ontario's thirty year "Places to Grow"[23] legislation. A Local Growth Management Strategy[24] is exploring options for growth. There will be significant residential and commercial densification, allowing more energy supply and efficiency options which is a crucial aspect in the Community Energy Plan.

6.5.2. Water Resources

Guelph is one of the few Ontario municipalities that obtains all of its water from groundwater sources. The city has recently completed a 50-year Water Supply Master Plan to ensure the reliable long-term supply of high quality affordable water. The Plan, as adopted by City Council considers the updating and on-going implementation of the city's award-winning Water Conservation Plan, as well as optimization and upgrades of current groundwater sources and the potential availability of new groundwater and surface-water sources. Although the plan considered all alternatives, including a pipeline to Lake Erie, the council excluded the pipeline from approval for implementation. Energy is up to 70%[25] of the cost of potable water and waste water and the Community Energy Plan includes some specific recommendations on reducing overall use of potable water.

6.5.3. Transportation

The Guelph Wellington Transportation Study, based in part on the review of the household travel habits for 12 municipalities in the region and a '2005/2006 Tomorrow Survey'[26] has recently been completed and supplements the city's Transportation Strategy framework adopted in 2001.

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[21] City of Guelph, Growth Management Workshop, May 24, 2006

[22] City of Guelph, http://guelph.ca/living.cfm?smocid=1964

[23] Ontario Ministry of Public Infrastructure Renewal, http://www.pir.gov.on.ca/english/growth/index.html

[24] City of Guelph, http://guelph.ca/living.cfm?smocid=2106

[25] Range is 30%-70%. http://www.ase.org

[26] City of Guelph, Transportation Planning, http://guelph.ca/living.cfm?subCatID=1514&smocid=2093

6.5.4. Waste Management

Managing municipal waste is a major challenge for all cities, and Guelph is no exception. The city has a source-separation program for the separate collection of both recyclable waste and compostable waste and an innovative Wet-Dry facility which includes a Material Recovery Facility (MRF) and composting facility. The composting facility is currently shutdown temporarily for repairs and upgrades, but is budgeted to be reopened in 2008. In addition, the city has initiated a master plan for solid waste which will explore all viable technical and economic options for an integrated waste management program for Guelph for the next 25 years. The Master Plan process is being supported by Green Municipal Enabling Funds (GMEF). In addition to implementing strategies to reduce the total amount of waste by recycling and composting as much as possible, the remaining combustible component is increasingly seen as a potential fuel source and as such has a place in the Community Energy Plan deliberations.

In addition, Guelph Hydro Electric Systems and the city have a landfill gas cogeneration project at the city's recently closed landfill site. The city collects landfill gas and provides it to Guelph Hydro's Ecotricity cogeneration facility located on the closed landfill. This project is supported by federal funding programs. The city is also working with Guelph Hydro to consider energy conservation options for the city's Wet-Dry facility.

6.5.5. Waste-water Management

The city is undertaking capital upgrades to an on-site cogeneration facility at the Waste-water Treatment Plant to generate electricity from biogas to offset electricity requirements of the facility. This capital project is being supported by Guelph Hydro's Conservation and Demand Management Program (CDM). The city is also working with Guelph Hydro to replace existing equipment at the Waste-water Treatment Plant with high efficiency options.

This is not a complete list of city initiatives by any means. However, it summarizes the key areas that have the potential to be a major impact on Guelph's energy use and/or energy supply, and the reader is recommended to peruse the referenced documents and web sites. These initiatives along with the Community Energy Plan, also underline Guelph's visible and growing commitment to long-term sustainability.

6.6. Overview of Built Infrastructure

The majority of energy use in any modern city is in residential homes, commercial and institutional buildings, with industrial use being a major added component. The overall inventory of Guelph's so-called "Built Infrastructure" is summarized in[27] Figure 6.2.

[27] Property data sourced from City of Guelph – Economic Development – status 2005

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Sector	Square metres (m^2)	Square feet (ft^2)	Number
Residential[28]	5,205,212	55,970,026	33,376
Commercial	847,627	9,103,518	3,137
Institutional	836,289	8,992,356	367
Industrial	1,707,702	18,362,384	2,321

Figure 6.2 Property Areas for Guelph by Building Sector

A base for any Community Energy Plan must include an assessment of the scale of the built infrastructure, including its use, age, efficiency, and its likely evolution going forward. These are used in the creation of energy benchmarks for the city.

The overall land use of Guelph is summarized in Figure 6.3.

Sector	km^2	% Total
Residential	33.36	35.9%
Agricultural	22.05	25.7%
Parks/Open Spaces	11.75	13.7%
Commercial	3.21	3.7%
Institutional	7.40	8.6%
Industrial	8.08	9.4%

Figure 6.3 Guelph Land Use by Sector[29]

The Residential profile was available in some detail, and is summarized in Figure 6.4.

[28] The residential category – "Other" - of approximately 32,000 sq. m is not included in the total.

[29] City of Guelph, Growth Management Workshop, May 24, 2006

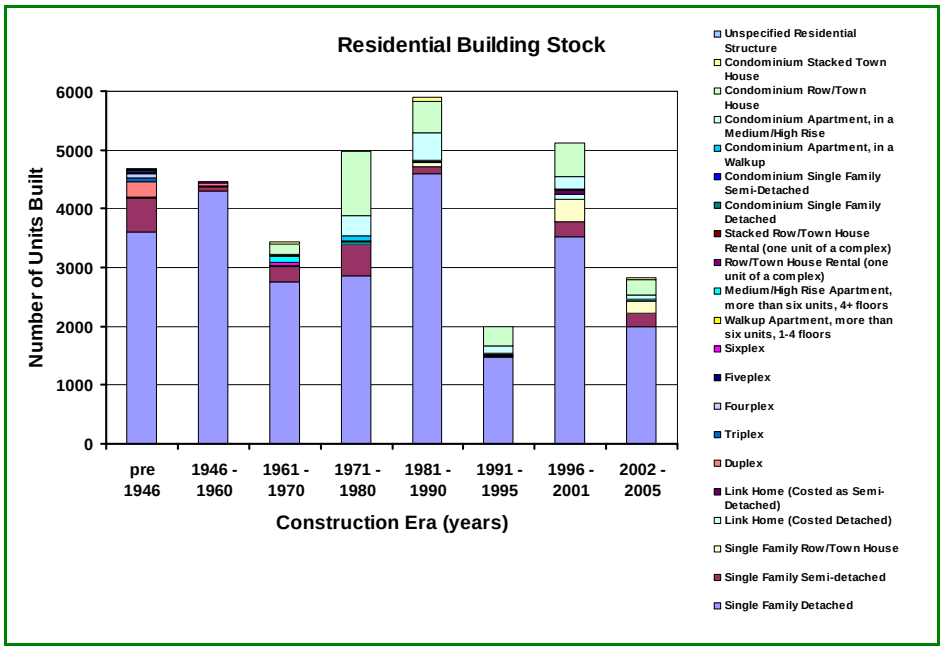

Figure 6.4 2005 Estimates of Residential Property[30] by Age and Building Type

(See Appendix 8 for Full Size)

Information on commercial, institutional and industrial buildings was more fragmented and there is ample scope for more systematic analysis in the future.

6.7. Climate

Clearly, climate has a huge role in the use of energy. Heating and cooling buildings of all types is one of the largest uses of energy. Climate also has major impacts on transportation energy use. Today, with wind, sunshine and biomass products increasingly seen as alternative energy supplies, the role of climate is becoming increasingly important in the total energy equation.

6.7.1. Heating & Cooling Degree Days

Heating and cooling degree days are a measure of the degree to which buildings need heating or cooling to maintain a specified level of temperature comfort.

Guelph is predominantly a heating environment, an average of 4,352 heating degree days per year.[31] This indicates a high heating demand.

As a comparison, Mannheim in more temperate Central Germany has about 3,470 heating degree days and Cleveland, Ohio in the US about 3,900. Cooling degree days[32] are about 180[29] referenced to an average outdoor temperature of 18 degrees C. Traditionally, cooling would have been seen as an unnecessary luxury. However, with the increased use of air conditioning throughout the affluent developed world, cooling load is becoming more significant and must be incorporated into the energy planning.

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[30] City of Guelph Residential Property Data provided jointly by City of Guelph Economic Development and Technical Services

[31] http://www.on.ec.gc.ca/weather/winners/intro-e.html

[32] NRCan, RETScreen Clean Air Technologies modeling tools, http://cetc-varennes.nrcan.gc.ca/en/retscreen.html

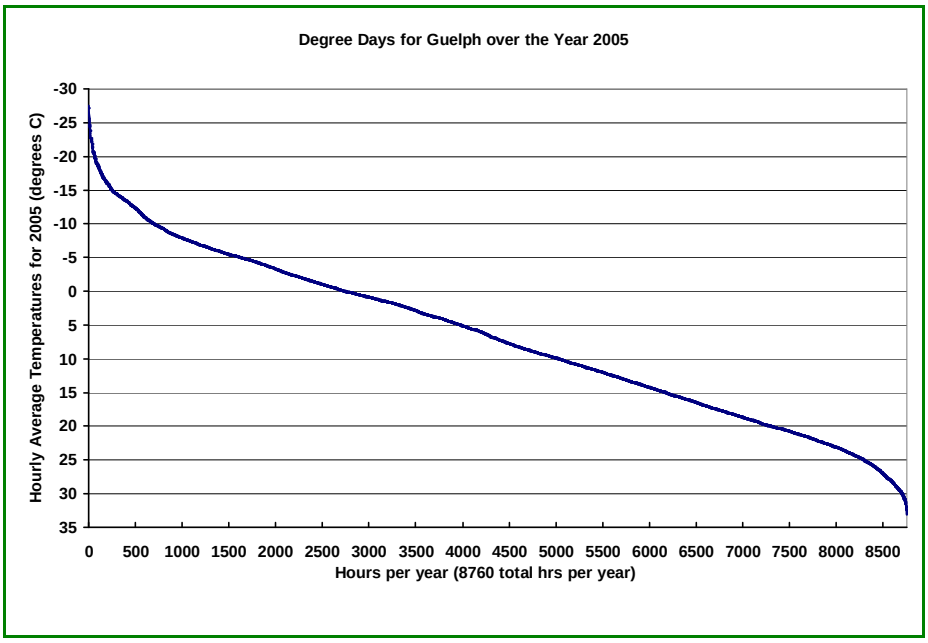

Figure 6.5 Distribution of Hourly Temperatures in Guelph

An overview of Guelph's hourly temperature levels is summarized in Figure 6.5, and is the basis for calculating heating and cooling degree days. These are two critical elements in estimating the energy needs of buildings. Other climate data including solar radiation, wind speed, and humidity were gathered[33] and used in the energy modeling. (See Figure 6.6)

	Solar Radiation (MJ/m²/day)		Temperatures °C				Wind km/h
	Global	Diffuse	Dry Bulb	Wet Bulb	Amplitude	StdTmp	
January	5.01	3.1	-6.9	0	12.7	3.13	16.44
February	10.22	4.32	-7	0	11.7	2.8	15.21
March	13.32	6.16	-2	0.07	14.6	2	15.68
April	16.31	7.96	5.4	6.76	10.4	1.6	15.32
May	20.27	9.25	11.9	10.5	8.23	1.8	13.02
June	22.72	9.68	17.4	14	6.53	1.3	12.05
July	22.06	9.4	19.9	16	5.33	1.1	11.65
August	19.01	8.42	19	14.7	6.14	1.3	11.62
September	13.97	6.84	15.2	10.9	9.42	0.9	13.31
October	9.32	4.97	8.9	6.37	10	1.5	15.07
November	4.9	3.31	2.2	0.91	12.6	1.5	16.83
December	4.5	2.7	-4.1	0	13.9	2.8	16.94

[33] NASA surface meteorological and surface radiation data site, http://eosweb.larc.nasa.gov/sse/

Figure 6.6 Other Climate Data Used for Modeling of Buildings in Guelph

6.7.2. Solar Resources

Sunshine is increasingly a "fuel" for solar electricity and solar heating. The University of Guelph manages the Elora Research Station near Guelph (43.39°N, 80.25°W) and supplied detailed hourly data of solar radiation. Figure 6.7 summarizes the solar radiation intensity for a 12 month period between 2004 and 2005.

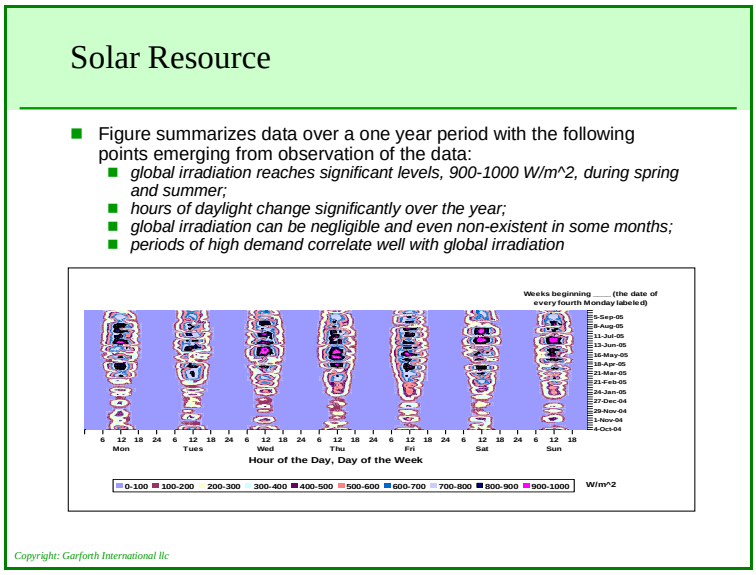

Figure 6.7 Irradiation Data in the Guelph Region (04/05)

(See Appendix 8 for Full Size)

When this data is correlated with the electricity demand and electricity pricing, the periods of maximum solar radiation align reasonable well with high demand and high prices. The overall annual solar electricity potential with current technology is about 185 kWh/m^2.[34] This is a reasonably attractive level when put in the context of the current Standard Offer Contract[35] support level of $0.42/kWh.

In the case of solar thermal applications, the data of Figure 6.7 is also relevant. The likelihood of solar heating being a significant energy contributor is low. However, there are some experimental data that was not fully available at the time of this report from earlier experiments that should be evaluated before a final determination is made.[36] Data from this trial would be of interest to the CEP as would the operational results of the new technology solar thermal plant installed on the new Guelph Hydro Building.

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[34] Remmer D., Rocha J.. – A Study of the Potential for Integrating Renewable Energy Technologies within the Existing Provincial Highway Transport Infrastructure of Ontario. Report prepared for Ministry of Transportation of Ontario, Highway Infrastructure Innovation Funding Program 2004.

[35] Standard Offer Contract
http://www.powerauthority.on.ca/Page.asp?PageID=122&ContentID=2009&SiteNodeID=161&BL_ExpandID

[36] Government of Ontario – Solar Hot Water Project conducted by SOLCAN – Remmer Consulting for details

6.7.3. Wind Resources

The wind potential within the Guelph region has been evaluated in a recent project done by the faculty and students at the University of Guelph[37]. The following two slides (Figure 6.8 and Figure 6.9) summarize their findings.

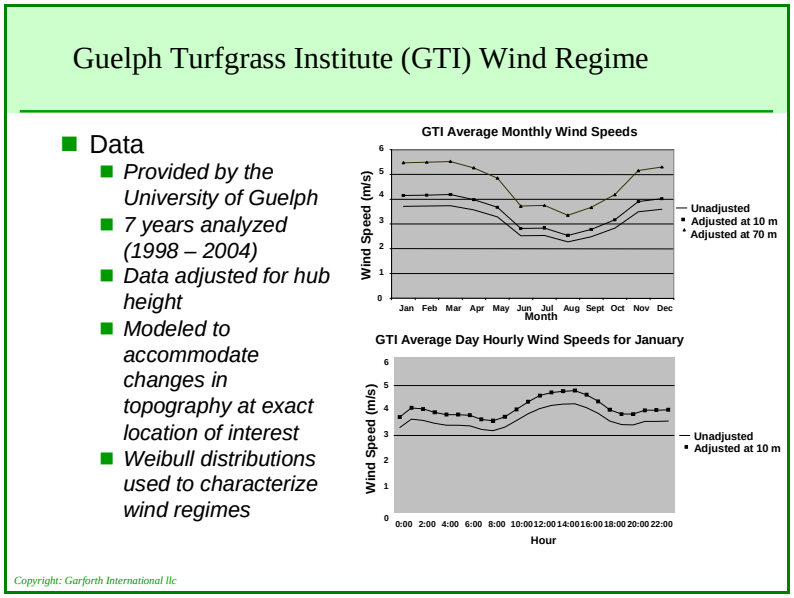
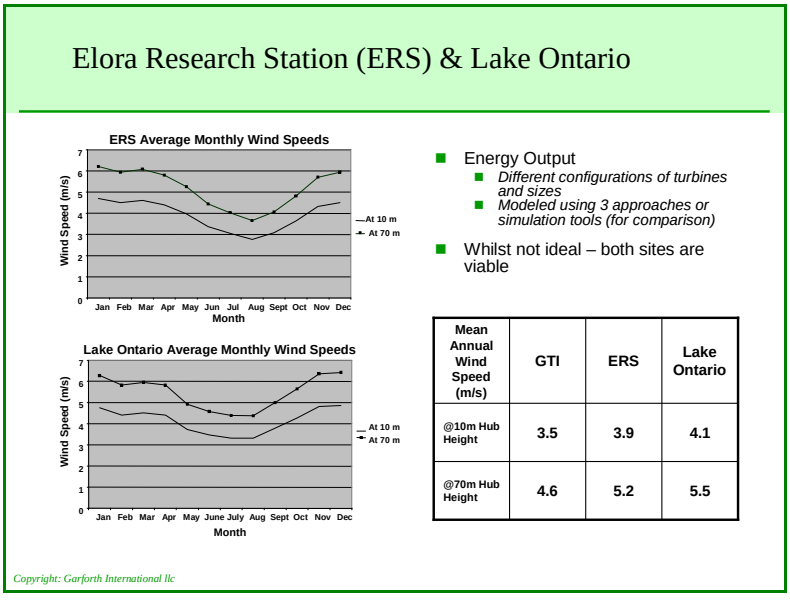


Figure 6.8 Daily Wind Pattern



Mean Annual Wind Speed (m/s)	GTI	ERS	Lake Ontario
@10m Hub Height	3.5	3.9	4.1
@70m Hub Height	4.6	5.2	5.5

Figure 6.9 Yearly Wind Pattern

[37] Jessica Beuning and Dorothy Remmer, School of Engineering, University of Guelph, Summer 2004

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The wind regime is not excellent but it may provide a reasonable payback and some significant non-financial values in support of the CEP. Wind generators are visible commitments to changing the game, and as symbols, they can have a value that goes beyond cash. Recently, newer technologies and a revised Standard Offer Contract for renewable electricity with a support level of $0.11/kWh, will also begin to push this to financial viability, especially for farmers. Last but not least, the wind regime actually compliments to the solar regime and the overall electricity demand.

6.7.4. Rainfall Data

Sixty years of rainfall data is available from a team[38] in the School of Engineering, University of Guelph. They are exploring the possibilities for rainwater harvesting (RWH). At this stage, the CEP is making some broad recommendations on rainwater harvesting. Given the future challenges for potable water supply, this is an area for much deeper assessment.

[38] Supervisor: Dr Khosrow Farabakhsh Students: Chantelle Liedl and Chris Despins, School of Engineering, University of Guelph (2006)

7. ENERGY & WATER PROFILE TODAY

7.1. Process to Establish CEP Baseline

The achievement of the Community Energy Plan Goals will be measured against a baseline. A first effort to establish a 2005 baseline for Guelph has been conducted, and is summarized in this section. This is one of the toughest efforts for any Community Energy Plan. Obviously, the more complete the data, the more reliable the baseline will be.

The Guelph Community Energy Consortium was very forthcoming in providing what data was readily available. However, in many cases this has proved to be incomplete or inconsistent in some way, and a significant amount of refinement and adjustment of this baseline can be expected during the first couple of years of the implementation of the CEP. The requested and available data[39] are summarized in the following table.

Figure 7.1 Summary of Data Availability and Needs for the Guelph CEP Project

[39] Data used is archived and available to the Consortium, subject to confidentiality conditions from the data owner

[40] Source: Guelph Hydro Electric Systems Inc – High completeness of data

[41] Source: Union Gas – Moderate completeness of data, some confidentiality constraints

[42] Source: Guelph Hydro Total consumption only – UoG may have periodic indications

[43] Source: City of Guelph – Economic Development

[44] Not available at time of report – Ontario estimate used for modeling

[45] Source: City Transportation Department plus estimates

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Where only partial data was provided, the baseline is predicted using estimates based on global, national or provincial data.

The team modeled energy use for each sector: residential, commercial, industrial and institutional. The results were compared with national and provincial statistics for credibility. Results were also compared with the utility data provided by the Consortium. Through a process of iteration and some judgment calls, indexes are derived.

In the interests of moving the CEP implementation ahead and given the inevitable data collection challenges decisions have been made. Each index and the elements that contribute to it should be revisited as data availability improves. **However, where indexes are directionally correct with reasonable confidence in the source data, the CEP development team is cautioned against becoming overly focused on data precision at the cost of moving into action.**

The following sections of the report discuss and summarize the analyses and results of modeling undertaken to establish baselines by end-use category, building sector and energy source.

7.2. Energy Use in Buildings

The sectors used for benchmarking are residential, commercial, institutional and industrial. Some overlaps exist between categories, and where this occurs, the default is to the readily available data for ease of future tracking.

7.2.1. Residential

Based on the climate, demographics and other assumptions, Figure 7.2 summarizes the energy use model for the two most common residential building types in Guelph. The single-family-detached results assume a 2-story, brick home with finished area of 214 m^2 and the row house results for a 2-story, brick, full basement, middle unit.

Domestic hot water (DHW) consumption and electricity use per person is calculated using the HOT2000 program[46] based on occupancy.

Home type ▼	New Ontario Code (2007)	Existing Ontario Code (1997)	1985	1975	1965	1955
	(kWh_e/m^2/year)					
Single-family-detached	163	189	268	305	335	373
Row houses	152	170	205	239	272	320

Figure 7.2 Modeled Residential Energy Use by Age and Type

Methodology:

- Modeling performed using the Natural Resources Canada HOT2000 Version 9.31 program.
- Climate was modeled for Toronto and heat loss was then increased by 3% to adjust for the slightly cooler climate in Guelph

[46] See http://www.eere.energy.gov/buildings/tools_directory/software.cfm/ID=45/pagename=alpha_list

- Program defaults were used for Domestic Hot Water and Electrical (lighting, appliances, etc.) consumption

Modeling Assumptions:

House style:

- Single family detached: 2 Storey brick, full basement
- Row house: 2 Storey brick, full basement, middle unit
- Gas energy conversion efficiency: 80%

House finished area:

- Single family detached: 214 sq.m.
- Row house: 149 sq.m.

House components:

	New Code (2007)	Existing code (1997)	1985	1975	1965	1955
Ceiling insulation	R40	R31	R28	R17	R12	R12
Wall insulation	R19	R17	R12	R10	R10	R6
Basement insulation	R12 (to 2 ft. below grade)	R8 (to 2 ft. below grade)	none	none	none	None
Window R-value	R2.8	R1.7	R1.4	R1.4	R1.3	R1.3
Air Tightness, ACH@ 50 Pa	3.57	3.57	4.55	6.50	8.70	11.20

The “New Ontario Code” refers to the recently announced building code that raises the energy efficiency requirements of materials, structure and appliances and will be fully in force by 2012.

The energy consumption is estimated in the following categories;

- Net space heating
- Space heating fan
- Domestic hot water load
- Lighting, appliance, exhaust fan (other electrical uses)
- Net space cooling load (thermal)
- Cooling fan

The energy use for each of these categories for a single family home for the different ages and codes is summarized in Figure 7.3

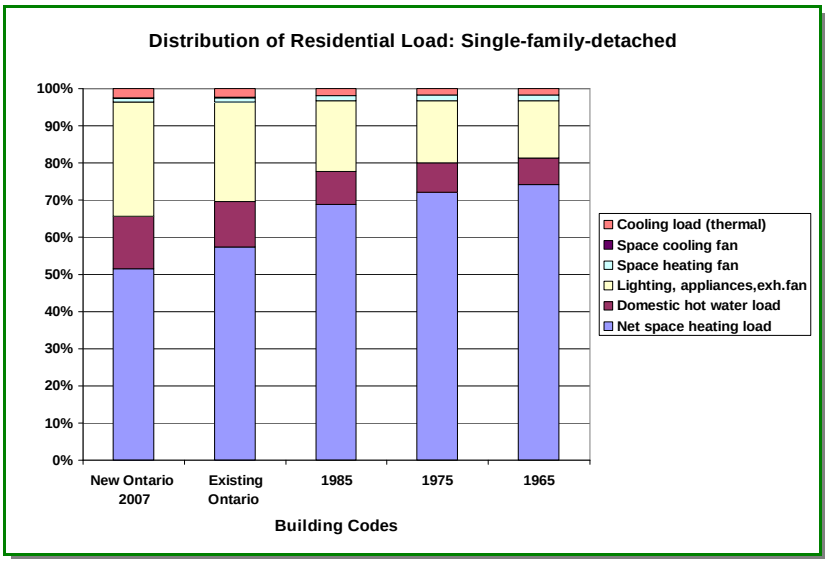

Figure 7.3 Energy Use of a Detached Home Residence Under Various Building Codes

Source: HOT2000 modeling results, of which the heat losses are shown in Figure 7.2.

Modeling Assumptions:

- Domestic hot water and electrical loads are the same for all building ages
- Domestic hot water (DHW) consumption is the default used by the HOT2000 program.
  - DHW consumption: 85 L/day plus 35 L/day per occupant.
  - Four occupants
  - Total consumption: 225 L/day
  - DHW temperature: 55ºC
  - DHW energy: 5,330 kWhe/year
- Electrical consumption is the default used by the HOT2000 program:
  - Interior
    - Lighting: 3.0 kWh/day
    - Appliances: 14.0 kWh/day
    - Other: 3.0 kWh/day
  - Exterior use: 4.0 kWh/day
  - Ventilation exhaust fan: 1.2 kWh/day
  - Total base load: 9,198 kWh/year

The significance of space heating load is clear. Over the years, the overall energy use has reduced considerably. Other electrical loads are gaining in share. This model assumes that all domestic hot water will be provided via natural gas heating which is not always the case for Guelph. Approximately 10% (3270 units) of all homes have electrical water heating. As comparison, statistics [47] for residential energy use Ontario are shown in Figure 7.4.

[47] NRCan, Office of Energy Efficiency
http://oee.rncan.gc.ca/corporate/statistics/neud/dpa/tablestrends2/res_on_2_e_1.cfm?attr=0

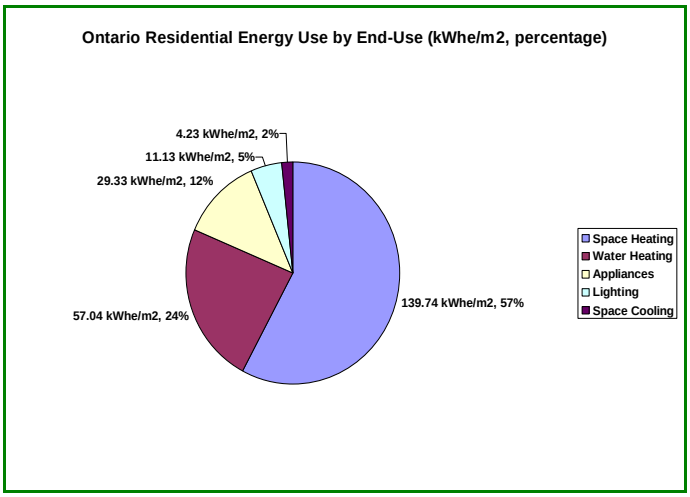

Figure 7.4 2004 Ontario Residential Energy Use by End-Use

The estimated totals for Guelph's residential energy use in 2005 are show in Figure 7.5.

Residential Benchmarking Comparison**			
	MWh_e/year	kWh_e/m^2/year	MWh_e/capita
Canada (2004)		255	12.22
Ontario (2004)		242	12.05
Guelph (Actual)	1,609,597	309	14.00

**10% assumption each for heating oil and wood consumption*
*** Excludes the electrical conversion losses*

Figure 7.5 Benchmarking of Residential Energy End Use in Guelph

The following section is meant clarify sources and calculations for Figures 7.6, 7.10, 7.11, 7.12, and 7.13.

Modeling Assumptions:

Electricity:

- All raw data used to create the benchmark for electricity consumption in Guelph in 2005 was provided by GHESI.
- No conversion factor required for electricity (there is 1 MWhe per MWh electricity)
- MWhe/capita is derived by dividing the MWhe amount by 115,000; the population figure used in this report to estimate the Guelph population in 2005.

The following table summarizes the way in which the raw data was summarized to represent the broad customer categories of interest. “Other”, which is a combination of UM, un-metered loads, and SE, street-lighting, is included in the overall calculations of energy use for the citizens of Guelph.

customer categories	Residential	Commercial	Institutional	Industrial	Other
GHESI codes that included in each customer category	R+G3+MU+SH +BS	GM+GD+GB	T1+T2+G1+G2+ FS+FP+L	GS+GP	UM+SE
Energy Consumption by category (MWh)	364,329	344,098	47,833	870,097	3,371

Gas:

- The benchmark for gas consumption in Guelph in 2005 comes from several sources that include:
    - Union Gas; both metered consumption and large contractual customers
    - University of Guelph, UGDSB, and WCDSB are all part of co-operative contracts for gas and provided their consumption figures separately
- Conversion factor of gas to kWhe: there are 10.31 kWhe per m^3 gas (energy content factor published in “Canada’s Energy Outlook 1996 – 2000”, NRCan, April 1997, pg D-3)
- MWhe/capita is derived by dividing the annual MWhe amount by 115,000; the population figure used in this report to estimate the Guelph population in 2005.

The breakdown into customer categories for gas is more difficult to achieve since only the residential and industrial sectors are able to be clearly discerned from the overall data. Therefore, commercial and institutional categories are combined. “Other” comes from inability to reconcile category totals with total consumption figures as provided by Union Gas. “Other” is included in the overall calculations of energy use for the citizens of Guelph.

customer categories	Residential	Commercial Institutional	Industrial	Other
Union Gas dwelling types that are included in each customer category	MAPTUN, MCNDOU, MQUAD, MROW, MROWU, MTRIPX, RDUPLX, RCUPLX, RSEMI, RSINGL, MAPTBG, MCNDOB, MFUNCD, MROW	CD, PB, PBIS	I	
Gas Consumption by code (m^3)	93,672,244	37,865,582	28,849,604	395,447
Gas Consumption by contract		25,589,067	45,000,000	

Wood and Oil:

Numbers for wood and oil and estimated as 10% of the overall modelled space heating requirement. In each case, this amounts to 139, 753 MWhe/year

National and provincial averages are expected to be lower than for an urban community like Guelph. National statistics[48] for the use of wood and heating fuel oil place consumption at about 20% of gas. With revised assumptions, the recommended residential sector benchmarks in Guelph are in Figure 7.6.

Residential Total Energy Use Benchmarks**			
Energy Source	**MWh_e/year**	**MWh_e/Capita**	**kWh_e/m^2/year[49]**
Electricity	910,825	7.9	175
Gas	965,761	8.4	185
Heating Oil*	139,753	1.2	27
Wood*	139,753	1.2	27
Totals	**2,156,092**	**18.8**	**414**

**10% assumption each for heating oil and wood consumption*
*** Includes electricity conversion losses at efficiency of 55% &transmission losses of 5%*

Figure 7.6 Recommended Residential Energy Benchmarks

7.2.2. Commercial and Institutional

Commercial and institutional sector modeling was undertaken by eQuest Strategies llc.[50], and results were derived for various building types and ages. Figure 7.7 summarizes the modeling results for retail, office, and acute care hospitals. Very limited actual data was

[48] NRCan, Table for Canada's Secondary Energy Use and GHG Emissions by Energy Source, http://oee.rncan.gc.ca/corporate/statistics/neud/dpa/tableshandbook2/aaa_ca_1_e_1.cfm?attr=0
[49] Calculated using a residential property area of 5,205,212 m^2
[50] Joe Pustai, eQuest Strategies, Cleveland, Ohio

available. The data for the University of Guelph are based on actual usage. The ranges from a little over 200 kWhe / m^2/yr to over 600 are reasonable in the experience of the Team and relative to known example buildings. Hospitals always have a higher energy use than the sector average due to sterilization, patient comfort, and catering.

However, in this sector, it is important to look at individual buildings or groups of buildings. As an example, Guelph School Boards, also assumed to be institutional customers, have been aggressive in the area of energy use reduction. Their energy consumption per m^2 is 235 and 250 kWhe/m^2/yr for the UGDSB and the WCDSB respectively[51]. Comparisons should be made with the express consideration of the vastly different operating requirements for the different building types.

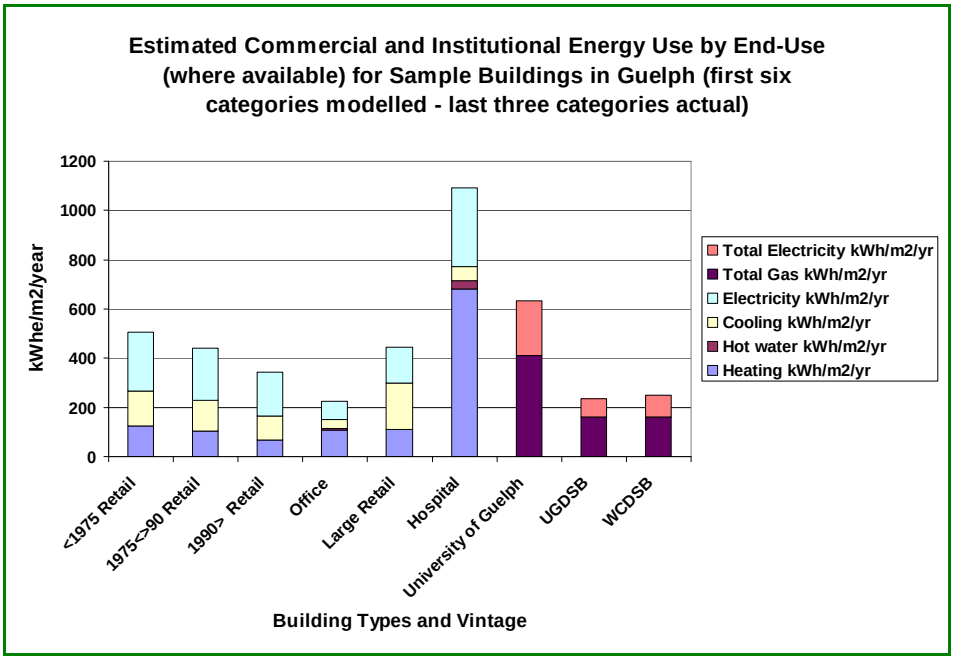

Figure 7.7 Modeled Commercial and Institutional Energy Use

Modeling Assumptions:

	Retail Strip Malls					
	< 1975	1975<>90	1990>	Office	Hospital	Large Retail
Area, sq.m.	1,858	1,858	1,858	3,404	15,370	24,732
No. occupants	200	200	200	119		1,331
Cooling temp.	23.3ºC					
Heating temp.	21.1ºC					
Wall U-value, W/m^2C	1.67	0.84	0.71		0.95	0.73
Roof U-value, W/m^2C	0.71	0.71	0.36		1.13	0.71

[51] School Boards Facilities Management

Modeled building results were combined with property data to project commercial and institutional energy use in Guelph. Modeled data is difficult to reconcile with actual, given the information available to the Team. One explanation is the difficulty in separating commercial and institutional in terms of energy use and also in terms of property areas. National data combines commercial and institutional classes. Figure 7.8 combines the two for Guelph, together with a comparison for Canada and Ontario.

Commercial & Institutional Benchmarking Comparison**			
	MWh_e/year	**kWh_e/m^2/year**	**MWh_e/capita**
Canada (2004)[52]		558	10.07
Ontario (2004)[53]		570	10.10
Guelph (Actual)	1,046,149	621	9.10

*** Excludes the electrical conversion losses*

Figure 7.8 Combined Commercial & Institutional Energy Use Indexes[54]

Commercial plus institutional building energy consumption accounts for 22% of the total energy use in the buildings sector. The breakdown of the energy use in terms of electricity and natural gas is summarized in Figure 7.9. The apparent higher level of per capita productivity of Guelph compared to the rest of Ontario, maybe accounted for by the partial dormitory nature of a part of the city's population.

Commercial & Institutional Energy Use Benchmarks by Energy Source			
Energy Source	**MWh_e/year**	**MWh_e/Capita**	**kWh_e/m^2/year**
Electricity	391,931	3.4	232
Gas	654,218	5.7	389
Totals	**1,046,149**	**9.1**	**621**

*** Excludes the electrical conversion losses*

Figure 7.9: Commercial & Institutional Sector Use by Energy Source[54]

These are recommended at this stage as CEP benchmarks, with the proviso that, in this sector operational benchmarks must be established by both history and building class. Some validation of the per capita index could be appropriate given its level relative to the provincial norm.

[52] NRCan Office of Energy Efficiency, Commercial/Institutional Sector Canada Table 6: Secondary Energy Use and GHG Emissions by Region – Excluding Electricity-Related Emissions[1], http://oee.rncan.gc.ca/corporate/statistics/neud/dpa/tablestrends2/com_ca_6_e_1.cfm?attr=0

[53] NRCan Office of Energy Efficiency, Commercial/Institutional Sector Ontario Table 1: Secondary Energy Use and GHG Emissions by Energy Source, http://oee.rncan.gc.ca/corporate/statistics/neud/dpa/tablestrends2/com_on_1_e_1.cfm?attr=0

[54] Guelph indexes are based on 1,046,149 Mwh_e/yr on a total of 1,689,916 m^2 and 115,000 population

7.2.3. Industrial

A few large customers in Guelph account for a major portion of the energy used. A typical example is Owens Corning, with a continuous operation glass melting tank using millions of dollars of natural gas a year. Figure 7.10 summarizes the industrial energy indexes.

Industrial Energy Use Benchmarks by Energy Source		
Energy source	**MWh_e/year**	**MWh_e/Capita**
Electricity	870,097	7.57
Gas	761,389	6.62
Totals	**1,631, 486**	**14.19**

*** Excludes the electrical conversion losses*

Figure 7.10 Industrial Sector Energy Use Benchmarks

Analysis of industrial energy use only makes sense at the level of a specific industry, company or process type. In the case of Guelph, greater detail will be addressed in the next phase of the Community Energy Planning process in selected Scale Projects[55].

Not included in this assessment is the industrial use of other energy commodities such as fuel oil, propane, oxygen and other combustion gases. In many industrial processes these can be significant components of the energy mix and should not be overlooked in more detailed site-specific assessments.

7.2.4. Combined Industrial, Commercial, and Institutional Benchmarks

In support of the basic premise of the CEP to look for simple, easily tracked indexes, the Team is recommending including a "non-residential/non-transportation" index encompassing all IC&I energy use.

Commercial & Institutional & Industrial Energy Use Benchmarks*		
Energy Source	**MWh_e/year**	**MWh_e/Capita**
Electricity**	3,155,071	27.4
Gas	1,415,607	12.3
Totals	**4,570,678**	**39.7**

** Includes electricity conversion losses*
*** Assumes electricity conversion efficiency of 55% and transmission losses of 5%*

Figure 7.11 Non-Residential/Non-Transportation Energy Use Benchmarks

This is the index that will be useful as a natural link to the energy productivity economic activity of the city, and as the quality of the data improves, will naturally migrate to indexes that directly relate the city's GDP and commercial tax base to energy use and climate change impact.

[55] See CEP Sections 10 and 11

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7.3. Energy Use in Transportation

Actual transport fuel delivery data was not available to the CEP Team. This information is difficult to obtain because it comes from a multitude of various sources (gas stations, etc.) This assessment of transportation fuel use is derived from estimates of transport patterns from the city's Transportation Planning Department, which has often been the case in other cities when faces with this issue. Transport strategies are currently under review in Guelph and, like all other reviews, is surrounded by issues of sustainable growth.

7.3.1. Basic Travel Statistics [56]

- Between 1967 and 1994 daily vehicle trips increased by 160% from 105,000 per day to 270,000 per day, compared to a population increase of 74% in the same period.
- Transit trips over the period 1967 to 1994 increased 60%
- In 1967 there were 2 cars per 7 people, now there is 1 car for every 2 residents
- 42% of all households have more than 2 cars
- In 1996, 48% of all travel was directly related to commuting

7.3.2. Findings From Recent Resident Survey

- Work destinations were Guelph 77% : Wellington County 4% : GTA 7% : Waterloo Region 11%
- 81% thought that it was important to reduce car use
- 75% supported rail service between Kitchener/Waterloo, Guelph, and Toronto
- 60% supported bus service between Kitchener/Waterloo and Guelph

The city assessments were combined with national vehicle fuel use statistics for 2001[57] and extrapolated using the city demographics. Though small in current volume, the biodiesel use by the Guelph Transit Authority, as well as GHESI Fleet Vehicles and other publicly owned vehicles, is highlighted as a first step to reducing the fossil fuel content of the city's mass transit.

Figure 7.12 summarizes estimated transportation fuels use and associated greenhouse gases.

Fuel Type	Total delivery MWh_e/yr	Total delivery MWh_e/yr/Capita	CO_2 per capita (tonnes)	Fuel Use (litres)
Gasoline	1,285,028	11.17	2.74	133,440,038
Diesel	435,187	3.78	0.96	40,520,164
Biodiesel	23,002	0.20	0.03	2,248,514
Totals	**1,743,216**	**15.16**	**3.73**	**176,208,716**

Figure 7.12 Transportation Fuel Use and Greenhouse Gas Emissions

[56] City of Guelph, Transportation Update
http://guelph.ca/living.cfm?itemid=68785&smocid=2093

[57] Statistics Canada, CANSIM table (for fee) 051-001

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Modeling Assumptions:

Transportation fuel use is based on the following assumptions with calculations undertaken and provided for this report by the City of Guelph Transportation Planning Department:

- fuel use for Guelph is based on national fuel vehicle fuel use statistics for 2001 (Statistics Canada, CANSIM table (for fee) 051-001) and extrapolated using population numbers
- Diesel and Bio-diesel fuel use for 2006 has been provided by Guelph Transit. Bio-diesel is used by the Guelph Transit Authority in all its buses; 5% in the winter and 10% in the summer
- GHG conversion factors for each fuel type are listed in Figure 7.13

This table estimates the use for light vehicles (cars, SUVs and light trucks) only. At this stage, no attempt was made to include the heavy trucks, rail and aircraft. In terms of the total energy use, these will be a small proportion and national averages could be applied to get an overall energy and greenhouse gas footprint for the population of Guelph. An estimate is included in the overall benchmarking.

Given the influence of transportation on overall GHG consumption, outcomes of the following initiatives currently being undertaken are of great interest to the CEP:

- Guelph-Wellington Transportation Study
- Major Roadway Improvements
- Inter-regional Transit – North Mainline Rail Service

7.4. Total Energy Use and Greenhouse Gas Emissions

A critical goal of the CEP is to reduce the overall creation of greenhouse gases considered responsible for global warming. Any gains in energy efficiency will reduce greenhouse gases proportionally. However, different energy sources cause different levels of greenhouse gases through their use. This needs to be accounted for in the overall benchmarking.

In the benchmarking tables in the previous segments, a detailed breakdown of greenhouse gas by sector was beyond the scope of this initial phase of the CEP. The one exception was in transportation where the relatively straightforward linking of fuel use and greenhouse gas emissions easily facilitates this.

To establish the overall benchmark for the Guelph CEP Goal 3, Figure 7.13 summarizes the greenhouse gas creation directly attributable to the energy use within the city boundary.

GHG Production by Energy Type in Guelph			
Energy Source ▼	**MWh_e**	**Conversion Factor**	**Tonnes CO_2**
Electricity (Net)	1,629,730	0.272 kg CO_2/kWh	443,286
Electricity* (Gross)	4,074,325	NA	NA
Gas	2,381,368	0.370 kg CO_2/m^3	85,461
Oil	139,753	2.830kg CO_2/L	38,029
Wood	139,753	NA	NA
Gasoline	1,285,028	2.360 kg CO_2/L	314,918
Diesel	435,187	2.730 kg CO_2/L	110,620
Biodiesel	23,002	1.907 kg CO_2/m^3	3,773
Totals	**8,478,416**		**995,769**

**assumes an electricity conversion efficiency of 55% plus 5% transmission and distribution losses*

Figure 7.13 Summary of Energy Use and GHG Production by Source[58]

This gives us the key data to benchmark energy use per capita and greenhouse gas creation per capita.

Per Capita Energy Use and GHG Emissions		
	MWh_e/Capita	Tonnes CO_2/Capita
Guelph (2005)	73.73	8.66
Canada (2004)	101.02	23.72

Figure 7.14 Per Capita Energy Use and GHG Production within Guelph[59]

On the surface this suggests that Guelph is doing pretty well relative to the Canadian national average relative to greenhouse gasses. However, the following aspects need to be considered:

- No truck, maritime or aviation emissions are included. On a prorated basis this would add about 3.0 Tonnes/capita.
- No significant mineral, metals, mining or pulp and paper emissions are included. Again on a prorated basis this would represent 1.44 Tonnes/capita.
- No significant domestic refining and fossil fuel production destined for use in Canada. Again, this represents about 2.07 Tonnes/capita
- The bulk of the rest of the difference is from the fact that Ontario/Guelph has relatively low carbon electricity (272 kg/MWh) as opposed to some other provinces where coal is a much larger factor and the greenhouse gas emissions rate is in excess of 900kg/Mwh.

Each area of Canada will have distinctive profiles, and a final decision for the baseline for Guelph needs to be made by the Consortium. The current recommendation of the CEP is to use a per capita greenhouse gas index for Guelph of 15.17 Tonnes[60], reflecting the reality that every citizen of Guelph is part of the overall national economy, and that Canada, in turn, is a part of the global climate challenge.

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[58] GHG Conversion factors are sourced from Environment Canada, "National Inventory Report, 1990-2003; Greenhouse Gas Sources and Sinks in Canada". http://www.ec.gc.ca

[59] Guelph per capita energy use based on 8,478,416 Mwh_e/yr divided by a population of 115,000. Per capita CO_2 based on 995,769 tonnes divided by 115,000 population.

[60] Benchmark CO2 for CEP purpose is .66 tonnes/capita from local energy use plus 3.0 tonnes (maritime, truck, aviation), 1.44 tonnes (other national industry), and 2.07 tonnes (domestic energy industry).

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In summary, for the energy use per capita index, the CEP is recommending using the 73.73 MWh_e since the totality of this number can be affected by specific actions from the community. In a similar way the greenhouse gas per capita of 8.66 reflects controllable activities within the community.

7.5. Water

Water is an issue of major concern to the citizens of Guelph, and as stated earlier, has been the subject of a recent major strategic evaluation in the form of a 50-year Water Supply Master Plan that, in compliance with the Ontario Environmental Assessment Act, included and assessment of all options for future water supply, including a pipeline to Lake Erie.
The average daily potable water use for Guelph in 2005[61] was 52,579 m^3 with a maximum daily demand of 67,975 m^3. The average household demand is 230 - 250 liters/equivalent population/day[62]. This latter figure can be compared with data from the EU for household water consumption.

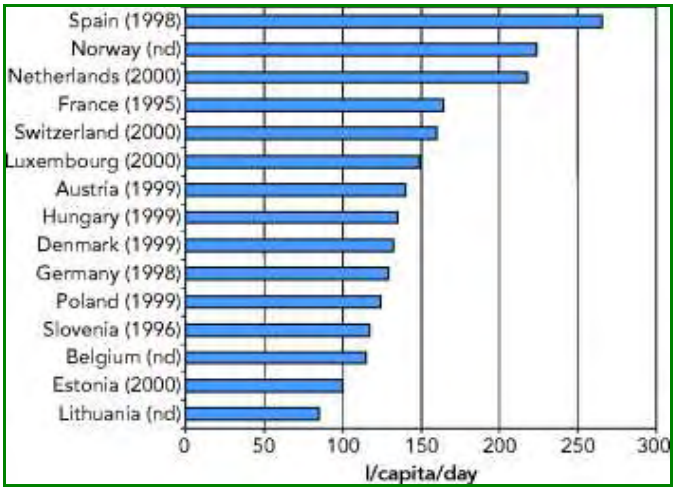

Figure 7.15 Per Capita Household Water Use for Selected EU Members

Countries with comparable living standards and economy to Canada could be Germany or Denmark in this data set, where average household use per capita is about 125 liters/capita/day.

[61] Waterworks Summary Report 2005-page 11.
(http://guelph.ca/uploads/ET_Group/waterworks/Waterworks_Summary_Report_2005.pdf)

[62] Associate Professor Khosrow Farabakhsh, University of Guleph, School of Engineering

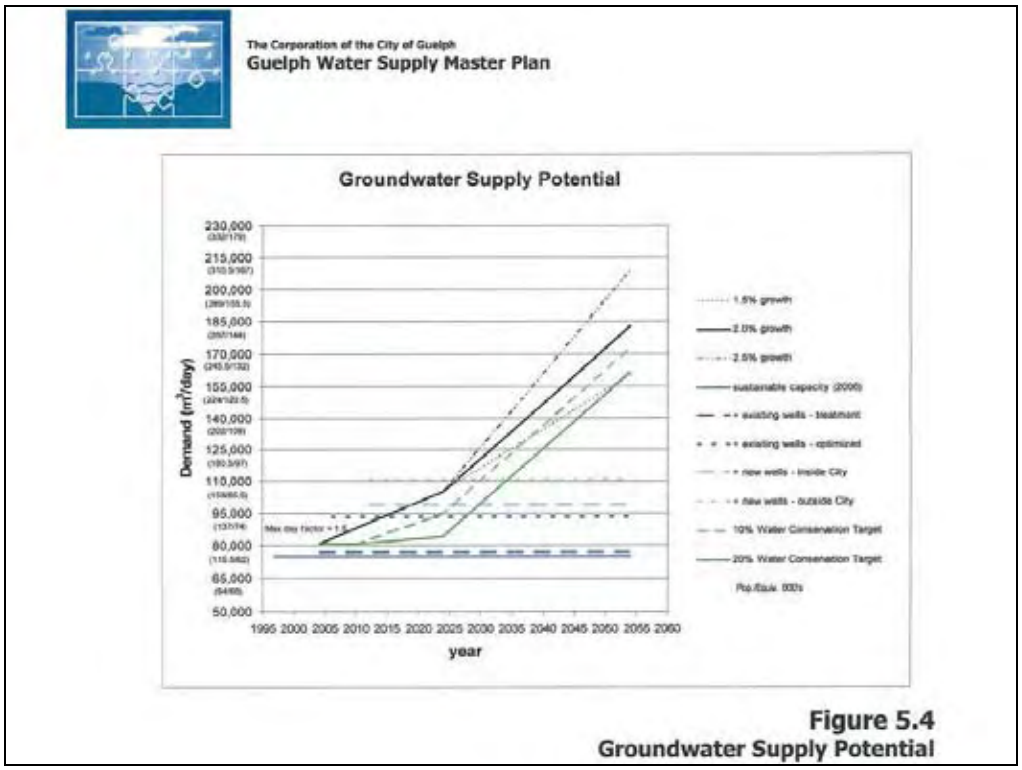

Figure 7.16 Projected Water Demand for the City of Guelph to 2055[63]

(See Appendix 8 for Full Size)

Under current estimates, the maximum water needs for Guelph will rise to about 110,000 m^3/day by 2031, clearly indicating the need either for new supplies or substantial improvements in water efficiency. As with energy, and as the benchmarking with the EU indicates, there is enormous potential for conservation measures to delay the need for large infrastructure investments. The city's completed Water Supply Master Plan (WSMP) [64] recommends an update to the city's 1999 Water Conservation Plan to identify all possibilities for reducing water demand and increasing supply.

7.6. Energy Supply and Organization

7.6.1. Brief History of Energy Regulation in Ontario

Energy regulation[65] in Ontario began in 1907 aimed, in part, at preventing the wastage of natural gas. Since that time there has been constant effort at regulation towards the goals of economic efficiency driven by competition. The *Ontario Energy Board Act, 1960* created the Ontario Energy Board to set reasonable rates for selling natural gas. The OEB also became the agency to authorize the routing and construction of gas and oil pipelines. In 1965 an amendment allowed the OEB to determine gas prices and gave them regulatory powers relative to gas companies.

[63] City of Guelph, Growth Management Workshop, May 2006
[64] http://guelph.ca/living.cfm?subCatID=1403&smocid=1986
[65] Excellent summary for further reading - http://www.oeb.gov.on.ca/html/en/abouttheoeb/history.htm

In 1973, the Ministry of Energy was established including the OEB and extended their jurisdiction to include rate and rate-related matters of Ontario Hydro, thereby including electricity as well as gas.

In the early 1970s, the oil crisis in the Middle East caused natural gas prices to soar. Ontario Hydro turned to nuclear generation and the public became conservation conscious.

The OEB's mandate changed with the passage of the *Energy Competition Act, 1998*, aimed at establishing a competitive market for electricity and natural gas. The Ontario Hydro monopoly broke into several entities including two commercial companies; Ontario Power Generation (OPG) and Hydro One Inc. and one Crown corporation, the Independent Electricity System Operator (IESO). All three operate independently.

OPG is responsible for electricity generation and Hydro One owns and maintains monopoly transmission and distribution wires. The IESO's task is to manage the wholesale electricity market and deal with system emergencies. It collects offers from competing generators and bids from purchasers, settles accounts, monitors compliance of market rules and the performance of market players.

The *Energy Competition Act, 1998* (ECA), expanded the OEB's mandate. The OEB now regulates all local electricity distribution companies for compliance with various market rules and ensuring they do not abuse their market positions. Both the IESO and the OEB advise the government on overall market performance and to alert them of any problems arising from OPG's dominant market position.

In 2002, Ontario's new electricity market opened. Generating electricity became a competitive activity, with electricity bought and sold on the new spot market at competitive prices with IESO successfully operating the wholesale market. Over the summer of 2002, record-high temperatures drove up the demand for electricity as well as the market price, which resulted in considerable consumer concern. In response, the government introduced the *Electricity Pricing, Conservation and Supply (EPCS) Act, 2002*, which capped electricity prices for residential, small-business and other low-volume consumers. Under the Act, all transmission and distribution rates were frozen through 2006. Utilities were constrained in asking for rate increases. The Board was actively charged with promoting conservation.

By 2003, the OEB was a self-financing Crown corporation. In the same year they were given new pricing mechanisms to more accurately reflect the true cost of production and to ensure the electricity infrastructure had sufficient investment. This included allowing distribution companies to recoup some frozen costs.

In 2004 the Ontario Power Authority (OPA) was established to develop a plan to restructure the electricity sector to encourage new electricity supply, energy conservation and stable prices at a level reflecting the true cost of electricity. OPA's role formally included the establishment of a Conservation Bureau to provide leadership in planning and coordination of electricity conservation and demand management.

On the gas front, the natural gas sector has been evolving since the federal/provincial agreement in 1985 that deregulated the priced supply at the wellhead. In recent years the growth of natural gas marketers in the wholesale and retail markets has meant more choice for consumers when purchasing their natural gas commodity. The delivery of natural gas between provinces remains regulated by the National Energy Board and, within Ontario, by the OEB.

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7.6.2. Distribution of Natural Gas in Guelph

The gas distribution system is privately owned and operated by Union Gas, a division of Spectra Energy, operating under the regulatory constraints of the OEB. Gas pricing is tied to the broader market place, and is subject to fluctuations. This is most noticeable for residential users, since larger users negotiate longer term pricing contracts. In addition to Union Gas, customers or groups of customers can buy gas directly from the market or through gas marketers. These options are provided to give customers more market choice. Essentially though, marketers are selling customers futures in gas.

The gas distribution companies also manage energy conservation programs under the auspices of the OEB and other legislation, and these are summarized in Section 8.

7.6.3. Distribution of Electricity in Guelph

Guelph Hydro Electric Systems Inc. (GHESI) is a municipally owned Local Distribution Company (LDC) operating under the rules of the OEB and regulating pricing mechanisms. OPG has most of Ontario's centralized generating plants, with Hydro One Inc. operating the transmission network. GHESI is allowed to develop new businesses, but must keep these clearly separated from its core, monopoly electricity distribution business. These businesses operate in the open market as independent companies. An example is Ecotricity which uses gas recovered from the Eastview Landfill to generate electricity.

The city is the sole shareholder of Guelph Hydro Electric Systems Inc., which in turn, is the sole shareholder of Guelph Hydro Electric Systems Inc. and Ecotricity. They operate as normal tax[66] paying business corporations. The City Council appoints the Board of Directors for each business, The GHESI Board comprises eight private Directors and a representative from Council."[67]

Figure 7.17 summarizes Guelph's electricity demand in 2005, measured at the three main Hydro One-owned transformer stations:

- Campbell, to the north off Dawson Road
- Cedar, south of the river off Municipal Street
- Hanlon, next to the new GHESI offices in the Hanlon Business Park

[66] Called Payments in Lieu of taxes (PIL's) used to pay off the stranded debt of the former Ontario Hydro.

[67] Guelph Hydro, Message from the President, http://www.guelphhydro.com/GuelphHydroWeb/index.html

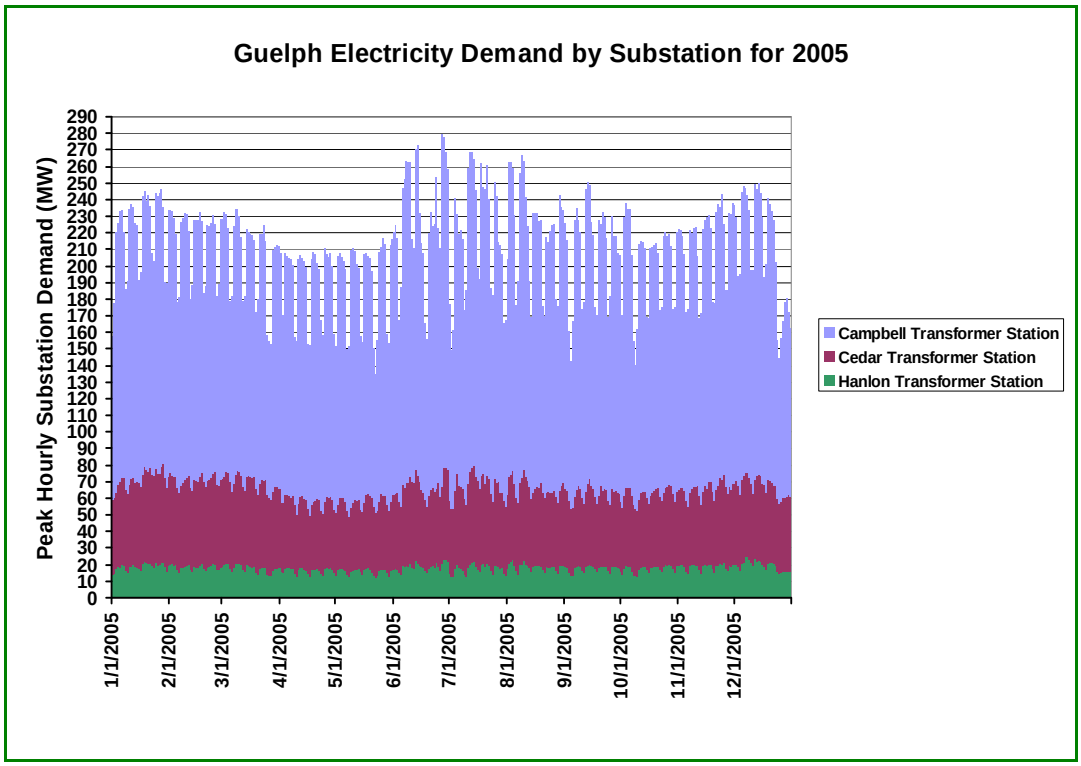

Figure 7.17 Guelph Electricity Demand (MW) Broken Down by Substation for 2005

Electricity demand has a summer peak of approximately 280MW, a winter peak of about 250 MW, and base load is close 130 MW. Figure 7.18 provides another view of the annual electricity demand on an hourly and weekly basis. This is a convenient overview that clearly shows the overlap between the times of high demand, and the high solar radiation shown in Figure 6.4, boding well for the potential attractiveness of solar electricity as a peak supply option.

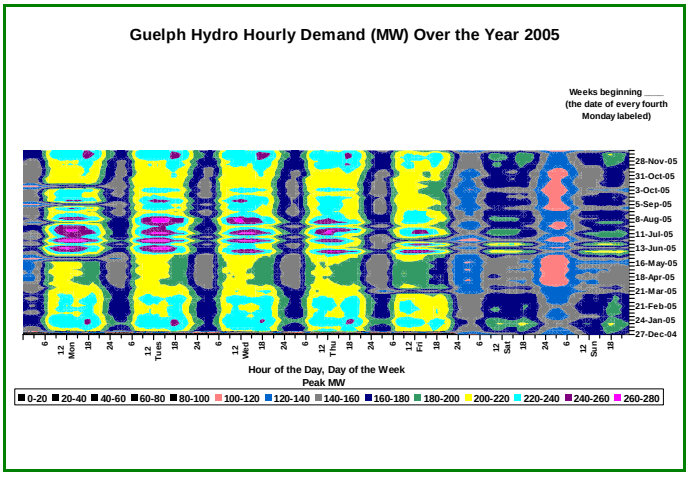

Figure 7:18 Hourly Electricity Demand in Guelph for the Year 2005

(See Appendix 8 for Full Size)

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Electricity peak demand is forecast to increase by nearly 30% in the coming decade mostly driven by increased air conditioning in new and existing homes and buildings. This is summarized in Figure 7.19.

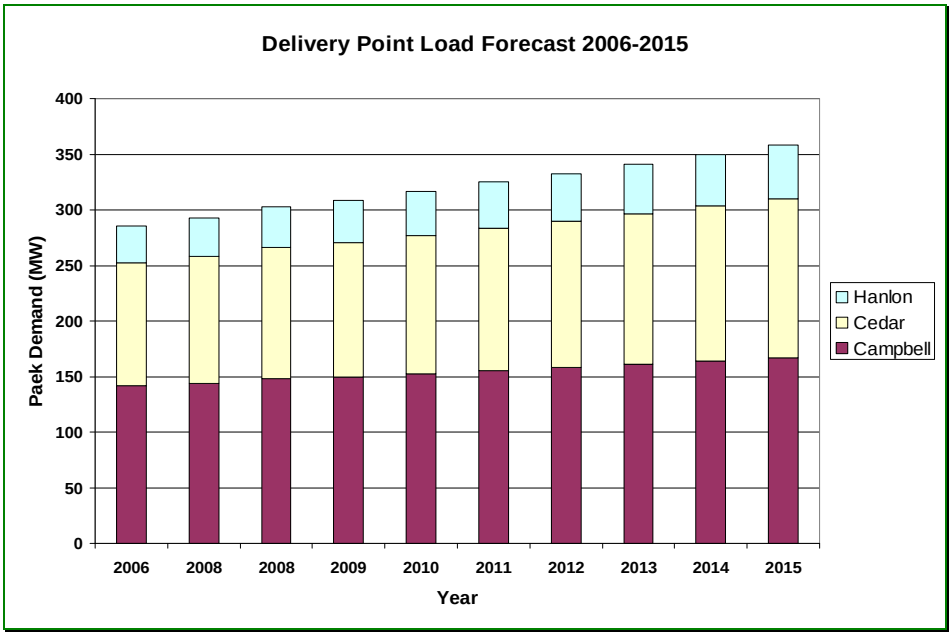

Figure 7.19 Electricity Demand Forecasts for Guelph 2006 - 2015[68]

This rate of increase, if unchecked by efficiency and alternative supply strategies, will put significant investment pressure on GHESI and the city.

GHESI has a number of active conservation programs, guided by the Ontario Conservation Bureau. A summary of these can be found in Section 8

[68] Load forecast data based on raw data supplied by GHESI

8. COMMUNITY ASSETS IN COMMUNITY RELATED AREAS

8.1. Overview

The long term success of the Community Energy Plan will only be achieved by mobilizing many parts of the community. Guelph is blessed with a wide range of organizations, companies and individuals that already have much of the motivation and expertise needed. This is reflected in the wide-ranging membership of the CEP Consortium itself.

This section summarizes a cross-section of these so-called Community Assets, including individuals, physical structures, natural resources, institutions, businesses, or informal organizations. The assets presented are a cross-section that illustrates what already exists within the community in energy related areas.

The CEP Consortium should see this as the first step in developing a constantly updated pool of expertise, experience, services and products. This will develop an awareness of the resources available, build new relationships that reinforce each other, and increase the probability of a successful implementation of the Community Energy Plan.

8.2. Guelph School Districts

The success of the CEP requires an enduring commitment making the education of primary, middle and secondary school pupils around sustainability key to its overall success. This education includes both being in schools where energy is clearly managed well and where they can be actively involved. Both of Guelph's school boards Upper Grand District School Board (UGDSB), and the Wellington Catholic District School Board (WCDSB) have embraced this role and actively promote energy and water conservation in their schools.

Many schools also have staff/student groups that actively encourage good sustainability practices. At a recent consortium CEP workshop, student representatives of many of these groups shared their successes and were invited to suggest ways to improve the energy and water performance of their schools. The overview slides and the summaries of the student presentations are attached in Appendix 2.

Both boards have undertaken serious upgrades, retrofits, and improvements to new building standards. They are systematically upgrading building management systems, heating, ventilation, water and lighting systems, which have already resulted in significant cost savings and environmental benefits. The two boards have combined forces with others to cooperatively purchase energy further improving the economic performance of their energy systems.

In 2003 the UGDSB developed and launched the Energy W.I.S.E. (We're Into Saving Energy) program to "focus attention on energy conservation"[69]. Its goals were two fold. Firstly to encourage the staff/student energy teams and clubs. At a conference, the Board hosted speaker David Suzuki and awards were given to recognize the achievements of groups such as the John F. Ross CVI Environment Club. Energy W.I.S.E. continues to be the vehicle for promotion of energy and water conservation efforts in its schools.

In parallel, working in partnership with the energy services company, Ameresco, the UGDSB committed to invest over $12M in a wide range of energy and water efficiency improvements. These wise investments have all paid back in less than eight years, and in many cases, much

[69] UGDSB Director's Annual Report, 2004 - 2005

faster[70], clearly underlining the value of sound energy management as a way to free up valuable resources to pay teachers and educate students.

Since 1999 the WCDSB has embarked on an ambitious program to build new and upgrade several existing schools which has resulted in greater energy efficiency throughout the Board's schools. Approximately $75 million was spent between 1999 and 2005 which increased the total area of buildings by 42%. However, in the same period energy use decreased from 277 to 250 kWhre/m2/yr, a savings of almost 10%.

New WCDSB schools have been built with energy efficiency in mind and those built within the last three years are achieving energy consumption figures between 146 and 197 kWhre/m2/yr. Retrofits during the summer of 2006 included boiler, roof, and window replacements at several schools, and these should continue to improve energy conservation. These retrofits will continue to be made throughout 2007.

Collectively the UGDSB and the WCDSB stand out as examples to the community, and more importantly, to the next generation of citizens.

8.3. *City of Guelph Commitment to Efficiency*

The City of Guelph is showing growing leadership in the area of energy and water conservation, and the creation and adoption of the CEP will be a clearly visible reinforcement. Among many are:

- Addition of energy efficient systems to the city-owned Senior Center
- The cogen facility at the city's landfill site, in partnership with GHESI (Ecotricity)
- The cogen facility at the WasteWater Treatment Plant, in partnership with GHESI
- Current work with GHESI to improve operating efficiencies at the WasteWater Treatment Plant through replacement of existing equipment with high efficiency options
- Current work with GHESI to explore energy efficiencies at the Material Recovery Facility at the city's Wet-Dry Solid Waste Management Facility
- Use of biodiesel in city buses
- Free transit to entire community on National Clean Air Day
- Subsidization of rain barrels, toilet replacement, washing machine replacement
- Outside Water Use Program
- Other water conservation programs (mentioned elsewhere in the report)
- Annual Children's Ground Water Festival
- Investigation of adjusting water billing rates to promote conservation
- Water/WasteWater IC&I capacity buy-back program
- Introduction of fuel efficient vehicles to the city's fleet for assessment
- Replacement of incandescent bulbs to LED in all traffic signals
- Programs to encourage use of transit to seniors, high school students and university students and large industrial areas or individual facilities
- The City Council's commitment in 1998 to meeting the Kyoto targets by 2010

[70] Upper Grand District School Board, Energy Retrofit Project Update, memo, April, 2005

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Such leadership is also becoming evident in new buildings.

8.3.1. Southend Library

As yet another early indicator of innovation, in 1883 the City of Guelph was the first municipality in Ontario to establish a Free Public Library. The Westminster Square Branch was recently completed and is an example for the use of natural lighting in a public building.

Figure 8.1 Westminster Square Branch Library

8.3.2. Guelph City Hall

The concept for the new Civic Administration Centre approved in 2005 is forecast to achieve the LEED (Leadership in Energy and Environmental Design) rating. LEED includes enhanced focus on the energy use and water use characteristics of the building.

Figure 8.2 Original and Final Concept Designs for the New Guelph Civic Administration Centre[71]

A full list of all the environmentally focused elements that will be included in the building appears in Appendix 3.

8.4. Guelph Hydro Administration and Service Centre

The new Guelph Hydro Administration and Service Centre is a clear demonstration of their commitment to high environmental standards as an essential element of running a successful and responsible business. It is an example of energy conservation and energy management, and a good design example for businesses throughout the community.

Figure 8.3 Guelph Hydro Administrative Centre

Energy features of the building include:

- Geothermal system estimated to offset 300 tonnes of CO2e emissions annually

[71] City of Guelph Website, New Civic Administration Centre, http://guelph.ca/cityhall.cfm?subCatID=1508&smocid=2087, accessed Dec 2,2006

- 5 kW rooftop photovoltaic array,
- Solar thermal system for hot water production,
- Indirect lighting technologies
- Waste heat recovery

Figure 8.3 Guelph Hydro Administrative Centre Energy Efficient Features

(Geothermal control center; daylighting roof, windows that open; solar PV and thermal technology to be installed on rooftop)

The building is LEED certified and is a pleasure to work in. It will be the first building in Canada to request European Energy Performance Certification[72]. It is also one of the largest renewable energy sites in southwestern Ontario[73].

8.5. Woolwich Arms Hotel Sustainable Business Approach

This is a pub that supports the view to "Think Globally, Act Locally", an underlying philosophy of the Arrow Neighborhood Pub Group. It serves locally produced craft beers and food. Transportation of food is a major contributor to GHG emissions and transportation energy use. "In Canada, the food we eat has traveled, on average, 2,500 kilometres to reach your plate!"[74]

In addition to its focus on local produce, the Woolwich Arms purchases 100% wind power to run its operations.

8.6. Owens Corning "Energy: Mission Possible"

Owens Corning (OC) is a major employer in the City with a Composite Fibreglass plant on York Road. It is also a major energy user, like most OC facilities around the world. Starting in 1998, OC put in place a multi-dimensional energy productivity program – Energy: Mission Possible – to increase energy productivity by 20%. Within five years, energy productivity had increased by nearly 30%, equivalent to about $80M profit contribution in their worldwide business. The Guelph plant was one of the best energy performers in the company, and remains so today.

[72] Danish 2006Standards will be used – see Section 10 for more background on EU EP Certification

[73] GHESI, Official Opening Ceremony, October 12, 2006

[74] The Arrow Neighborhood Pub, Newsletter, http://www.arrowpubs.com/, accessed December 10,2006

In terms of physical assets, the glass melter still has a high level of un-recovered heat produced 365 days a year that is being considered as a possible source for integration into a district energy concept in St. Patrick's Ward.

8.7. University of Guelph and Conestoga College

The University of Guelph (UoG) is a member of the CEP consortium. It is the largest educational institution in Guelph. The University is a renowned research institution that includes many science buildings, growth facilities, a hospital, greenhouses, high density student housing, athletic facilities and other high energy use facilities. As one of the largest users of energy in Guelph, it is showing great leadership in managing energy costs and impacts.

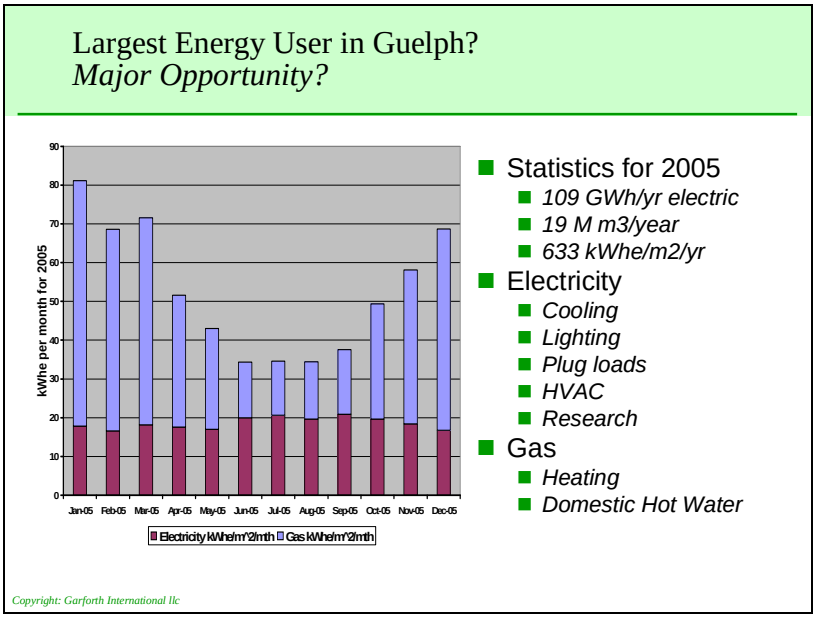

Figure 8.4 University of Guelph Energy Consumption for the Year 2005

Electricity demand is relatively constant through the year, with heating and cooling supplied by a centralized district heating and cooling system. The University has adopted a systematic approach to managing energy efficiency and costs, concentrating on projects with the best financial payback and those that improve the deferred maintenance situation.

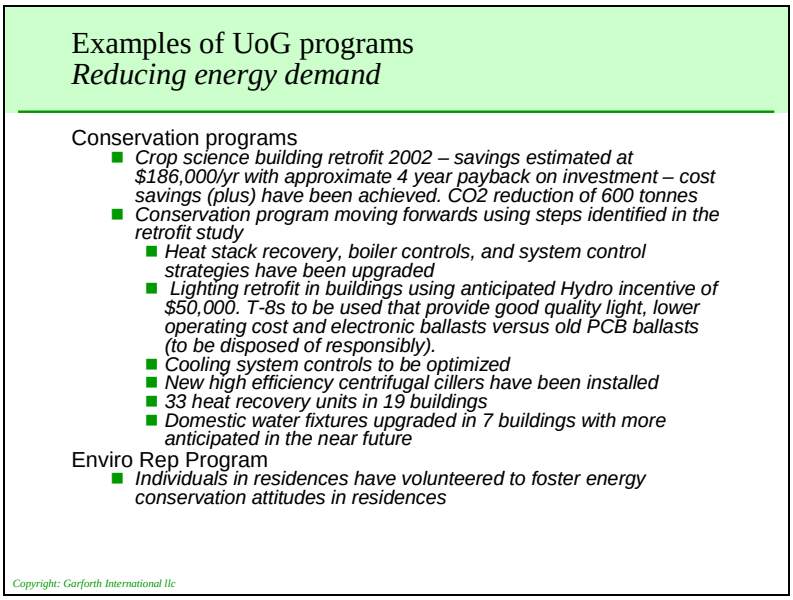

Figure 8.5 Examples of UoG Energy Efficiency Programs

These efforts are ongoing, with significant opportunities still to be harvested. The University has a Sustainability Coordinator who actively participated representing the University on the CEP consortium. In Section 11.3, the University is discussed briefly in terms of its role as a potential scale project within the long term plans for Guelph.

Both the University and Conestoga College can be also key Assets for the CEP by serving the community as a place to learn the planning, management, technical and business skills associated with the rapidly changing energy future.

In 2006, the University of Guelph's Office of Research[75] summarized all energy related activities within the University. A database summarizing the activities of over 80 individuals plus other programs on the Campus is now available. Each of these institutions, along with the City's schools, can be breeding grounds for the community energy practitioners of the future serving the City, Canada and the World.

8.8. Guelph Hydro Conservation and Demand Management (CDM) Program

In 2004, the Ontario Energy Board (OEB) allowed local utilities like Guelph Hydro Electric Systems Inc. (GHESI), to invest in and track actions to both reduce electricity demand through conservation and better management of peak loads, so called Conservation and Demand Management (CDM) programs. Approval was given to invest $163 million to Ontario electrical distributors over three years from 2005 with a goal to reduce electricity demand by 5% by 2007.

The cash was generated through an entitlement that allowed Local Distribution Companies (LDCs) such as GHESI to recover incremental revenue through its electricity rates, as long as this was re-invested in an equivalent amount in CDM initiatives. These revenues had previously been unrecoverable due to a rate freeze.

[75] Project Leader – Karen Farbridge : Research Student: Matthew Fox

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GHESI has been very active in developing a wide range of programs with the details publicly available on the Ontario Energy Board website.[76] In 2005 alone, the GHESI programs avoided 22,000 MWh of use through education, low-income family support, efficient buildings and air conditioner efficiency programs. Further details of these are summarized in Appendix 4.

The following initiatives will be supported from 2006 onwards:

- ***Low Income – Residential:*** GHESI plans to team with Green Communities Canada to expand on an energy efficiency assistance program targeting low income electrically heated homes, to deliver "extended measures" such as draft-proofing as well as basement and attic insulation.
- ***System Optimization and Distribution Loss Reduction:*** GHESI will install equipment to reduce its distribution system losses through the installation of capacitor banks on distribution feeders where power factor correction is warranted.
- ***Distributed Energy:*** GHESI will complete the installation of a 500kW natural gas fired stand-by generator at GHESI's Administration and Conference Centre. This generator will be able to contribute to provincial load reduction efforts by offsetting GHESI's building load during those periods when system demand is high.
- ***Metering Pilot:*** The SMART Metering Pilot started in 2006 and will continue in 2007 to further assess metering, communications, data flow and business processes. GHESI will look at opportunities for load control through the Smart Metering infrastructure, and will use the Smart Meter interval data to educate customers on their energy use and consumption patterns, which may assist the customer in managing their energy costs. (see Appendix 5 for more details)
- ***Load Control:*** GHESI will explore load control options to disable customer loads during system peak periods to relieve pressure on the electricity grid.
- ***Energy Efficient Building Upgrades*:** GHESI will work with the University of Guelph to reduce campus energy consumption through lighting upgrades and energy efficiency improvements.
- ***City Leadership – Waste Water Treatment***: GHESI will team with the City of Guelph WasteWater Treatment Plant to install and commission a 2 x 290 kW cogeneration facility. This facility will produce energy from the waste treatment process, and reduce the treatment plant's energy needs.

In addition to the programs identified above, GHESI is pursuing multi-year funding to support other energy efficiency initiatives in the community.

[76] Ontario Energy Board, Conservation and Demand Management, http://www.oeb.gov.on.ca/html/en/industryrelations/ongoingprojects_distconservation.htm, accessed September,2006

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8.9. Union Gas Conservation and Demand Management (CDM) Program

Union Gas's CDM programs very much are focused on education[77] and incentives. The Union Gas website offers a great deal of information for consumers regarding improving efficiency in the home and the environmental benefits of gas conversion.

With the heightened focus on CDM across all energy sectors, the OEB issued a decision in August 2006 that will require the gas utilities in Ontario to follow similar processes as do the electric utilities. Union Gas will submit a 3 year CDM plan for the period beginning in January 2007.

Union Gas is the leader in developing and driving Demand Side Management (DSM) and Conservation and Demand Management (CDM) Programs in Ontario. Since 1998 Union Gas programs have saved customers in excess of 450 million m^3 of natural gas.

Union Gas Limited offers financial, educational and marketing support to our end use customers and energy partners such as architects, consulting engineers, energy service (ESCO) companies and trade contractors, who offer energy efficient products & services in the residential, institutional, commercial and industrial markets for retrofit and new build projects. Energy efficient solutions in building design, HVAC system & equipment selection, process improvement and operating and maintenance procedures are supported in all markets . Union Gas's programs assist partners in developing new products & services and delivering value to customers through lower operating costs.

The following Initiatives are delivered or supported by Union Gas:

Hot Water Conservation Program – Energy Savings Kits consisting of Low Flow Shower Head, Kitchen and Bathroom Aerators, pipe wrap and the Union Gas Wise Energy Guide are available for residential home owners at no cost to them, while shower heads and aerators are supplied to Social Housing, Multi-Family and Hotel/Motel facilities at no charge. Also, the supply and installation of low-flow pre-rinse Spray Nozzles in Commercial Kitchens located in the Institutional, Food Service and Hotel/Motel facilities are available at no charge.

Energy Savings Program - Incentives are available for the installation, in both commercial retrofit and new build projects, of; Energy/Heat Recovery Ventilators, High-Efficiency Condensing Furnaces (retrofit applications only), Programmable Thermostats, Rooftop Units, Infrared Heaters, Condensing Boilers, and Demand Control Kitchen Ventilation Units.

Custom Application Program - Variable funding is available to support the implementation of high efficiency HVAC equipment/systems in commercial applications (exclusive of Energy Savings Program). Typical projects include building controls, process equipment and building envelope measures and are subject to a financial model, based on the natural gas savings, as well as the life expectancy and the incremental cost of the proposed higher efficient alternative.

Boiler Auditing Program & Steam Trap Survey – Financial assistance is available to to support the testing, identification and continuous re-commissioning of condensing boilers and condensate return systems.

Feasibility Study Program & Design Assistance Program – Financial assistance is available for a building modeling study that examines the energy and environmental performance of a new or major-renovated commercial/institutional building during the design phase.

[77] http://www.uniongas.com/home/ngforhome/energyEfficiencyIndex.asp

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The Union Gas website (www.uniongas.com) includes detailed information on how residential and commercial customers can improve their energy efficiency, decrease their consumption of natural gas and save on their total energy bill.

8.10. City of Guelph Water Conservation

Water conservation and supply are priority issues for Guelph. All possibilities for reducing water demand and for increasing supply are to be investigated and a more aggressive approach to water conservation is planned for the near future.

The water related programs that are currently supported by the City:

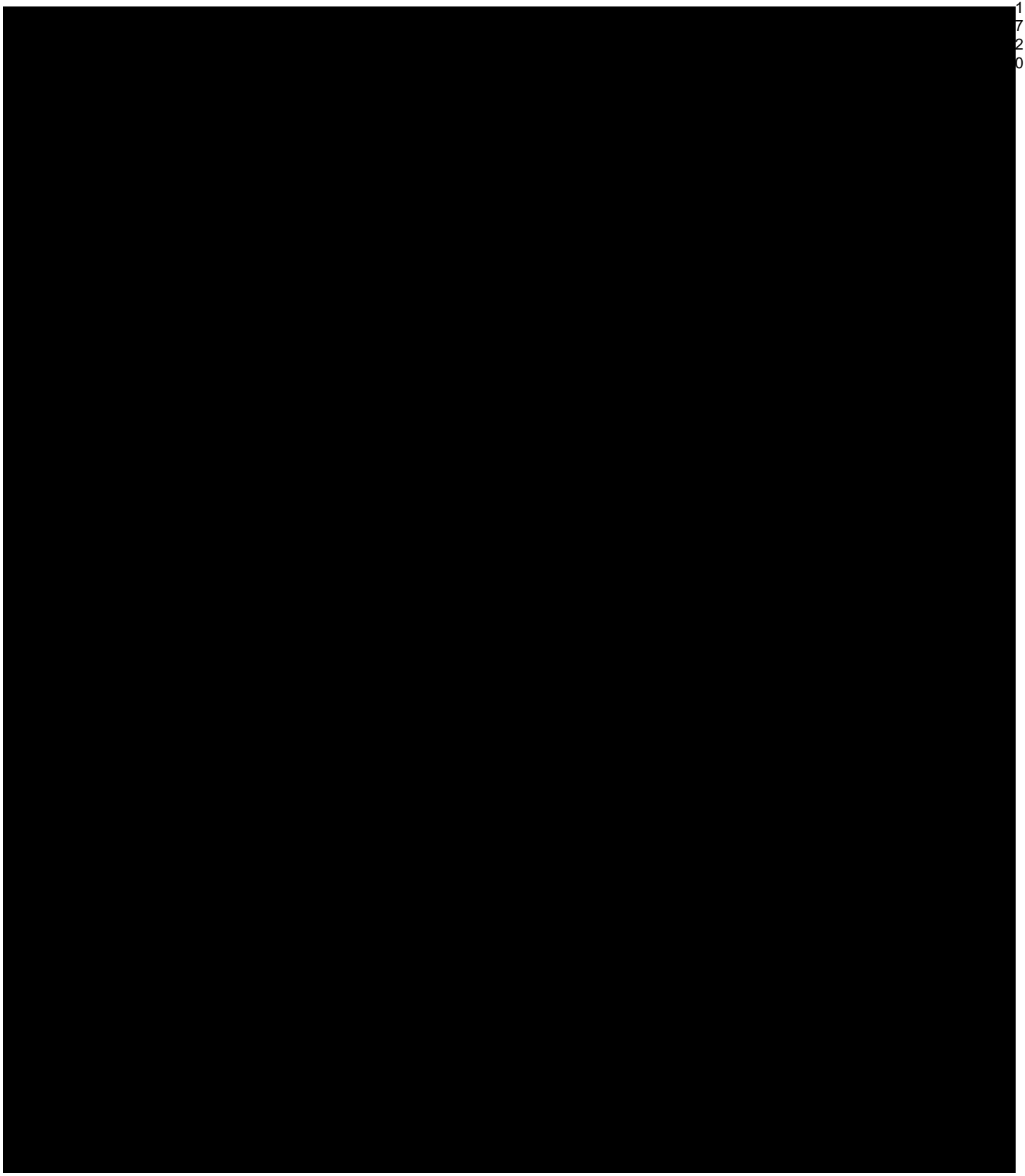
- ***Royal Flush Toilet Rebate Program:*** Rebates of both $40 and $60 (multi-residents and single-family dwellings) are available for each low-flush (6-litre or less) toilet replacement of a traditional high water use one. This alone reduces household water use by 15%. This program registered 4,500 replacements between 2003-2006.
- ***Wastewater Flow Reduction Programs:*** One-third of the City's electricity costs are for wastewater treatment. There is an urgent requirement to reduce flows into the wastewater system to save energy and postpone the need for expansion to the existing system. Targets established in 2001 for both electricity reduction and waste flow reductions are being met.[78]
- ***Storm Water Management:*** The city has guidelines with respect to storm water management. The guidelines provide for a variety of storm water outlets with some of these outlets resulting in runoff to green spaces and corridors that can also be used for recreational uses such as walking and biking purposes.[79]
- ***Comprehensive Public Education and Awareness Program –*** Targeted all households from 2001-2006
- ***Multi-residential Washing Machine Replacement Program*** – In partnership with GHESI
- ***Industrial, Commercial, and Institutional Water/WasteWater Capacity Buy-back Program***
- ***Outside Water Use Program –*** Aggressive citywide program ensuring that the community minimizes use of water for lawn watering and car washing, etc.

8.11. Organizations Supporting Sustainable Objectives

The following lists organizations of all types that have a significant role in supporting sustainability and resource efficiency goals. This gives an impressive view of the breadth of expertise already available. This list is representative, and should be seen as the basis for building more complete Asset directories in the future.

- ***Guelph Environmental Leadership:*** A partnership of volunteers throughout the community that *"support progress toward responsible behaviors that improve sustainability, resilient ecology, healthy people, reduced costs and lasting resource use."*

[78] City of Guelph, Growth Management Workshop, May 24, 2006
[79] Don Kudo, P.Eng, Community Design and Development Services – Engineering Services – City of Guelph

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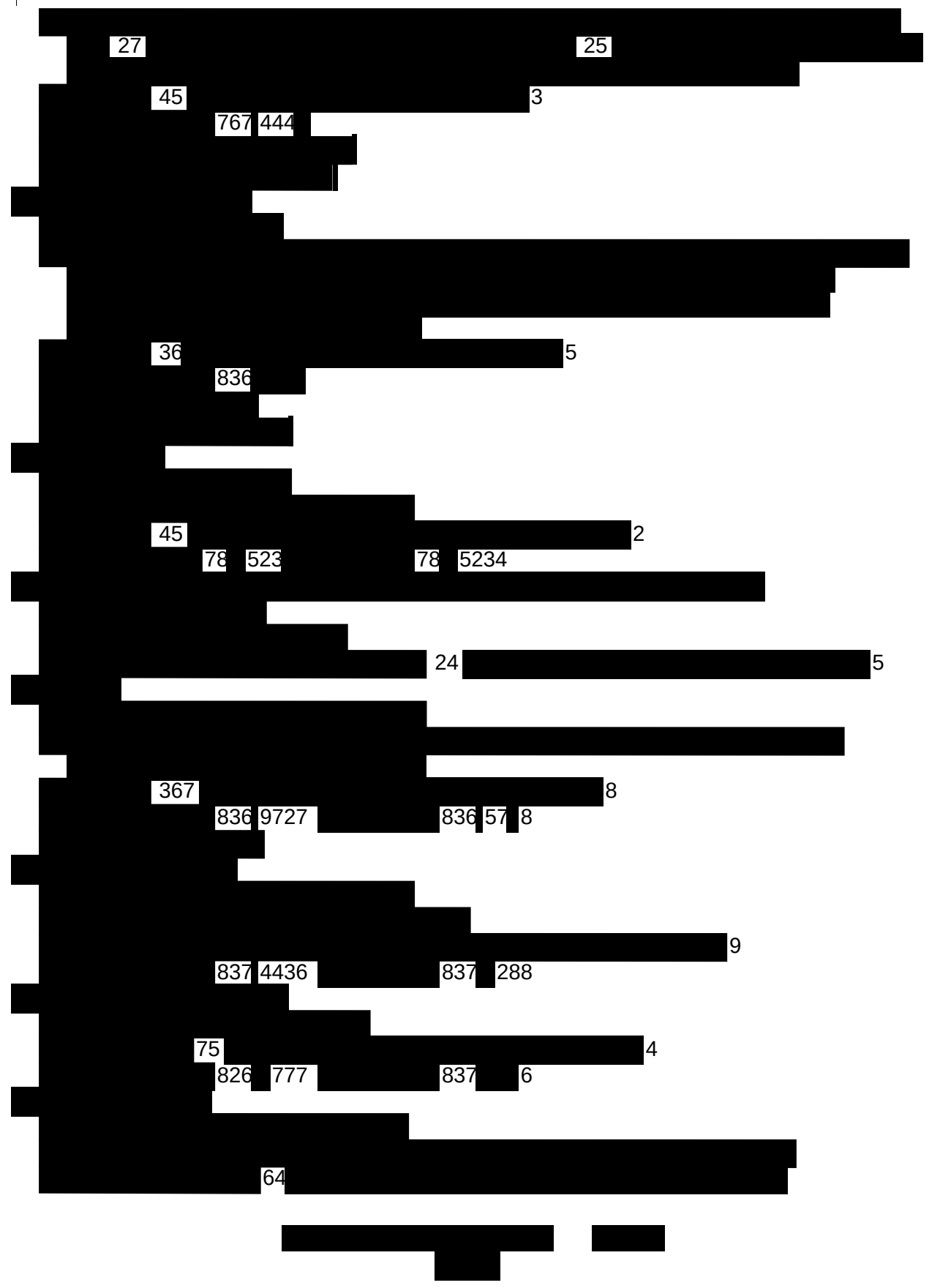
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[redacted]estate Developers, Architects and Planners

Thomasfield Homes has built a solar home in the Pine Ridge Subdivision and marketed a solar package to buyers. Thomasfield also undertook an Affordability and Choice (ACT) project in the Pine Ridge Subdivision with innovative zipper lots, corner lots and a granny flat that increased densities, had specially designed live/work units, and took advantage of passive solar energy. Throughout the Southend of Guelph there is a system of greenways in Pine Ridge, Westminster Woods, and Clairfields that clean and infiltrate storm-water and also link the communities through walkways. Local developers have been asked to lecture to Ministry of the Environment employees annually regarding these innovative greenways. Local builders including Reid's Heritage Homes and Terra View Homes are Energy Star Builders

Given the overall importance of the built environment to both the current energy use, and the future success of the CEP, a rigorous data base of builders, architects and developers committed to offering energy and water efficient new buildings, renovations and scale developments needs to be developed.

This is suggested as an immediate and ongoing task for the Guelph Development Association, and Guelph and District Homebuilders Association.

8.14. Other Public Interest Programs and Successes

- ***Project Porchlight:*** A campaign to distribute Compact Fluorescent Light bulbs (CFL) one by one to citizens of the city, originally started in Ottawa and has come to Guelph. This initiative has prompted many people to expand their use of CFLs. http://www.onechange.org/
- ***Solar groups:*** Two community groups currently pursuing the prospect of establishing solar electricity generation in Guelph. One group, GRASP (Guelph Residents Advocating Solar Power), is hoping to bring enough households together that a group purchase of solar generation can lower cost. The second group, Sunpark Energy Corp of Rockwood, is challenging citizens anywhere to purchase a solar cell for $25. to be part of a Sunpark to be built at sites across the country.[80]

8.15. OMAF Cogeneration Installations

The Ontario Ministry of Agriculture and Food has its main offices at 1 Stone Road in Guelph. 1 Stone Road and two other Ontario Reality Corporation buildings in the vicinity are in the process

[80] Sunpark Challenge, http://www.sunpark.ca/index.html

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of installing co-generation equipment within each building. These could have the potential to be integrated into a neighbourhood system.

8.16. University of Guelph Central Steam System

The UoG has a campus wide steam system with four central boilers providing up to 200,000 lb/hr of steam in the winter, and as little as 30,000 lb/hr in summer. The system has the potential to be upgraded, made more flexible in terms of services offered, and potentially to become a part of a future neighborhood system.

8.17. Renewable Fuels

Guelph's commitment to developing a well structured community energy plan has resulted in a high level of interest from a number of entrepreneurs interested in establishing renewable fuels-based businesses. These include ethanol and biodiesel as transportation fuels, waste-to-energy conversion and wood-pellets as heating fuel. None are yet at a stage for listing as part of the CEP Assets. However, the high level of interest is a testament to the impact of the plan.

8.18. Sources for Funding and Intellectual Support

Many financial and non-financial public interest sources exist to support the implementation of the Community Energy Plan. It is proposed that an appendix or separate document be created in conjunction with the Consortium over the coming months, as the specific priorities and programmes arising from the CEP become clearer. Agency programs need to be researched and clearly understood. Where appropriate they can be aligned with the CEP to achieve its goals and targets. Some such agencies are:

- Ontario Centres of Excellence
- Ontario Power Authority
- Conservation Foundation Funding
- National Science & Engineering Research Corporation
- Natural Resources Canada
- Environment Canada
- Federation of Canadian Municipalities
- Ontario Ministry of Transport
- Pew Center for Climate Research
- Private Trusts
- Socially Responsible Investors

This list should not limit the efforts of the CEP to seek out and obtain funding partnerships from a vast number of sources in the government, public, and private sectors. Given the global concern over climate change, some non-Canadian sources should not be overlooked.

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9. SUSTAINABLE ENERGY GOALS AND MEASUREMENTS

9.1. Background

The goals of the Community Energy Plan selected by the Consortium, and their associated benefits were outlined in Section 4. One of the criteria was that these should be easily measurable with readily available data. This section summarizes the recommended measurements.

Some will be in areas such as Economic Development, where there will need to be alignment between the measures to avoid overlap, duplication or confusion. Where this is the case, this is highlighted.

9.2. Goal 1 - Attracting Investment

Guelph will be the place to invest, supported by its commitment to a sustainable energy future	
Measures of success	**Units**
Inbound direct investment in all sectors	• $ invested • Year-on-year % increase compared to Canadian average • Narratives where the final decision was specifically based on Guelph's energy offerings
Employment created	• Number of new jobs
Employment in energy related services and industries	• Total number of jobs • Year-on-year % increase

This goal underlines the growing strategic importance of energy as a factor in decision making by industrial, and occasionally, commercial investors. Clearly, energy is only one factor in attracting new inbound investment to the city. The final measure and units that will be used should be completely aligned with those used to track economic development in general.

In the event that Guelph's unique approach to energy became the deciding factor, this should be captured in narrative form for use to attract further investors with the same needs, and for wider communication of the success of the CEP.

This goal also underlines the potential for creating businesses clustered around a successful implementation of the CEP. This aspect of the goal will be measured over time by the number of people gainfully employed in the energy services, alternative energy and associated sectors.

The City and the Guelph Chamber of Commerce should supply 2006 benchmarks as an immediate task towards CEP implementation. The assumptions should be well documented to ensure consistent future comparisons.

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9.3. Goal 2 Competitive Reliable Services

Guelph will have a variety of reliable, competitive energy, water, and transport services available to all	
Measures of success	**Units**
Residential services	• Average $ cost per capita for all residential energy services – gas, electricity, oil, and district heating (future) • Average $ cost per capita for all residential water services • % difference to Canadian averages
Commercial/Institutional services	• Average $ cost per square meter of Grade A commercial property for normal energy and water services - lighting, heating, air conditioning, domestic hot water • % difference from Canadian average
Industrial services	• Average $ cost per kWh electricity • Average cost per GJ natural gas • % difference to Canadian averages for above two • Average $ cost per GJ heat (if supplied) • Average $ cost per GJ steam (if supplied) • % difference to normal on-site practice for above two
Individual transportation	• % of total passenger kilometers using communal transit • Consortium should agree to a measurement for the effectiveness of strategies to encourage use of bicycles and walking
Commercial transportation	• Recommendation is to wait until a later stage of the implementation of the CEP before selecting a set of measurements
Interruptions	• Duration • Number of events

This will be an area where measurements are likely to evolve. However it is also where it is better to be directionally correct rather than strive for precision.

In the case of residential services the focus is on the average individual total cost. In the case of commercial and institutional, the focus is on the average cost per square meter. Industrial services are hard to bundle as indexed costs using external data, so unit cost is used.

In all cases, the measures should reflect both traditional and non-traditional supplies of energy services including (but not limited to):

- Electricity via grids
- Electricity from on-site fossil fuel generation
- Electricity from on-site renewable generation
- Natural gas
- Heat from district heating networks

- Heat from on-site cogeneration
- Steam from district steam networks
- Steam from on-site cogeneration
- Heat and/or steam from on-site bio-mass boilers or solar collectors
- Cooling from district cooling networks
- Water/waste water via grids
- Water/waste water from grey and black-water systems

The measurement recommendations will be relatively easy to capture as long as most energy and water services are supplied to end-users via public energy services. The situation will develop new complexity as more distributed, on-site and alternative technology solutions are deployed.

The individual fuel-driven transportation measure is defined essentially as a market share of individually owned vehicle journeys against communally owned vehicle journeys. This measure would lump passenger kilometers from programs such as AutoShare[81] or Green Wheels/StattAuto[82] into the communal category.

Commercial transportation is a complex multi-dimensional category and the recommendation is not to have a systematic measure at this time. As a point of data, commercial transportation accounts for about 12% of all Canada's energy use, a significant, but not overwhelming percentage of the total.

9.4. Goal 3 Environmental Performance

Guelph energy use per capita and resulting greenhouse gas emissions will be less than the current global average

Measures of success	Units
Energy use per capita *2005 Estimate* *74 versus 14*	• Total energy of all types delivered to all users in a year expressed in megawatt hours equivalent divided by the current census population of the city • Ratio to total global energy use per capita as defined by the EIA[83] to the equivalent for Guelph
Resulting greenhouse gas caused per capita *2005 Estimate* *15 versus 4*	• Greenhouse gas caused per year as defined by the emissions factors for all primary fuels used by the city expressed in Tonnes carbon-dioxide equivalent divided by the current census population of the city • Ratio of total global greenhouse per capita as defined by the EIA[84] to the equivalent for Guelph

This is a set of measurements that could become very complex very quickly, if all the second-order factors are included. The recommendation is to stay with very straightforward measures

[81] http://www.autoshare.com/

[82] http://www.greenwheels.de/

[83] World Primary Energy Consumption by Region, 1995-2004 http://www.eia.doe.gov/emeu/aer/txt/stb1103.xls

[84] World Carbon Dioxide Emissions From Energy Consumption, 1995- 2004 http://www.eia.doe.gov/emeu/aer/txt/stb1119.xls

for the time being which are directionally valuable, even if they can be challenged on a detailed basis.

The measure of energy use per capita in the city will always be on the basis of the primary fuel used to create the service. So in the case of electricity this will include the conversion, transmission and distribution losses which occur outside the city. The table used for the global comparison from the EIA is on this basis.

Greenhouse gas will be calculated using the emissions factors assigned by Environment Canada in support of Canada's obligations under the Kyoto Treaty.

9.5. Goal 4 National Comparison

Guelph will use less energy and water per capita than comparable Canadian cities	
Measures of success	**Units**
Energy use per capita	• Ratio of Guelph's energy use per capita as defined in Goal 3 relative to one comparable city in Ontario and one in British Columbia or Quebec
Resulting greenhouse caused per capita	• Ratio of Guelph's greenhouse as creation per capita as defined in Goal 3 relative to the same two cities

This is a key measure of energy performance relative to a couple of benchmark cities that would either be a potential national champion and/or a competitor for inbound investment. The choice of benchmark cities is at the discretion of the Consortium. One in Ontario is recommended to have a comparable climatic benchmark. The other Canadian city should be selected on the basis of being a potential competitor for inbound investment, especially in high-tech areas, and will also be very challenging environmentally due to climate difference and the high percentage of hydro electricity.

9.6. Goal 5 Public Investments

All publicly funded investments will visibly contribute to meeting the four CEP goals	
Measures of success	**Units**
New construction	• All new facilities owned or leased by tax funded entities or Crown Corporations will meet or exceed the prevailing energy efficiency, climate performance and water efficiency guidelines in place under the CEP
Major renovation	• All major renovations of facilities owned or leased by tax funded entities or Crown Corporations will meet or exceed the prevailing energy efficiency, climate performance and water efficiency guidelines in place under the CEP
Vehicles	• All vehicles acquired by tax funded entities or Crown Corporations will be at least 10% more fuel and greenhouse gas efficient than the prevailing European Union average – based on current indications

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The responsibility of public authorities to be seen as fully engaged with the goals of the CEP cannot be overestimated. Many programs in the EU, now seen as part of the "normal" way of doing things, were triggered by public authorities acting as the lead.

The choice of the European Union average is a convenient, well documented stake in the ground which is relatively easy to achieve with careful vehicle choice. It is also likely to remain the global best practice for at least one full vehicle design generation (approximately 12 years).

9.7. Communicating Community Energy Plan Performance

Section 10 "Overall Energy and Water Strategy" will cover overall communications surrounding the recommended Community Energy Plan Strategy. However, it is appropriate to underline in this section on Community Energy Plan Goals and measurements, the need for regular, transparent reports of the city's progress against its goals.

The recommendation is that all the agreed measurements for the four primary goals are regularly available to all Guelph's citizens in both detailed form and in the form of a Community Energy Dashboard. The reporting interval will be determined by the final availability of data. The recommendation is that the CEP Dashboard should be updated at least two times a year with data no more than six months old.

10. SUCCESSFUL COMMUNITY ENERGY PLANS

10.1. Benchmarking Community Energy Plans

There is a widespread interest in integrated Community Energy Planning in Canada. This reflects the recognition that the challenges outlined in Section 3 of this Plan need concerted approaches at the community level. However, most plans fail to meet their targeted outcomes. The Guelph CEP Consortium recognized this risk and sought out benchmark communities from around the world that had clearly achieved a satisfactory combination of the following outcomes:

- Reliable, economic energy services tailored to needs of various consumers
- High levels of energy efficiency including transport
- Low greenhouse gas creation
- Flexibility to incorporate new fuels, both renewable and fossil
- Flexibility to incorporate new technologies
- Marketing energy and water productivity expertise beyond their administrative borders

Two specific cities were reviewed, Copenhagen in Denmark, and Mannheim in Germany. Both, like Guelph, are in climates that demand more heating than cooling. Both, like Canada, are liberal democracies with a high standard of living. Their energy approach will be briefly described.

10.2. Community Energy Approach - Copenhagen

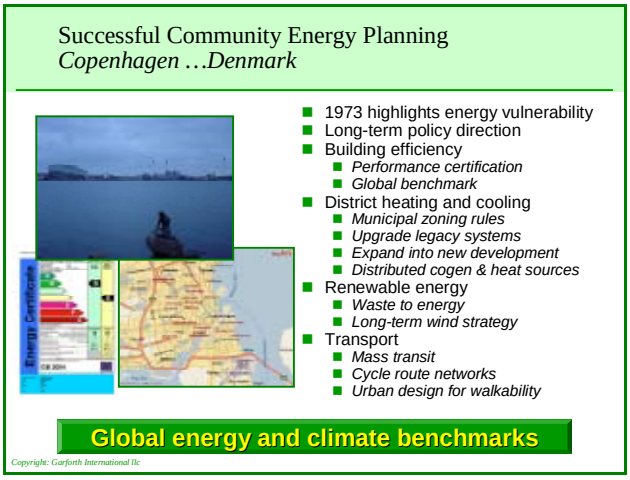

Figure 10.1 Overview of Copenhagen Energy Approach[85]

During the 1973 events that led to dramatic increases in oil prices and fears of supply interruption, Copenhagen was particularly vulnerable since its electricity was mostly oil-generated. The city embarked on a conscious path to minimize its energy vulnerability. The most striking feature has been the overall policy and implementation consistency over many decades. The city boasts some of the most efficient building practice in the world, and has been a pioneer in establishing approaches to guarantee and maintain the energy performance of buildings. Building efficiency performance standards are regularly reviewed and upgraded, typically once every five years.

[85] Slide from presentation used by Consortium in CEP input meetings during 2006 –source GIL and various

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At the start of the planning, the city core had a communal system for delivering heating. Instead of this being closed down as has been the case in many US and Canadian cities, it was seen for the asset it was, and has been systematically upgraded and widened to cover most of the city and many of the new and remodeled suburbs. Having a thermal network to deliver space heating and domestic hot water allows vast amounts of heat traditionally wasted in the generation of electricity to be used. Most of the city's buildings and homes are served in this way. Over time, the city has become effectively zoned for heating.

A thermal network also facilitates the connection of multiple energy sources into a convenient, efficient system. The city uses a range of fuels for heat and electricity generation including coal, natural gas, oil, combustible municipal waste, wood chips, solar sources and wind. The availability of a thermal network also facilitates the optimum economic use of boilers, generators and other energy conversion equipment across the city. To further make use of the available heat from a wide range of sources, especially during the summer, district cooling is being added to the network[86].

As the city grew and redeveloped, conscious decision making processes were put in place to minimize the use of personal cars and to maximize the use of walking, mass transit and bicycles. The details are many and all relatively well documented in many descriptions of urban planning principles. They include creating more mixed use areas, densification of dwelling and activities, streetscape design for visual and social interest, traffic calming measures, mass transit priorities and investments, and integration of green spaces into the core urban design. Copenhagen has also been a pioneer in shared use bicycles and cars. Incidentally, these urban design concepts also help create more energy efficient buildings and improve the economics of thermal energy distribution.

The community energy system is run by a consortium of neighborhood multi-utility cooperatives bound together by mutual cooperation agreements and a common dispatching system with common technical standards.

In recent years, there has been an increasing focus on rainwater recovery and reuse systems, combined the increasing deployment of so-called grey-water systems, to reuse a portion of domestic water use for non-potable applications. The main driver of this is less to conserve water in an absolute sense, but more to reduce the energy and chemicals use in water processing and transportation.

In addition to creating a highly efficient community energy system, Copenhagen and its surroundings have become a recognized center for efficient architecture, construction technologies and consulting.

The average Dane uses 64% less energy than the average Canadian, and, despite the high portion of hydro-electricity in Canada, the average Dane still produces 58% less carbon dioxide than their Canadian counterpart.[87]

[86] Heat is converted to cooling using absorption cooling technology. Many references on this are widely available.

[87] IEA Key World Energy Statistics 2006

10.3. Community Energy Approach of Mannheim

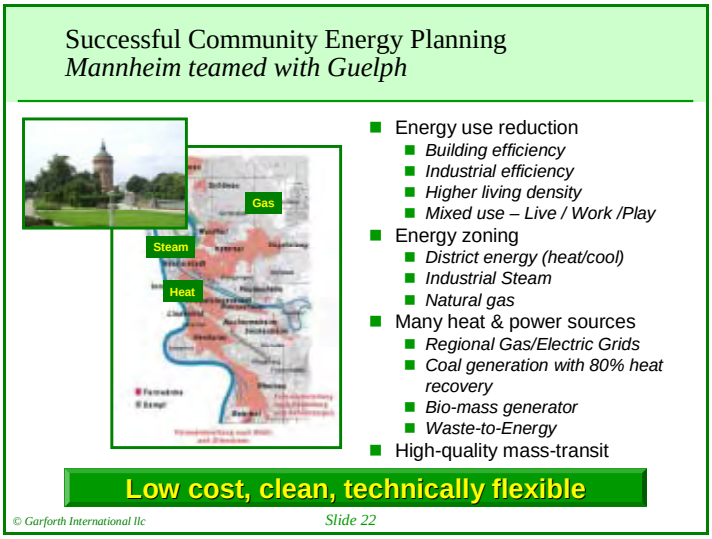

Figure 10.2 Overview of Mannheim Energy Approach[88]

Like many industrialized German cities, Mannheim was heavily damaged in World War II. In the immediate post-war period, existing infrastructure, including a pre-existing district heating system and tramway system were put back into service. In the late sixties and early seventies, the combination of declining quality of domestic coal, dependency on Soviet gas and oil and Middle East oil, combined with the demands of a booming economy, put a high premium on effective use of energy.

The resulting Mannheim energy infrastructure has many similarities to Copenhagen. Homes and buildings are efficiently constructed and managed, against building performance codes that are regularly updated.

Like Copenhagen, the strategic decision was made in the 1980's to upgrade and extend the district heating system, and it now extends across wide areas of the city (see the red shaded areas in the map above) serving the majority of both residential and commercial users with heating and domestic hot water. Again, like Copenhagen, district cooling is being added to serve the downtown business district and selected specific sites, including the new SAP Arena.

A specific feature of the Mannheim structure is the creation of an industrial enterprise zone on an island in the Rhine River that has tailored energy supply which includes industrial grade steam as a community utility, in addition to supplying district heating, gas and electricity. This has attracted investors with specific process steam needs, since they avoid significant capital and operating costs.

The thermal and electric network facilitates the inclusion of multiple fuel and technology options. The bulk of the heat is sourced from large scale coal generation located very close to the city, supplemented by natural gas, combustible municipal waste, recycled lumber from building demolition, and some solar sources.

[88] Slide from presentation used by Consortium in CEP input meetings during 2006 –source GIL and MVV

A good example of how a flexible system such as Mannheim or Copenhagen can incorporate new technologies is the way Mannheim is piloting a trial of appliance-sized micro cogeneration units that fit into individual homes and act as both electricity generators and heat sources.[89] If successful, this could put thousands of electricity and heat generators into the overall community system, owned and operated by the city utility.

Being a predominantly 17th century city, the core of Mannheim is essentially designed along "New Urbanism" principles, and is naturally oriented more to walking, biking and mass transit. The tramway system has been radically updated in the past 15 years, and is served by frequent, air-conditioned light rail infrastructure. In parallel with upgrading the mass-transit, the city has discouraged car use in the downtown through conveniently located central parking near to mass transit, along with large areas off limits to cars.

Unlike Copenhagen, the energy (electricity, gas, district heating, district cooling etc), water and transportation supply system is run by a single municipal entity. This entity is a private corporation, majority owned by the city, with minority participation via the stock exchange.

The utility, MVV Energie AG, has developed a world-wide consulting and engineering practice based on its expertise from its operations in Mannheim, and recently other cities in Germany and Poland.

The average German uses 59% less energy than the average Canadian, and, despite the high portion of hydro-electricity in Canada, the average German still produces 55% less carbon dioxide than their Canadian counterpart.[90]

10.4. Community Energy Examples from North America

Mannheim and Copenhagen were chosen as examples of the results when efficiency, flexible distribution and efficient fuel use are combined in an entire city. There are no real parallels in North America. However, there are indicative examples that are relevant:

10.4.1. California Building Efficiency

California has had a systematic approach to reviewing, measuring and upgrading building efficiencies over a number of decades[91]. This systematic approach has resulted in buildings that are on average between 30 to 40% more efficient than the rest of the USA and the average will continue to increase as the 2005 version impacts the overall building stock. The new Ontario Code[92] will approach these levels of efficiency.

10.4.2. Markham District Energy

Since 2002, Markham has installed a new small community owned heating and cooling [93] cogeneration system supplying about 400 hectares of the downtown core. The ultimate goal is to connect 25,000 residents and 17,000 employees with this system. It is municipally owned, and operates in parallel with the local electric utility. Like all district

[89] See Appendix 1 for the Mannheim press release on this initiative – also see www.whispergen.com

[90] IEA Key World Energy Statistics 2006

[91] See California Energy Commission Title 24 http://www.energy.ca.gov/title24/

[92] See http://www.mah.gov.on.ca/userfiles/HTML/nts_1_27483_1.html

[93] See www.markhamdistrictenergy.com

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energy systems, it has the flexibility to be expanded as the need or opportunity arises and to incorporate alternative fuels.

10.4.3. Austin District Energy

Austin Energy[94] installed its first electric-driven district cooling system, serving part of the downtown, and will soon be expanded to a second phase. This system serves commercial and multi-family residential customers. They also operate a district energy system in a light industrial park supplying electricity, steam, heating, cooling and compressed air. Austin Energy is a regulated electric utility owned by the City of Austin, also supplying value-added services including district energy via its deregulated business unit.

10.4.4. Dockside Green – Victoria

This is a planned 6 hectare brownfield development[95] in the City of Victoria, and has set the overall goal to be a model of efficiency and sustainability[96]. The scope includes super-efficient buildings, 55% better than the Canadian Model National Energy Code[97], combined with efficient appliances, solar electricity, efficient water management systems and biomass district heating.

Other comparable small and medium scale examples exist, all of which point to the elements that are integrated into the following strategy for Guelph. Guelph is unique in Canada at present in that it is setting a Vision, Goals and long term community commitment to deliver breakthrough energy and water outcomes for the entire city. For that reason, the benchmarking focused very much on the entire city models such as Copenhagen and Mannheim.

[94] See http://www.austinenergy.com/Commercial/Other%20Services/On-Site%20Energy%20Systems/districtcooling.htm

[95] See http://www.docksidegreen.ca/dockside_green/overview/index.php

[96] GIL, consultant to the project, is also developing scale project energy plans for similar developments in South Carolina, California and Tennessee. Details are available on request

[97] See http://oee.nrcan.gc.ca/commercial/financial-assistance/new-buildings/mnecb.cfm?attr=20

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11. GUELPH ENERGY AND WATER STRATEGY

11.1. Framework for Guelph Community Energy Plan

Following formal acceptance of the Community Energy Plan by the Consortium and the City Council, Guelph will commit to a multi-decade implementation of an energy and water strategy that will clearly drive the entire city towards the vision and goals outlined in Sections 5 and 9 of the Plan. This will be a broad based commitment of all major constituents within the city, with the support from all sides of the political spectrum. Progress will be reported on a systematic basis and corrective actions taken if there is insufficient progress to the goals.

The common feature of all the benchmarking examples used above is that the activities are assessed in the following priorities. All significant public investments in Guelph will be challenged to respond to the following questions where applicable:

1. Have all reasonable measures been taken to maximize the energy and water efficiency in buildings, transportation and industry?

   This underlines the obvious fact that the cleanest and ultimately cheapest energy source is the energy that is not used through efficiency.

2. Have all reasonable measures been taken to implement combined heat and power (CHP) solutions?

   To fundamentally change the efficiency of electricity generation from its present 30 to 40% range to levels approaching 70 to 90%, significant amounts of combined heat and power are a pre-requisite.

3. Have all reasonable measures been taken to incorporate renewable energy sources, including renewable transport fuels, or to ensure they can incorporated in the future?

   In addition to reducing the greenhouse gas footprint through efficiency and CHP, the next level of greenhouse reduction and fuel flexibility must come from renewable sources. In many cases, these will be future options as costs and technology become competitive; however, systems should be designed to accommodate them.

4. Have productive teaming relationships been established with the existing electricity and natural gas networks to supply the remaining energy needs for Guelph?

   This addresses eliminating the ultimately non-value added risk of competition between existing traditional energy supply structures and the reworked energy structure of Guelph. The intent is to ensure all the energy needs addressed in the CEP and the systems that supply them are operated at optimum returns and technical performance. Further investigation needs to be taken into possible jurisdictional and/or provincial issues.

This priority is a well documented, but rarely implemented, approach to achieving breakthrough energy goals. It is the basis of European Union and Californian energy policies, and is called the “Trias Energetica” or “California Loading Order” respectively.

The following strategy for the City will address each of these priorities in turn, with recommendations.

11.2. Maximizing Efficiency of Homes and Buildings

They are a major source of greenhouse gases, especially when the carbon associated with their electricity use is included.

The estimated total energy cost to the homes and buildings consumers today is $150 to $200M, which could easily double within the next two decades. Managing this cost on the city will be a key element of affordability and competitiveness.

A major challenge in all strategies is to reconcile the energy performance anticipated from a building constructed according to any particular Code, and the actual buildings. The latter number is usually somewhat higher[98]. The CEP strategy will recommend an approach to reconcile this systemic discrepancy for both commercial and residential construction.

11.3. Residential Developments – Efficiency Expectations and Guidelines

Target – Use efficiency to create at least all the energy needs to support the growth of the residential sector

Guelph is entering a growth phase where at least 21,000 homes will be added in the next 25 years, potentially adding 650 GWH_e annual energy consumption per year from today's total of about 1,610 GWH_e/yr assuming today's code levels.[99]

During the same time approximately 3 million square meters of residential property will be renovated, presenting opportunities for substantial efficiency upgrades.

The following strategies are recommended

1. Provide incentive programs to accelerate meeting the efficiency standards of the new Ontario Building Code 2006 scheduled to be fully in force by the end of 2012 starting in 2007. According to the *Backgrounder* news release[100] where estimated incremental costs were tracked progressing from the current code to the 2012 code, the estimated construction cost impact on a 200 m^2 home is expected to be within the range of $8,600 and $9,300. The expectation is that about one-third of this can be absorbed in market pricing and two-thirds in avoided long-term investments in the energy supply systems. The energy service supplier can reflect this latter value either in reduced tariffs or avoided plant costs for the builder.
2. Implement a sustained efficiency improvement of 1.5% per year for ongoing new construction from 2012 to 2031. This would bring the average energy use to about 175 kWh_e/m^2, a level comparable with Sweden today.

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[98] Owens Corning estimates this at about 20% non-compliance based on a mix of US and Canadian experience.

[99] 650 GWh_e/yr based on linearly adding 21,500 homes from 2007 to 2031 with average area of 150 m^2 and average estimated energy use of current new construction estimate of 250 kWh_e/m^2

[100] *Backgrounder* news release entitled "Energy Efficiency in the 2006 Building Code" published by the Ministry of Municipal Affairs and Housing, the Province of Ontario. *Backgrounder* footnote: "Figures are based on a typical 2000 square foot gas-heated house in the Greater Toronto Area.

3. All major renovations will be expected to achieve at least a 25% energy efficiency increase from today's overall city-wide average of 309 $kWh_e/m^2/yr$ starting from 2007. In subsequent years, this level will be improved by a net 3% per year through at least 2031. By 2031, the average efficiency of renovated properties would be about half the average of today's city wide average.
4. The city will set the expectation that all residential construction (new and major renovation) will have Energy Performance Certification similar to the EP labelling initiative required by the latest "Energy Performance of Buildings" Directive in Europe. This will achieve a "compliance premium" conservatively estimated to be about a 5% additional improvement in overall energy efficiency. *See full discussion in Paragraph 11.5 below.*
5. For residential developments where the property is greater than 30 acres in area, the proposed density is greater than 40 units per acre, or the anticipated demand for energy will be greater than 30 MW per K^2 , the expectation is that there will be an assessment of the viability of distributed cogeneration, distributed renewable heat or electricity generation, or heat pumps. If the development is in one of the Scale Projects targeted for district energy (heating or cooling) the assessment should include an evaluation of this energy supply option.

Collectively these guidelines would have the effect of absorbing all the growth and additionally delivering a net reduction in residential energy use of 120 GWh_e from today's total.

11.4. Commercial and Institutional Buildings

Target – Use efficiency to create all the energy needs to support the growth of the commercial and institutional sectors

To support the population growth of about 65,000 people and their associated employment, shopping, and recreation, the commercial and institutional space is likely to grow by about 475,000 m^2 from its present estimated 1,683,916 m^2 [101], potentially adding at least 303 GWH_e/yr energy consumption to the present 1,046 GWH_e/yr by 2031. Over the same period, half of the same area of commercial and institutional space will be renovated.

Similar expectations as for residential would be put in place:

1. Encourage the accelerated implementation of Ontario Building Code 2006 to full level by 2007, and expect a 1.5% per year improvement from 2012 onwards through educational and other incentives.
2. Major renovations should achieve a 25% improvement from above city average of 621 kWh_e/m2/yr from 2007, followed by a 3% year-on-year net improvement through 2031
3. All new commercial and institutional buildings and major renovations are recommended to have an EP Label.
4. Collectively these guidelines will have the effect of absorbing all the growth in the commercial sector to within 5% of today's total energy use levels.

[101] Estimate based on CN Watson Development Charges Nov 2003 adapted by actual 2005 energy deliveries

5. For Commercial developments where the total constructed area exceeds about a 10,000 m^2, the expectation is that there will be an assessment of the viability of distributed cogeneration, distributed renewable heat or electricity generation, or heat pumps. If the development is in one of the Scale Projects targeted for district energy (heating or cooling) the assessment should include an evaluation of this energy supply option.

11.5. Energy Performance Labelling of Buildings

Target - Adopt an energy performance labelling scheme for buildings as a voluntary initiative for the City, teamed with Natural Resources Canada and a local mortgage bank, to act as a pilot for the whole of Canada to gain about 5% incremental delivered efficiency

Canada, like many jurisdictions, is awakening to the fact that the energy performance of buildings as delivered is often significantly lower than should be the case according to prevailing codes. The European Union is tackling this issue with the Energy Performance Labelling requirement spelled out in the 2002 Energy Performance of Buildings Directive.

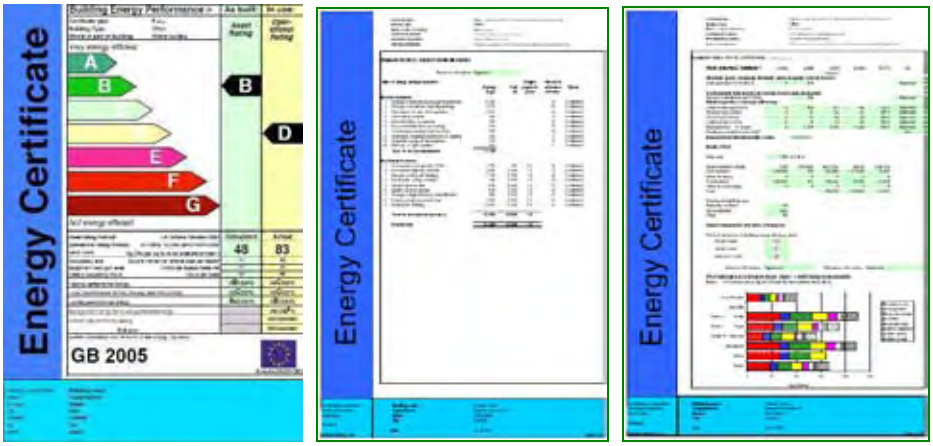

Figure 11.1 Sample EU Energy Performance Label

(See Appendix 9 for more information)

The basic principles of the labelling process are:

- Applies to all homes and buildings over 50 square meters
- Available to buyer or tenant when sold or rented
- Include both energy and greenhouse gas indicators
- Should reflect the current state of the building, whether new or existing
- Excludes historic and similar structures if appropriate
- Prominently displayed in public buildings
- Based on “Asset” (calculated) rating for new buildings
- Based on “Operational (as used) for existing buildings
- Independent inspectors certify the buildings
- The labels are a simple three page document

1. Comparison with building peer group or code
2. Measures and estimate costs to improve performance going forward
3. The methodology used to derive the performance indexes

The goal is to move to a market expectation that the energy performance of a building will be transparent, such that the buyer can reasonably anticipate costs and performance.

The EU-wide label that is being adopted is based on a pattern already familiar to most people in the Union from appliance labelling. Natural Resources Canada is leading a national process to recommend a labelling format, implementation process and legal framework. The form will probably be similar to existing Energuide labelling. The process is expected to be based on the EU experiences.[102]. NRCan has expressed an interest in exploring a city wide pilot with Guelph. Owens Corning is also expressing an interest to participate in a pilot scheme.[103]

This is an area where the Guelph Development Association, the City Planning Department, the University of Guelph and the Conestoga Community College should form a small group to develop the details of implementing an effective, visible and low cost EP labelling scheme.

Other than a mandatory approach, experience from other jurisdictions indicates that the mechanisms likely to encourage labelling are:

- Some form of risk sharing for the energy performance guarantees, either with a commercial sponsor and/or public agency
- Influential early adopters from the construction community forcing a competitive reaction
- Team with financial institutions to make EP Labeling a visible and strongly recommended part of the financing process.
- Initially require EP Labelling in selected Scale Projects (see below) developments rather than the entire community

All of these should be explored by the CEP Committee.

An effective labelling scheme provides the basis for a number of possible market mechanisms:

- Public awareness of the climate impact of homes and buildings – this is a link that is often not fully appreciated and the label helps make this more transparent.
- Provides a base for future market mechanisms
  - Differential property taxes
  - Accelerated planning approval
  - Differential mortgage costs
  - Rental negotiation
  - Price negotiation
- Builder / developer credibility
  - Opportunity for good builders to promote their excellence
  - Could be a future basis for rectification or recourse

[102] Garforth was keynote speaker at NRCan "Building Energy Labelling Forum" – Dec 2006. and discussed the potential teaming with the Guelph CEP

[103] Private communication with Peter Garforth – December 2006

- Building owner peer pressure
  - Visible public labelling
  - Who wants a poorly rated ("F") building?

Public operators of buildings should follow the lead of Guelph Hydro and label their buildings as visible statements around this aspect of the CEP. The labelling should be done irrespective of whether the Energy and Climate Performance is "good" or "bad".

11.6. Maximizing Quality and Efficiency of Industrial Development

Target: - Add to Guelph's attractiveness for quality industrial investment by offering world class tailored energy services and achieve annual investment growth rates higher than the underlying population growth, with no overall increase of the primary energy needed to serve the first fifteen years of growth.

Due to its proximity to transportation and markets, Guelph is an attractive location for high-quality manufacturing and industrial services of many types. The CEP should support the City's growth plan by ensuring the energy infrastructure is reliable, clean and competitively priced.

The base-line assumption used was that this would grow at about the same rate as the population, with no significant change in overall efficiency. In this base-line, by 2031, economic activity would grow by 65% and energy consumption would grow by 1045 GWh_e/yr to 2,676 GWh_e/yr, with the associated increases in greenhouse gases.[104]

To both accelerate the industrial growth and to mitigate the impacts of energy, the following strategies are recommended:

1. Designate the Southern Business Parks, the Northern Industrial areas, and the Eastern Industrial Parks and areas as "Scale Projects" for energy purposes and offer a tailored energy supply infrastructure suited to the targeted investors. The Mannheim and Austin examples covered in Section 10 indicate the concept that is being recommended. The energy services that could be bundled may include:
   - Electricity
   - Natural gas
   - Heating
   - Industrial grade steam
   - Cooling
   - Water and waste water
   - Compressed air

   A full analysis is needed for each specific sub-project; however, typically these approaches create a reliable, lower cost energy service package, with a substantially lower greenhouse gas footprint due to the increased efficiency of fuel use.

[104] Assumption is that baseline industrial energy use of 1,167 GWh_e/yr will grow at 2% per year from 2007 to 2031 with no significant improvement in efficiency.

2. On a site offering these energy services, the countervailing assumption is that the industrial users will be actively engaged in energy productivity measures and continuous improvements. This includes buildings with higher levels of efficiency than the current norms. Supporting user's continuous energy improvement programs may itself become a commercial opportunity for the energy services provider of the sites.

To estimate potential benefits, the assumption was made that tailored energy services would attract investment at a rate 25% higher than the underlying population growth and that industrial energy productivity would improve at about 2% per year for the period up to 2031.

Under these assumptions, industrial activity would grow by about 85% from today's levels, and delivered energy increase would be constrained to no more than 20%, or 216 GWh_e/yr.[105]

Further, the integration of energy services on the Scale Projects will contribute to about half of the estimated gains in the city from improved fuel efficiency due to cogeneration strategies. This is a further reduction of Guelph's overall energy footprint due to industrial development of 400 GWhe/yr when the gross impact of electricity use is included.[106]

11.7. Transportation Efficiency

Target – As a result of sensitive urban design, effective alternative transport options, and encouraging vehicle efficiencies, Guelph's growth in transport needs be met while reducing the transportation energy use by 25%.

The currently available data on transportation within the city of Guelph is at a formative stage, and under active development. Based on the best assumptions available, personal and light commercial transportation within the city consumes about 1,743 GWh_e/yr or about 33% of all energy used. It is also the energy usage with the highest greenhouse gas content. Heavy freight adds about a further 10% to the total transportation energy of the city. Heavy freight will not be addressed at this time.

With unrestrained growth, energy usage by light vehicles will increase by 947 GWh_e/yr to 2,722 GWh_e/yr by 2031[107]. This is probably understated as it assumes the same journey length on average, with growth simply being driven by population growth. This energy growth is nearly three times the targeted energy use for new housing. It is clearly an area for a high degree of focus.

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[105] Assumption is that baseline industrial energy use of 1,167 GWh_e/yr will grow at 2.5% per year from 2007 to 2031 a 2% per year improvement in overall efficiency.

[106] Total 2006 baseline electricity delivered is 1,629,730 MWh_e/yr using 4,074,325 MWh_e/yr fuel. 2031 total electricity delivered is assumed to linear indexed by the total energy consumption of the city equal to 1,473,862 MWh_e/yr. The combined effect of cogeneration and solar PV reduces the assumed gross factor from 40% to 65% yielding a gross fuel requirement of 2,268,148 MWh_e/yr. The difference between delivered and fuel used in 2007 and 2031 is 1,650,309 MWh_e/yr. 25% of this is attributed to industrial efficiency, rounded down to 400GWh_e in the text.

[107] 2006 Baseline is 1,743,000 MWh_e/yr for transportation. 2031 calculated with km/capita at 69% of today's levels based on impacts of urban design. Fuel efficiency per km traveled (by all mechanical transport means) is at 60% of today's average. These combined yield energy demands for transportation of 1,126,029 MWh_e/yr.

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The CEP is recommending the following strategies:

1. As a high priority, develop a detailed transportation strategy that fully integrates energy and greenhouse gas objectives.
2. Develop Scale Projects with urban design elements to reduce the number of journeys using individual vehicles by at least 1% per year for the foreseeable future, recognizing there will be an absolute increase in the number of journeys due to population growth. The bulk of this reduction will come from creating districts where many daily tasks can be completed on foot or by bike.
3. Identify high volume routes where high quality cost-competitive light rail or low-impact (clean-diesel[108]/diesel hybrid/natural gas) buses could be used. The target should be at least to further reduce the number of individual vehicle journeys by 0.5% per year.
4. Create a city wide program to encourage the widespread use of increased fuel efficiency personal use vehicles that will increase the average fuel efficiency by 2% per year for the foreseeable future.

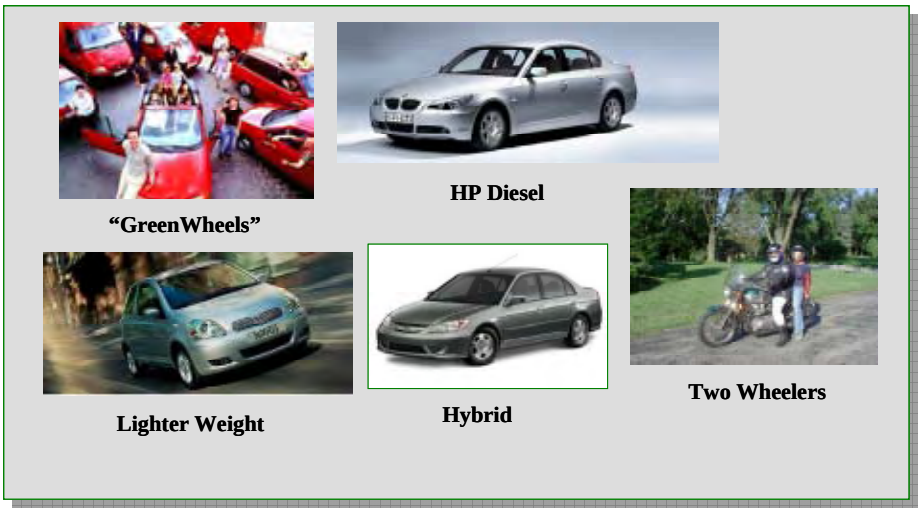

Figure 11.2 Encourage Fuel Efficient Light Vehicles

The choices will include the vehicle types in Figure 11.2. In a free market, there are limits to what a city can do, but at a minimum the following approaches should be considered:

- All publicly funded vehicles should be a visible contribution to the goal
- Parking privileges can be adjusted for different classes of vehicles and number of passengers
- Team with dealers to promote specific choices
- Team with fuel providers to promote specific choices

As an aside, the 2% per year efficiency improvement will require the 2031 average fuel efficiency to be 40% less than today. On an individual vehicle basis, this could be easily achieved with a 10 to 20% average weight reduction and switching to either HP Diesel or Hybrid drives. To achieve it at the city level will be an enormous challenge and require significant culture change.

[108] Clean-diesel includes bio-diesel and mineral diesel vehicles using low sulphur fuel at Euro IV standards

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Meeting the goals of journey avoidance and vehicle efficiency gains has an enormous impact on the energy footprint and greenhouse gas footprint of Guelph. The energy use in transportation instead of growing to 2,722 GWhe/yr, will reduce to 1,126 GWhe/yr even after allowing for the increased demand from a growing population. Clearly this is one of the most challenging targets, but is also one of the most attractive efficiency opportunities.

11.8. Summary of Efficiency Opportunities

Sector	2005 GWhe/year	2031 GWhe/year	2005 MWhe/capita	2031 MWhe/capita
Residential	1,610	1,473	14.00	8.18
Commercial	1,046	1,076	9.10	5.98
Industrial	1,631	1,848	10.15	10.27
Transport	1,743	1,126	15.16	6.26
Total* (Net)	**6030**	**5,523**	**48.31**	**30.69**

**Does not include electricity conversion energy*

Figure 11.3 Summary of Efficiency Opportunities

11.9. Ensuring Flexible Energy Supply

Target – Incrementally create energy distribution architecture in Guelph that will allow the majority of the city to be served with fuel choices that optimize cost, availability and environmental impact long into the future.

A successful community energy plan must take into account that over the decades that form the horizon of the plan, options for fuel, energy conversion, distribution and management technologies will change, and there must be sufficient flexibility built in to adapt as costs and technologies change.

As the CEP is implemented, each of these will be the subject to detailed assessments. The benchmark cities of Mannheim and Copenhagen share the following basic energy architecture.

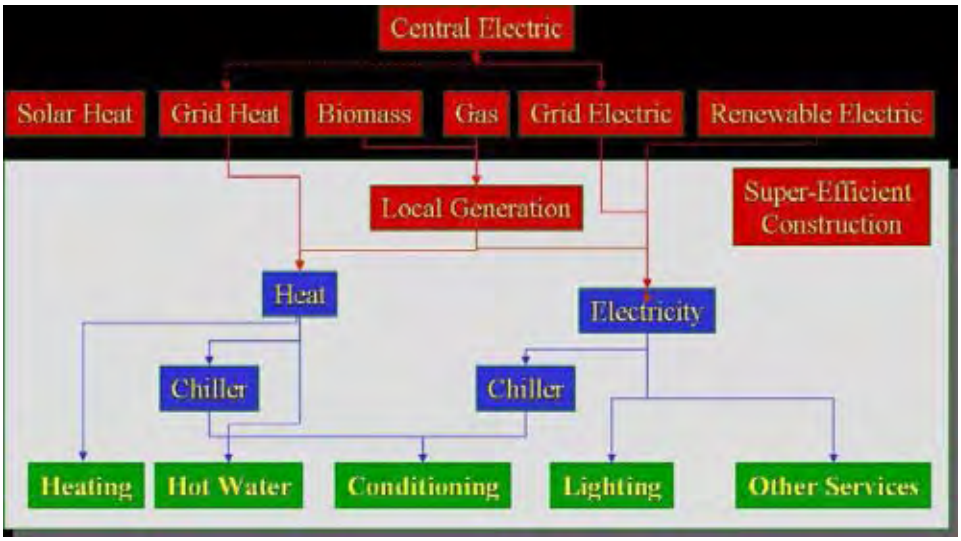

Figure 11.4 Example of Integrated City Energy Architecture

This approach allows distribution of not only gas and electricity, but also heat, and sometimes cooling, as public utilities. Once a reasonably widespread district energy network is in place, various heat and electricity sources can be easily combined, and can change over time.

As seen in Section 7, Guelph has a very high heating demand for its buildings and homes. It is the recommendation of the CEP team that a priority focus be placed on developing district energy in areas where a high density of heating demand already exists, or is planned to exist. This is one of the basic features of the scale projects. This is done by developing a network using pressurized hot water, running at about 120ºC. This approach is more efficient than individual boilers and furnaces. Heat distribution is done via insulated pipes laid in the streets. These typically have a fully functional lifespan of 75 to 100 years. Figure 11.5 shows a typical preparation of a street prior to laying the district heating pipe.

Connection at the buildings or homes is via a simple heat exchanger that transfers heating to the building's heating and domestic hot water system, obviating the need for a boiler and a furnace. If justified by the economics, there are analogous district cooling networks. In Guelph's climate these will probably be limited to high-density commercial developments, and significant industrial cooling loads.

Figure 11.5 Laying District Heat Feeders in Mannheim

The basic recommendations of the CEP are:

1. Develop a long-term approach to creating a district heating system that covers the high density areas of Guelph
2. Initially focus on developing local networks within the context of the Scale Projects with the medium term aim to interlink the local networks into a city wide structure where justified by demand and economics.
3. Create a municipal energy services company that has a franchise to deliver a wide portfolio of energy services including electricity, gas, heating and cooling. Other services, such as compressed air, could be included selectively.

Over time, a district energy system becomes more and more efficient and economically attractive as multiple heat sources are integrated along with a growing portfolio of clients. The experience of Mannheim and Copenhagen is that the sale of heat utility is ultimately more attractive than the sale of electricity. The creation of a municipal energy service must be done considering current regulatory factors. In general, while sometimes challenging, these do not appear to be insurmountable.

11.10. Integrating Renewable Energy Sources

Target – Within fifteen years, at least a quarter of Guelph's total energy requirement will be competitively sourced from locally created renewable resources

The climate and surroundings of Guelph have reasonable potential for the implementation of renewable energy. However, with the current relatively low costs of electricity and natural gas, many of these will need to be phased in selectively.

A constant challenge for renewable is that they are competing in markets where there is no carbon penalty for use of fossil fuels, nor carbon avoidance benefit for avoiding carbon creation through the implementation of efficiency and the use of renewable fuels and heat recovery. In the EU, the value of a tonne of carbon has fluctuated between a low of $CAD 7 and a high of $CAD35 since the opening of the European Trading Scheme in

2005. There is some merit in including a band of hypothetical benefit/penalty to evaluate the future potential opportunity or risk avoidance due to reduced greenhouse gases.

The strategic recommendations are:

1. ***Solar Photovoltaic*** - Develop a plan that would replace at least 20% of all anticipated electricity requirements by 2031. At anticipated efficiency levels, this would be between 800,000 and 1,200,000 m2 of cells[109]. This area would translate roughly into a "Thousand Roofs" – which could serve as a simple way to communicate the target.[110]

   The solar profile of Guelph outlined indicates that the area is a reasonable to generate electricity. Without subsidies, this would be unattractive, but with the Standard Offer Contract of 42 cents / kWh for at least twenty years, it is reasonably attractive. Solar production would peak in the summer when overall electricity demand is highest; an added plus for the traditional electricity provider

2. ***Wind Electricity*** – Not proceed with local wind solutions unless efficiencies or incentives change significantly.

   Guelph is an average area for wind generation, and with the relatively modest Standard Offer Contact, it is an unattractive option. with current technologies and pricing. There may be isolated locations and circumstances where this recommendation should be revisited.

3. ***Biomass Heat*** – At least 10% of the base load heat for the city should be targeted, which would be in the 25 to 40 MW (thermal) range. Biomass should be evaluated as a viable alterative for base load heating for large commercial or institutional structures, typically larger than 10,000 m2.

   Guelph is well placed to source large quantities of biomass fuels, generally from locally sourced forestry waste, probably in the form of wood pellets. The City Council approved in the 2007 budget, funds to assess the feasibility of building a wood cogeneration facility at the city's Wet-Dry Facility. There is a local entrepreneur planning to place a plant in the city. In Europe, where wood based biomass is increasingly common as a scale fuel, the experience is that prices rapidly align with natural gas equivalents, so the earlier long-term contracts are made, the more advantageous the returns.

[109] Referring to Section 6.7.2, the potential for electricity generation from a PV system facing directly south at a tilt angle of 34 degrees, is 185 KWh/m^2. The areas quoted of 800,000 and 1,200,000 m2 assume a system efficiency of 12.7%. This system efficiency is based on the use of commercially available multi-crystalline PV modules and high efficiency grid-connected inverters.

[110] Comparable to the State of California's "Million Roofs" Program

Figure 11.6 Typical Modern 1 MW (Thermal) Wood Boiler

With the right pricing for fuel, biomass is a very effective base-load heat source for the 2000 to 3000 hours needed in a Guelph winter. Biomass will be a high probability alternative for winter heat sources where local area networks are being put in place via the Scale Projects.

4. ***Waste to Energy -*** Evaluate using municipal waste as an energy source for heat and electricity. One of the most neglected fuels in North America is municipal waste.

Figure 11.7 Modern Municipal Waste-to-Energy Plant

Figure 11.7 shows a modern waste-to-energy plant using French technology, in South Carolina. It uses about 200,000 tonnes of fuel a year, generating about 9 MW of electricity and slightly more equivalent useable heat. These systems meet global clean

air standards, and generate much less greenhouse gas than landfill or composting alternatives.

Guelph generates about 109, 000 tonnes of waste a year, most of which is combustible. With the appropriate site for fuel handling and proximity to a heat load, this is perfectly viable option to evaluate. The recommendation would be to do this in conjunction with a scale project to ensure a heat load be available. Guelph's volume of waste seen as fuel is at the bottom end of the economic range, and teaming with municipalities like Waterloo, Cambridge and Kitchener might make sense.

5. ***Other Non-transport Renewable –*** Depending on future costs of electricity supply, ground source heat pumps may be a viable option. Generally, they are less attractive than other options, especially when efficiency or district heating is a viable alternative. Solar heating this far north is a less attractive option, since the heat demand is at the highest during the least viable times. If associated with district energy, or other large scale heat distribution system, the economics may be justified.
6. ***Renewable Transport Fuels*** - Given the small size of Guelph, it is unrealistic to have a dedicated strategy for the city around renewable transport fuels. The recommendation is that public and individual vehicle users should constantly review available renewable fuel options, and where they make sense, procure and drive vehicles accordingly. The city can put its influence behind provincial or national renewable transport fuels initiatives. A potential investor, Amaizing, is already exploring the possibility to build an ethanol plant in Guelph.

11.11. Integrating Combined Heat and Power (Cogeneration)

Target – At least 30% of Guelph's anticipated electricity requirements will be associated with Combined Heat and Power (cogeneration) by 2031.

As the city energy system evolves as indicated in Section 10.8, it is easier to include small and medium scale combined heat and power (CHP) installations. Today, Guelph uses 1,627 GWh_e/yr of electricity all distributed with no heat recovery. The energy value of the fuel used to make the electricity is 4,074 GWh_e/yr. The difference of 2,447 GWh_e/yr is the fuel value lost in heat at the generator, and in transmission losses between the central plants and the city. The consumer is paying for this unused energy, and the planet is absorbing the environmental impact. Implementing CHP has a major positive impact on greenhouse gas creation.

The basic recommendations are:

1. Implement CHP solutions in selected Scale Projects, initially probably St Patrick's Ward and Southern Business Park area. These produce both electricity and heat for distribution via a district energy network.
2. Encourage commercial CHP projects such as the one being implemented at OMAF and potentially in areas such as the university. To enhance the overall economics, wherever possible, look for ways to incorporate these into emerging district energy systems.

To meet the above target, and to develop reasonable scale, the initial two or three installations are likely to be in the 15 to 25 MW (electric) size, with a comparable amount of heat recovery.

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11.12. Integrating Innovative Cooling Strategies

Target – Guelph will reduce the magnitude of the summer grid electrical peak by at least 40% by 2031 to avoid the need for investment in new electrical infrastructure to serve the growth of the city

Guelph, like many prosperous northern continental cities, is experiencing a growing consumer demand for air conditioning in the summer. This creates the significant summer peak electrical requirements for a relatively short space of time in turn driving high levels of investment for the electrical utility.

The basic strategic elements to achieve the above target have basically already been recommended:

1. Solar generation from a “Thousand Roofs”
2. Efficient residential and commercial construction
3. CHP systems in the Scale Projects

The following strategies to reduce cooling peaks are also recommended:

1. Explore opportunities to use low-cost heat in the summer to deliver cooling via absorption chilling. This is generally attractive when large amounts of existing industrial waste heat are available. The most obvious source in Guelph is the Owens Corning glass melter in St. Patrick’s Ward.
2. Explore opportunities to smooth the peak, by using ice-storage techniques using off peak electricity

Both of these opportunities would probably be in a partnership between a significant commercial or institutional demand and the proposed municipal energy services provider.

11.13. Integrated Network and Building Management

Target - Guelph will systematically create an integrated energy metering, billing and management network across the entire city to allow cost-effective management of all energy forms

The breakthroughs that Guelph is aiming to create through the CEP will come from the ability to integrate many separate actions and gain the leverage between them.

For this reason, the CEP is recommending that the city develop a detailed concept for the reasonable integration of both utility and consumer owned energy generation assets. This should include bi-directional time of day metering[111] of all forms of energy. The concept should allow centrally managed dispatching of distributed energy assets, regardless of ownership.

This will evolve stepwise, probably starting within the scale projects. However, having framework architecture in place will encourage the long term creation of the network.

[111] The GHESI Smart Metering pilot is a initial step in this direction – See Section 8

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11.14. Establishing City Guidelines for Homes and Buildings

The CEP calls for energy efficiency of buildings consistently above the prevailing code for both new and existing buildings. The experience of most markets around the world is that purely voluntary programs rarely deliver significant results above code. Where they have been successful, there is usually a confluence of some combination of the following items:

- Planning Authorities require narrative comments that address the degree with which the planning requests are expected to meet the CEP's expectations
- There may be some timing preference given to approving construction requests that meet the CEP guidelines
- The influential builders and developers in the community throw their weight, reputation and commitment behind the enhanced guidelines
- Provincial or Federal bodies treat the City Scale Project as a pilot for the province or the country and provide both process and financial support
- Some group in the city, usually a teaming between city administration, university and some key builders, support education and professional development programs for builders
- Local lenders give a preference in some way to the enhanced buildings, usually in the form of extended credit limits or discounted mortgage rates

The following are the CEP recommendations

1. The City will develop clear, unequivocal guidelines based on the CEP strategic targets and work with a variety of constituencies to bring them to life
2. The City should engage the OPA Office of Conservation and Natural Resources Canada to have the CEP positioned as a provincial pilot including the EP labelling
3. Construction and planning requests should respond to the guidelines, even if the legal framework does not explicitly demand this
4. The Guelph Development Association, the University of Guelph and Conestoga College cooperate to develop an educational and professional development program to assist builders and contractors to build energy related understanding and expertise
5. Identify a local bank to set up a pilot program to create clear incremental benefits for a financing or mortgage request if supported by an EP labeled building

11.15. Accelerating CEP Implementation - Scale Projects

Target – Guelph will implement large area high efficiency Scale Projects that accelerate progress towards a successful implementation of the Community Energy Plan by creating early successes and developing a deep pool of community expertise.

A key part of the overall CEP recommendations includes so called Scale Projects. We are seeing a trend for cities to develop Community Energy Plans in response to the challenges highlighted in Section 3. Despite the quality of many of these plans, there is an underlying question as to how many will be successfully implemented. The Guelph Consortium was clear in its guidelines that it was looking for a plan that would deliver real results.

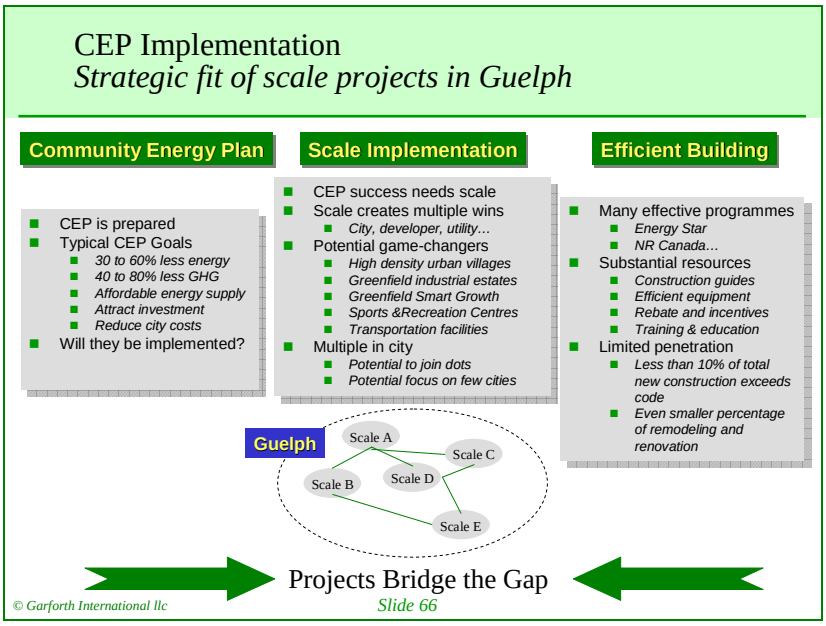

Figure 11.8 Accelerating CEP Implementation with Scale Projects

Typical CEP goals are on the left of Figure 11.8. They address achieving substantial energy use reductions accompanied by even greater greenhouse gas creation reductions to deliver a competitive attractive city with breakthrough environmental performance. Delivering these involves tackling the overall efficiency of homes, buildings, transportation, industry and energy supply, which are daunting tasks at a city level.

All too often, once the true scope of the energy productivity challenges becomes apparent, CEPs stall and become visionary statements of intent, with little implementation success.

On the other hand, there are many excellent programs to encourage efficiency in individual buildings by raising consumer awareness, offering guidelines for builders, various types of training and voluntary rating. Examples are Energy Star[112], Canada Green Building Council[113] , and Green Globes[114] among many from around the world. Utilities also have excellent energy saving guidelines for all users. These all offer excellent materials to support awareness and efficient construction and operation of buildings. They are to be applauded in radically raising the awareness of the opportunities and solutions available.

By definition, a CEP is energy and water productivity goals that go far beyond the statutory minimum of the day. For this reason, the CEP is recommending the rapid implementation of the new Ontario Building Code.

However, implementing a CEP “one building at a time” does not create the scale that clearly incorporates efficient energy supply, and inevitably fails to demonstrate the potential scale economics and other market benefits.

[112] See http://oee.nrcan.gc.ca/energystar/english/consumers/index.cfm

[113] See http://www.cagbc.org/

[114] See http://www.thegbi.com/greenglobes/history.asp

When Guelph benchmarked cities with successful energy and water efficiency achievements, it was clear that one of the differentiating aspects was the willingness of the community to embark on implementing multiple Scale Projects at an early stage of CEP.

Typically these are distinct areas of the city where the size and timing of planned development was such that "new rules" in line with the CEP could be applied within large, but contained boundaries. They are of a scale that is large enough to address the issues of both the efficiency demand and energy and water supply.

Each would be developed in such a way that over time, multiple Scale Projects would ultimately blend into an overall city context and by "connecting the dots" create the city wide outcomes.

The recommendations are:

1. As a part of the final Community Energy Plan, the Consortium confirm the recommendations of the initial portfolio of Scale Projects
2. The City, working with all relevant parties, ensures adequate resources are identified to develop investment grade Integrated Energy and Water Master Plans for each Scale Project to confirm the viability and identify the critical implementation steps. These planning resources may be available in part from Provincial or Federal programs that support energy and water conservation efforts.
3. The City, working with all relevant parties, ensures that early actions especially around long-term infrastructure, such as reserving land for distributed energy installations and establishing rights of way for projects like district heating networks or grey water management systems.
4. Once the viability of a Scale Project is confirmed, the city must put in place a process to ensure the step-by-step implementation of the Scale Project ultimately meets the goals of the CEP as a whole. This can be in various forms, from a formal "Urban Sustainability Planning Overlay District" to gaining the commitments from commercial developers.
5. Throughout the process communicate clearly the goals and the steps being taken to all relevant parties. The successful implementation of these Scale Projects should be clear examples of success that the City as a whole should take pride in.

IT IS VERY IMPORTANT TO UNDERLINE THAT SCALE PROJECTS ARE NOT A SUBSTITUTE FOR THOUSANDS OF INDIVIDUAL ACTIONS AND PROGRAMS AROUND HOMES, BUILDINGS, TRANSPORTATION CHOICES AND CONTINUOUS IMPROVEMENTS. THEY ARE AN ADDITIONAL ELEMENT THAT IS CRITICAL TO THE OVERALL SUCCESS OF THE COMMUNITY ENERGY PLAN.

11.16. Scale Project Selection Criteria

Target – Guelph will identify potential Scale Projects that have high probability of being successfully implemented as a critical early step in the roll out of the Community Energy Plan

Selection of possible Scale Projects is already underway, with a candidate list proposed that will be discussed in Section 12. The following general criteria would guide the selection of future candidates:

1. Be of a size to encompass customized energy and water supply strategies as well as large scale efficiency

   This will vary depending on project, but typically would be one that would have an overall energy demand at least in the 15 to 25 MW (electric and thermal) range.

2. Be sufficiently clearly defined as such that bounded energy and water solutions are possible

   A crucial aspect of the Scale Projects is to demonstrate many aspects of a sustainable energy and water solution as early as possible. This means timely implementation, availability of clear and specific data and ease of communication is key.

3. Have leadership that is motivated or at least open to consider new approaches

   Leadership could come in many forms. It could come from a motivated commercial developer, visionary University leadership, dedicated utility and city management, or an engaged Neighborhood Development Group. This is not an exhaustive list.

4. Have the potential to attract appropriate energy supply investments and energy services operators

   This will usually mean the engagement of the local utility or utilities with other appropriate investment or operating partners

5. Have the potential to accept different energy supply, design guideline and building efficiency standards than in the rest of the city

   This is clearly one of the toughest criteria. How this will be done will vary with each specific project, but it is clear that mechanisms, voluntary or otherwise, must be in place.

Typical types of Scale Projects are:

- ***High Density Urban Villages***

  These are typically areas of cities targeted for urban renewal usually covering at least 50 hectares with high density mixed use development planned. Scharnhauser Park, Stuttgart and Navy Yard at Noisette, Charleston examples are summarized in Appendix 6

- ***Industrial Estates / Commercial Parks***

  These are typically either completely new or existing industrial estates where availability of high quality, tailored energy services could be a key differentiator in attracting quality investment. They will typically be at least 100 hectares and be aimed at multiple industrial clients. Mannheim Island example is summarized in Appendix 6.

- ***Greenfield Smart Growth***

  The growing trend for mixed use, greenfield developments aimed at reducing suburban sprawl and creating more livable communities, also creates opportunities for innovative energy and water solutions. Suitable Scale Project would have at least 500 homes with some commercial-retail development with relatively high density. Bells Landing, Nashville example is summarized in Appendix 6.

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- ***Sports and Recreation Centers***

  These facilities with long opening hours and high energy facilities like auditoria, rehearsal rooms, swimming pools, ice rinks, saunas, gymnasia etc. makes them candidates to be Scale Projects. They are frequently operated as publicly supported facilities and have energy and water cost as significant challenges. They often also need to be examples of community values around energy and water efficiency. Often, they can be combined with other Scale Projects to optimize a larger energy at low cost. The YMCA Corning, New York and the SAP Stadium, Mannheim are summarized in Appendix 6.

- ***Transportation Facilities***

  Major transportation centers such as airports, railway centers, and multi-modal transport interchanges have similar energy characteristics to sports and recreation centers.

- ***Academic Campuses***

  These develop over the years with buildings being added and expanded often with a less than integrated approach. They are large energy consumers, frequently challenged by budgets. They also have accountability to form the ideas of the future, and are a natural supporter of successful energy and water efficiency plans. They also have scale. Lakeland Community College example is summarized in Appendix 6.

The examples in Appendix 6 demonstrate multiple benefits for all parties and substantial reduction in environmental impact. They also indicate improved reliability of energy supply and future cost risks being more effectively managed.

11.17. Guidelines for Energy Supply

Target – Guelph will put in place guidelines and processes that move users to the most effective sources of energy for both the individual user and for the city as a whole

A key part of successful implementation of scale projects will be the effective integration of efficient energy supply with appropriate urban design and efficient buildings. In some case this may require large scale changes in the way buildings receive some of their energy services.

The most obvious examples have already been extensively covered in the CEP. These include:

- Heating and domestic hot water via district heating networks rather than via electricity, heating oil or natural gas fired boilers and furnaces
- Obtaining cooling via district cooling networks rather than via in-building
- Obtaining a part of electricity via solar photovoltaic systems
- Obtaining heating and electricity via in-home micro-cogeneration

Given that regulatory reality today would generally not allow the city to mandate these changes, the following recommendations are made:

1. All planning requests in a designated Scale Project should clearly explain why a solution other than the Scale Project Energy Plan recommendation is being proposed

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2. Requests that utilize the recommended energy supply solution will receive various forms of public support including installation training and any applicable conservation incentives
3. Realign the energy services framework of the city, starting in the scale projects, to eliminate the operational risks of new approaches for the individual developer, builder, owner or tenant
4. The possibility to enact formal bylaws or regulations around "energy zoning" will be explored as a future possibility, starting with "overlay zoning" in the Scale Projects

The experience from other jurisdictions suggests this is a transitional issue. Once the community recognizes that new energy systems are lower in cost and equally as reliable and convenient as the current solutions, the resistance to change falls away. In fact, the reverse happens – they start demanding connection to the emerging new systems once the building design advantages and consumer benefits are clearly understood.

11.18. Incentives

Target – Guelph will have a highly effective information sharing and assistance resource to ensure that all available energy and water conservation and climate change mitigation incentive programs are publicized and available to all interested parties.

Target – Guelph will establish local incentives to accelerate progress towards the goals of the community energy plan

All the recommendations in the CEP are based on the experiences from around the world that the market value of energy and water efficiency rapidly becomes self financing. However, there is a range of incentives from Federal, Provincial and utility sources that support selected renewable energy, efficient appliances, avoided electrical consumption and efficient construction.

There are incentives for industrial and commercial users, the construction industry and homeowners. Natural Resources Canada[115] and Ontario Provincial[116] sites have good overviews of consolidated information. This report will not attempt to summarize all the various incentives at this stage.

A successful Community Energy Plan will be implemented with incentives viewed as added value to the Plan. The availability of an incentive program may adapt the priorities slightly by accelerating a particular approach or technology. The basic city framework outlined in this CEP has the potential to be reprioritized without changing the basic direction.

However, some general recommendations around local management of incentives are being made:

1. Guelph should establish a clearing house providing information, application support, and outreach to ensure that all available incentives are publicized and used.

[115] See http://oee.nrcan.gc.ca/corporate/incentives.cfm

[116] See http://www.conservationbureau.on.ca/

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Many incentives can be relatively short lived, are subject to a degree of interpretation and not always easy to apply for. Creating a resource that can support potential applicants in a systematic way will ensure the incentive value is maximized.

2. Guelph should make any investment incentives for commercial or industrial investors conditional on meeting the above-code standards of energy and water performance.

   Communities frequently offer incentives to attract investors. This is an opportunity to guide investors to use communal energy resources such as district energy, and to encourage the incoming investor to build and operate their facilities at a high level of energy productivity.

3. Incentives such as selected parking, energy efficient mortgages and priority planning approvals have already been discussed at the city level and should be encouraged

11.19. Regulatory Aspects

Target – The City and the wider community leadership is committed to positively handle all legal and regulatory aspects with local, provincial and national bodies to ensure Guelph's commitment to deliver the CEP is never jeopardized by constraining regulations or market practices.

Target – Guelph is offering its community as a national prototype for adjusted regulatory and business models to guide Canada's pathway to meet its energy, climate change and water challenges of the future.

There is a basic paradox in most of the recommendations within the CEP. They are all based on benchmarking information that clearly demonstrates the elements necessary to be integrated in terms of end use efficiency, energy distribution, and the choice and effective use of fuels. However, the benchmarking examples are operating in different regulatory regimes where the implementation of many of the measures has been either made mandatory or barriers to voluntary implementation have been removed.

In the case of Guelph, the following are the basic regulatory constraints along with recommendations to manage them:

1. ***Building Codes*** – Even though these are a provincial jurisdiction, the new 2006 Ontario code will be one of the strongest in North America upon implementation in 2012. Accelerating the implementation offers an opportunity for developers to get ahead of the competition and will have minimal impact on profitability in a solid property market like Guelph. The voluntary EP Labelling simply reinforces their potential to capture market added-value, and has a high probability of being supported as a national pilot.

2. ***Electricity Generation and Distribution*** – Electricity generation, transmission, distribution and pricing fall under provincial jurisdiction. The CEP at a minimum is calling for significant amounts of electricity from cogeneration within the scale projects and solar electricity distributed across the city. GHESI can be a generator. A precedent to be a non-traditional generator has been established with the Ecotricity operation. It would appear to be within the realm of probability that Guelph could be treated as a provincial pilot for a more integrated system.

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3. ***Gas, Heating and Steam Distribution*** – Gas distribution is owned by Union Gas (a Spectra Energy Company) and is under provincial jurisdiction with minor competitive market options. The CEP calls for district heating and maybe industrial steam distribution to be an option, initially within the scale projects, and ultimately across wider areas of the city. District heating can be considered to be a functional competitor with retail gas, and experience from other jurisdictions, especially in Germany, Scandinavia and central Europe, sustained competition between the two media is not economically sound. Hence the earlier recommendation of moving towards some form of voluntary or mandated energy zoning. Since both Guelph Hydro and Union Gas are members of the consortium, and given the growing interest in Ontario in creating, or recreating, district energy systems, a resolution to these market and regulatory aspects should be able to be resolved. Gas will be a significant fuel source for any district heating system.
4. ***Vehicle Efficiency and Transport Fuels*** – These are regulated at the Federal level. The CEP calls for a voluntary and urban design approach to these aspects, therefore there are no regulatory issues.

11.20. Managing the Process - City Leadership

Target – The commitment of the elected officials and professional management of the city from all sides of the political spectrum will never be in doubt

The City's role is crucial in successfully implementing the CEP. The recommendations are:

1. The Community Energy Plan will be a part of the public record, voted on by the City Council.

   The plan should probably be revisited about once every five years for adjustments and course corrections on the recommendations. The basic Vision, Goals and Measurements should not be adjusted except to make them even more aggressive (a very unlikely event for at least 20 years) or if they have clearly been found to be counterproductive to achieving the overall intent.
2. All elected leaders, now and in the future, should be fully briefed on the Vision, Goals and status of implementation of the energy plan

   The importance of maintaining political neutrality in support of the basic framework of the CEP cannot be overemphasized. Developing an efficient communal infrastructure that can deliver the kind of goals Guelph has embraced will only happen with consistent long-term implementation.
3. All non-elected leaders and department heads, now and in the future, should be fully briefed on the Visions, Goals and status of the implementation of the energy plan, and the importance and role of their department in contributing to their goals.
4. The public "owner" of the Community Energy Plan's Vision, Goals and Results should always be clearly and visibly seen to be the incumbent Mayor

   This is analogous to the consultant's experiences in industrial energy management. Companies where the CEO is visibly and continuously committed to energy and water productivity are the ones that deliver the breakthroughs. This is not a role that can be delegated.

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5. Progress against the CEP should be a routine agenda item on all City Council Meetings

   All that is needed is a few minutes report on progress against the goals, significant actions taken, challenges and corrective actions underway. It should be a clear commitment by the City to regularly report on its progress. This will enable groups willing to act as the conscience of the City in this aspect to be able to carry out that task.

6. Assign a City Energy/Water Manager as the single point of contact for the CEP

   A common argument against creating this role is that it may cause other departments to not fully take on their role and contribute to the success of the CEP. Whoever takes on this role must have a high level of credibility in the community, and be clearly seen as having the full support of the Mayor and the City Manager.

11.21. Managing the Process - Community Engagement

Target – The business community, financial institutions, neighborhood groups, utilities, architects, developers, construction industry, acadaemia and the city administration will treat the vision, goals, recommended actions and progress of the CEP as a key measure of Guelph's overall success in becoming a world class city in which to live, work and play.

The community in Guelph has shown extraordinary leadership to date in gathering together the key constituencies to develop the dialog that has led to the draft CEP. Moving into the implementation phase, the role of the Consortium members becomes even more important.

The recommendations for CEP are:

1. The original mandate of the Consortium was to bring forward a document that would form the foundation of a Guelph Community Energy Plan. Upon receiving and accepting the vision and goals laid out in the final Guelph Community Energy Plan document this mandate will have been met. The co-chairs of the Consortium will be tasked with establishing recommendations on a strategy for moving forward.

   As the CEP moves to implementation, the Consortium's guiding role has changed. The clear ongoing role for the individual members of the Consortium is to ensure that the Visions and Goals of the CEP and the associated results become part of the daily fabric of Guelph's future development. This shift should be seen as a clear measure of success for the Consortium as a whole.

2. Actively create neighborhood and community groups around the Scale Projects that are committed to ensuring there is a high level of local understanding and engagement in the broader goals

   As the Scale Projects develop each will have their own constituency - some more business and industry focused, other in existing urban neighborhoods, yet others will be mostly newcomers to the city greenfield environments

3. Utilize the University and community colleges as the focus for educating all areas of the community in the multiple aspects of moving towards sustainable urban structures

   This is a very broad area including formal curriculum offerings around energy and water resource planning and management, construction and facility management training, high

school orientation, and public awareness. This is probably the logical focus to consider for the clearing house for national and provisional incentives. The consultant is strongly recommending teaming this with academic and civic leaders in either Germany or Scandinavia

4. Utilize local schools as an outlet for educating the community in all aspects of the plan and energy conservation initiatives arising from it.

   Elementary school students would be an ideal source for promoting energy conservation initiatives within their family environment and subsequently the community as a whole. All schools could take part in Board-wide initiatives that could lead to measurable energy and GHG reductions at respective schools. High School curricula could include discussion on the CEP and monitoring progress on initiatives arising from it.

11.22. Managing the Process - Energy Services Organization

Target – Guelph will be served by a municipal energy service organization that is structured to ensure the highest reliability, least cost and least environmental impact energy services of all types.

This is probably the easiest recommendation to make, and maybe the most sensitive politically. In all the benchmarking, the operating model that consistently comes to the forefront is one with the following characteristics:

1. Delivers, meters and invoices electricity, gas, district heating, district cooling within a single business model under a franchise controlled by the municipality
2. Has centralized dispatching capability for all energy forms
3. Is either the sole buyer for the output of, or the operator of, renewable, waste-to-energy, and cogeneration, central heat-only, and central cooling-only facilities
4. Is financially managed and accountable to its stakeholders in the same fashion as any normal commercial company
5. Captures and summarizes the bulk of the data and measurements to track the prevailing community energy plan

The legal and investment structures can be very different. MVV Energie AG, Mannheim is a city/private partnership listed on the stock exchange. Austin Energy is a city owned multi-utility. Copenhagen is served by a federation of neighborhood cooperatives. In other cases, the entity is some form of investor owned partnership with the City as the franchisor.

Once fully established, with reasonable scale, these entities typically generate returns around two times higher than traditional electric utilities. Further detailed assessment is needed for Guelph, but there is no reason not to see this as the most likely outcome.

The recommendation is for Guelph to develop a framework that over a reasonable period of time would create a unified, municipal multi-utility operating under franchise from the city.

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11.23. Measurement, Reporting and Communications

Target – Guelph will consistently measure and report its progress towards the goals of the CEP to its citizens

As the CEP is implemented, the residential, commercial, institutional and industrial energy, potable water and associated greenhouse gas data will be made available by the energy services entity. The building energy and water efficiency data can easily be derived by the city planning and builders, and the operational efficiency data through the EP labelling program. Reporting would be at regular council meetings, and on the City web site.

A multilayer communications strategy needs to be developed, which should be an immediate task of the Consortium and the City following the acceptance of the draft CEP. Most of the elements have been covered through this strategic narrative. The Consortium and the city need to budget for this in 2007.

11.24. CEP Budgeting

The bulk of the financial impacts of the CEP become self-financing as the benefits of integrated energy and water productivity takes hold. However, some items will need to be budgeted to create a basic infrastructure to manage the roll out of the Community Energy Plan; the Consortium needs to address the need for some initial budgeting of the following items:

1. City Energy Manager
2. CEP Communications Plan Development and Implementation
3. CEP Training / Workshops
4. EP Labelling program
5. Pre-Feasibility Integrated Energy and Water Master Planning for Scale Projects

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Guelph Community Energy Plan - Initial Start-up Budget

Item	2007 (x1000)	2008 (X1000)	2009 (x1000)	Ongoing pA (x1000)	Comments
City Energy Manager	$100	$100	$100	$100	Full-time city employee
CEP Communication Plan	$250	$50	$50	$50	Design & program maintenance cost only
CEP Training	$150	$50	$50	$50	Design & program maintenance cost only Operating cost covered by fees
CEP Workshops	$20	$20	$20	$20	Estiimated 10/year - direct costs only
EP Labelling Program	$75	$50	$50	$50	Design & program manintenance costs Operating cost covered by fees
CEP Refinement	$50	$50	$20	$20	Incidental consulting Goal/data validation
Scale Projects Feasibility IEMP				$200	Multiple projects and sub-projects' IEMPs
South Area Phase 1	$275				Industrial/Commercial & key linkages
South Area Phase 2		$150			Residential / Smart Growth
St Patrick's Ward Phase 1	$50				Engineering and Feasibility Study
St Patrick's Ward Phase 2		$275	$275		Critical infrastructure and priority development areas
York Road Industrial		$150			Industrial/Commercial & key linkages
Downtown Community Improvement Plan	$50	$50	$50		Overall Scope & critical infrastructure folowed by sub-project IEMP's
Total	**$1,020**	**$945**	**$615**	**$490**	

Figure 11.09 CEP Initial Start-up Budget

This has been estimated based on the market value of the various activities. However, some area will be candidates for in-kind or sponsored public/private partnerships, especially in the areas of communications, training or workshops. Other areas such as the EP labelling program and the Feasibility studies for scale projects are natural candidates for matching funds from Provincial or Federal Conservation programs.

11.25. Summary of Overall Energy Evolution

Consolidating the expected impacts of efficiency, cogeneration and solar electricity, the overall energy picture will directionally appear as summarized in Figure 11.10. Under this scenario, the greenhouse gas per capita for Guelph as defined earlier would drop from about 16 Tonnes per capita to about the current level of Sweden or 7 tonnes.

This is a very aggressive goal, but still 50% higher than the ultimate goal of the Community Energy Plan. These greenhouse gas goals will not be achieved by efficiency alone, and the need for aggressive cogeneration, district energy and renewable strategies cannot be overstated. This is clearly seen in the evolution of energy lost in electricity conversion;

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Sector	2005 GWh_e/yr	2031 GWh_e/yr	2005 MWh_e/cap	2031 MWh_e/cap
Residential	1,610	1,473	14.00	8.18
Commercial	1,046	1,076	9.10	5.98
Industrial	1,631	1,848	14.19	10.27
Transport	1,743	1,126	15.16	6.26
Total (Net)	**6,030**	**5,523**	**52.45**	**30.69**
Electrical conv.	2,445	612	21.26	3.40
Total (Gross)	**8,475**	**6,135**	**73.71**	**34.09**

Figure 11.10 Summary of Efficiency Opportunities

As reminder, this evolution is based on a population increase from 115,000 in 2005 to 180,000 in 2031 with an associated economic growth at a somewhat higher rate.

12. TYPICAL SCALE PROJECTS

12.1. General

As outlined in the overall CEP Strategy, parallel implementation of selected Scale Projects is a pre-requisite for a successful overall implementation of the CEP. There follows a set of recommendations for potential Scale Projects that could be considered for implementation.

They were selected on the basis of the consulting team's experiences from around the world as typical where the likely multiple benefits would be substantial, and where the technical implementation would present minimal challenges. They have been openly discussed with various sectors of the Community, and have generally received a favorable reaction, and some healthy inputs.

However, it is important to underline that none of these has been given any detailed assessment. Typically, projects like these would have a detailed feasibility study, which would then be refined to an investment grade assessment leading to infrastructure and construction engineering. The one exception is St. Patrick's Ward, where a small amount of further detail has been assessed for one section of the Ward.

With these provisos, the following thoughts are offered to move the Community debate around scale projects in Guelph.

12.2. Industrial Parks in the South

The business parks developing to the south of the City, including the Hanlon Creek Business Park will be a key component of the successful growth of Guelph, aimed at attracting high-quality investors who will offer long term quality employment. This area will be developed in phases, with the initial phases already at an advanced stage.

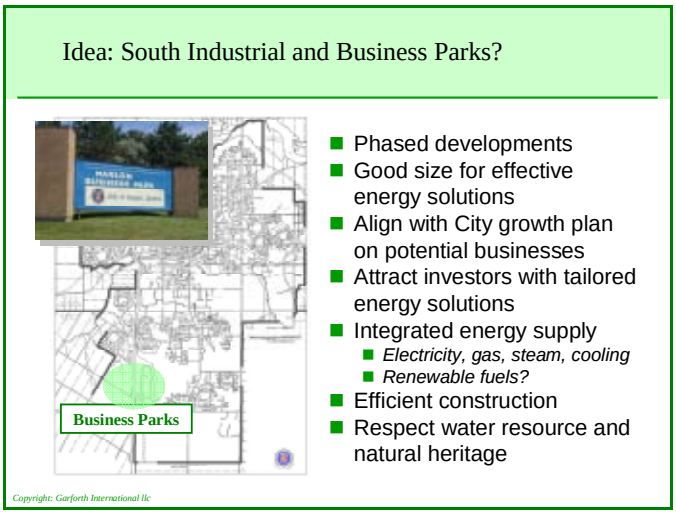

Figure 12.1 Industrial Parks in the South

These business and industrial areas will also have new commercial and residential neighbors as the southern part of the City develops. The CEP is recommending developing an integrated

energy concept for the South as one of the high priority scale projects. The concept would be to initially offer tailored energy solutions including heating, electricity, cooling, and industrial quality steam at prices and reliabilities that would add the attractiveness of the site. This is doubly attractive to the investor in that they not only get high quality tailored energy services, but they also avoid significant costs in terms of capital equipment and specialist staff. The planned phases are large enough to have a high efficiency local cogeneration facility with high levels of fuel efficiency due to the ability to deliver large amounts of heating and cooling.

In some cases, existing development will already have defined the energy frameworks, in other cases, there should be sufficient flexibility to adjust the direction along the guidelines recommended in the CEP.

The recommendation is to complete the Pre-Feasibility Integrated Energy Master Plan for this site during the first part of 2007.

The site is close enough to other parts of the city which show suitable Scale Project potential, so the potential to link this initiative into a wider structure in the future is very real.

12.3. Campus Energy Master Plan – University of Guelph

The University is a research intensive institution and is one of the largest energy consumers in the city. As a thought leader, the CEP creates a unique opportunity for UoG to take their active energy and water management program to a whole new level.

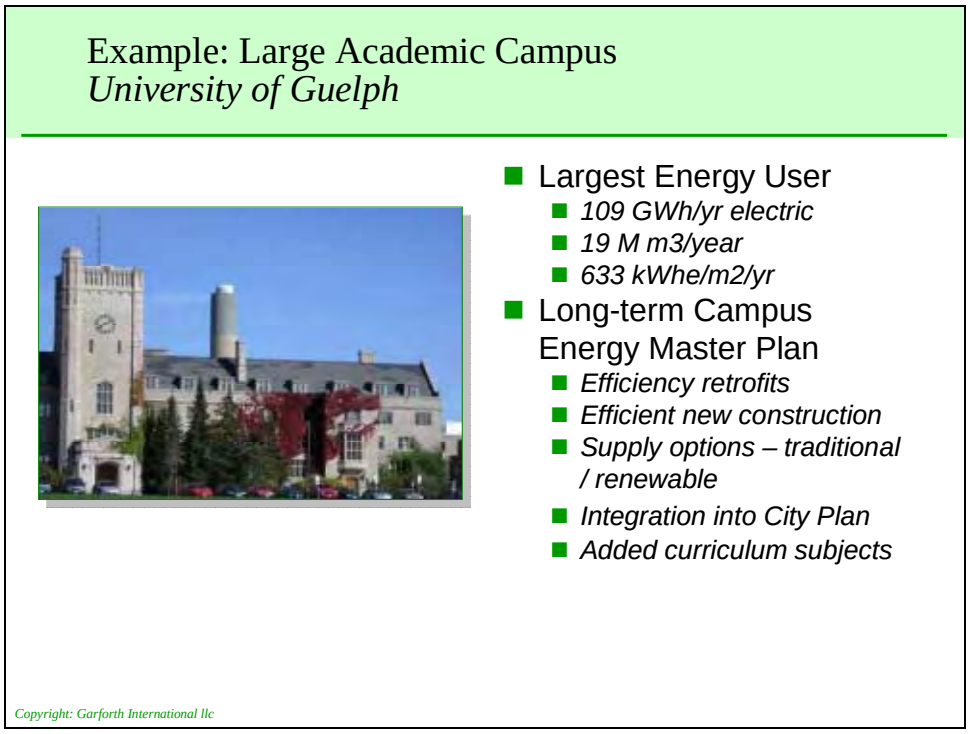

Figure 12.2 Overview of University of Guelph

The campus is a natural candidate for a fully integrated plan similar to the one described in Appendix 6 for Lakeland College but on a much larger scale. From energy auditing, there seems to be substantial opportunities to dramatically lower the operating costs of the campus by

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some millions of dollar per year. This would be achieved over the years with clearly prioritized investments in efficiency upgrades, upgrading for the district heating and cooling system, and possible implementation of cogeneration.

The University also has the opportunity to use its own implementation of a CEP Scale Project to be a live laboratory for training students, the wider community, and extending its offered curriculum.

The location of the university close to the rest of the city neighborhoods will make the campus a natural node in a wider city energy structure.

12.4. High-Density Urban Redevelopment – St. Patrick's Ward

The St. Patrick's Ward (SPW) is a unique community with a strong historical connection to Guelph and its early industries.

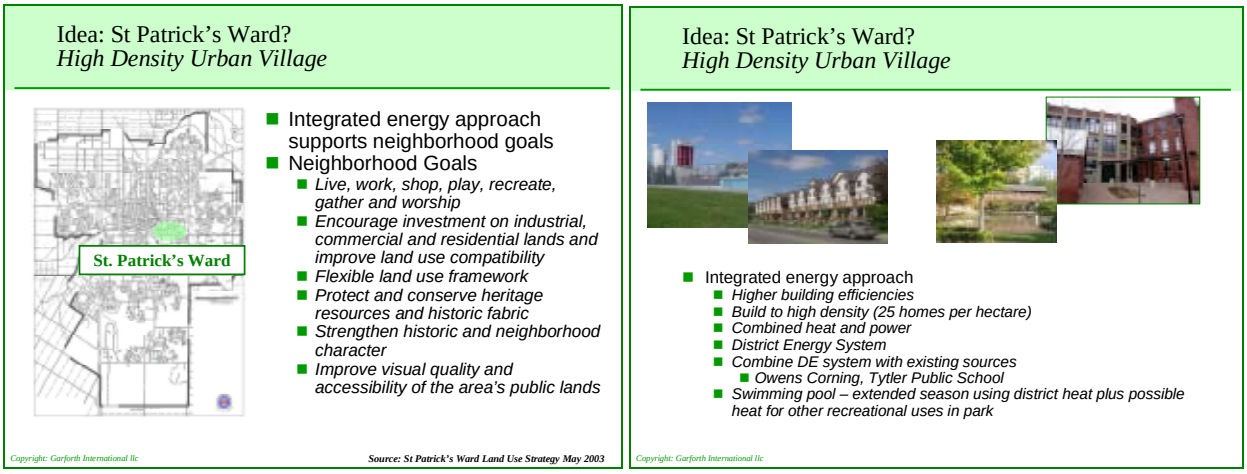

Figure 12.3 Overview of St Patrick's Ward

An initial assessment of the Ward suggests it is a suitable site for a district heating system serving at least 70% of the fully developed site. The site would be compatible with cogeneration, probably in the 25 to 40MW range, and even has the potential for biomass peak heating.

New sewage and street renovation is planned to start soon, so the recommendation is to complete a pre-feasibility Integrated Energy Master Plan within the next six months, i.e. by mid-2007.

The team spent some time looking at this idea in more detail. Development to the east of the Speed River and the subsequent annexation of the SPW was in response to the construction of a railway in 1855. The Grand Trunk Railway (GTR) connection to Toronto spurred this development, attracted industry to the area and, with it, workers. A need for competition in pricing, spurred the creation of a second railway through Guelph, the Guelph Junction Railway, in 1888. These historical facts created:

- Mixed density residential neighborhood historically blended with both industrial and commercial zones;

- Community where industrial expansion took over from planned residential development and large residences needed to cater to the rooming house needs of the workers;
- Community separated, to this day, from neighbourhoods to the north and downtown to the west by another railway, the GTR (now the CNR);
- Community split down the middle by one railway, the GJR.

A recent community improvement planning process recognized the unique character and history of the SPW and proposed the following goals (City of Guelph, 2003A):

1. Enhance SPW as an attractive place, with a high quality of life, for Guelph Residents to live, learn, work, shop, play, recreate, gather, and worship by investing in community improvements.
2. Encourage investment on industrial, commercial and residential lands and improve land use compatibility.
3. Provide a clear and flexible land use framework to accommodate change and provide a degree of certainty for private and public investment.
4. Improve the visual quality and accessibility of the area's public lands by improving key pedestrian linkages, parks, trails, streetscape and gateway entrance features.
5. Provide a prioritized 10-year program of community improvement initiatives for consideration in the City's Capital Budget process.
6. Consider future programs to encourage desirable development and investment.
7. Improve land use compatibility between residential, industrial and railway uses.

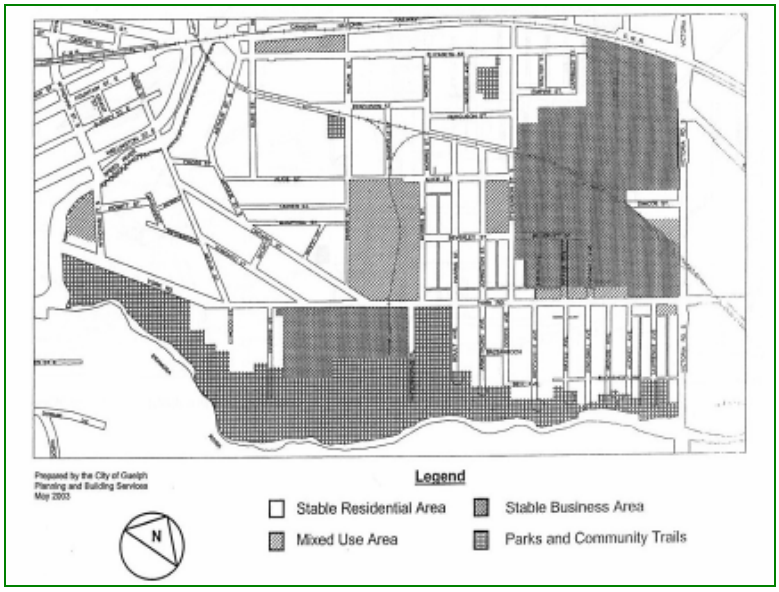

Figure 12.4: St. Patrick's Ward

Figure 12.4 is taken from the "St. Patrick's Ward Land Use Strategy" (City of Guelph, 2003), a document that was developed by the Planning and Building Services department as a reflection of public input to a process of identifying the need for community reinvestment.

St Patrick's Ward is:

- Bordered, to the west, by the Speed River, and to the south, by the Eramosa River, the point where John Galt first established the City of Guelph.

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- A neighbourhood through which railroads run. Forming the northern border is the Canadian National Railway (CNR) tracks and running straight through the SPW is the Guelph Junction Railway (GJR).
- Bordered by Victoria Road to the northeast.

The SPW has an approximate area of 1.8 km^2 and can be broken up into four main land use areas:

- Parks and Community Trails: Community trail linkages and community parklands
- Stable Residential Area: More than 90% of the residential properties in SPW were constructed prior to 1929. Nearly 200 properties are heritage listed. 70% of housing stock is detached; 30% semi-detached, duplex, townhouse or apartment units. Most lots are narrow and/or shallow. The land use strategy (City of Guelph, 2003A) promises to minimize change in the Stable Residential areas, especially those adjacent to business uses.
- Stable Business Area: These are the lands where major change is expected to occur. “Staff believes that the reform of business land use policies will have the greatest potential to improve the quality of life in the neighborhood while revitalizing and supporting the small business sector.” (City of Guelph, 2003A) Development in the Stable Business area will need to be compatible with the Stable Residential area. This will be present itself as an ongoing balancing act between conflict and opportunity.
- Mixed Use Area: These areas are meant to meet neighborhood needs and build upon the existing character while reducing automobile dependency.

The land use strategy of 2003 confirms the existence of support for land use change in SPW, particularly in transitioning larger business use areas. A ten year investment plan was also created as part of the community consultation process.

The following issues stemming from these municipal plans, historical facts and neighborhood understandings support the immediate need for an integrated energy master plan for SPW:

- Plans to replace aged infrastructure are looming and are detailed in the Community Reinvestment Strategy document (City of Guelph, 2003B). Infrastructure recommendations stemming from an integrated energy plan could be incorporated economically and efficiently in existing plans now, ahead of their implementation in 2007.
- Residential intensification is likely or already planned for existing commercial properties. The WC Woods lands will be redeveloped for high-density residential and park use. Other industrial lands, such as the IMICO site, could support residential uses after clean-up. Zoning permissions and Official Plan amendments are assisting many properties to convert SPW slowly into a higher density residential mixed neighborhood.
- Commercial areas are moving from manufacturing to service oriented business focus.

This mix of small business and residential is a foundation to building the live, work and play village concept. Energy densities in such village neighborhoods can be zoned to increase energy productivity using district heating and cooling networks. These networks, as mentioned previously, could be installed in concert with the infrastructure upgrades of the 10-year SPW community investment strategy (City of Guelph, 2003B).

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Using aspects of the SPW, the following sections will illustrate the methodology for creating an integrated energy master plan. The first step develops energy zones for the SPW. We then illustrate the process involved in benchmarking current and future energy and domestic hot water demand. The zones where interest in future development exists are added. The assessment closes with a discussion of possible scenarios for the zones.

Developing Energy Zones Within a Sample District

Energy zoning is the first step in the preparation of an integrated energy plan and is common practise in the European Union. Energy zones anticipate future changes plus they divide the larger districts into smaller areas with similar properties. Each zone can then be analyzed to determine scenarios of future energy needs and associated densities. An number of combinations and timeframes are possible for bringing these zones together in a long term integrated plan. Each variation provides a district scenario of opportunity for consideration in the integrated energy master plan.

A preliminary assessment of SPW suggests 17 energy zones:

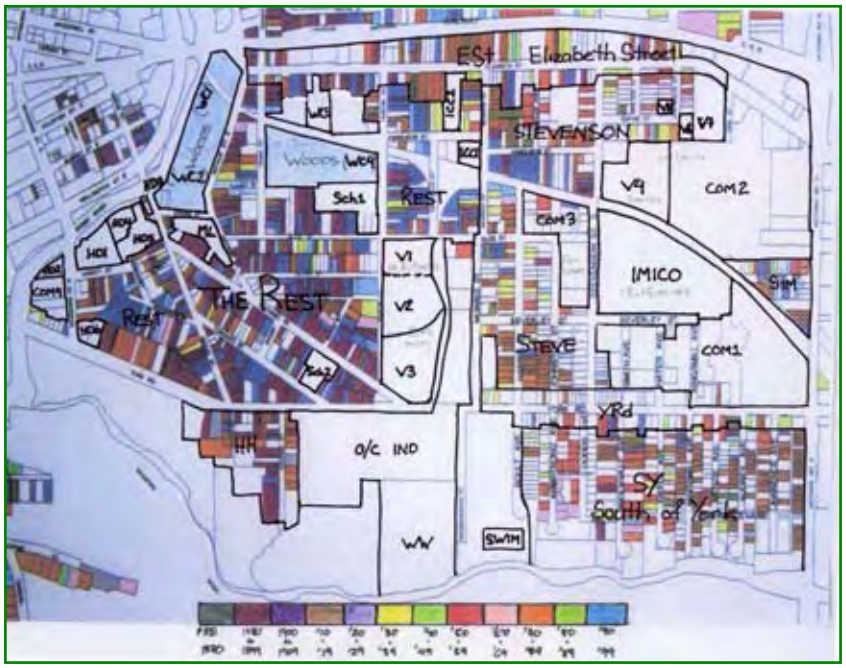


Figure 12.5 St Patrick's Ward – Indicative Energy Zones

These near-homogenous zones can be summarized according to streets as in Figure 12.6

Zone	Streets included either fully or partially within zones
Woods (WC)	Arthur St, Duke St, Huron St, Elizabeth St
Industrial (Ind)	York Rd, Morris St, Alice St
Vacant (V)	Huron St, York Road, Stevenson St, Empire St, Garibaldi St
Commercial 1	Beverley St, York Rd, Smith Ave, Kingsmill Ave, Hayes Ave
Commercial 2	Elizabeth St, Victoria Rd, Erie St
Commercial 3	Johnston St, Alice St
Commercial 4	Wyndham St
Elizabeth Street	Elizabeth St, Stevenson St, Ferguson St
Stevenson (Steve)	Empire St, Harris St, Beverley St, Johnston St, Morris St, Wheeler Ave, Ferguson St, Garibaldi St, Walter St, Stevenson St
High Density (HD)	Wyndham St, Neeve St
Italian Canadian Club (ICC)	Ferguson St
Schools	Ontario St, Huron St
Simcoe (Sim)	Simcoe St, Victoria Rd
The Rest (Rest)	Alice St, Arthur St, Duke St, Howitt St, Huron St, Manitoba St, Margaret St, Menzie Ave, Morris St, Neeve St, Oliver St, Ontario St, Richardson St, Sackville St, Short St, Stevenson St, Toronto St, Victoria Rd, Wood St, Wyndham St, York Rd
Hood/Hooper (HH)	Hood St, Hooper St
York Road East (YRd)	Armstrong Ave, York Rd
South of York (SY)	Armstrong Ave, Audrey Ave, Balsarroch Pl, Bell Ave, Boult Ave, Brockville Ave, Dodds Ave, Hayes Ave, Kingsmill Ave, Lawrence Ave, Menzie Ave, Victoria Rd
Mills Lofts (Mill)	26 Ontario St
Swimming Pool (Swim)	within the York Rd park
Total area of SPW	**Approximately 1.8 km^2**

Figure 12.6 Streets and Energy Zones for SPW

Combining this zoning with knowledge of the existing and planned building types, and the timing of the neighborhood development, the energy demands for differing levels of efficiency would be evaluated for heating, cooling, lighting and other electrical uses.

Simply as an example, the heating demand for the Woods District has been modeled based on differing efficiency levels:

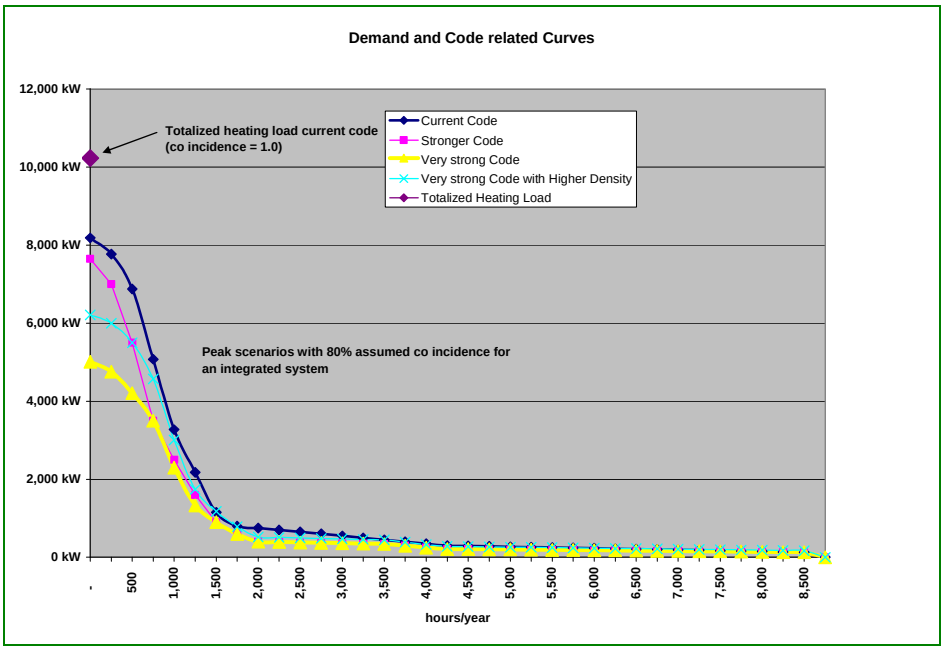


Figure 12.7 Heating Demand for Woods

This indicates that by building to the current code, the peak heating for this area would 12 MW, and by going to the new Ontario Code, as recommended by the CEP, this peak drops to 5MW, having enormous implications on the size of the heat sources and the district heating pipes needed. It also means much less pollution, and much less costs for the occupants.

Assessments would be made for cooling and other energy needs for each of the 17 zones, and then integrated to make a final recommendation on the energy infrastructure. A Pre-Feasibility IEMP includes a full economic assessment.

A full analysis has not been completed for the entire Ward, but this initial work indicates some of the detailed process that would be followed, and also indicated the potential energy saving that are possible through integrated approaches.

12.5. Downtown Revitalization – Downtown Community Improvement Plan

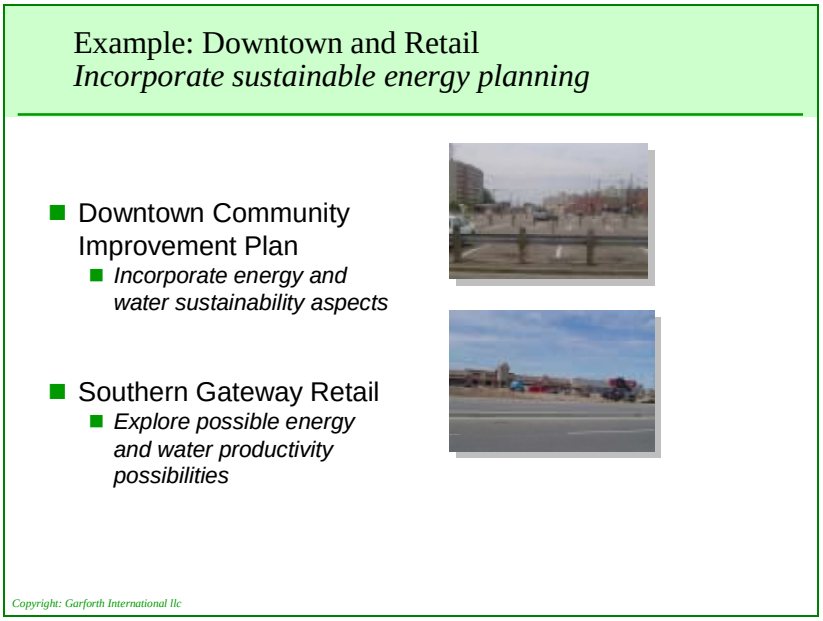


Figure 12.8 Overview of Downtown and Retail

A number of initiatives are being considered to revitalize the City core, aimed at stimulating repopulation by creating an attractive urban living community. The relatively high density of these kind of projects, combined with the potential for renewing old utility infrastructure often bodes well for the creative implementation of the kind of energy productivity measures recommended in the CEP. Given downtown revitalization typically takes place over many years, the CEP is recommending establishing an integrated energy framework as soon as possible to guide this aspect of the Downtown revitalization efforts.

12.6. Greenfield Mixed-use Neighborhood – South Guelph Developments

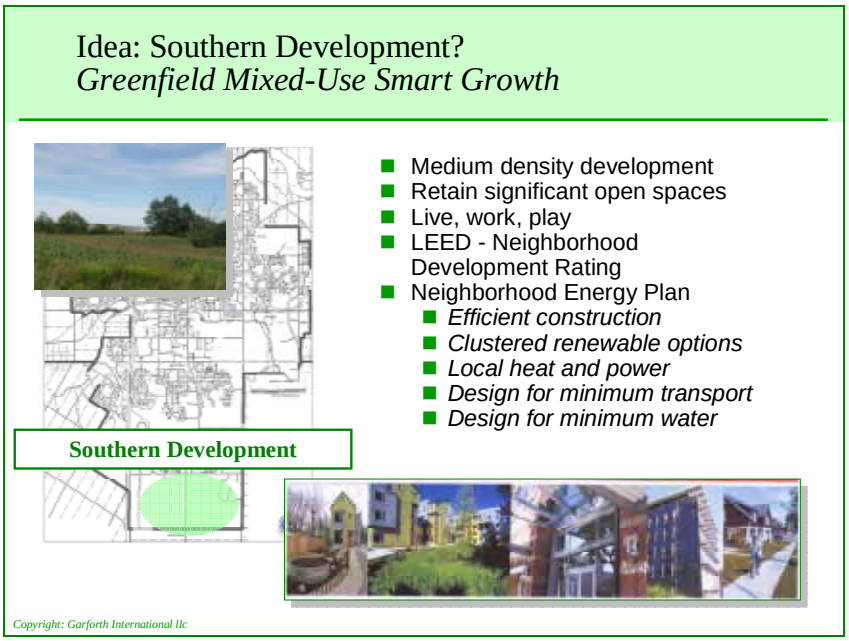
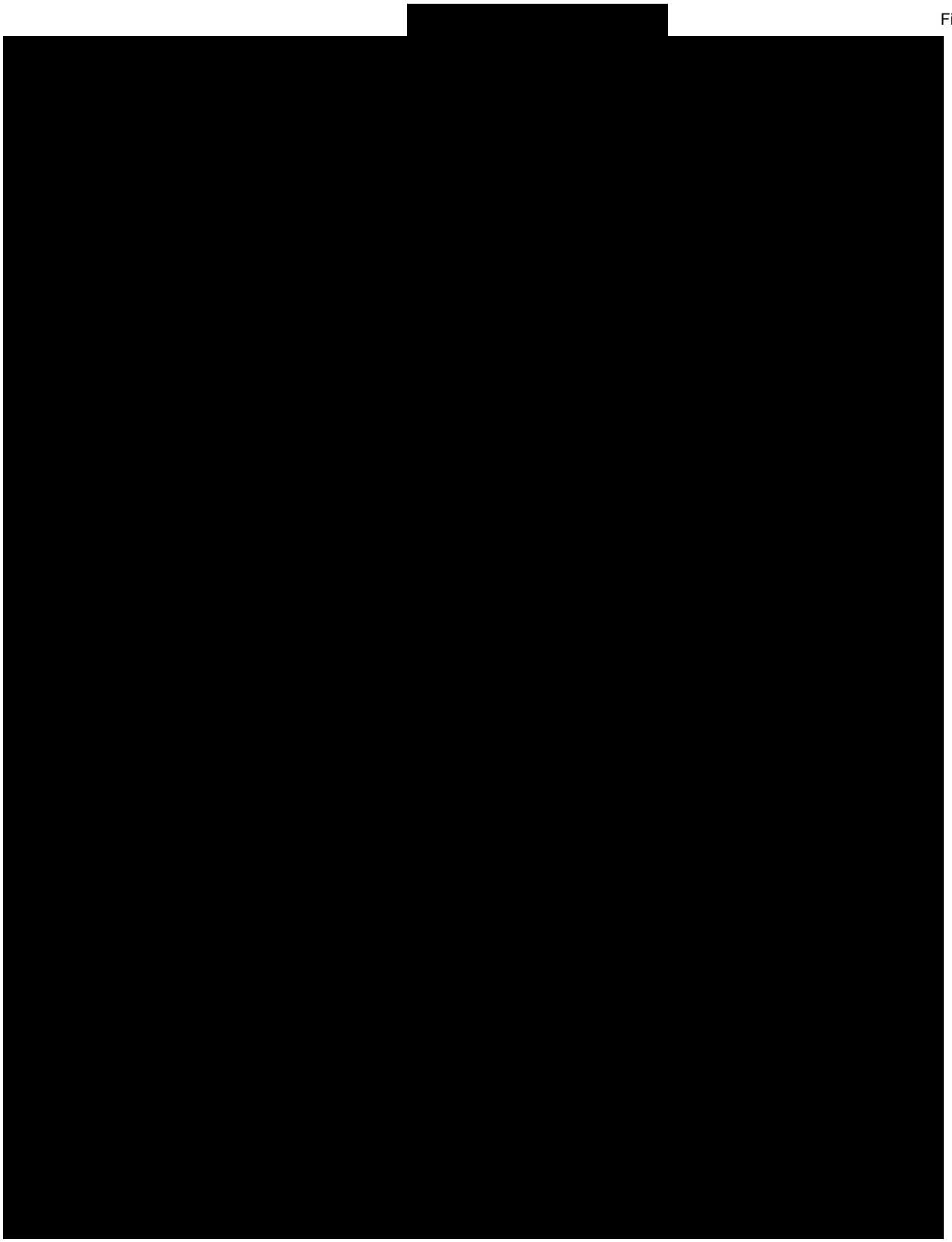


Figure 12.9 Overview of Southern Development

As was indicated at the start of this section, the entire South Side of Guelph is likely to be developed with Business and Industrial Parks, extensive retail developments and mixed use residentially focused areas. This is a window of time where the benefits of adopting an integrated approach to energy and water will pay dividends for the next 100 years. The CEP is recommending completing the Feasibility level Integrated Energy and Water Master Plan for this area within the 2007/2008 time frame.

These ideas are by no means cast in stone, nor are they the only possibilities. The recommendations is that the Consortium and the City get started on developing detailed IEMPs for at least St Patrick's Ward and the Southern Industrial areas, and then build from there.



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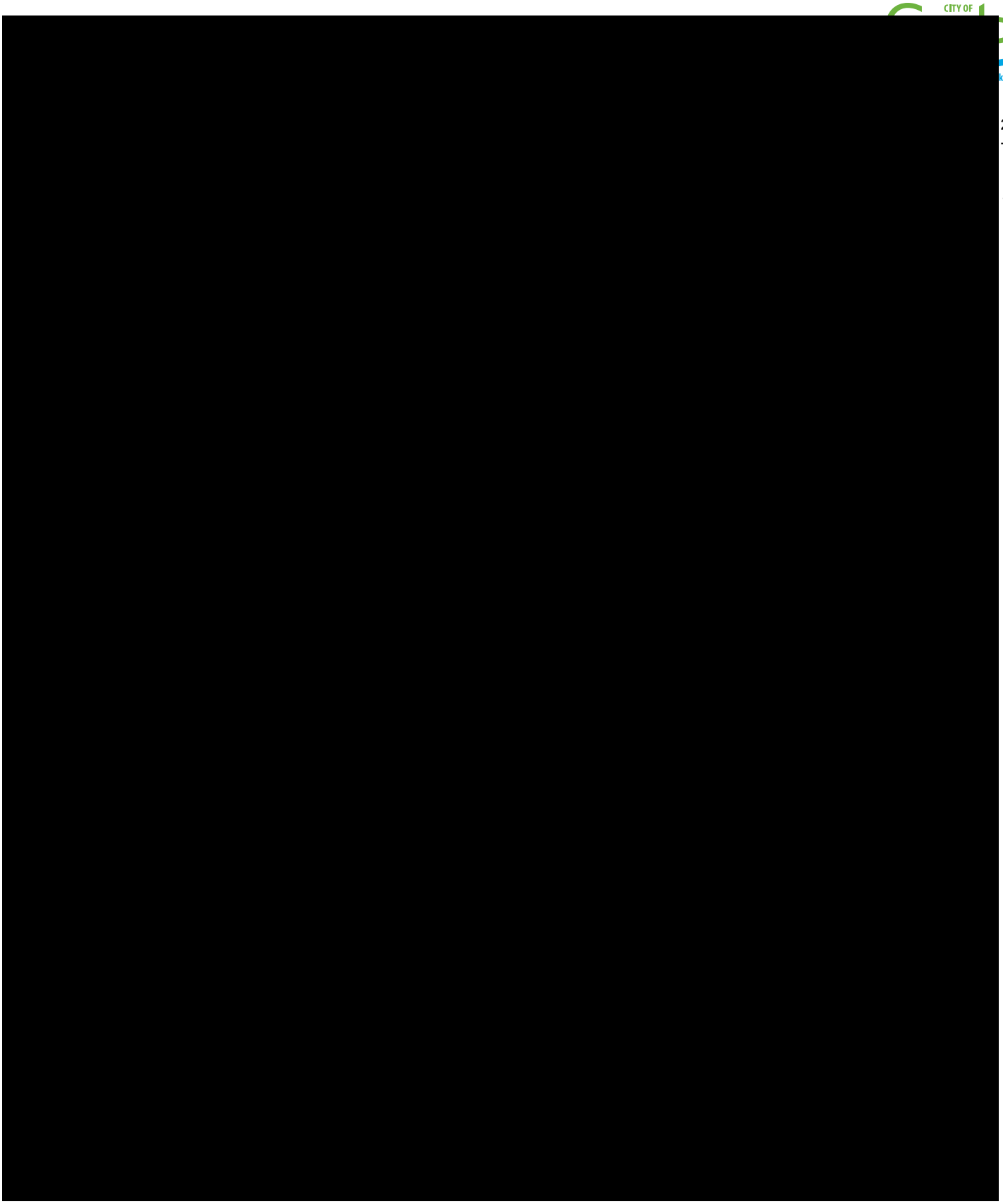

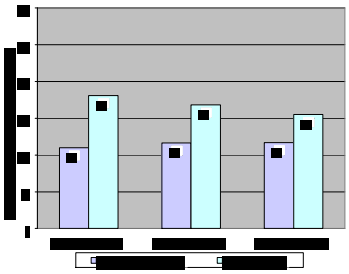

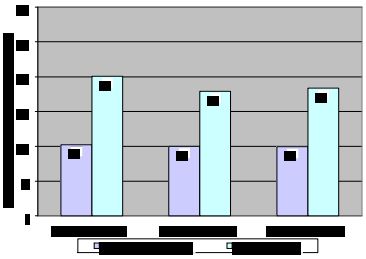

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APPENDIX 3

ENVIRONMENTAL FEATURES – CIVIC ADMINISTRATION CENTER

The following is a summary of environmental initiatives to be incorporated in the new structure[117] in support of the LEED certification of the building.

Alternative Transportation – Showers and bicycle storage to encourage walking and bicycling to work, which could help to reduce fossil fuel consumption, reduce air and water pollutants, and aid in promoting physical fitness and social interaction

Parking Capacity – Minimize motor vehicle parking capacity with only 43 underground parking spaces provided. This will reduce the amount of impermeable hard surfaces that cause Heat Island Effect as well as reducing water pollution from storm water runoff. This also encourages use of public and other forms of transportation.

Light Pollution – Minimize the night time light that will go beyond the property. Not only will this reduce overall energy consumption, reduced night lighting has proven health benefits to neighbors.

Heat Island Effect Reduction – About half of the roof will be "Green Roof" using soil and plants as the top layer of the roof. This reduces heating and cooling needs and storm water runoff, and improves air quality.

Volume Design – Footprint versus vertical height to promote green space use for land.

Low VOC Emitting Materials - Low VOC (volatile organic compounds) emitting carpet, paint and adhesive improves indoor air quality, and improves the health and comfort of occupants.

Living Wall – Using a wall of plants inside the building to filter the air and provide oxygen, provides air filtration, oxygen, and humidification, as well as a more psychologically pleasing working environment.

Building Automation System – This optimizes the amount of fresh air used based on CO_2 levels. This avoids over-ventilation and energy waste.

Humidification – Incorporating a humidification system in the air systems to increase comfort and reduce static electricity

Reduced Water for Irrigation – Landscaping incorporates drought tolerant plants that are also disease and insect resistant. This reduces water consumption for irrigation purposes, as well as improves air quality by not using chemicals for pest and disease control.

Efficient Water Fixtures – Install water conserving plumbing fixtures which will reduce water consumption.

Natural Light – Design allows natural light penetration into interior areas. This reduces energy consumption and creates a more psychologically pleasing working environment.

Free Cooling – Use outside air to cool the building in Spring and Fall when the temperatures allow, reducing energy consumption.

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[117] City of Guelph Website, New Civic Administration Centre, Environmental Initiatives, http://guelph.ca/cityhall.cfm?subCatID=1556&smocid=2135, accessed Dec 2, 2006

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Window Glazing – Use low-E, double glazed windows, with a high quality thermally unbroken frame. This reduces energy consumption, thereby reducing the size of cooling and heating systems.

Equipment Selection – High efficiency chillers, variable volume pumping systems, variable air flow systems, exhaust air heat recovery, occupancy sensors to turn off air flow, high efficiency motors, high efficiency air filtration system, high efficiency boilers, energy efficient light fixtures, energy saving control systems, all contributing to the overall reduction of energy consumption.

Waste Management – Diverting 50% of demolition and construction waste from landfill to recycling plants, reducing waste materials.

Material Selection – The use of recycled materials and minimum 10% local materials helps to reduce construction waste as well as pollution by reducing the transportation of materials to the site. Promotes the use of environmentally friendly materials, and supports the local economy.

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APPENDIX 4

GHESI 2005 CONSERVATION AND DEMAND MANAGEMENT PROGRAM RESULTS (NOTE: 2006 RESULTS WILL BECOME AVAILABLE IN MARCH 2007)[118]

CD&M Programs	Objective	Cost Benefit Ratio	# Participants or #units	kWh saved over plan	kW Peak demand saved
Education & Promotion	Increase awareness and shift customers to a conservation culture, which is anticipated to result in demand and energy reductions	3.8	7,405	5,181,986	35
Low Income	Provide special consideration for low-income homeowners and low-income tenants who directly pay for their electricity by focusing on their specific energy needs through audits, in partnership with existing local organizations who directly deal with low-income residents, and other organizations such as Natural Resources Canada	12.36	3,433	1,347,604	0
City Leadership	Showcase leadership in the area of CDM via the City of Guelph and Guelph-Eramosa Township, while realizing reductions in demand and energy, for the benefit of the community	1.35	97	732,960	77
Technology & Research	Evaluate technologies to be used as pilot projects in the design of the LDC's new building, for research, development and demonstration purposes. Monitor and track energy gains	2.11	190	11,001,967	108
Air Conditioner Replacement	Educate customers about energy consumption of window air conditioners, and the importance of timers and having the right size room air conditioner. Develop partnerships so that for example, customers could bring their old AC unit back during a designated period of time, and receive a discount on a new Energy–STAR Rated or otherwise qualified model air conditioner.	0.53	27	4,203	4

[118] From Guelph Hydro Electric Systems Inc.

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APPENDIX 5

GHESI CONSERVATION AND DEMAND MANAGEMENT PROGRAM SMART METERING PILOT STARTED IN 2006

A “Smart Meter” is an advanced electronic electricity meter that records energy usage on an hourly basis, and will allow a consumer to track how much electricity is being used at different times of the day. In 2005 Guelph Hydro reviewed various Smart Metering technology options with a view to undertaking a smart metering pilot project in 2006. The pilot was intended to let Guelph Hydro assess metering, communications, data flow, settlement as well as other business process issues.

A review of various technology options led us to select General Electric meters with Silver Springs Networks wireless networking communications for the pilot. In the summer & fall of 2006 we installed smart meters at 214 electric customers (200 residential customers, 14 small commercial) in the south end of Guelph. Related new secure wireless communications infrastructure (gateways, relays and "backhaul" equipment) were installed as part of the pilot.

The results of the pilot proved that successful daily radio communications for transmitting hourly electricity consumption information were achievable. Late in 2006 GHESI expanded the pilot to include an additional 50 meters utilizing newer more robust wireless communications, and in early 2007 we will be further testing the expanded pilot meters & communications.

In 2007 we will start to generate "shadow bills", and to educate customers on the future Time-of-Use rates that will be used with smart meters interval data. The detailed information captured by the Smart Meter will become an invaluable tool to evaluate energy consumption patterns, and may assist the customer in managing their electricity costs.

Later in 2007 we anticipate the start of smart meter deployment to a larger group of Guelph customers, to ensure that we meet the government's target of smart meters installed at every customer in Ontario by 2010.

Communication from Art Stokman – CEO GHESI January 2007

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APPENDIX 6

EXAMPLES OF SCALE PROJECTS

This Appendix lists some representative scale projects from around the world where selected areas of a city have been developed following different norms from the rest of the surrounding city. In the interest of keeping the document to a reasonable length, the detailed reports have not been included. Further background of these projects can be obtained upon request from Garforth International, llc.

- High density urban villages
  - *Scharnhauser Park, Stuttgart, Germany*
  - *Navy Yard at Noisette, Charleston, South Carolina, USA*
- Industrial estates
  - *Mannheim Island, Mannheim, Germany*
- Greenfield Smart Growth
  - *Bells Landing, Nashville, Tennessee, USA*
- Sports and Recreation Centres
  - *YMCA, Corning, New York, USA*
  - *SAP Stadium, Mannheim, Germany*
- Academic Campuses.
  - *Lakeland Community College, Lake County, Ohio*

APPENDIX 7

PUBLIC FORUM

Below you will find a objectives summary from the large public forum that was held as part of the development phase of the CEP. If you would like a full list of ideas and the public opinion, please go to the following link:

http://www.palmatierproperties.com/Summary_from_CEP_Public_Forum_111606

COMMUNITY ENERGY PLANNING

Community Energy Plan Public Forum Summary

Thursday, November 16, 2006 7pm to 9pm
River Run Centre – Cooperator's Hall
84 participants excluding City Councillors and Consortium Members

Objectives of the workshop:

- An opportunity for residents to listen to international expert Peter Garforth
- First open public forum that allowed for ideas to be generated, shared and community momentum to build
- Examine ideas that could be implemented within participants' local environments such as their home, street, neighbourhood, workplace, school, etc.
- Attempt to build community consensus on project priorities
- To gather future participation feedback
- An opportunity to give some direction/message to the Consortium members

Red dots indicated ideas that participants felt were the least costly to implement.

#of red dots	Idea
14	Education on the issue
2	Rainwater harvesting
2	Collective purchasing of solar power systems
2	Solar hot water heating, training for trades, subsidy programs
9	Increase tree planting
1	Schools or neighbourhood groups sell CF bulbs vs. choc.bars
2	Better urban planning
5	Bike lanes/community plan
2	Behaviour / changing habits and expectations
2	Solar hot water heating, training for trades, subsidy program
2	Incentives for landlords to make rental properties more efficient
1	Endorse new green building guidelines and standards
5	More energy conservation information on hydro bill
1	Use goats instead of lawnmowers
3	Sliding scale energy use / industrial pays more
3	Change toilet flush to control flush
3	Disbursed city nodes system for the bus system, examine routes
4	Building code improvement for older homes
8	Allow clothesline
2	Neighbourhood garbage collection

1

APPENDIX 8 – FULL SIZE GRAPHS FOR READABILITY

Figure 3.2 – China's Energy Demand Forecast

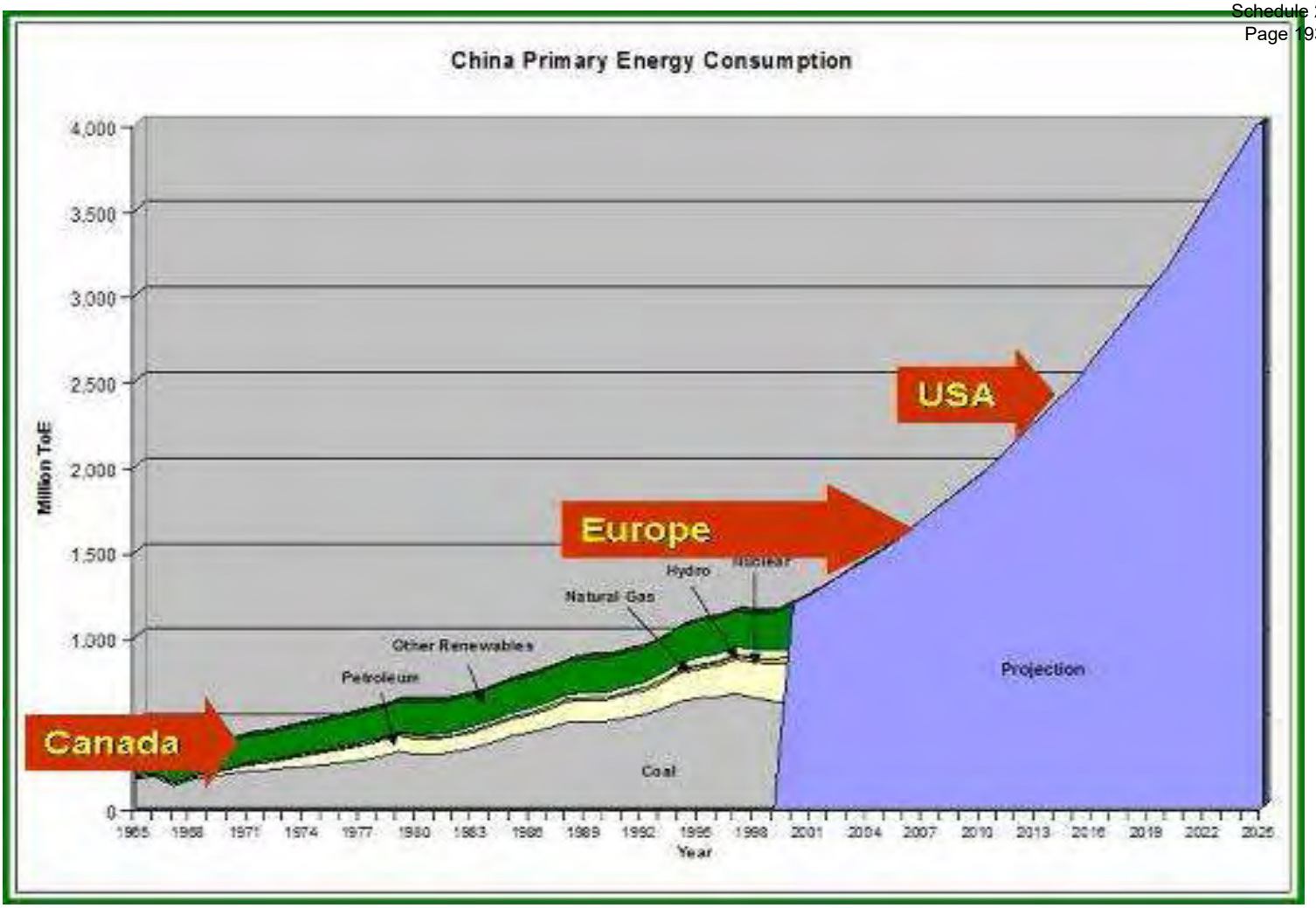

Figure 3.3 Greenhouse Gas and Surface Temperature

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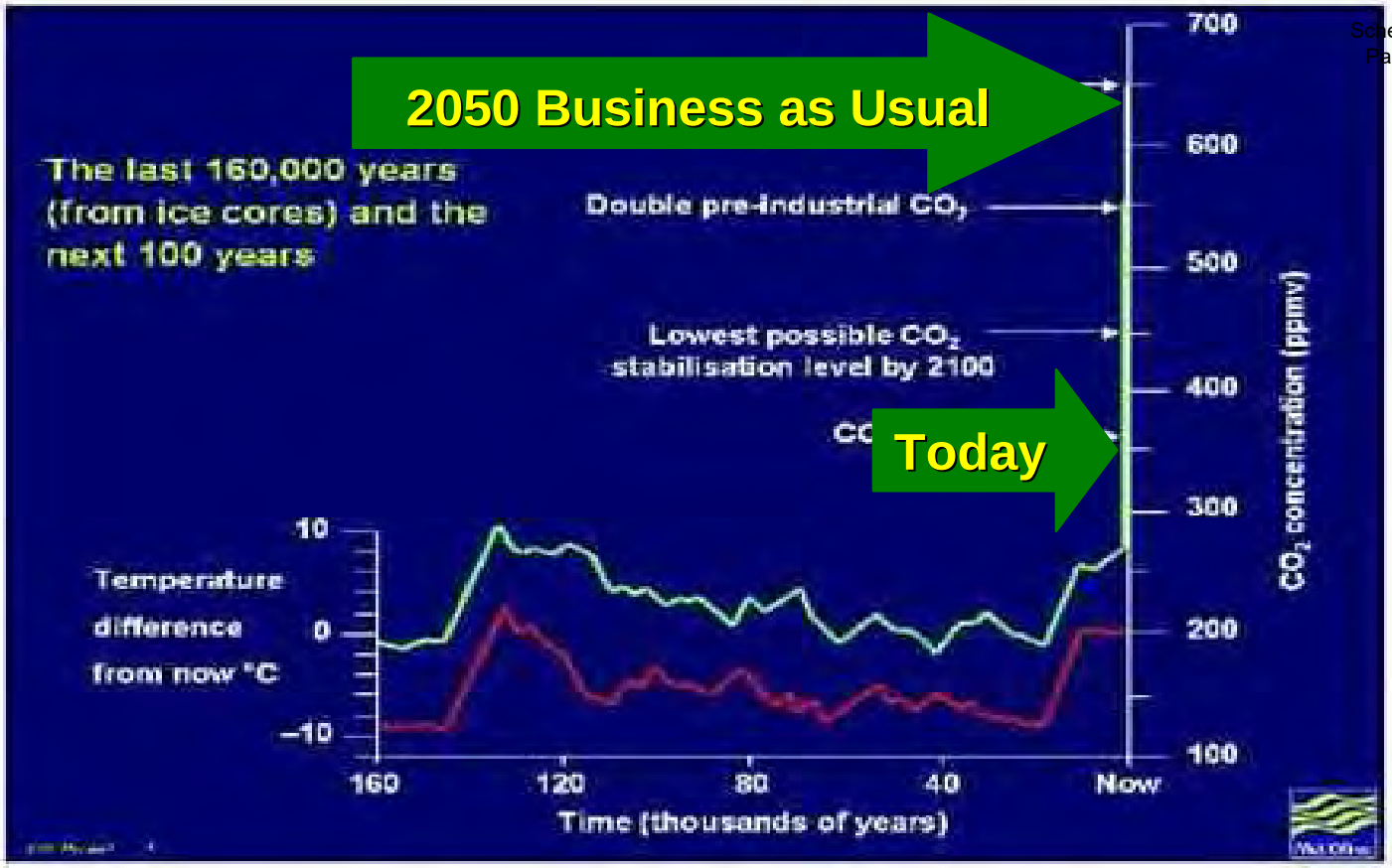

Figure 5. Atmospheric temperature and carbon dioxide concentration as measured from the Vostok ice core from Antarctica. On the right of the diagram are shown projections of carbon dioxide concentration for the 21st century. The temperature measured by the ice core is an average for the polar region. Changes of global average temperature are about half of those in the polar average.

Figure 3.4 Impacts of Global Warming

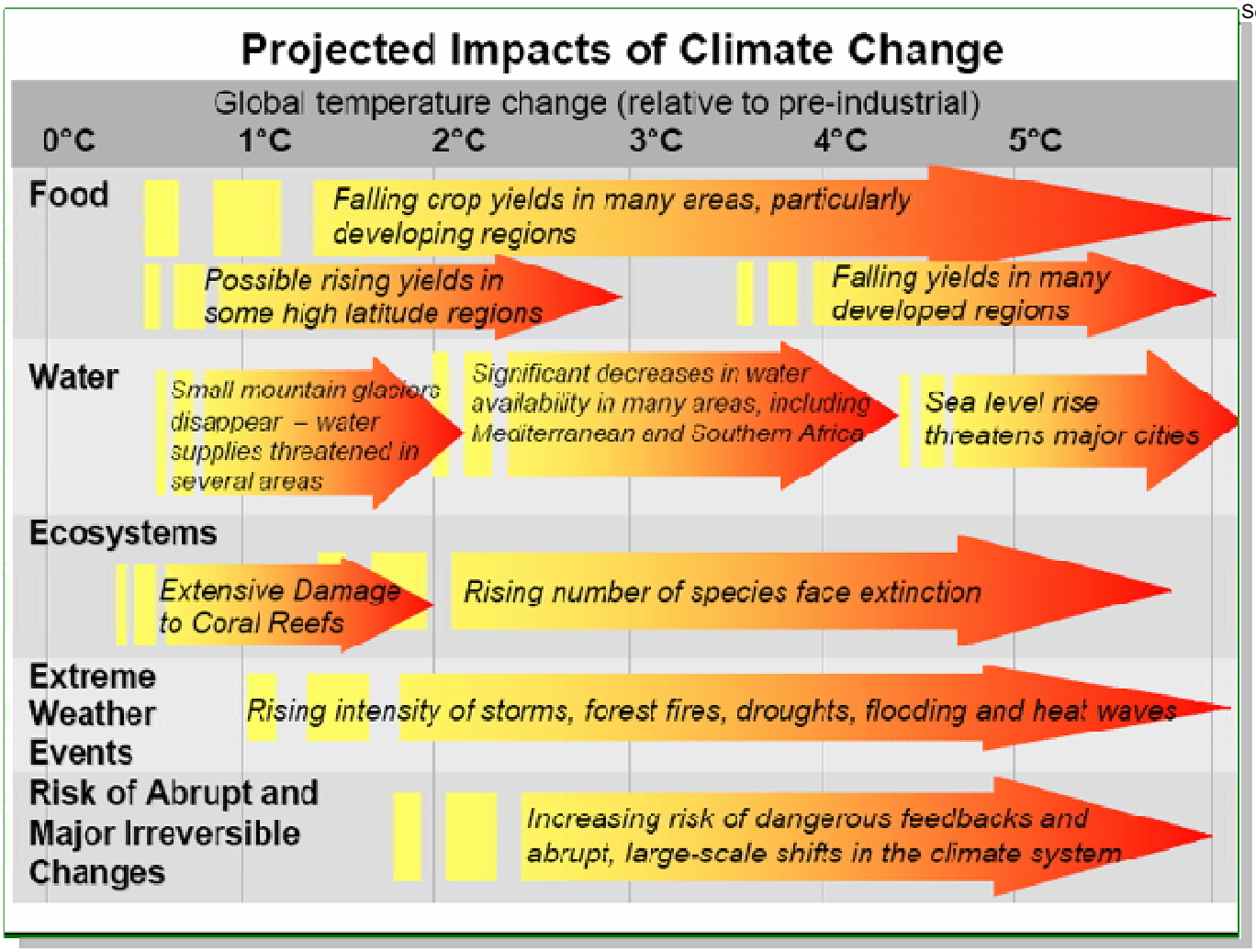

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Figure 6.4 2005 Estimates of Residential Property by Age and Building Type

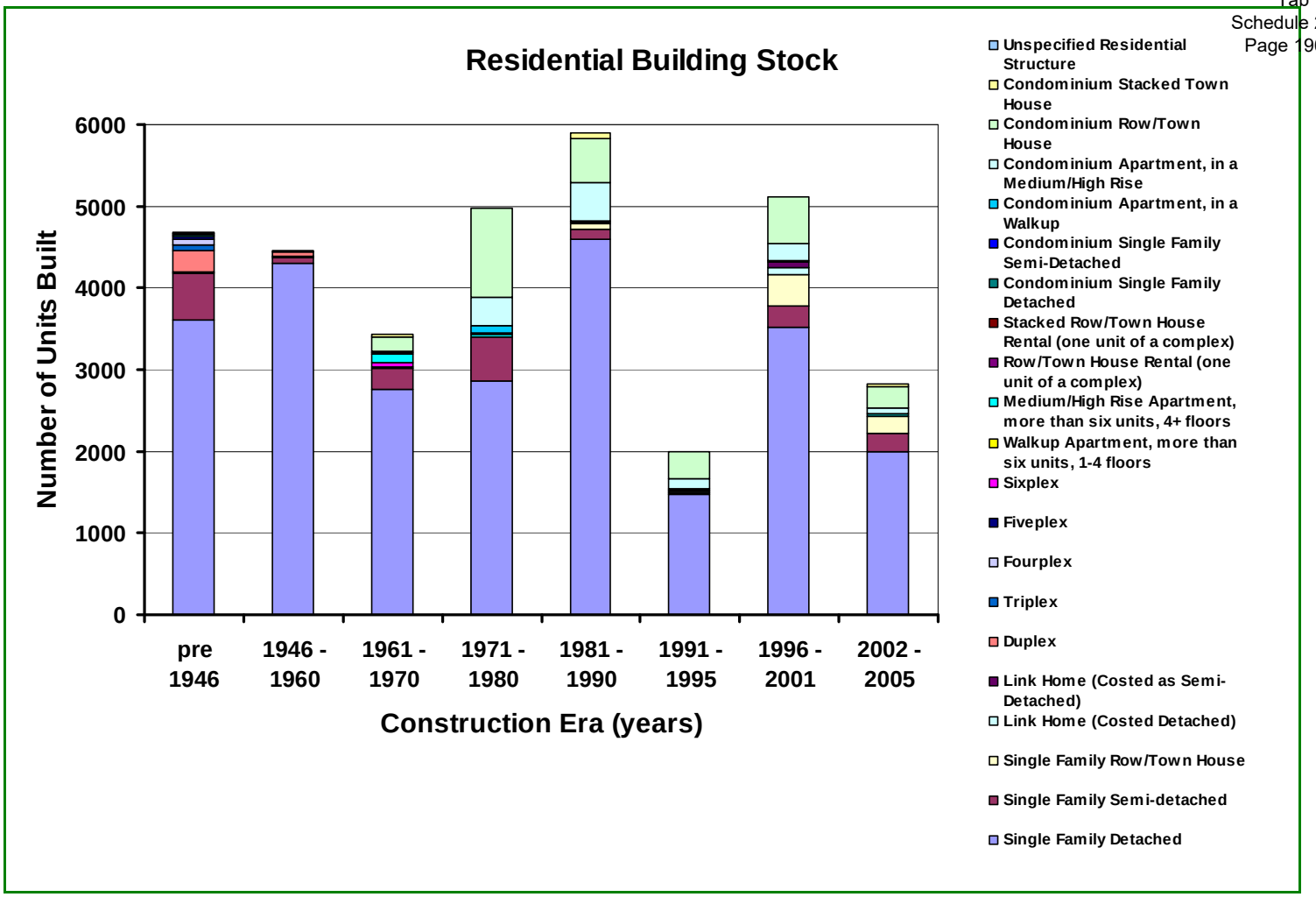
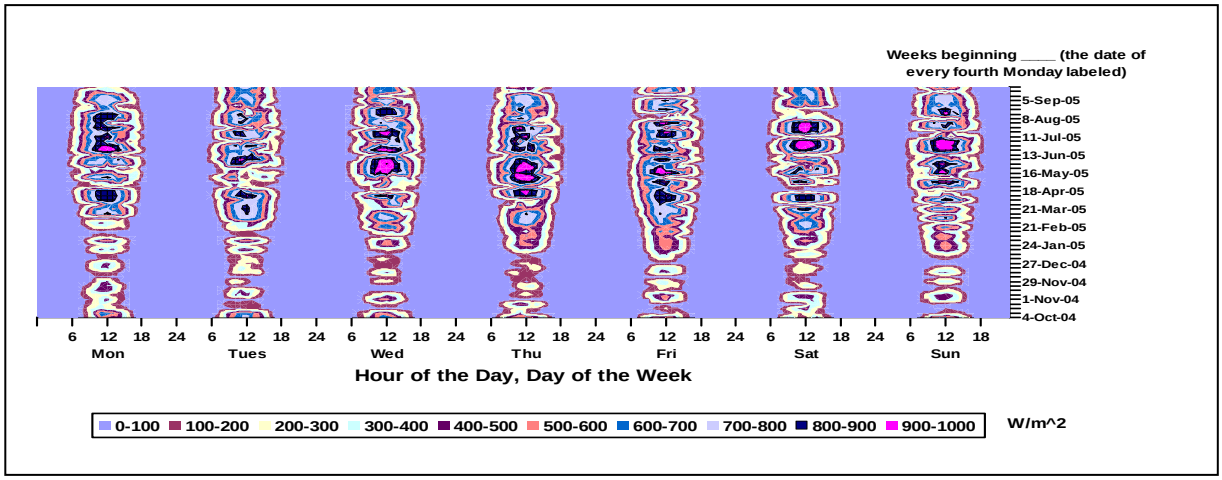


Figure 6.7 Irradiation Data in the Guelph Region (04/05)

Solar Resource

- Figure summarizes data over a one year period with the following points emerging from observation of the data:
  - *global irradiation reaches significant levels, 900-1000 W/m^2, during spring and summer;*
  - *hours of daylight change significantly over the year;*
  - *global irradiation can be negligible and even non-existent in some months;*
  - *periods of high demand correlate well with global irradiation*



The Corporation of the City of Guelph
Guelph Water Supply Master Plan

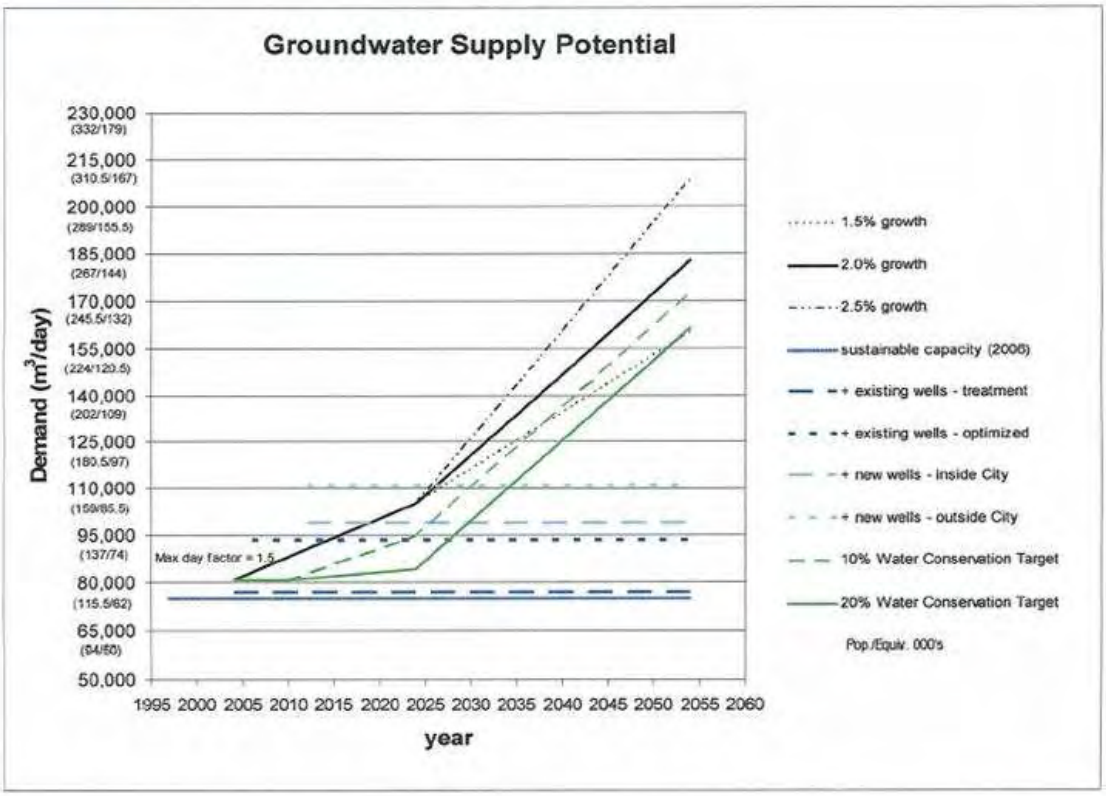


Figure 5.4
Groundwater Supply Potential

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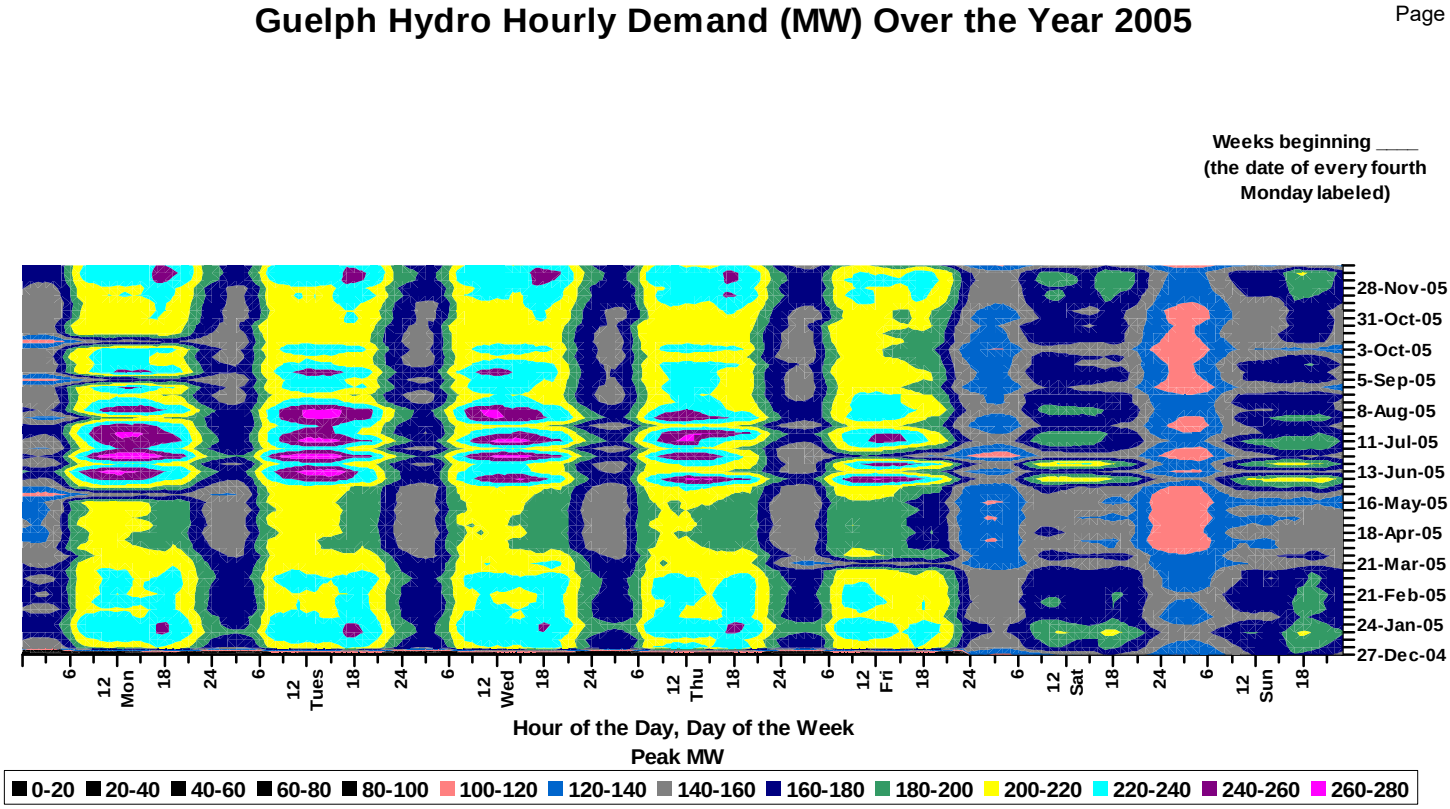
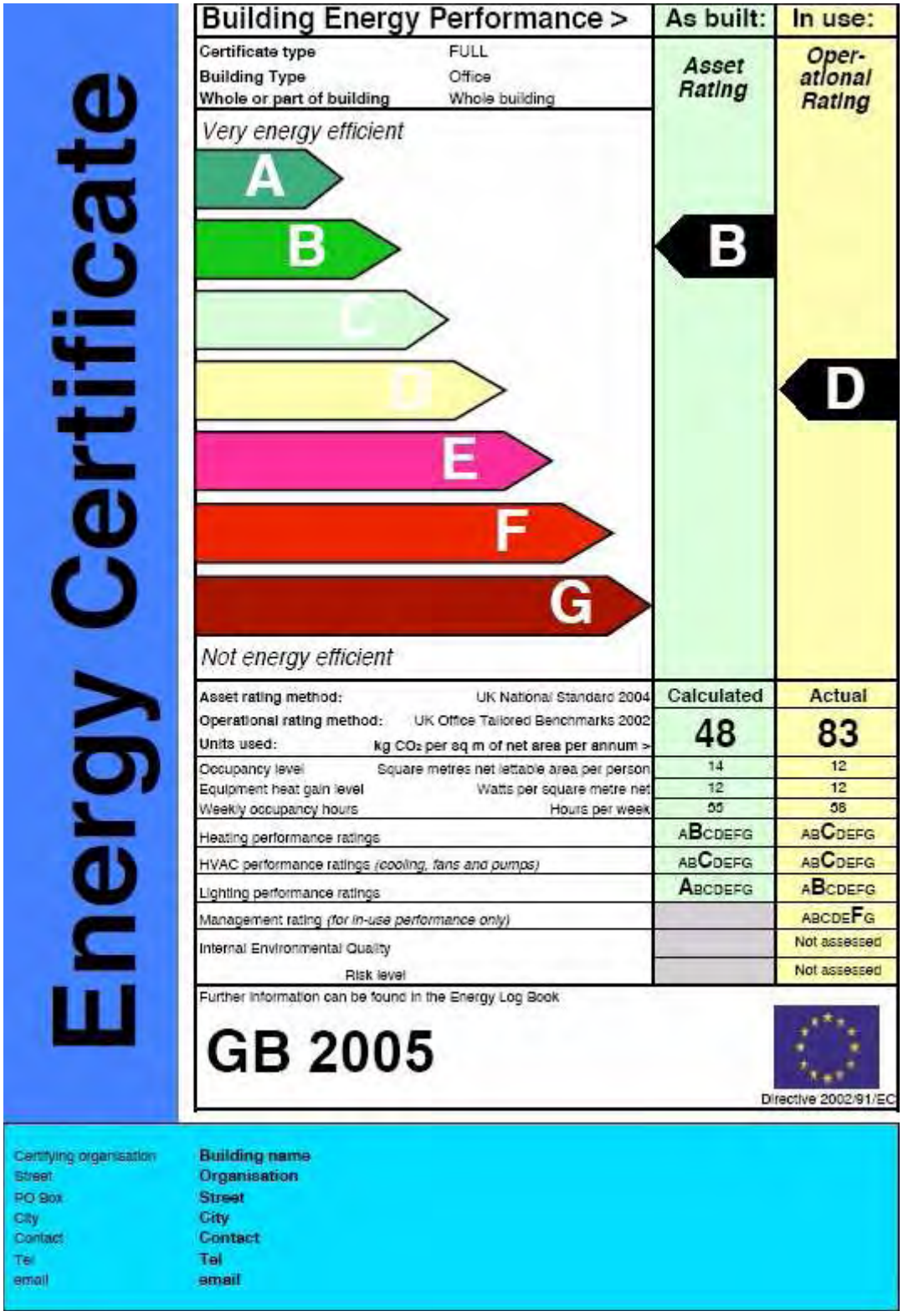
Figure 7.18 Hourly Electricity Demand in Guelph for the Year 2005



APPENDIX 8-BUILDING EFFICIENCY LABELING INFORMATION



Energy Certificate

Building Energy Performance >		As built:	In use:
Certificate type	FULL	Asset Rating	Oper-ational Rating
Building Type	Office		
Whole or part of building	Whole building		
Very energy efficient A			
B		B	
C			
D			D
E			
F			
G			
Not energy efficient			
Asset rating method:	UK National Standard 2004	Calculated	Actual
Operational rating method:	UK Office Tailored Benchmarks 2002		
Units used:	kg CO_2 per sq m of net area per annum >	48	83
Occupancy level	Square metres net lettable area per person	14	12
Equipment heat gain level	Watts per square metre net	12	12
Weekly occupancy hours	Hours per week	55	55
Heating performance ratings		ABCDEFG	ABCDEFG
HVAC performance ratings *(cooling, fans and pumps)*		ABCDEFG	ABCDEFG
Lighting performance ratings		ABCDEFG	ABCDEFG
Management rating *(for in-use performance only)*			ABCDEFG
Internal Environmental Quality			Not assessed
Risk level			Not assessed

Further information can be found in the Energy Log Book

GB 2005

Directive 2002/91/EC

Certifying organisation	**Building name**
Street	**Organisation**
PO Box	**Street**
City	**City**
Contact	**Contact**
Tel	**Tel**
email	**email**

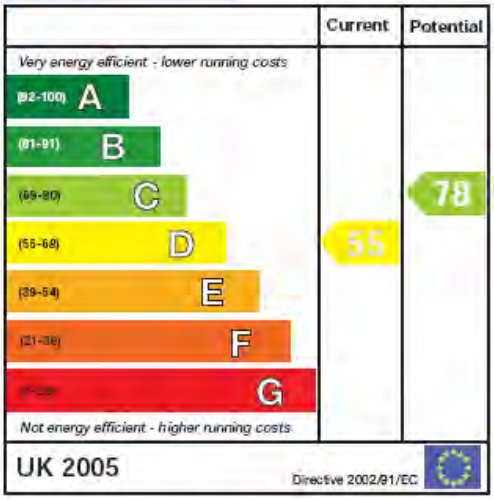
Section H: Energy Performance Certificate

100 Any Street,	Dwelling type:	Detached	Certificate number:	XXXX
Any Town,	Assessment method:	SAP	Date issued:	XXXX
Anywhere, AB1 CD2	Date of inspection:	XXXX	Name of inspector:	XXXX

This home's performance ratings

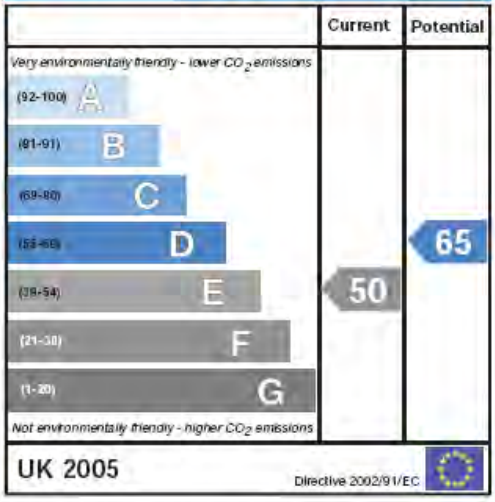
This home has been assessed using the UK's Standard Assessment Procedure (SAP) for dwellings. Its performance is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO_2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills will be.

Environmental (CO_2) Impact Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide emissions. The higher the rating the less impact it has on the environment.

Typical energy use, carbon dioxide (CO_2) emissions and fuel costs of this home

This table provides an indication of how much it will cost to provide lighting, heating and hot water to this home. The fuel costs and carbon dioxide emissions are calculated based on a SAP assessment of the energy use. This makes standard assumptions about occupancy, heating patterns and geographical location. The energy use includes the energy used in producing and delivering the fuels to this home. The fuel costs only take into account the cost of fuel and not any associated service, maintenance or safety inspection costs. The costs have been provided for guidance only as it is unlikely they will match actual costs for any particular household.

	Current	Potential
Energy use	xxx kWh/m^2 per year	xxx kWh/m^2 per year
Carbon dioxide emissions	xx tonnes per year	xx tonnes per year
Lighting	£xxx per year	£xxx per year
Heating	£xxx per year	£xxx per year
Hot water	£xxx per year	£xxx per year

To see how this home can achieve its potential rating please go to page ii

THIS IS AN EXAMPLE REPORT AND IS NOT BASED ON AN ACTUAL PROPERTY

Energy Performance Certificate Report Section

Certificate number: XXXXXXXXXXXXXXXXXXX
Date issued: XXXXXXXXXXXXX
Name of inspector: XXXXXXXXXXXXXXXXXXX

Summary of this home's energy performance related features

The following is an assessment of the key individual elements that have an impact on this home's performance rating. Each element is assessed against the following scale: Very poor/ Poor/ Average/ Good/ Very good

Element	Description	Current performance
Main walls	Uninsulated cavity wall	Poor
Main roof	Pitched, 100mm loft insulation	Average
Main floor	Uninsulated solid concrete (assumed)	Average
Windows	Single glazed throughout	Very poor
Main heating	Mains gas back boiler	Poor
Main heating controls	No controls	Very poor
Secondary heating	Flame effect fire	Very poor
Hot water	From main heating system; uninsulated cylinder	Very poor
Lighting	Low energy lighting in all fixed outlets	Very good
Current energy efficiency rating		D 55
Current environmental impact rating		E 50

Cost effective measures to improve this home's performance ratings

The performance ratings after improvement listed below are cumulative, that is they assume the improvements have been installed in the order that they appear in the table.

Lower cost measures	Typical savings	Performance ratings after improvement	
		Energy efficiency	Environmental impact
Cavity wall insulation	£xx per year	D 65	D 56
Loft insulation top up to 250mm	£xx per year	D 68	D 57
Hot water cylinder and pipe work insulation	£xx per year	C 69	D 58
	Sub-total £xx per year		
Higher cost measures			
Condensing boiler	£xx per year	C 75	D 63
Installation of a full heating controls package	£xx per year	C 78	D 65
	Total £xx per year		
Potential energy efficiency rating		C 78	
Potential environmental impact rating			D 65

Further measures to achieve even higher standards

The further measures listed below should be considered in addition to those already specified if aiming for the highest possible standards for this home.

Double glazing	£xx per year	C 80	D 67
Solar water heating	£xx per year	B 81	D 68
Enhanced energy efficiency rating		B 81	
Enhanced environmental impact rating			D 68

Improvements to the energy efficiency and environmental impact ratings will usually be in step with each other. However, they can sometimes diverge because reduced energy costs are not always accompanied by reduced carbon dioxide emissions.

For advice on how to take action and to find out about offers available to help make your home more energy efficient call 0800 512 012 or visit www.est.org.uk/myhome

ii

THIS IS AN EXAMPLE REPORT AND IS NOT BASED ON AN ACTUAL PROPERTY

Energy Performance Certificate Report Section

Certificate number:	XXXXXXXXXXXXXXXXX
Date issued:	XXXXXXXXXXXX
Name of inspector:	XXXXXXXXXXXXXXXXX

Measures to improve this home's performance ratings

Lower cost measures (typically up to £500 each)

These measures are relatively inexpensive to install and are worth tackling first. Some of them may be installed as DIY projects. DIY is not always straightforward, and sometimes there are health and safety risks, so take advice from an energy advisor before carrying out DIY improvements.

Measure 1 Cavity wall insulation
The external walls of this home are built with a gap, called a cavity, between the inside and outside layers of the wall. Cavity wall insulation fills this gap with an insulating material, which reduces heat loss through the external walls. The insulation material is pumped into the gap through small holes that are drilled into the outer walls, the holes are made good afterwards. As specialist machinery is used to fill the cavity a professional installation company should carry out this work. Such 'approved contractors' should carry out a thorough survey before commencing work to be sure that this type of insulation is right for this home. They should also provide a guarantee for the work and handle any building control issues.

Measure 2 Loft insulation
Insulation laid in the roof space over the joists or between roof rafters to a depth of at least 250 mm will significantly reduce heat loss through the roof. The anticipated cost is based upon a contractor installing or making up the loft insulation to the equivalent of a 250mm quilt; although the insulation can also be installed by a capable DIY enthusiast. Loose granules may be used instead of insulation quilt; this form of loft insulation can be blown into place and can be useful where access is difficult.

Measure 3 Hot water cylinder and pipe insulation
This is a partially or fully formed insulation that fits around the hot water cylinder. Installing this, or increasing the thickness of existing insulation, around the hot water cylinder will help to reduce fuel bills. The jacket should be fitted over the top of any existing insulation and over any thermostat clamped to the cylinder. Hot water pipes from the hot water cylinder should also be insulated, using preformed pipe insulation of 50mm thickness, for as far as they can be accessed. All these materials can be purchased from DIY stores and installed by a competent DIY enthusiast.

Higher cost measures (typically over £500 each)

Measure 4 Condensing boiler
A condensing boiler is capable of much higher efficiencies than other types of boiler, meaning it will burn less fuel to heat the property. This improvement is most appropriate when the existing heating system needs repair or replacement. Only a qualified, CORGI registered heating engineer should carry out the installation. Building Regulations apply to this work, so it's a good idea to get advice from the local Building Control Authority.

Measure 5 Installation of full heating controls package
The heating system requires a programmer and room thermostat to be fitted to ensure the boiler switches off when no heat is required. Thermostatic radiator valves are a useful addition to the room thermostat, allowing the temperature of each room to be controlled to suit individual needs, adding to comfort and reducing heating bills - for example, they can be set to be warmer in the living room and bathroom than in the bedrooms. Ask a competent heating engineer (e.g. CORGI registered) to install radiator valves and a fully-pumped system with the pump and the boiler turned off by the room thermostat. Radiator valves should be fitted to every radiator except one - the radiator in the same room as the room thermostat. Remember you still need the room thermostat to ensure the boiler switches off when no heat is required.

Further measures to achieve an even higher standard

The further measures listed below should be considered in addition to those already specified if aiming for the highest possible standards for this home.

Measure 6 Double glazing
Double glazing is the term given to a system where two panes of glass are made up into a sealed unit. Replacing existing single glazed windows with double-glazing will improve comfort in the home by reducing draughts and cold spots near windows. Double glazed windows may also reduce noise, improve security and combat problems with condensation. Building Regulations apply to this work, so either use a contractor who is registered with FENSA or obtain advice from the local Building Control Authority.

Measure 7 Solar water heating
A thermal panel, usually fitted to the roof, uses the sun to pre-heat the hot water supply. This will significantly reduce the demand on the heating system to provide hot water and hence save fuel and money. These panels are among the most cost effective renewable systems that can be installed on dwellings in urban or rural environments. The Solar Trade Association has up to date information on installers in your area and any grant that may be available.

Remember to look for the energy saving recommended logo when buying energy efficient products. It's a quick and easy way to identify the most energy efficient products on the market.

For advice on how to take action and to find out about offers available to help make your home more energy efficient call 0800 512 012 or visit www.est.org.uk/myhome

Energy Performance Certificate Report Section

Certificate number:	XXXXXXXXXXXXXXXXXXX
Date issued:	XXXXXXXXXXXXX
Name of inspector:	XXXXXXXXXXXXXXXXXX

About this energy inspection

Energy inspections are not new and they have been available in the UK since the late 1980s. This inspection has been undertaken by a qualified inspector who has received appropriate training to collect the correct information about the energy performance of homes. This information has been processed by a Government approved organisation to produce the energy performance certificate and the recommendations for improvements in this report. Both the inspector and the energy performance certificate supplier are regularly monitored to ensure that their work is up to standard.

For clarification of the technical information in this energy performance certificate please contact:
Inspector *on*

About this home's performance ratings

The ratings provide a measure of the overall energy efficiency of this home and its environmental impact. Both are calculated using the Standard Assessment Procedure (SAP), which is the Government's recommended system for assessing the energy performance of dwellings. The ratings take into account the home's insulation, heating systems, hot water system, fixed lighting, ventilation, number of windows and fuels used.

Not all of us use our homes in the same way so to allow one home to be directly compared to another, energy ratings are calculated using 'standard occupancy' assumptions. Standard occupancy is based on a home in a central UK location and assumes that during the heating season the house is heated for 9 hours a day during weekdays and 16 hours a day at weekends, with the living room heated to 21ºC and the rest of the house at 18ºC.

The ratings are expressed on a scale of 1 to 100. The higher the energy efficiency rating the more energy efficient the home and the higher the environmental impact rating the less impact it has on the environment.

Homes which are more energy efficient use less energy, saving money and helping to protect the environment. The cost of providing lighting, heating and hot water to a home with an energy efficiency rating of 100 would be practically zero. Similarly the carbon dioxide emissions from lighting, heating and hot water for a home with an environmental impact rating of 100 would be practically zero.

The potential ratings shown on page one describe the energy performance of the home assuming all cost effective measures have been installed. For comparison a home built to the 2006 Building Regulations would typically be around the boundary of bands B and C.

This home's impact on the environment

Carbon dioxide is one of the biggest contributors to the man-made greenhouse effect. We all use energy every day – at home, at work and when we travel. To generate that energy, we burn fossil fuels (coal, oil and gas) that produce 'greenhouse' gases – particularly carbon dioxide – which are changing our climate and damaging the environment. The energy we use for heating, lighting and power in our homes produces over a quarter of the UK's carbon dioxide emissions.

The average household in the UK creates about six tonnes of carbon dioxide every year. There are simple steps you can take to cut carbon dioxide emissions and help prevent climate change. Making your home more energy efficient by adopting the suggestions in this report can help protect the environment by reducing carbon dioxide emissions. You could reduce your emissions even more by switching to renewable energy sources.

What can I do today?

In addition to the specific measures suggested in this report, don't forget there are many simple measures you can put into action today that will save you money, help reduce your impact on the environment and improve the comfort of your home.

For example:

- Check that your heating system thermostat is not set too high (21ºC in the living room is suggested) and use the timer or programmer to ensure you only heat your home when necessary.
- Make sure your hot water is not too hot. Your cylinder thermostat shouldn't need to be set higher than 60ºC/140ºF.
- Turn off lights when not needed and do not leave appliances on standby. Remember not to leave chargers (e.g. for mobile phones) turned on when you are not using them.
- Buy energy saving recommended appliances. Remember to look for the energy saving recommended logo when buying.

energy saving recommended

Remember to look for the energy saving recommended logo when buying energy efficient products. It's a quick and easy way to identify the most energy efficient products on the market.

For advice on how to take action and to find out about offers available to help make your home more energy efficient call **0800 512 012** or visit **www.est.org.uk/myhome**