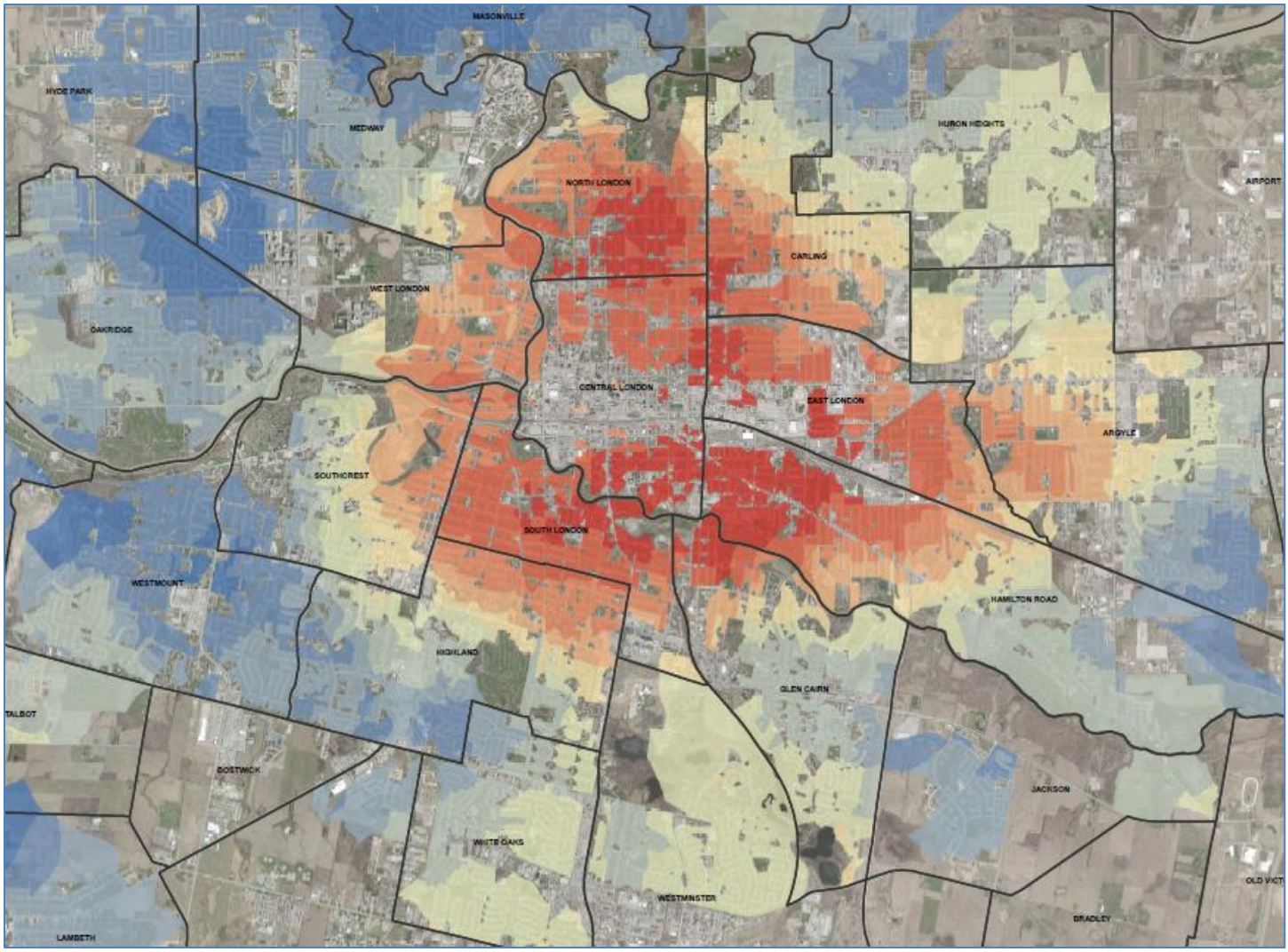

Map Showing Relative Energy Efficiency of London's Housing Stock for Natural Gas Use (2008 Data)

CITY OF LONDON

Understanding the Data

Background Document for the Community Energy Action Plan

December 2013

RETHINK ENERGY LONDON

London CANADA

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1. COMMUNITY ENERGY ACTION PLAN - BACKGROUND

The Corporation of the City of London does not have a lot of direct control over how much energy is used in London, but it does have a lot of influence. The control over energy use in London rests primarily with our citizens, visitors, employers and employees. Individual and collective action with respect of sustainable energy use, energy management, and energy conservation is the key to our future.

Urban planning can have a significant impact on how much energy we use. Designing new communities with a mix of land uses and density reduces the need to drive all the time, and can allow for innovative energy-saving technologies that take advantage of the different heating and cooling needs of these buildings. Infill development projects, particularly in older, car-dependent suburban neighbourhoods, can help "retrofit" these neighbourhoods to have these same benefits. The City's **Rethink London** campaign is being used to help get Londoners' thoughts on how we can do a better job through urban planning.

Transportation planning is also highly dependent upon urban planning. Today in London, the main transportation mode used by residents is the private automobile, which accounts for almost 75 percent of travel during rush hour. Public transit carries about 12 percent, and active transportation (walking and cycling) represent a further nine percent. The City's **Smart Moves 2030 Transportation Master Plan** analyzed various growth scenarios in order to determine what needs to be done from both land use and transportation perspectives to provide more travel choices for those who live, work and play in London.

The Corporation of the City of London is also one of London's largest employers, operating over 200 facilities and over 300 vehicles involved in delivering a wide range of services to London. The City of London is expected to lead-by-example, and the City's new **Corporate Energy Management Plan**, currently under development, will outline this plan.

Finally, one of the most critical roles that the City plays is to "connect the dots" between all of the major community stakeholders, the activities they engage in, and the role that these stakeholders can play in our rolling out the Community Energy Action Plan.

1.1 What is Rethink Energy London?

Rethink Energy London was a community engagement and action plan that has been running since January 2010. Its purpose was to increase public awareness, encourage stakeholder action, and seek input on sustainable energy and greenhouse gas (GHG) emission mitigation actions that also creates local social and economic benefits. Rethink Energy London covered a broad range of topics under four main themes – Our Homes, Our Neighbourhoods, Our Transportation, and Our Economy. Over the last two years, City staff

has met with stakeholders by attending their meetings and events, and by hosting workshops, seminars and conferences. Rethink Energy London has been promoted at numerous public and community events, such as the London Home Show and Car Free Day. To reach larger audiences, City staff made use of relationships with local media, including regular appearances on Rogers Daytime's Green Segment.

City staff have made presentations about Rethink Energy London at 15 stakeholder meetings (between 10 -200 people each) and has had Rethink Energy London materials on display at more than 20 public events (between 30 – 10,000 people each).

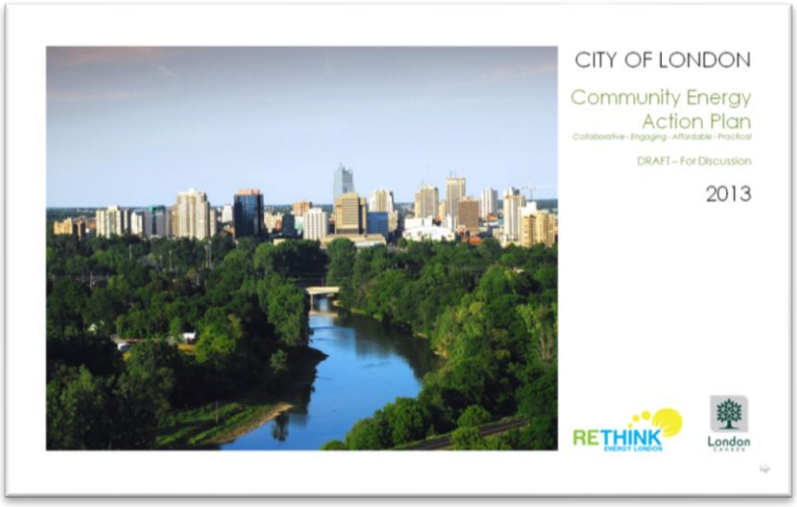
Rethink Energy London was supported by and/or connected to a number of key activities:

- Smart Moves 2030 Transportation Master Plan
- London Strengthening Neighbourhoods Strategy
- London's Roundtable on the Environment and the Economy
- Integrated Energy Mapping for Ontario Communities
- Rethink London
- The City of London's Corporate Energy Management Plan

1.2 What is the Community Energy Action Plan?

London's Community Energy Action Plan builds upon what City staff learned through Rethink Energy London and supporting activities, and sets out an action plan with the following key principles:

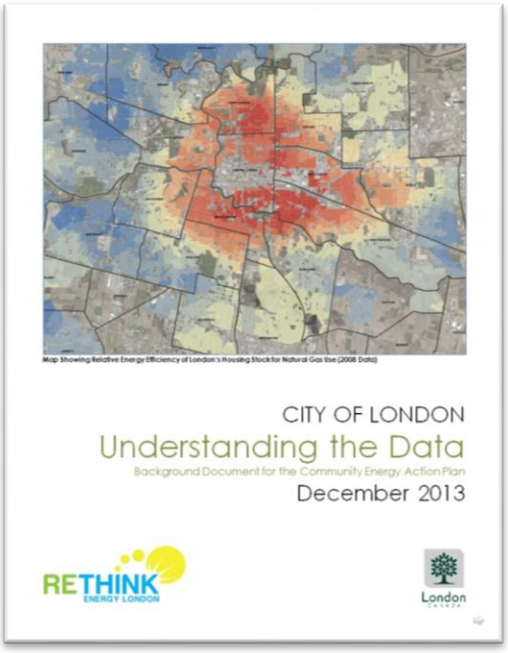
1. This needs to be the community's plan for London, not the City of London's plan for the community.
2. We can't control the price of energy, but we can control the cost of energy.
3. Start first with conservation.
4. Get the size right.
5. Invest in energy efficiency and good design.
6. Make use of free heat and free light.
7. Reduce waste.
8. Make it local.
9. Build on local strengths.
10. Use renewable energy.
11. Measure your progress.
12. Share your stories.



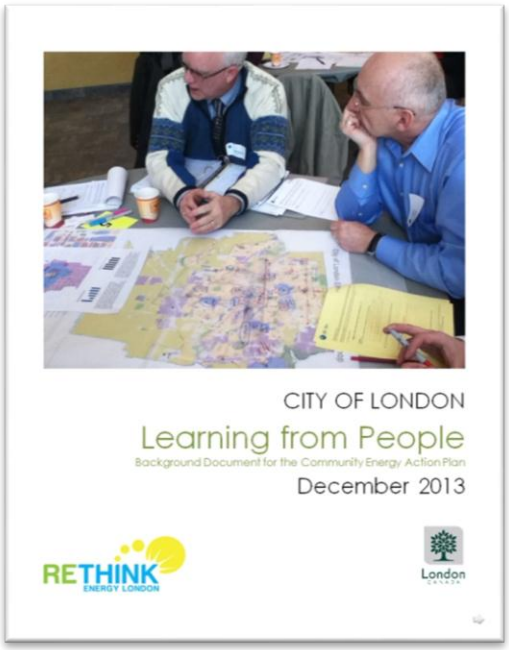
London's Community Energy Action Plan will be a "living document", in that the actions taken by the City of London and community stakeholders are expected to grow and change over time. In fact, we have chosen to deliberately leave sections of the draft action plan blank to remind

Londoners that we need to hear about what actions they are taking. We need to hear about your activities to complete this plan.

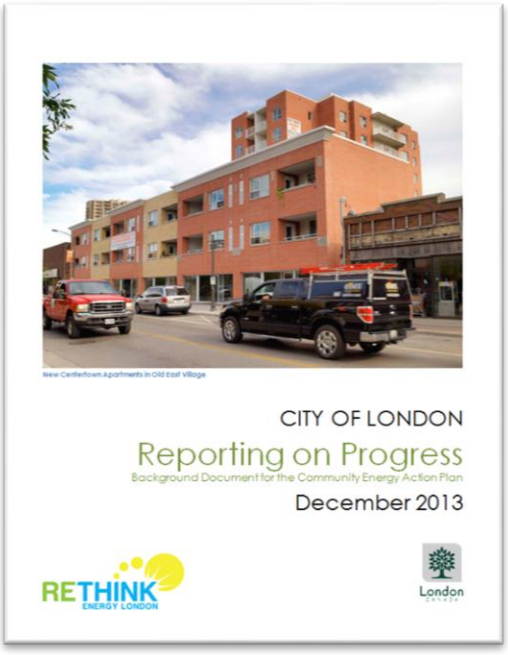
In order to keep the Community Energy Action Plan focussed on "just the actions", we have placed all of the plan's supporting information within the following documents:



Understanding the Data summarizes what City staff knows to date about "big picture" issues like climate change and global energy supply, as well as local information on how much energy we use, what we use it for, how much it costs to use it, and how much greenhouse gas emissions it creates. This document also talks about some of the information City staff has about the options we have in London to reduce energy use, reduce energy costs, reduce greenhouse gas emissions, and create jobs in the process.

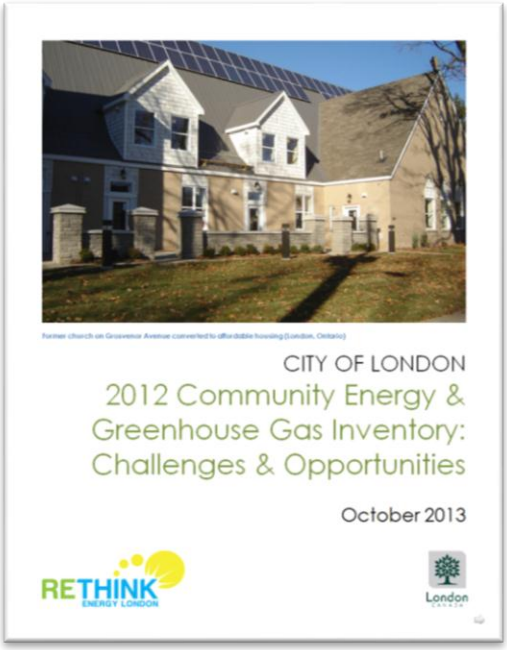


Learning from People summarizes what City staff learned through public engagement activities undertaken through Rethink Energy London, including London's Roundtable on the Environment and the Economy and the Community Energy Stakeholder Workshop, as well as community-led engagement activities.



Reporting on Progress outlines how Council and Londoners will be kept informed on progress made on the Community Energy Action Plan. This includes:

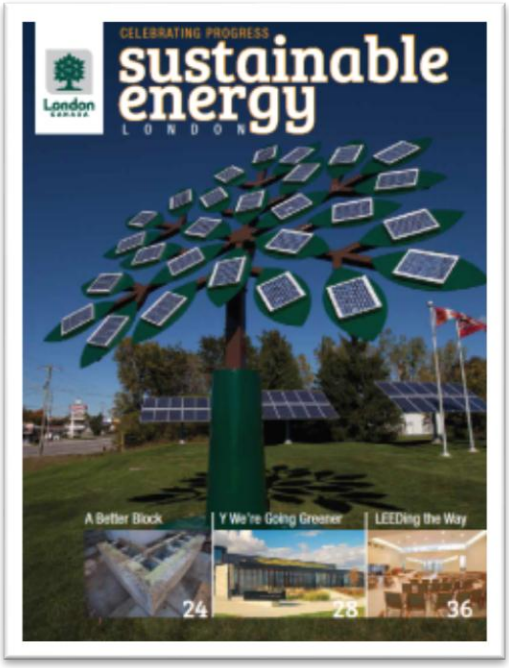
- annual *Community Energy & Greenhouse Gas Inventory Reports*
- Developing new progress indicators
- Open Source data solutions
- Reporting on progress for City of London community energy actions, and
- Recognizing progress made by Londoners



2012 Community Energy & Greenhouse Gas Inventory: Challenges & Opportunities provides an overview of London's 2012 annual energy consumption and greenhouse gas (GHG) emissions. This includes information on what energy commodities are used, which sector they are used in, and the estimated cost for using these commodities.

Celebrating Progress - Sustainable Energy London 2013 (and three minute video) is a publication that draws attention to energy conservation, energy efficiency, and renewable energy projects undertaken by London's energy stakeholders in recent years.

The publication illustrates the depth of projects and programs and serves as a showcase of the 'possible'. It can also be viewed as promotional piece for London's future in sustainable energy projects.



Many of the projects highlight what Londoners and London business have done to both reduce energy expenditures and/or localize the expenditures. These projects include examples of:

1. Harnessing the sun
2. Tapping into the Earth's energy
3. Capturing the wind
4. Changing the way we move
5. Using less energy
6. Leading the way

2. UNDERSTANDING THE DATA - THE PURPOSE

The purpose of this *Understanding the Data* document is to summarize all of the information that City staff have on hand regarding energy use in London and the associated environmental issues.

For issues at the global level, such as the science behind climate change and the global outlook for energy supply and security, City staff rely on the activities undertaken and information provided by recognized international and national entities.

The City of London is fortunate to have information on community energy use that goes back as far as 1990. Also, the *City of London Air Emissions Study*, prepared by SENES Consultants in association with Proctor and Redfern Limited and Torrie Smith Associates for the City of London's *Vision '96*, was completed in September 1995. This information was then updated in 2000 by the report *Air Emissions and Energy Use in the City of London*, prepared for the London Energy/Air Emissions Reduction Strategy Task Force. Since 2004, the City of London has maintained an annual inventory of community energy use and associated greenhouse gas emissions based upon this work.

The City is also fortunate to have participated in the Integrated Energy Mapping for Ontario Communities Project, prepared by the Canadian Urban Institute. This project provided a number of new tools to City staff, including a detailed spreadsheet model for energy use and greenhouse gas emissions in London, projections for energy use and emissions in 2030 for business-as-usual as well as two different efficiency scenarios, information on the cost-effectiveness and job creation for various strategies for efficiency scenarios, and a range of "energy maps" to assist in the development of targeted future actions.

3. THE BIG PICTURE – CLIMATE CHANGE AND ENERGY SUPPLY AT THE GLOBAL LEVEL

Before getting in to the detail about energy use and associated greenhouse gas emissions in London, Ontario, it is important to take stock of the most recent information about these issues at the global level.

3.1 ISN'T THERE A DEBATE ABOUT CLIMATE CHANGE – AND DOES THIS MATTER TO LONDON?

Yes and No.

Yes, there are still ongoing debates about climate change in the media, in academia, and in some political circles. However, in the science community, there is a "scientific consensus" that climate change is occurring and that human activities are largely to blame. The official statement from the United Nation's Intergovernmental Panel on Climate Change (IPCC) in the Fifth Assessment Report's *Summary for Policymakers* (September 2013) includes the following statements:

- *Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased.*
- *Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. In the Northern Hemisphere, 1983–2012 was likely the warmest 30-year period of the last 1400 years (medium confidence).*
- *Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent (high confidence).*
- *The atmospheric concentrations of carbon dioxide (CO_2), methane, and nitrous oxide have increased to levels unprecedented in at least the last 800,000 years. CO_2 concentrations have increased by 40 percent since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions. The ocean has absorbed about 30 percent of the emitted anthropogenic carbon dioxide, causing ocean acidification.*
- *Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing, observed warming, and understanding of the climate system.*
- *Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. This evidence for human influence has grown since the Fourth Assessment Report in 2007. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.*
- *Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.*

The vast majority of national and international scientific bodies and organizations support the position of the IPCC, and there are no national and international scientific bodies that take a dissenting position.

The following scientific bodies have issued statements that are "non-committal" on the human contribution to climate change. These are:

- American Association of Petroleum Geologists,
- American Geological Institute,
- American Institute of Professional Geologists, and
- Canadian Federation of Earth Sciences.

In terms of dissenting scientific opinions, there are only about 40 individual scientists who have gone on record with their opinions. Their dissenting opinions can be summarized in to the following four separate groups:

- The current models are not good enough to estimate future global climate to justify the ranges projected for temperature and sea-level rise over the next century;
- Observed global warming is more likely attributable to natural causes than to human activities;
- No principal cause can be ascribed to the observed rising temperatures, whether man-made or natural; and
- Rising global temperatures will be of little impact or a net positive for human society and/or the Earth's environment.

3.1.1 Does this Matter to London?

Yes it does.

The 2007 Environment Canada document, *From Impacts to Adaptation: Canada in a Changing Climate* provides information on climate trends to date and predictions of future impacts of climate change on London and southern Ontario. These impacts can be summarized as follows:

- By 2050, summer and fall rainfall are projected to decrease up to 10 percent;
- By 2050, winter precipitation is projected to increase around 10 percent;
- Increases in the frequency, and possibly the intensity, of extreme rainfall events are projected;
- Lake-effect snow may increase in the short- to medium-term as lake temperatures rise and winter air temperatures are still low enough to produce snow;
- By the end of the twenty-first century, lake-effect snowfall may decrease and be replaced by heavy lake-effect rainfall events;
- The annual average number of hot days with temperatures at or above 30°C could more than double by 2050, and more than triple by the 2080s; and
- Higher temperatures associated with climate change will increase the potential for smog formation, and also increase ambient air concentrations of pollen.

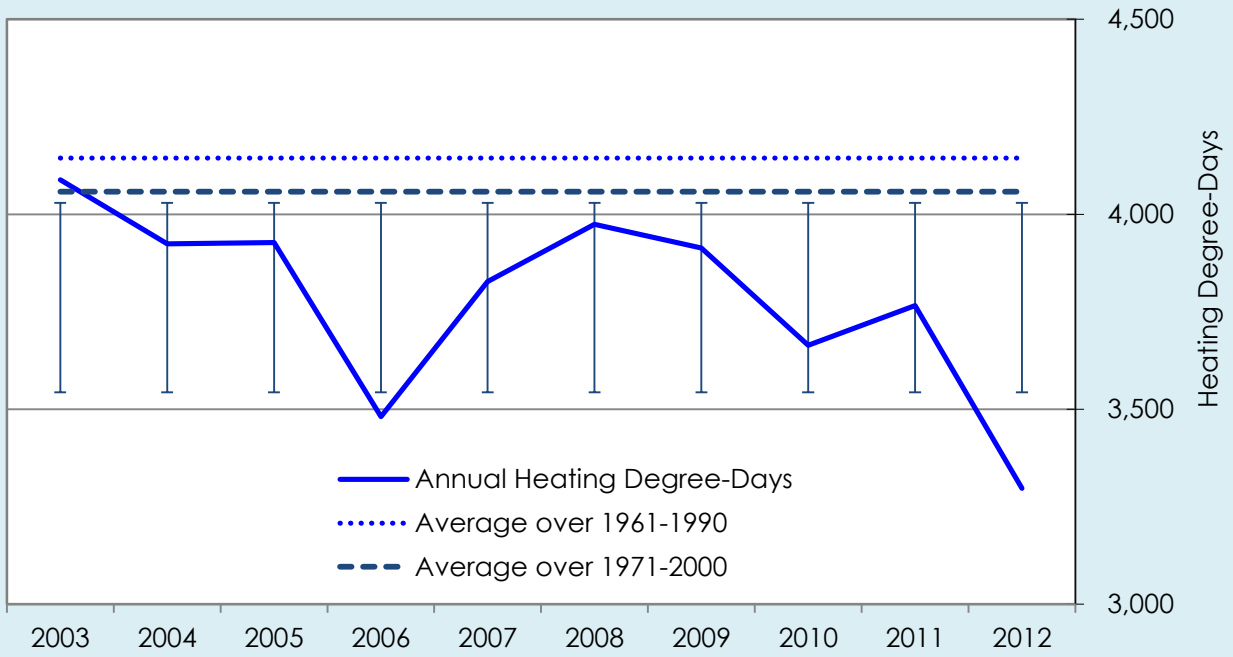
These predicted changes to the climate of southwestern Ontario will impact all aspects of living in London. Some aspects may be positive, such as an extended growing season for

local agriculture and reduced energy demand for space heating. However, any benefits will be offset by negative impacts like greater variability in rainfall and increased energy demand for air conditioning.

One of the ways that we can see the impact of changing climate has had here in London is by looking at the most recent trends in what Environment Canada calls "heating degree-days". These are based on the principle that if the average temperature over the day is significantly below 18 °C, you will need to turn the heating on. The bigger the difference, the harder your heating system has to work.

The following chart shows the trend for the last ten years compared to historical ranges.

Recent Trend for Winter Heating Needs in London



As can be seen from the chart, London's winters over the last ten years have definitely been warmer compared to winters in the latter half of the 20th century. In particular, "The Winter that Wasn't" in 2012 can be seen clearly.

"I've been in this business for over 40 years and it takes a lot for me to be surprised and shocked by weather," said David Phillips, senior climatologist with Environment Canada. "It's like snowing in July or a hurricane in Winnipeg - it's just not possible."

Source: National Post, March 30, 2012

City staff have worked with scientists at Western University to understand how predicted increases in intensity of extreme rainfall events could impact London. City staff are also working on a Climate Change Adaptation Initiative with the Middlesex-London Health Unit to

determine how predicted climate change could impact municipal services provided to Londoners.

It is also important not to lose sight of the potential indirect impacts that extreme weather events on other parts of Canada, North America, or the rest of the world, will have on London. Some examples include:

- Rising property insurance premiums, combined with reductions in insurance coverage related to weather events;
- Increased budget pressures on senior levels of government to address disaster response and climate change adaptation measures in Canada;
- Increasing economic losses associated with extreme weather events, due to property damage and lost productivity;
- Higher food prices as a result of higher likelihoods for droughts and other extreme weather events in agricultural regions; and
- Increased political instability in developing countries that lack the resources to address climate change impacts, with the higher likelihood for regional conflicts over water.

3.1.2 What Do Canadians Think about Climate Change?

Focus Canada 2013 - Canadian Public Opinion about Climate Change, is a partnership between the Environics Institute for Survey Research and the David Suzuki Foundation. This survey has been carried out since 2007, and provides information on trends in public opinion on different aspects of climate change. Some key findings from this recent survey, carried out between October 1st to 17th, 2013, include:

- *Six in ten Canadians now believe that climate change is real and caused by human activity, up marginally over the past year and continuing an upward trend dating back to 2010. Those not yet certain about the science remain divided on whether it is best to take action now or wait until we know more.*
- *One in four (23%) now say climate change is real but do not feel the science proves humans are the main cause (down 5 points since 2012), while one in ten (12%) continue to be skeptical about the scientific evidence (largely unchanged since 2007).*
- *Opinions differ somewhat across the country. Belief in the science of climate change is most widespread in Quebec (66%) and Atlantic Canada (65%), followed by Ontario (61%) and B.C. (59%). This view is least apt to be shared in Manitoba/Saskatchewan (52%) and Alberta (47%, where 17 percent are skeptical about the reality of climate change.*
- *Education continues to be the strongest predictor of belief in climate change, although the gap has narrowed over the past 12 months as this view has strengthened among Canadians without post-secondary education.*
- *Canadians who are not convinced of the scientific reality of climate change remain divided on how best to deal with the uncertainty surrounding the issue. Half (50%) of this group continue to say we should take strong actions now to reduce the chances of a worst case scenario (versus 52% in 2012), while 45 percent think it is best to hold off taking action until stronger evidence emerges of what may happen in the future (unchanged).*

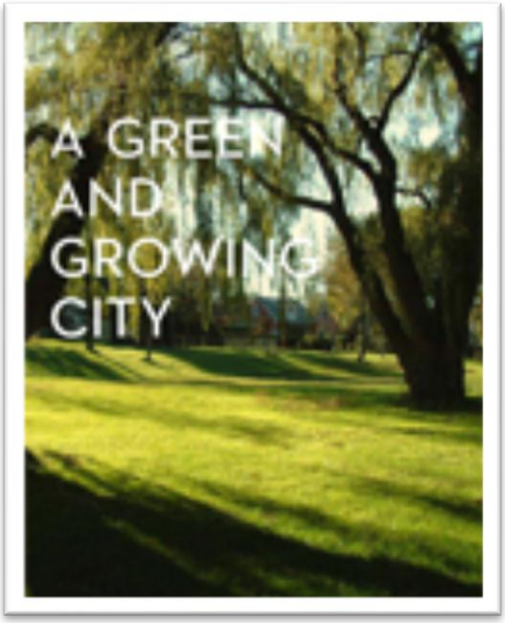
- *Close to eight in ten believe that climate change is definitely (48% or likely (38%) causing melting permafrost and sea ice in the arctic. The public is somewhat less likely to see climate change being the cause of more flooding of rivers and coastal areas (76%), more frequent and intense storms (71%), and increased drought conditions (72%) in Canada.*
- *Canadians continue to believe the most essential progress on addressing climate change must come from government standards and regulations, rather than through the voluntary actions of industry or consumers. But confidence in government leadership has weakened noticeably over the past 12 months.*
- *A majority (56%) agree with the view that the solutions are now well known but that society is not ready to move ahead with them, compared with 38 percent who believe the solutions are not yet well enough understood to justify clear action.*
- *A strong majority of Canadians believe it is possible for their province to shift its energy resources from fossil fuels to renewable power… …In Ontario – where there has been considerable controversy over the implementation the province's Green Energy Act – opinions remain stable with 68 percent of residents saying their province can make the shift to renewable power.*

3.1.3 What If I Don't Believe In or Care About Climate Change?

It is of interest to note that the *Focus Canada 2013* survey found that half of those people who were not convinced on the science of climate change "continue to say we should take strong actions now to reduce the chances of a worst case scenario". In the engineering, health, and legal professions, this is often referred to as the "precautionary principle", in that if there's the potential for something bad to happen, you have to assume that it can happen and do everything you can reasonably do to prevent it or protect people from it.

What about the other half, who "think it is best to hold off taking action until stronger evidence emerges of what may happen in the future"? Are there other issues related to climate change that they would support taking action now? Examples of some of the benefits related to a wide range of greenhouse gas reduction actions include:

- Attracting & retaining young entrepreneurs
- Attractive streetscapes
- Comfortable buildings
- Demand for "green" products & services
- Energy conservation
- Energy security
- Improved physical health
- Reduced air pollution
- Reduced obesity
- Saving money
- Stronger neighbourhoods
- Walkable & bike-friendly communities



3.2 Are We Running Out of Oil?

Yes and No.

Yes, in that oil and other fossil fuels like natural gas and coal are finite resources upon which global demands keep rising.

However, national and international energy boards and agencies do not report any immediate concerns about the ability to supply oil and other key energy commodities for the next 20 years. The most recent reports from the International Energy Agency (IEA), the United States Energy Information Administration (USEIA), and Canada's National Energy Board are outlined below. All three do assume that oil and other energy commodities will become more expensive over time.

3.2.1 International Energy Agency's World Energy Outlook 2013

The recent edition of the International Energy Agency's *World Energy Outlook 2013*, issued in November 2013, included the following:

- *Many of the long-held tenets of the energy sector are being rewritten. Major importers are becoming exporters, while countries long-defined as major energy exporters are also becoming leading centres of global demand growth. The right combination of policies and technologies is proving that the links between economic growth, energy demand and energy-related CO_2 emissions can be weakened.*
- *As the source of two-thirds of global greenhouse-gas emissions, the energy sector will be pivotal in determining whether or not climate change goals are achieved… …In our central scenario, taking into account the impact of measures already announced by governments to improve energy efficiency, support renewables, reduce fossil-fuel subsidies and, in some cases, to put a price on carbon, energy-related CO_2 emissions still rise by 20% to 2035. This leaves the world on a trajectory consistent with a long-term average temperature increase of 3.6°C, far above the internationally agreed 2°C target.*
- *A renewed focus on energy efficiency is taking hold and is set to deliver benefits that extend well beyond improvements in competitiveness… …As well as bringing down costs for industry, efficiency measures mitigate the impact of energy prices on household budgets and on import bills. But the potential for energy efficiency is still far from exhausted: two-thirds of the economic potential of energy efficiency is set to remain untapped in our central scenario.*
- *The capacity of technologies to unlock new types of resources, such as light tight oil (LTO) and ultra-deepwater fields, and to improve recovery rates in existing fields is pushing up estimates of the amount of oil that remains to be produced. But this does not mean that the world is on the cusp of a new era of oil abundance. An oil price that rises steadily to $128 per barrel (in year-2012 dollars) in 2035 supports the development of these new resources, though no country replicates the level of success with LTO that is making the United States the largest global oil producer.*
- *Renewables account for nearly half of the increase in global power generation to 2035, with variable sources – wind and solar photovoltaics – making up 45% of the expansion in renewables.*

In summary:

"Major changes are emerging in the energy world in response to shifts in economic growth, efforts at decarbonisation and technological breakthroughs," said IEA Executive Director Maria van der Hoeven. "We have the tools to deal with such profound market change. Those that anticipate global energy developments successfully can derive an advantage, while those that do not risk taking poor policy and investment decisions."

Source: International Energy Agency, Press Release, November 12, 2013

3.2.2 United States Energy Information Administration - Annual Energy Outlook 2013

A similar outlook is also presented by the United States Energy Information Administration in their *Annual Energy Outlook 2013*, where their Reference Case (which assumes a gradual increase in the price of oil in 2011 dollars from about $95 to about $130 per barrel by 2030) included the following key results:

- *Continued strong growth in domestic crude oil production over the next decade—largely as a result of rising production from tight formations—and increased domestic production of natural gas;*
- *Evolving natural gas markets that spur increased use of natural gas for electric power generation and transportation and an expanding natural gas export market;*
- *A decline in motor gasoline consumption over the projection period, reflecting the effects of more stringent corporate average fuel economy (CAFE) standards, as well as growth in diesel fuel consumption and increased use of natural gas to power heavy-duty vehicles; and*
- *Low electricity demand growth, and continued increases in electricity generation capacity fueled by natural gas and renewable energy, which when combined with environmental regulations put pressure on coal use in the electric power sector. In some cases, coal's share of total electricity generation falls below the natural gas share through the end of the projection period.*

3.2.3 Canada's Energy Future: Energy Supply and Demand Projections to 2035

In November 2013, Canada's National Energy Board released its report, *Canada's Energy Future 2013: Energy Supply and Demand Projections to 2035*. This report used a reference case, which is based on the current economic projections, energy prices, and federal and provincial government policies and programs that were in place or are expected to be in place. The reference case assumes a slow but gradual increase in the price of oil, in 2012 dollars, from $90 to about $110 per barrel by 2035. The report's main conclusions are:

- *Canada has vast energy resources. The oil and natural gas resource base is large enough to meet Canadian needs for many generations, and abundant hydroelectric resources account for the majority of the electricity mix.*

- *Oil production leads this growth, with 2035 production reaching 928 million cubic metres per day (5.8 million barrels per day), or nearly 75 per cent higher than in 2012. In situ oil sands production makes up the majority of the increase. Natural gas production increases 25 per cent above current levels by 2035, led by higher levels of tight and shale gas development.*

- *Canadian electricity supply also steadily increases over the projection period. Natural gas-fired power generation capacity increases substantially. Coal-fired generation capacity declines, largely a result of federal and provincial regulations. Non-hydro renewable capacity doubles its share of Canada's electricity capacity mix. Total electricity generation increases 27 per cent over the projection period.*

- *Hydrocarbons continue to be the main source of energy to heat homes and businesses, transport people and goods, and many other functions that are integral to Canadians' standard of living. Canadian demand for oil and natural gas increases by 28 per cent over the projection period. Emerging fuels and technologies, such as solar hot water heating and electric vehicles, continue to gain market share.*

- *By 2035, the energy used per unit of economic output is projected to be 20 per cent lower than in 2012, due to improvements in energy efficiency. In a reversal of the long-term trend, passenger transportation energy use declines over the projection, largely due to new passenger vehicle emission standards which are expected to improve vehicle fuel efficiency.*

3.2.4 Information Related to Peak Oil

There have been a few national governments or agencies of governments that have formally investigated the potential impacts of constraints to global oil supply, such as:

- US Department of Energy, Peaking of World Oil Production: Impacts, Mitigation, & Risk Management (2005)
- UK Energy Research Centre, The Global Oil Depletion Report (2009)
- New Zealand Parliament, The Next Oil Shock? (2010)

There have also been studies carried out by military organizations focused on the national security risks associated with energy-dependent modern societies facing interruptions in the supply of oil.

- US Joint Forces Command, Joint Operating Environment 2010
- German Bundeswehr Transformation Centre, Peak Oil (2010)

A number of economists, such as Jeff Rubin, the former Chief Economist at CIBC World Markets, focus on the interrelationship between oil prices and economic growth, namely that high oil prices suppress economic activity:

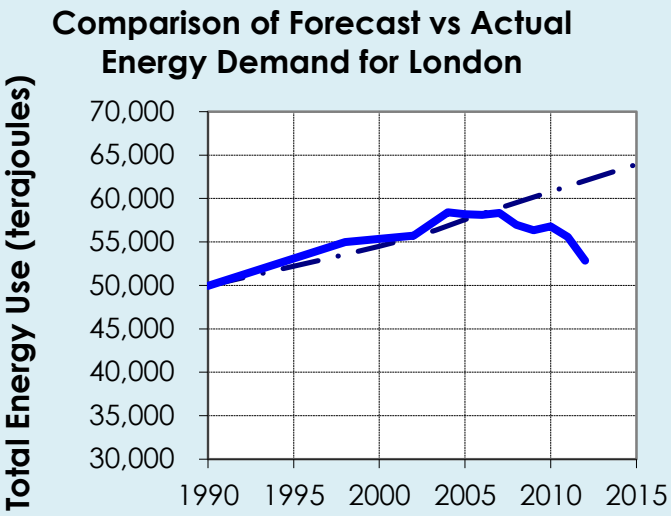
"It doesn't really matter whether the US drills for its own oil, gets it from Canada, or ships it in from Venezuela or the Middle East. Hostile or friendly, no foreign supplier has turned off the spigot. At least not since the last OPEC oil shock three decades ago. The problem for oil consumers right now isn't the availability of the fuel, but the price needed to get it out of the ground. Unfortunately, that's already more than we can afford."

Source: The Price for Energy Independence - http://www.jeffrubinssmallerworld.com

Non-government organizations such as the Association for the Study of Peak Oil and Gas (ASPO) take the position that national and international energy bodies like the IEA and USEIA use optimistic assumptions regarding the quantities of existing conventional oil and gas reserves (particularly those stated for OPEC countries), and the ability to draw upon unconventional reserves such as tight oil/gas and the oil sands.

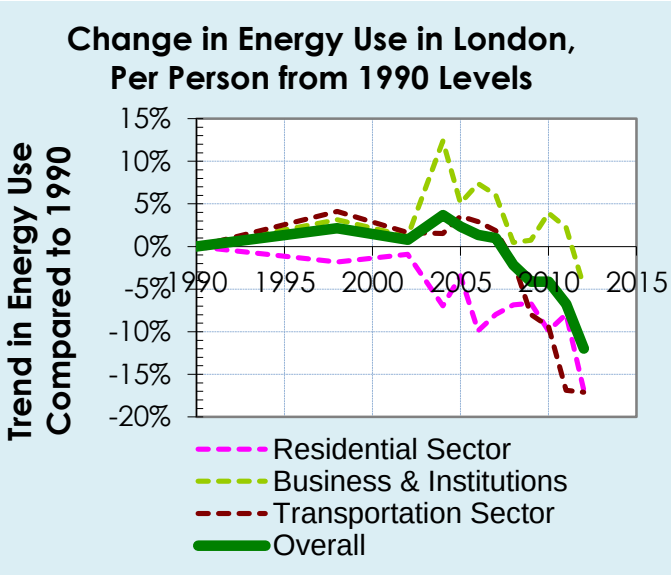
4. COMMUNITY ENERGY USE TRENDS SINCE 1990

Between 1990 and 2005, the total amount of energy used in London generally grew as fast as London grew in terms of population. However, starting in 2005, this trend started to change. At first, we saw that the total amount of energy used was levelling off. Then in 2008, total energy use saw its first annual drop.



In 2008, the global price of oil hit $147 a barrel, which resulted in gasoline prices approaching $1.40 per litre in London. These higher fuel prices resulted in a four percent drop in the retail sales of fuel in 2008 in London. Every year since 2008, we have seen the retail sales of fuel decline. By 2011, Londoners on average were using over 10 percent less fuel than they were in 1990.

Also, starting in 2003, we began to see the amount of energy used in single family homes start to drop. The pace of this increased after 2005, with home energy retrofit incentive programs (*EnerGuide for Houses, ecoENERGY Retrofit for Houses*), tax rebates for renovations, and *ENERGY STAR®* appliance incentives encouraging Londoners to fix up their homes. In addition, the London Home Builders Association has been a strong promoter of energy efficiency in new homes, such as *ENERGY STAR® New Homes* and the *London Energy Efficiency Partnership (LEEP) Project*. By 2012, Londoners on average were using over 10 percent less energy at home than they were in 1990.



The global recession that started in late 2008 and continued on in to 2009 was a contributing factor to recent energy use reductions in energy used in the employment sector. Although, generally speaking, the employment sector has seen the least improvement in energy efficiency overall, there are notable examples of local businesses and insitutions making significant improvements in energy efficiency. Many of these local successes are highlighted in , as described in *Celebrating Progress - Sustainable Energy London 2013*.

5. COMMUNITY GREENHOUSE GAS EMISSION TRENDS SINCE 1990

Between 1990 and 2002, estimated greenhouse gas emissions from London increased by 15 percent, a pace slightly faster than the increase in energy use due to increased use of coal for power generation in Ontario during that same period of time.

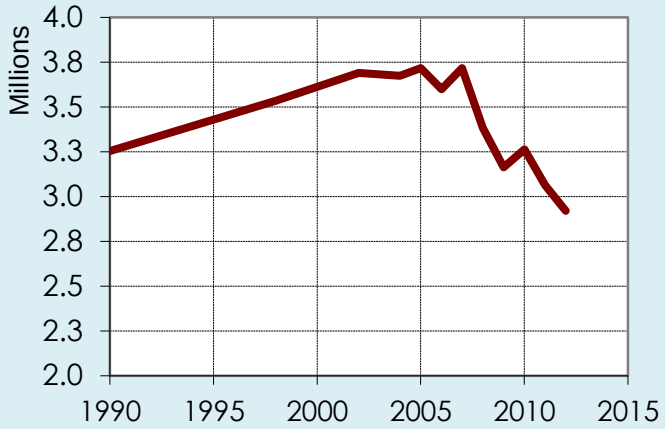
Starting in 2004, London's greenhouse gas emissions stabilized and then started to decrease slightly.

With the oil price spike in 2008, reduced fuel use resulted in lower emissions. Also, as noted above, a decrease in residential energy use also helped reduce emissions.

In addition, refurbished nuclear power generators, as well as new gas-fired power plants, started to come on to the grid in Ontario. Combined with electricity conservation measures, along with reduced electricity demand from the economic recession, the amount of coal required for power generation has dropped dramatically. As a result, electricity today is about three times "cleaner" than it was in 2002.

In total, London's greenhouse gas emissions in 2012 were ten percent lower than they were in 1990 and 21 percent lower than emissions in 2002.

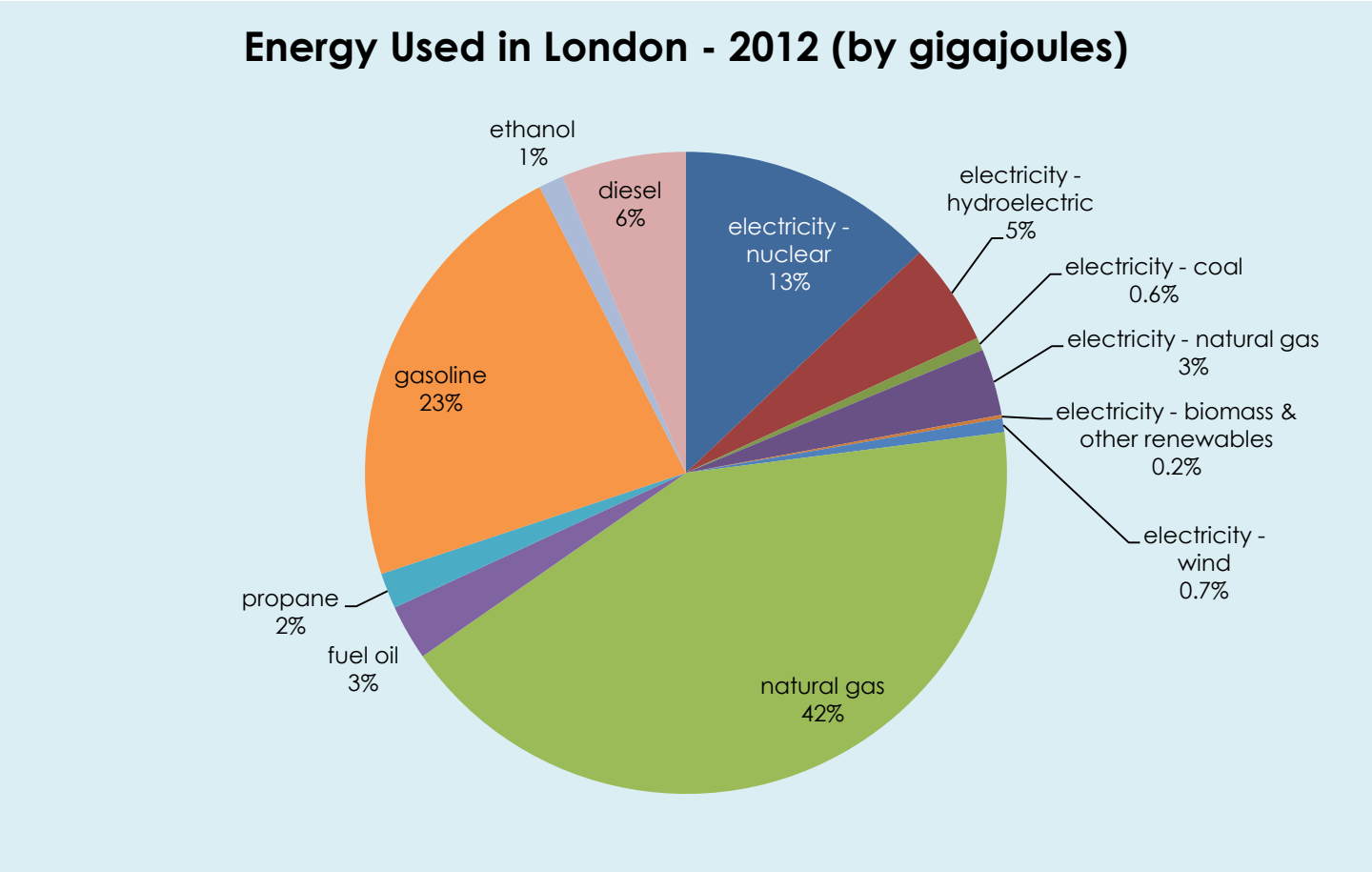
Total Greenhouse Gas Emissions from London (tonnes CO_2e/year)



6. ENERGY USE TODAY

6.1 SOURCES OF ENERGY USED

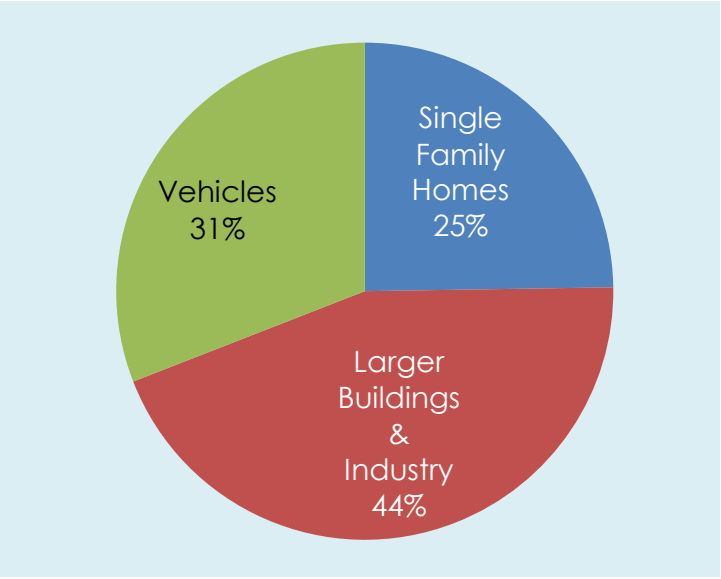
When most people think of energy, they tend to think about electricity and gasoline. People interact with electricity every day, when they flick a light switch or press the power button on the remote for their TV. People also have to fill their car's gas tank every week or so. They get a reminder every time they fill up that gas is more expensive today than it used to be.



However, from total units of energy consumed perspective, the most important source of energy we use in London is actually natural gas. Natural gas is primarily used for heating buildings and making hot water. It is also an important source of heat for making steam and other industrial processes requiring heat. As well, natural gas is being used more and more for "co-generating" heat and electricity at the same time. Cogeneration is being used in London by London District Energy, London Health Sciences Centre, Labatt Brewery, and Ingredion (formerly Casco).

Not surprisingly, gasoline (including ethanol-blended gasoline, which contains 10% ethanol) is the second most important source of energy we use in London, most of which is used for fuelling personal vehicles.

Electricity accounts for under one quarter of London's energy needs, and electricity is generated using a number of energy sources. Nuclear power, hydro-electric dams, and gas-fired power plants account for most of the electricity generated in Ontario. The Province of Ontario has plans to phase out coal-fired power plants by 2014. Under the Province's Green Energy Act, the Feed-In Tariff (FIT) and microFIT programs are encouraging the development of wind, solar, biomass, biogas, landfill gas, and small hydro power generation.

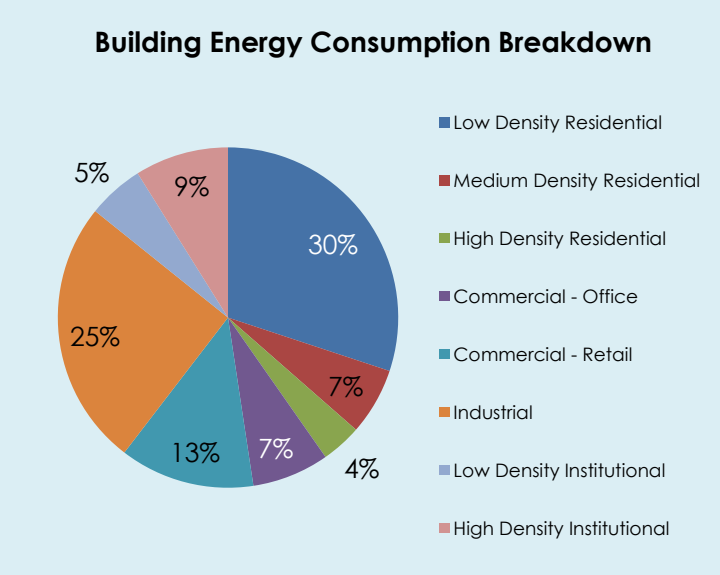


Diesel is the primary fuel used for heavy-duty vehicles, such as trucks and buses. Diesel fuel is also used in some imported European cars, where diesel fuelled vehicles are more popular. As a fuel, diesel has a higher "energy density" than gasoline, which means that diesel fuelled vehicles tend to have higher fuel economy

6.2 Where This Energy is Used

The major sectors where energy is used in London are single family homes, larger buildings (apartment building & condos, office buildings, stores, industrial buildings), and transportation (personal vehicles and fleet vehicles). Given that most of the transportation energy used is for personal vehicles, one can simplify this further by saying that there's roughly a 50:50 split in energy use between London's households (at home and on the road) and London's employers.

From the *Integrated Energy Mapping for Ontario Communities* Project, prepared by the Canadian Urban Institute for the City of London, we were able to match up 2008 utility data with property information to get a better picture of where energy was being used in London.

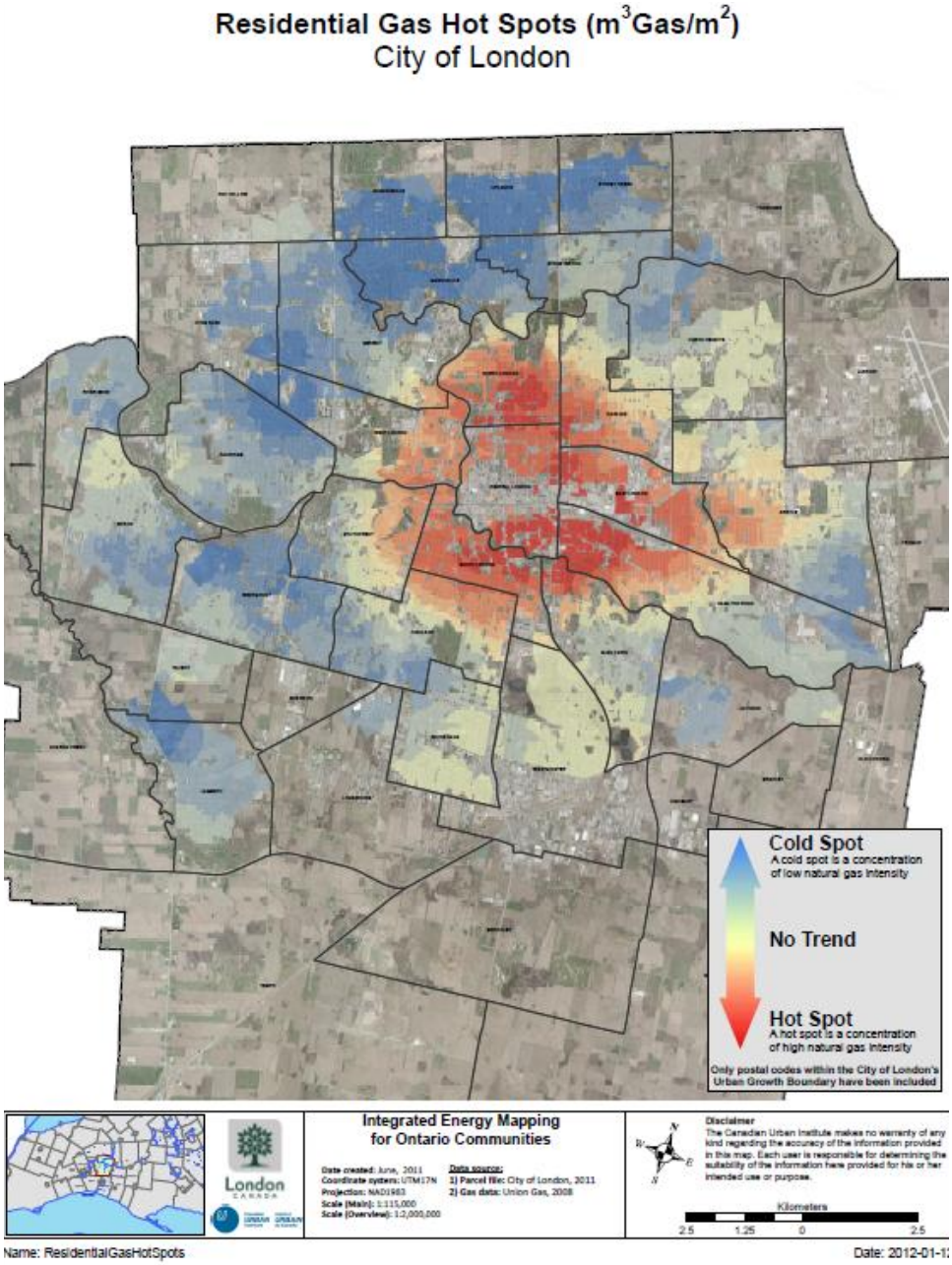


In terms of building types, we now have a more detailed breakdown by types and sizes of buildings. This helps us better set priorities for the types of buildings that we need to focus on.

The energy mapping project also provided a

number of maps that illustrated where energy is being used in London. The maps that we have found to be of greatest value are the ones that show the energy efficiency of single family homes (low density residential) throughout London for natural gas use and electricity use. This information is being used to help focus energy efficiency and conservation efforts on those homes that need it the most – the red "hot spots" on the maps.

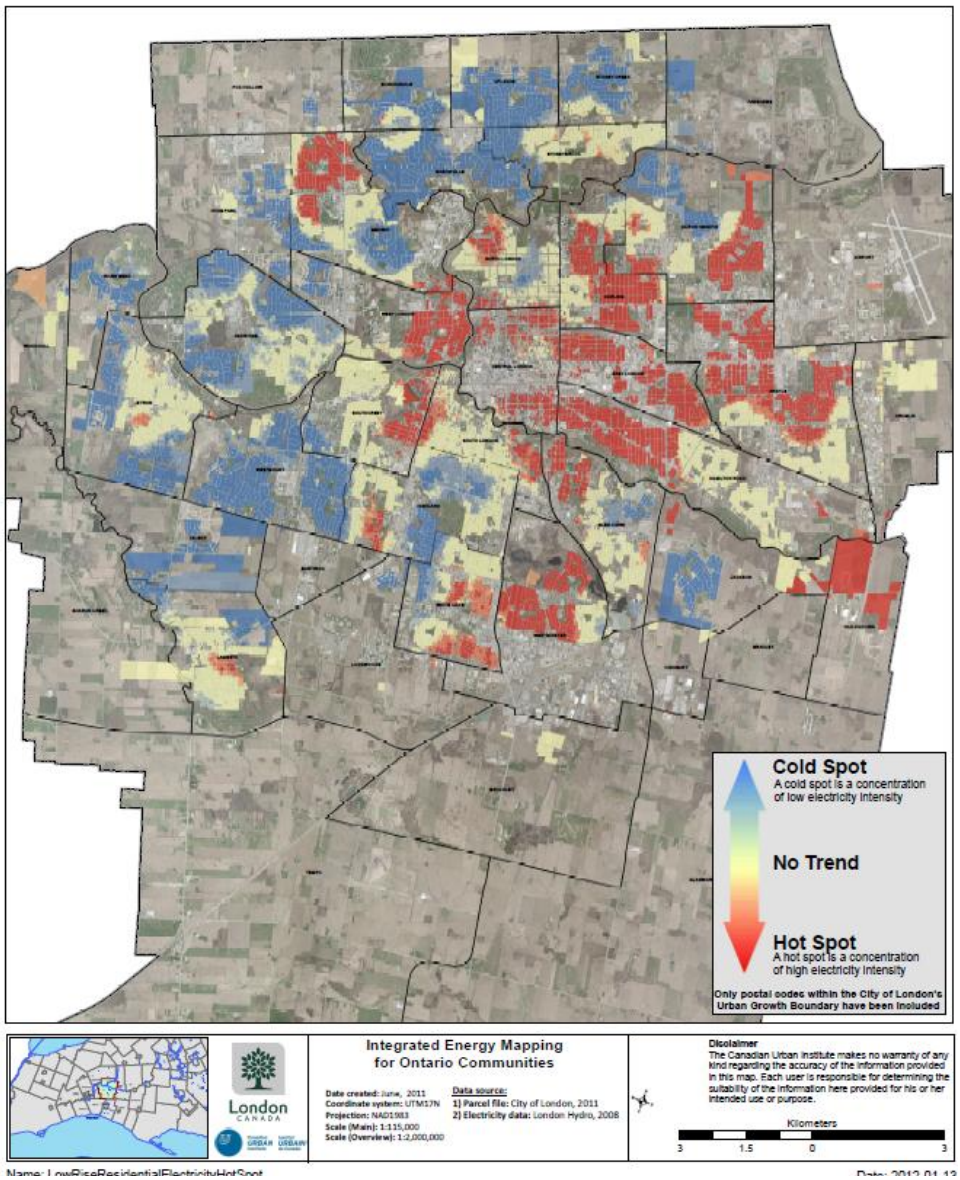
As can be seen from the natural gas energy map, the energy efficiency of London's housing stock for natural gas use roughly follows the age of the house, with older homes generally having below average energy efficiency. It is possible to pick out those older neighbourhoods where homes have been renovated, such as Old South, Woodfield, and Old North as being less of a hot spot (i.e., a lighter shade of red) for gas use than other older neighbourhoods.



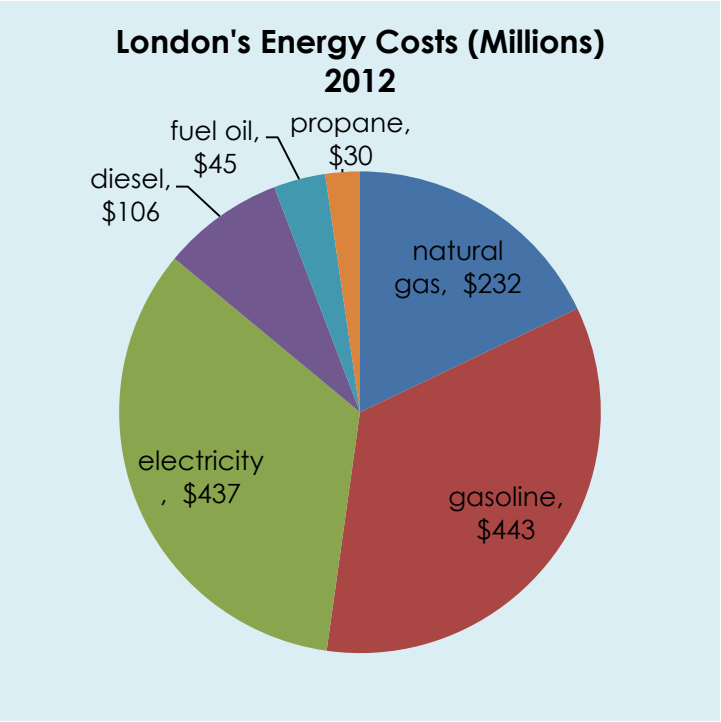
This pattern can also be seen more distinctly in these neighbourhoods with the electricity energy map. Improvements to appliances, insulation, draft proofing and air conditioning units in parts of these old neighbourhoods show up as being average or above average electricity efficiency. Neighbourhoods with electrically heated homes built in the 1970s are also easy to identify as electricity "hot spots".

Neighbourhoods with the newest homes tend to have above average energy efficiency on both maps, shown as the blue "cold spots". This is the result of improved building codes over time, as well as the voluntary adoption of energy efficiency programs such as ENERGY STAR® by local home builders.

Low-Rise Residential Electricity Hot Spot (kWh/m^2)
City of London



7. COST OF ENERGY USED

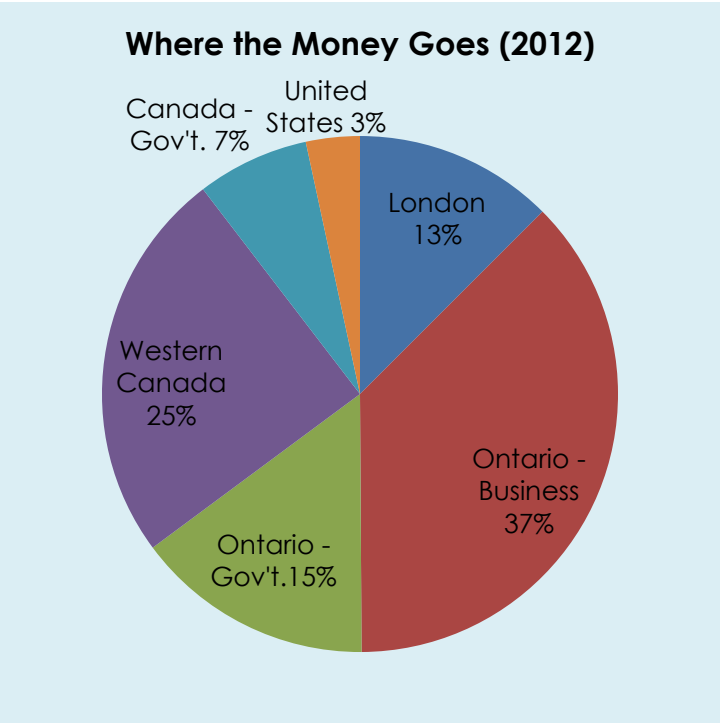


Using information on average fuel costs in London and the utility costs for electricity and natural gas, City staff estimate that Londoners spent about **$1.3 billion** on energy in 2012. Additional information can be found in the *2012 Community Energy & Greenhouse Gas Inventory: Challenges & Opportunities*.

Electricity costs in Ontario have increased in recent years, due to upgrading old transmission lines, refurbishing nuclear power plants, and replacing coal-fired power plants with cleaner sources of electricity (i.e., hydro-electric, natural gas, and renewables). These costs are expected to increase further in the near future as this work continues.

As discussed earlier, the global price of oil increased dramatically in 2008, and prices today are still well above where they were ten years ago. Oil prices are expected to continue to increase in the future as global demand for oil increases, and cheaper sources of oil are depleted.

Natural gas prices are actually significantly lower today than they were five years ago, as a result of new shale gas deposits being tapped in North America as well as lower industrial demand due to the economic recession and recovery. As a result of these low prices, natural gas is starting to replace coal for power generation in the United States. Over the long term, this could cause the price of natural gas to increase.



Out of the $1.3 billion spent on energy in 2012, it is estimated that about 13 percent of this money stayed in London, of which most of this went towards London Hydro's and Union Gas's local operations.

Almost 40 percent went to other parts of

Ontario, for power generators and transmission lines, oil refineries in Sarnia, and natural gas storage and transmission.

Money collected from federal and provincial taxes and other utility bill fees do also help pay for other government services in London. For example, the City of London gets a portion of the gasoline tax to help pay for improvements to local transportation and other infrastructure. Also, energy conservation incentives offered by utility companies are also funded through utility bills, as it is more economical to invest in conserving energy rather than producing more energy.

Almost every dollar spent on electricity stays in Ontario. However, over one-third of our energy dollars for fossil fuels goes to Western Canada. On the positive side, at least most of this money stays in Canada. However, London would be better off keeping more of its money in London. Money saved through energy efficiency and conservation can be used for other purposes, whether that's paying down debts faster or purchasing other goods and services. Investing in energy saving retrofits also creates local jobs for contractors. London can also keep more energy dollars in the community through investment in local energy production.

City staff recognize that more work needs to be done to refine the economic aspects of energy use in London.

8. BUILDING THE RIGHT ENERGY CONSERVATION AND GREENHOUSE GAS REDUCTION MILESTONES FOR LONDON

In order to determine what should be included within our *Community Energy Action Plan*, we need to look at what information we have on hand now and what we need to develop.

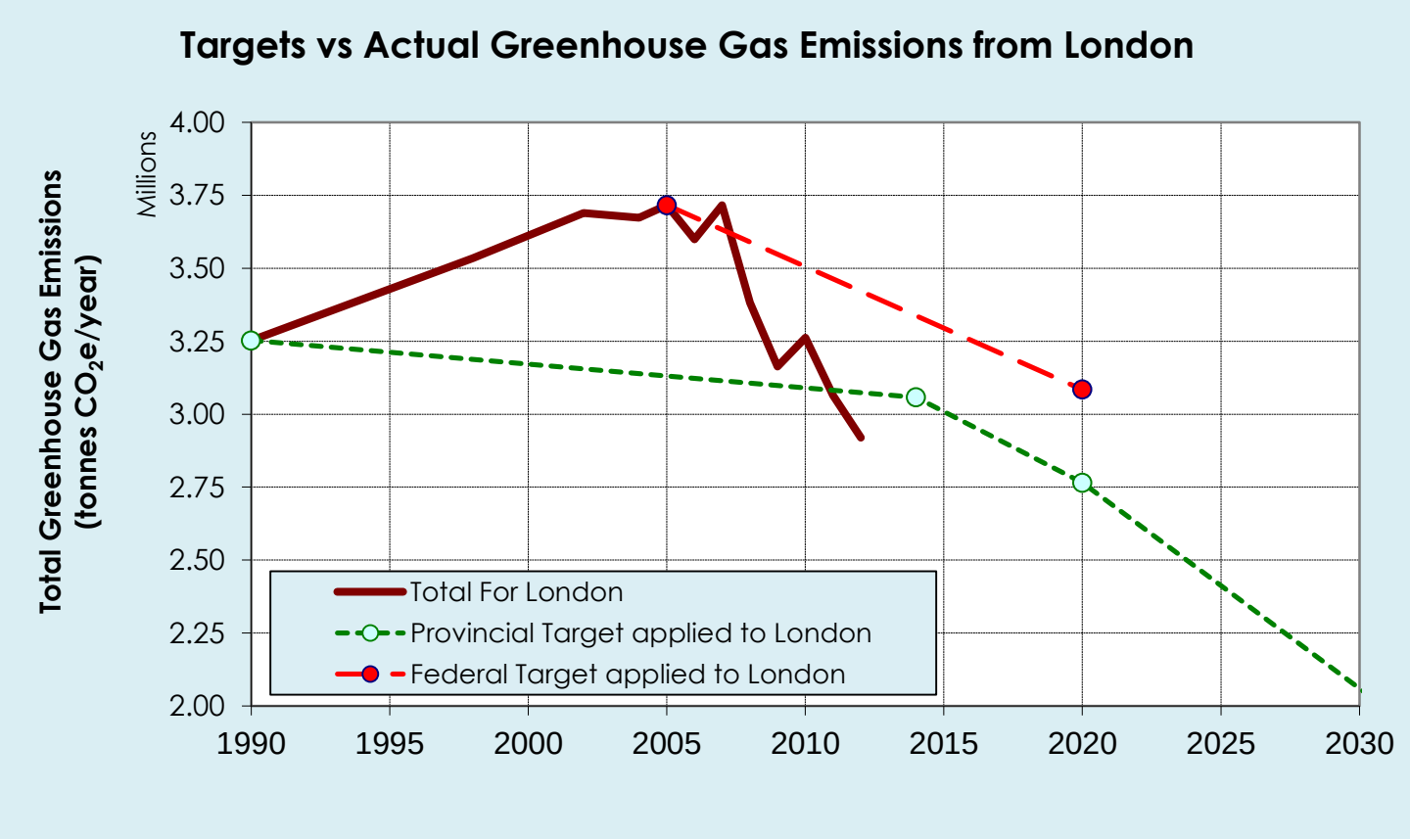
8.1 What Information and Analytical Tools are Available Today

8.1.1 Federal & Provincial Greenhouse Gas Emission Reduction Targets

There are a number of objectives being discussed in Canada and Ontario heading towards the years 2020 and 2050:

- Canada's Action on Climate Change calls for a 17 percent reduction in greenhouse gas emissions from 2005 levels by 2020.
- Ontario's Climate Change Action Plan calls for a six percent reduction in greenhouse gas emissions from 1990 levels by 2014, 15 percent by 2020 and 80 percent by 2050.

Of the two senior levels of government, the provincial goals are more aggressive than the federal goals.

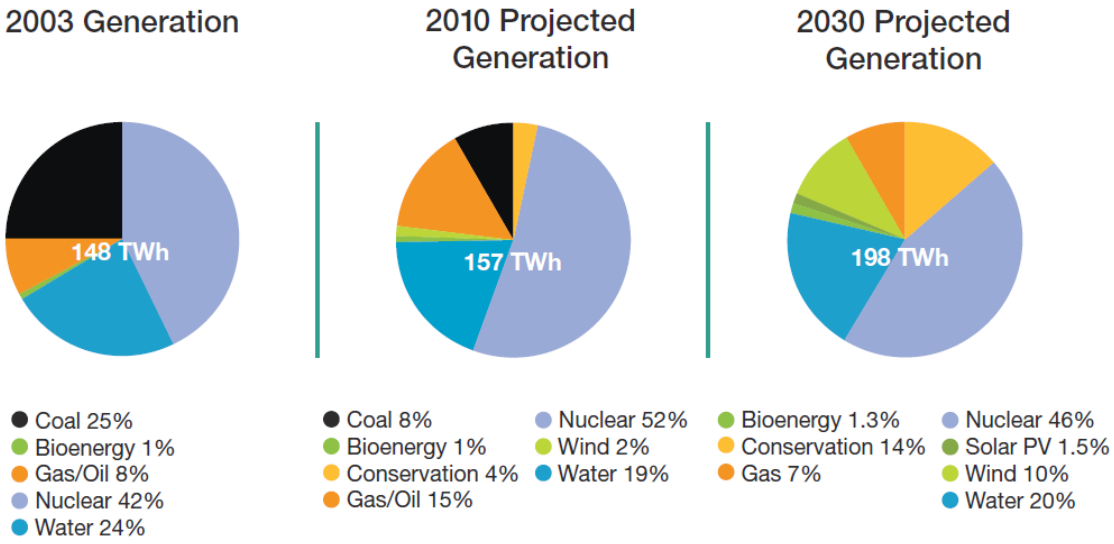


When federal and provincial targets are applied to London's greenhouse gas emissions, our trend is close to the track set out by Ontario. However, longer term provincial emission reduction goals become more challenging past 2014 and even more so after 2020.

8.1.2 Federal & Provincial Actions

The federal climate change regulations which will have the biggest impact on London are the *Renewable Fuels Regulations* and the *Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations*. As of December 15, 2010, gasoline is required to contain an average five percent renewable content (ethanol) and diesel fuel is required to have a two percent renewable fuel content (biodiesel). Also, it is projected that the average greenhouse gas emissions from 2016 vehicles will be 25 percent lower than from those vehicles sold in 2008.

The province's *Long Term Energy Plan* and the associated *Green Energy Act* will have the biggest impact on London. In Ontario, the province has set out its *Long-Term Energy Plan* for the province's electricity supply for 2030.



Source: Ontario Ministry of Energy

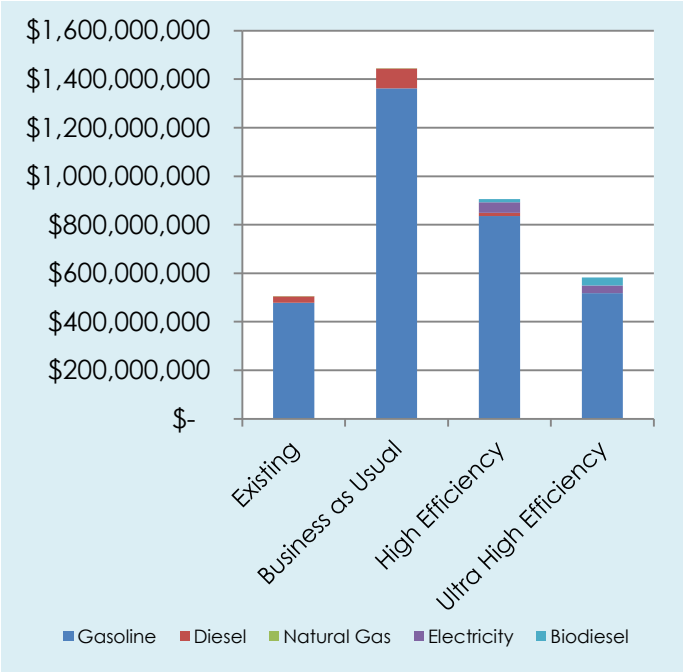
In this plan, nuclear and hydro-electric plants still form the core of Ontario's electricity supply. The province is aiming to keep nuclear power at approximately 50 percent of the province's electricity supply, and plans to grow its hydro-electric capacity with a target of 9,000 megawatts. Coal is planned to be phased out by 2014. Conservation will help temper the growing demand for electricity, and new demand needs are met by wind, solar photovoltaic (PV), and bioenergy (biomass, biogas, and landfill gas). Ontario's target for renewable electricity generation is 10,700 megawatts of capacity by 2018, which is currently being developed through the *Green Energy Act* and the associated Feed-In Tariff program.

The new *Ontario Building Code*, which came in to effect in 2012, increased the energy efficiency standards to which new homes and buildings are built, tempering the growing demand for both natural gas and electricity use. The Ontario Energy Board also requires electricity and natural gas utility companies to develop conservation and demand management programs.

Regarding transportation fuels, the province's *Electric Vehicles - A Plan for a Greener Ontario* provides purchasing incentive for Plug-In Hybrid Electric Vehicles (PHEVs) and Battery Electric Vehicles (BEVs). The province also has a goal to purchase 500 electric vehicles for the Ontario Public Service by 2020.

8.1.3 Projections for Future Transportation Energy Use in London

As part of the work under the *Integrated Energy Mapping for Ontario Communities* project, the Canadian Urban Institute developed a complex spreadsheet model of London's current (2008) and future (2030) transportation energy use. Data from the *Smart Moves 2030 Transportation Master Plan* were used as the basis for the transportation energy use model. Three different transportation scenarios were developed, looking at the impact of future use of biofuels, fuel efficiency, and travel modes. This energy use model was modified to take in to account information on the retail sales of fuel in London.



In terms of transportation energy use, we were unable to assess the cost of various transportation strategies (e.g., purchasing more fuel-efficient vehicles). However, we were able to estimate future energy costs and the energy savings associated with various strategies.

Under a business-as-usual scenario for 2030, total transportation energy costs could almost triple to over $1.4 billion per year, and greenhouse gas emissions would increase by around 160,000 tonnes per year. Using more fuel-efficient vehicles and reducing vehicle trips helps to contain these costs and reduces London's greenhouse gas emissions as well. The results are summarized in the table below.

	Transportation Energy & GHG Reduction Scenarios		
	1. Business As Usual	**2. High-Efficiency Improvements**	**3. Ultrahigh-Efficiency Improvements**
Transit trips	10% of trips	15% of trips	20% of trips
Walking & cycling trips	9% of trips	11% of trips	13% of trips
Vehicle fuel efficiency	Same as 2010	25% improvement	50% improvement
Number of trips	Same as 2010	5% decrease	10% decrease
Length of trips	Same as 2010	5% decrease	10% decrease
Annual fuel cost by 2030	$1.4 billion	$900 million	$600 million
GHG reductions by 2030	**up** 160,000 tonnes/year	260,000 tonnes/year	520,000 tonnes/year

8.1.4 Projections for Future Buildings & Renewable Energy Use in London

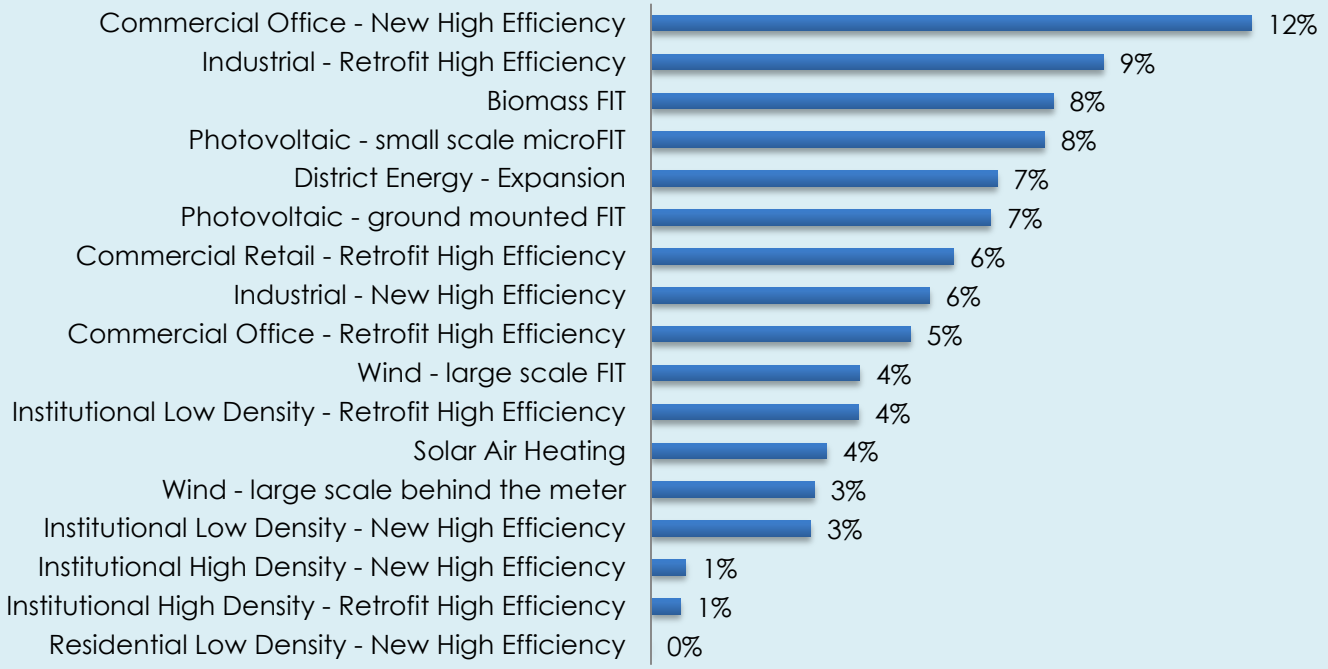
As part of the work under the *Integrated Energy Mapping for Ontario Communities* project, the Canadian Urban Institute also developed a complex spreadsheet model of London's current (2008) and future (2030) energy use, which was used to assess the impact of a wide range of green building, building retrofit, and renewable energy strategies on future energy costs, greenhouse gas emissions, and job creation. Details on the model's assumption can be found in the *Integrated Energy Mapping for Ontario Communities* report and appendices.

The City of London updated these models to include the most recent energy prices, as well as adding in the "all-in" cost of energy (commodity price, transmission, and distribution) to the model.

In terms of projected business-as-usual energy use between 2008 and 2030, it is estimated that the total "all-in" cost of energy used in buildings in London in 2030 could be almost twice as high as today – over $800 million per year – even though total energy use would only increase by about 15 percent in this business-as-usual scenario. Greenhouse gas emissions would remain unchanged in this scenario, as a cleaner provincial electricity grid would offset higher emissions from increased energy use, assuming the province sticks with its plans.

There are a number of building improvement strategies and renewable energy technologies that should provide a positive return on investment over a ten year time frame.

Estimated Rate of Return (Over 10 Years) for Building Improvement Strategies & Renewable Technologies



By design, renewable electricity technologies supported by the Feed-In Tariff program will provide a return on investment as the prices offered are higher than the electricity commodity price on average. Without the Feed-In Tariff, solar photovoltaic power would not provide a payback. However, in "behind the meter" applications where the power generated replaced electricity bought from the grid, wind and bioenergy power may still provide a reasonable payback based on avoided future electricity costs.

The energy model looked at three scenarios and the associated economic and environmental impacts for building improvements and renewable energy technology:

	Building and Technology Energy & GHG Reduction Scenarios		
	Scenario 1. Cost-effective reduction based on an internal rate of return of 6% or better over 10 years	**Scenario 2. Use of proven technology up to an unsubsidized cost of $20/tonne GHG over 10 years**	**Scenario 3. Maximum reduction of consumption of fossil fuels**
Local Investment over 20 years	$6.6 billion ($330 million/year)	$1.5 billion ($75 million/year)	$9.5 billion ($480 million/year)
New jobs created	3,300	760	4,600
FIT revenue by 2030	$520 million/year	-	$540 million/year
Energy savings by 2030	$180 million/year	$210 million/year	$330 million/year
GHG reductions by 2030	395,000 tonnes/year	475,000 tonnes/year	1,060,000 tonnes/year

Scenario 1 is a "payback" scenario that assumes:

- The Feed-In Tariff remains in place, and that solar PV and bioenergy opportunities in London are maximized – almost 1000 megawatts in total - by 2030.
- Retrofits for existing industrial buildings & processes, commercial retail buildings, and commercial office buildings;
- High efficiency construction for new commercial office buildings and new industrial buildings & processes; and
- Expanded use of district energy.

However, this scenario is subject to the risk that the province meets its solar PV procurement goal elsewhere in Ontario before all local solar PV opportunities are realized. Also, the greenhouse gas reductions associated with local FIT projects get attributed to the province's electricity grid, therefore would not contribute to local emission reductions (i.e., no double-counting).

Scenario 2 is a "break-even" scenario that assumes that the province meets most of its renewable electricity procurement goals elsewhere in Ontario, and that the Feed-In Tariff is no longer available as an incentive for local renewable electricity generation. In this scenario, energy savings and emission reductions by 2030 are achieved through:

- Retrofits for existing commercial office buildings, commercial retail buildings, industrial buildings & processes, and institutional buildings; and
- High efficiency construction for new commercial office buildings, new industrial buildings & processes, and new institutional (schools, hospitals, and government) buildings.

Scenario 3 is a "maximum reduction" scenario that assumes that all the measures outlined in the energy model are undertaken by 2030. This does not mean that every single building is retrofitted to be a net-zero energy building. The model assumed that there are limits to the extent to which older buildings can be retrofitted without requiring major renovation, and that there are also limits to the number of buildings that could accommodate technologies such as ground-sourced heat pumps and solar hot water heaters.

8.2 What Information and Analytical Tools We Need to Develop

The City of London is fortunate to have a lot of information on hand to help guide our Community Energy Action Plan. However, there are still gaps in the information and analytical tools, such as:

- **Better economic indicators** – information on energy use can be matched up with economic indicators such as gross domestic product and local employment. However, this information is currently only available for the greater London region (i.e., the London Census Metropolitan Area), which includes St. Thomas and Strathroy. We can prorate this information by population, but it is doesn't reflect accurately what is happening here in London.

- **Better transportation indicators** – Both London Hydro and Union Gas are able to tell us how much electricity and natural gas we use here in London. However, we don't really know how much fuel Londoners use. We do know how much fuel is sold in London, but this also includes people from out of town filling up here, and also does not cover off the fuel Londoners use when filling up out of town. We also can't tell whether Londoners in the suburbs actually use more fuel than Londoners living near downtown.

- **Better benchmarking** – it is part of human nature to want to know whether you are doing better than your friends, neighbours, and competitors. We are starting to get tools to make this easier, but we need to get these out to Londoners and we help them make "apples to apples" comparisons.

- **Better communication** – we have lots of good information, but we need to figure out better ways to let people know that we have it, and make it available in a format that is quick and easy to understand. With "Open Data", we can share our information with fellow data nerds who may have better ways to present this information. We also need easier ways to share and learn about the success stories here in London.

8.3 Can Our Data Show Us a Reasonable Path Forward?

For transportation, the "high efficiency" scenario is a reasonable one to assume for the short term. There are actions in place now and underway for improving the fuel efficiency standards of new vehicles sold in Canada. The City of London plans to make existing and new neighbourhoods more supportive of walking, cycling, and public transit, which will help people reduce trips made by car. In addition, City staff are also working on ways to get Londoners to make use of the walking and cycling infrastructure that we have today. Future higher prices for oil will likely drive people to make these changes. This would get us about 25 percent towards long term greenhouse gas reduction goals for 2030.

For buildings and renewable energy technology, the "payback" scenario is a reasonable one to assume for the short term. It is not known how long the window of opportunity for London to participate in the province's Feed-In Tariff program will remain open. However, London should take advantage of this program while we have it. The more important opportunity offered by this scenario is to focus efforts on energy-saving retrofits for existing commercial buildings and local industry, as well as encouraging new commercial buildings to be high-efficiency buildings. Retrofitting older housing stock (i.e., the red zones on the energy maps) will also likely provide payback for those homeowners. Elements of the "break-even" scenario should also be considered, specifically the role that local institutions (schools, hospitals, government) can play through leading by example. This would get us about 45 percent towards long term goals for 2030.

Taken together, this path should get us about 70 percent of the way towards long term greenhouse gas reduction goals for 2030.

Why not aim for 100 percent now? Well, many of the current technologies that could get us there do not provide a financial payback at today's prices for green technology and for energy. However, as the price of green technology falls and the price of energy rises, these green technologies start to move into the "payback" category.