



Climate Action Plan

Created and submitted by
Warrenville Environmental Advisory Commission

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List of Abbreviations

A/C	Air Conditioner
CAP	Climate Action Plan
CAPPA	Climate and Air Pollution Planning Assistant (http://www.icleiusa.org/tools/cappa)
CFL	Compact Fluorescent Light
CMAP	Chicago Metropolitan Agency for Planning (http://www.cmap.illinois.gov)
CNG	Compressed Natural Gas
CO ₂	Carbon dioxide
CSG	Conservation Services Group
CUB	Citizens Utility Board (http://www.citizensutilityboard.org)
DOE	U.S. Department of Energy
EAC	Environmental Advisory Commission
ECM	Energy Conservation Measure
EV	Electric vehicle
ICLEI	ICLEI originally stood for the “International Council for Local Environmental Initiatives,” but changed its name to “ICLEI-Local Governments for Sustainability” (http://www.icleiusa.org)
EII	Energy Impact Illinois
HOA	Homeowner Associations
HVAC	Heating, Ventilation and Air Conditioning
INAI	Illinois Natural Areas Inventory (http://www.inhs.illinois.edu/research/inai/)
IPCC	International Panel for Climate Change
kWh	Kilowatt hour, unit of energy equal to 1,000 watt-hours
GHG	Greenhouse gas
HES	Home Energy Savings (Nicor HES program)
LED	Light-Emitting Diode
LPG	Liquefied Petroleum Gas
MLS	Multiple Listing Service
MRED	Midwest Real Estate Data LLC
MTCO _{2e}	Metric Tons of Carbon Dioxide Equivalent
NIMEC	Northern Illinois Municipal Electric Collaborative
NIPC	Northeastern Illinois Planning Commission
REC	Renewable Energy Certificate
SNAV	Illinois Sustainable Natural Areas Vision
sq ft	Square feet
Therm	The energy equivalent of burning 100 cubic feet of natural gas
U.S. EPA	United States Environmental Protection Agency
VMT	Vehicle Miles Travelled

Executive Summary

This Climate Action Plan (CAP) describes steps that Warrentville can take to reduce global warming pollution to the target levels identified in the U.S. Conference of Mayors Climate Protection Agreement. The agreement was adopted by the Warrentville City Council and signed by Mayor Brummel on January 17, 2012. With his signature, Warrentville joined the Cool Cities Program, an initiative led by volunteers around the country striving for collaboration among community members, organizations, businesses, and local leaders to implement clean energy solutions that save money, create jobs, and help curb global warming.

A small city can make a difference with global warming. Through the Climate Protection Agreement, Warrentville residents and businesses join with more than 88 million people in over 1000 towns and cities, who have pledged to achieve the same goal. Over and above the reductions in greenhouse gases (GHGs) resulting from human actions, Warrentville can make an impact by being a model for other cities; demonstrating that with leadership and motivation, every town, every home, and every citizen can help prevent a climate crisis and enhance quality of life.

The EAC has developed this CAP consistent with the purpose of the commission to act as a resource and advocate to the City Council and the community at large to help develop educational and informational programs and materials that promote environmental awareness and behavior. The purpose of this CAP is to provide information that can be used by residents, businesses, the City, and other groups. It is not intended to set policy or to require any particular action; but rather to provide information that will assist the user in deciding what action a person or group may want to take. Many possible actions have been reviewed, calculations completed, and the list of potential actions has been reduced to those that would make the most difference. On that basis, the following actions are recommended within the CAP.

Easy, no- or low-cost strategies for residents that will make the most difference:

- Get an energy audit and take steps to make your home more energy efficient (Section 3.A)
- Change your behavior (i.e., shutting off lights or using a programmable thermostat) (Section 3.A)
- Avoid idling your vehicle (Section 4.C)
- Avoid using lawn chemicals, reduce the use of lawn mowers and other yard equipment (Section 7)

Other strategies for residents that will also make a big difference:

- Purchase an alternative fuel vehicle, and use public transportation or carpool or bike when possible (Section 4)
- Find ways to reduce waste (Section 5)
- Find ways to reduce water consumption in your daily activities (Sections 6 and 7)
- Consider a solar system (or other renewable energy source) (Section 3.A)
- Plant native trees (and protect existing mature healthy trees), prairie plants and grasses on your property while avoiding invasive species. (Section 7)
- Arrange for the City to plant parkway trees near your home and care for them (Section 8.A)
- Volunteer on a habitat restoration project (Section 8.B)
- Invest in local renewable energy projects or environmental groups (Section 9)

Easy, no- or low-cost strategies for commercial, government, or other large building owners that will make the most difference:

- Conduct an audit and make your building more energy efficient with insulation, air sealing, energy efficient windows, reflective roof, and energy efficient heating, ventilation, and air conditioning (HVAC) (Section 3.B)
- Change your behavior (i.e., shutting off lights or using a programmable thermostat) (Section 3.A)
- Use energy efficient lights/motion sensors/timers/enact a lights-out-at-night policy (Section 3.B)
- Purchase alternative fuel vehicles, reduce idling, and promote public transportation, carpooling and bicycling (Section 4)
- Avoid using lawn chemicals and reduce the use of lawn mowers and other yard equipment such as leaf blowers (Section 7)
- Increase water system efficiency (pumping), if necessary

Other strategies for commercial, government, or other large property owners that will also make a big difference:

- Find ways to reduce waste (Section 5)
- Find ways to reduce water consumption in your daily activities (Sections 6 and 7)
- Consider renewable energy for your building (Section 3.)
- Design a landscape plan to provide shade, water filtration, minimize erosion, provide habitat and minimize maintenance resources. I.e., incorporate bioswales, natural swales, rain gardens, native plants, and preserve established quality vegetation where possible. Protect existing mature healthy trees (Section 7)
- Promote habitat restoration projects (Section 7.B)
- Work with the existing grade, preserve existing mature quality vegetation, enhance wetlands and other natural features, consider permeable pavement where possible, provide pedestrian and bicycle connections, etc. - this is for new development.

The municipal aggregation program, with 100% renewable energy credits, may not reduce emissions locally; however, it is an important action to reduce regional emissions.

This CAP focuses on mitigating emissions from buildings and transportation, as they account for most of Warrenville's total emissions. It also includes strategies for maintaining biodiversity¹ because climate change affects natural areas, and natural areas affect climate change in a feedback process that is still being researched. Specific actions for mitigation aimed at promoting and sustaining biodiversity in a changing climate are described.

¹ The biodiversity of an area is a measure of the variety of life: it includes all of the species of plants, animals, and microorganisms. Since many species can only live in specific ecosystems, areas with more types of ecosystems have a higher level of biodiversity. The higher the biodiversity, the more sustainable an area. Higher diversity means more biological resources such as food and medicine. High quality ecosystems provide what is called "ecosystem services" which means minimizing flooding, cleaning the air and water, making oxygen, sequestering carbon, decomposing waste, pollinating crops, providing food and raw materials, controlling pests, etc.

1.0 Introduction

Agreements

On January 17, 2012, with the approval of the Warrenville City Council, Mayor David Brummel signed the U.S. Conference of Mayors Climate Protection Agreement. With this action, Warrenville joined the Cool Cities Program, an initiative led by volunteers around the country, striving for collaboration among community members, organizations, businesses, and local leaders to implement clean energy solutions that save money, create jobs, and help curb global warming. In November 2012, Warrenville received Sierra Club's Cool Cities Award in recognition of the City's continued efforts to improve the environment. Mayor Brummel signed a revised U.S. Conference of Mayor's Climate Protection Agreement confirming Warrenville's commitment to implementing changes.

Cool Cities Process

At their first public meeting in February 2012, the Warrenville Environmental Advisory Commission (EAC) announced the decision to join the Cool Cities Program, co-sponsored by the Sierra Club and the U.S. Green Building Council. The program is designed to help cities meet the goals and timetable of the U.S. Mayors Climate Action Plan. In February 2012, the EAC introduced the Cool Cities process to the public and invited stakeholders to provide input.

Climate Action Handbook

The *U.S. Mayors' Climate Protection Agreement Climate Action Handbook* recommends a five-step approach to reducing emissions:

- 1. Conduct a baseline inventory of warming pollutants.** Through the Municipal Energy Profile Project (MEPP) the City received a customized, *Warrenville Energy and Emissions Profile* in 2007. This report provides energy consumption and GHG emissions data specifically for Warrenville. The report is summarized in Section 2, and the entire report can be viewed online at www.warrenville.il.us, at City Hall or the Warrenville Library.
- 2. Establish a target to lower emissions.** As noted above, the Mayor signed the revised U.S. Conference of Mayors Climate Protection Agreement and committed the City to reducing emissions by 2% per year per person from 2009 baseline levels. However, the City's Energy and Emission Profile data is from 2007 and there is no baseline data from 2009. For the sake of this Plan, the 2007 data is being used and it is assumed that it is comparable to the 2009 data. Thus, Warrenville's target is to reduce emissions by 12% (2% per year for six years (2009-2015) from Warrenville's 2009 baseline levels. This means that the goal is to reduce total Warrenville emissions from approximately 231,000 metric tons of carbon dioxide equivalent (MTCO_{2e})² to 203,300 MTCO_{2e} by 2015. Assuming the population remains approximately the same (13,140), the average annual emissions for each person would be reduced from 17.6 MTCO_{2e}/person/year to 15.5 MTCO_{2e}/person/year.

Table 1. City of Warrenville Emission Reduction Goals

Year	2007	2015 Projection
Population	13,140*	13,140*
Emissions	231,000 MTCO _{2e}	203,300 MTCO _{2e}
Average Annual Emissions per Person	17.6	15.5

*Based on 2010 census

² Emissions of GHGs are expressed in MTCO_{2e} so that their impacts can be directly compared even though some gases are more potent (have a higher global warming impact) than others.

3. Develop a local Climate Action Plan (CAP) to implement actions that reduce global warming pollution. According to the *Climate Action Handbook*, “A local Climate Action Plan (CAP) is a customized roadmap to reduce global warming pollution by the target that your city has identified. The quantification of existing climate protection measures helps guide a city to understand where they can get the largest emissions reductions.” The goal of the Warrenville CAP is to present strategies that could reduce the City’s global warming pollution. Each subsection includes summary tables of the strategies, cost savings, costs to implement them, and the amount of emissions reduction that can be expected. Implementation of these strategies would require City Council review and approval. Calculations were completed using the Climate and Air Pollution Planning Assistant (CAPPA) developed by ICLEI-Local Governments for Sustainability.

4. Implement the local Climate Action Plan. This CAP has been prepared for the Warrenville City Council’s review and approval before implementation. It is anticipated that individual actions will be implemented as time, budget, and resources become available, and with the approval of City Council. This plan is intended as guidance - it is a living document, changing and adapting to different circumstances.

5. Measure, verify and report performance. In order to achieve the goals listed above, the emissions reductions of many of the recommended actions were calculated and presented in this CAP. The EAC recommends that the Warrenville Energy and Emissions profile be updated after the end of 2015; and that the actions proposed in this CAP be reviewed at the same time, if budget and resources are available.

There are many benefits from the climate planning process (in addition to reducing GHG emissions):

- Save taxpayer dollars
- Build the local economy and create jobs
- Improve air quality and public health
- Improve community livability
- Connect cities with national leaders and resources
- Create a legacy of leadership

According to the 2014 International Panel for Climate Change (IPCC) Working Group III Summary, mitigation and adaptation can influence the achievement of other societal goals, such as those related to human health, food security, biodiversity, local environmental quality, energy access, livelihoods, and equitable sustainable development. These influences can be substantial, although sometimes difficult to quantify.

2.0 Warrenville Energy & Emissions Profile

An energy and emissions profile was prepared for the City of Warrenville in 2007 to provide information about how energy is used by the entire community. This profile includes annual citywide electricity consumption, natural gas consumption, vehicle miles traveled (VMT), and a GHG emissions profile. It provides a baseline against which to compare future use and GHG emissions. This section includes a brief summary of the Warrenville Energy and Emissions Profile.

Table 2. Summary of 2007 Warrenville Energy & Emissions Profile

	Units	Residential (4,797 households)	Commercial/ Industrial	Total	MTCO ₂ e	Percent of Total Emissions
Electricity	(kWh)	43,900,000	113,900,000	157,800,000	111,000	48%
Natural gas	(Therms)	4,900,000	3,700,000	8,600,000	46,000	20%
		On-Road ⁽¹⁾	Household ⁽²⁾			
Transportation	(VMT)	125,500,000	99,700,000		63,000	27%
Solid Waste					2,000	1%
Wastewater					2,000	1%
Product use					7,000	3%
Total					231,000	100%

1. Captures trips only within municipal boundaries
2. Number of miles the average household in Warrenville drove

2.A. Warrenville’s Energy Use and Associated Emissions for Each Source/Sector

Warrenville’s total emissions in 2007 were estimated to be 231,000 MTCO₂e. The emissions resulted from electricity use (48%), transportation (27%), natural gas use (20%), product use (3%), solid waste (1%) and wastewater (1%). Ninety-five percent of the City’s emissions came from electricity, natural gas, and transportation. These are the main sources of Warrenville’s global warming impact. Therefore, most emission reductions must come from these areas.

Electricity

The amount of electricity consumed in Warrenville in 2007 was 157.8 million kilowatt-hours (kWh). Most of this electricity consumption (72%) was consumed in the commercial/industrial sector. Warrenville’s electricity usage resulted in total emissions of 111,000 MTCO₂e. In the residential sector, the City’s average annual consumption per household is 9,143 kWh, which is approximately the same as the DuPage County average (9,013 kWh).

Natural Gas

In 2007, the total amount of natural gas consumed in Warrenville was 8.6 million therms. Most of the City’s natural gas consumption (57%) occurred in the residential sector; the remaining 43% was consumed in the commercial/industrial sector. Warrenville’s natural gas usage resulted in total emissions of 46,000 MTCO₂e. In the residential sector, the city’s average annual consumption per household is 1,023 therms, which is approximately 10% higher than the DuPage County average (928 therms).

Transportation

In 2007, total on-road travel on Warrenville roads accounted for 125.5 million miles, which captures trips only within municipal boundaries. Further analysis shows that the average household in Warrenville drove 20,792 miles, totaling 99.7 million miles for all Warrenville households. Warrenville’s total emissions from transportation were calculated to be 63,000 MTCO₂e. The average miles travelled per Warrenville household (20,792 miles) was approximately the same as the DuPage County average (20,302 miles).

Solid Waste, Waste Water, and Product Use

In addition to energy and transportation, which are by far the biggest contributors to GHG emissions, the emissions profile includes estimates for Warrenville’s emissions from solid waste (2,000 MTCO₂e), wastewater (2,000 MTCO₂e), and product use (7,000 MTCO₂e) based on regional totals previously analyzed for a regional profile developed for the Chicago Metropolitan Agency for Planning (CMAP).

The GHG emissions associated with solid waste are the methane (CH₄) that is emitted during decomposition. According to the EPA, “Pound for pound, the comparative impact of CH₄ on climate change is over 20 times greater than CO₂ over a 100-year period.”

2.B. General Factors that Affect Energy Consumption

This section focuses on the three sectors that generate the most emissions (electricity, natural gas, and transportation).

Sources of Electricity

How much electricity people use is not nearly as important as how the electricity is produced. That is because electricity can be generated using a process that produces more GHG emissions (by burning coal) or by a process that produces less emissions (i.e. wind turbines). In the U.S., 100% of the nuclear power, 91% of coal that is burned, 55% of all renewable energy, 31% of natural gas, and 1% of all petroleum is used to produce electricity. Almost half of all electricity in the U.S. (46%) is generated by coal-fired power plants³.

Uses of Electricity

About 22% of all electricity is used for lighting. In U.S. homes, 48% of all electricity is used to power air conditioning, water heating, televisions, computers, space heaters, and dryers⁴.

Electricity consumption in both the residential and commercial/industrial sectors is currently increasing nationwide. Growth in consumer electronics and information technology equipment, as well as an increase in home size and air conditioning use are prominent reasons for consumption increases in the residential sector. Increasing consumption in the commercial/industrial sector is driven by telecommunication and network equipment along with specialized technologies such as medical imaging advancements. Factors that affect electricity usage include square footage, presence and efficiency of air conditioning, efficiency of lighting, appliances and systems, and occupant behavior.

Natural Gas Usage

In Northern Illinois, natural gas is the primary space heating fuel. In addition to space heating, natural gas is commonly used for hot water heaters, clothes dryers, and cooking in the residential sector. However, natural gas consumption has been decreasing slightly over time in both the residential and commercial/industrial sectors as homes and buildings become more efficient and de-industrialization occurs. Factors that affect natural gas usage include building size, building age, building envelope efficiency, efficiency of the furnace, boiler and water heater, as well as occupant behavior and building operations and maintenance.

Transportation Factors

Factors that affect vehicles miles travelled (VMT) per household include access to jobs, proximity to businesses and amenities, availability of public transportation, and community walkability. Variations are also influenced by many different demographic factors including income, household size, and workers per household. For example, large households with higher incomes may own multiple cars and drive more. Households situated close to reliable public transit or major employment centers may experience decreased annual VMT because they are not as dependent on cars.

³ Energy Information Administration, “Primary Energy Consumption by Source and Sector, 2011.”

⁴ Energy Information Administration, “Frequently Asked Questions; How Is Electricity Used in U.S. Homes?” 2011

3.0 Energy Strategies for Warrenton

In this section, the focus changes from the *sources* of energy (electricity, natural gas, and petroleum) to the *consumers* of energy (homes, businesses, governments, other organizations, and transportation). Who consumes the energy and how much do they consume? Nationwide, the industrial sector consumes the most (31%), followed by transportation (28%), residential (22%), and commercial (19%). The burning of fossil fuels produces gigatons of carbon dioxide, one of the gases that traps heat from the sun, warms the planet, and has thus come to be referred to as a greenhouse gas. Strategies for reducing energy consumption by these users are described in detail.

The descriptions in each section are followed by a two-part table. The first part lists potential strategies to reduce GHG emissions, an estimate of the potential GHG reduction, the cost and the potential savings. The second part of the table lists potential actions to implement the strategies, the status of each strategy (to be considered, ongoing, or completed), and the potential partners that could help implement the strategy. As noted in Section 1, the estimates of the GHG reductions were completed using the CAPP Assistant developed by ICLEI-Local Governments for Sustainability.

The purpose of listing the strategies and actions listed in this plan is to provide a basis for decisions about energy usage, transportation options, and waste management options. The calculated emissions for each strategy can be used to help make informed decisions. It is understood that additional input regarding the City's resources, funding, and other information will be required before moving forward on any specific action.

As noted in Section 2.B, a large percentage of electricity and natural gas is used to heat, cool, and light residential, commercial, government, and other buildings. According to the 2014 IPCC Working Group III Summary, recent advances in technologies, know-how and policies provide opportunities to stabilize or reduce energy use by buildings. For new buildings, the adoption of very low energy building codes is important because if they are not adopted, it is likely that buildings with long life spans will be locked into using less efficient systems for a long time. For existing buildings, retrofits form a key part of the mitigation strategy.

Most mitigation options for buildings have considerable and diverse co-benefits in addition to energy cost savings. These include improvements in energy security, health, environmental outcomes, workplace productivity, and net employment gains. Studies which have monetized co-benefits often find that these exceed energy cost savings and possibly climate benefits.

Strong barriers, such as split incentives (i.e. tenants and builders), fragmented markets, and inadequate access to information and financing, hinder opportunities. Barriers can be overcome by policy interventions addressing all stages of the building and appliance lifecycles. Building codes and appliance standards - if well designed and implemented - have been among the most cost-effective instruments for emission reductions.

According to the 2014 IPCC Working Group III Summary, thousands of cities are undertaking climate action plans. Current climate action plans focus largely on energy efficiency. Fewer climate action plans consider land-use planning strategies and cross-sector measures to reduce sprawl and promote transit-oriented development. Successful implementation of urban-scale climate change mitigation strategies can provide co-benefits, and action often depends on the ability to relate climate change mitigation efforts to local co-benefits.

Promotion of various strategies may include one or more of the following actions:

- Publishing information in EAC's *The Resource* newsletter, City newsletter, or local newspapers,
- Publishing information on the EAC's page on the City's website
- Featuring Public Service Announcements and education videos on the City's public access channel
- Sending out e-mail blasts, Facebook posts, etc.
- Marketing at City events such as Summer Daze
- Conducting environmental presentations at the library

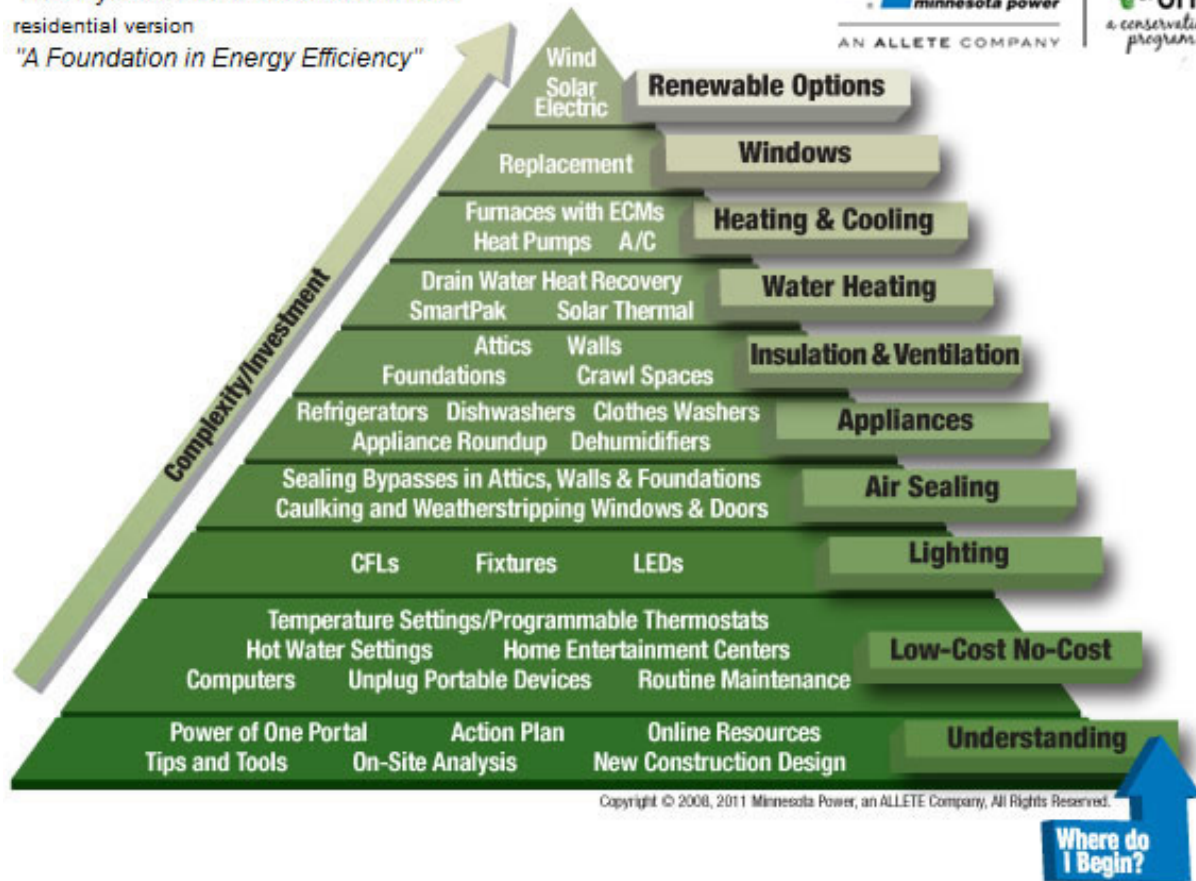
Each of the following sections describe energy audits as the place to start. Understanding energy consumption is the first step to increasing one's energy efficiency for each of the sectors described in the following sections: residential, commercial, and government. The image below depicts Minnesota Power's "Pyramid of Conservation," which suggests measuring consumption is the basis from which all other energy investments are made. An energy audit (or energy assessment) is an analysis of energy consumption of a building including a review of past energy consumption as found on utility bills. The building analysis involves a visual and diagnostic inspection of living space, all mechanical systems (HVAC, lighting, hot water), and the building envelope. Paired with a review of past energy consumption, an energy audit report summarizes key issues and recommendations for improvements that range from low/no cost strategies to larger investments. (<http://www.mnpower.com/EnergyConservation/PyramidOfConservation>)

It is beyond the scope of this report to include descriptions of all renewable energy options for the various sectors; however, some examples are provided in the following sections. The pyramid shows that an energy audit would be the first step in determining which system(s) would be appropriate for a building. The following sections also include resources for residents, businesses, and other organizations to obtain information about renewable systems such as solar power.

The Pyramid of CONSERVATION

residential version

"A Foundation in Energy Efficiency"



3.A. Residential Sector

Energy Audits and Weatherization (Retrofits to Existing Houses)

Over half of the energy used in the residential building sector is devoted to the heating and cooling of the home (U.S. Energy Information Administration). In almost all homes, leaks, cracks, and insufficient insulation allow energy to escape and outside air to penetrate the residence. Identifying and repairing these problems conserves energy, creates financial savings, and increases the comfort in the home for residents.

Usually, the first step to improve the energy efficiency of a residential building is to complete an energy audit (also called an energy assessment). An energy assessment includes a detailed report of the home's energy efficiency performance, an identification of the areas of their homes that are losing energy, a detailed list of measures the homeowner can take to repair problem areas, and safety checks. Free or low cost residential energy audits are available through partnerships of ComEd, Nicor Gas, and organizations such as SCARCE, Energy Impact Illinois (EII) and Conservation Services Group (CSG). In addition to measuring energy efficiency, an audit may also identify other important issues such as gas leaks, improperly installed insulation covering vents, etc.

Weatherizing a home makes it more energy efficient, thereby reducing its energy consumption and GHG emissions. Weatherization includes many best practices, tests and assessments. Some examples from the U.S. Department of Energy (DOE) include a blower door test, zone pressure diagnostics, a duct leakage test, a furnace and boiler test, a water heater test, a gas range test, a bathroom and kitchen exhaust fan test, an air sealing assessment, an attic insulation and venting assessment, a sidewall insulation assessment, a

foundation insulation assessment, and a window and door assessments.⁵ A study by the DOE found that weatherization reduced natural gas consumption for space heating alone by 32% and for all end uses, e.g., space heating, water heating, gas rangers, and clothes dryers by 23%.⁶

As a partner of ComEd and Nicor Gas, EII promotes energy efficiency by providing information about free or low-cost assessments, rebates, and low-interest loans for energy efficiency upgrades at their website: <http://energyimpactillinois.org/residential/>. The program offers instant rebates for air sealing and insulation work; high-quality contractors; and the Illinois Home Performance Certificate backed by Energy Star. “This Certificate is recognized on Midwest Real Estate Data LLC (MRED), the largest Northern-Illinois multiple listing service (MLS) as a third-party green and sustainable home designation; also, the Certificate may be uploaded to other MLSs as a feature just like other assets, such as granite countertops.”⁷

Citizens Utility Board (CUB) Energy Saver is a program to help people track their energy usage for free and measure energy savings. The program uses ComEd information for a resident to track electricity use, offers suggestions to reduce energy use, and offers rewards points for each kilowatt hour of electricity saved.

Low or No Cost Ways Households Can Reduce Electricity Usage (Behavioral Changes)

Behavioral changes alter the way occupants interact with the building. Small but important changes, such as turning off appliances and lights, and setting the thermostat lower in winter and higher in summer, can significantly reduce energy costs and greenhouse gas emissions. Small actions by many people can collectively make a big impact on energy consumption. In addition to energy savings, other benefits of these small actions include reduced household expenses and reduced pollution which leads to better health. These are some ways that households can easily reduce electricity usage at low or no cost:

1. Install and use a programmable thermostat, which can cost approximately \$20 to \$40, and set it lower in winter, higher in summer, and make appropriate adjustments when you are away on vacation. (<http://energy.gov/energysaver/thermostats>) (http://articles.southbendtribune.com/2007-07-07/news/26825420_1_programmable-thermostat-air-conditioner-home-lighting) (<http://www.fplblog.com/featured-posts/the-best-ac-settings-for-seasonal-customers/>)
2. Actions to take during the summer when air conditioning is on: close south-, east-, and west-facing curtains during the day to keep out solar heat; run energy-intensive appliances such as the dishwasher and clothes washer at night so that the heat produced by these appliances will not need to be offset by your air conditioner during the day.
3. Only heat and cool rooms you use. Close vents and doors to rooms that are not being used.
4. Turn off lights when you aren't using them and/or add dimmers or occupancy sensors to your home's lighting system
5. Clean the coils at the back of your refrigerator twice a year.
6. Check air filters monthly and replace as needed.
7. Wait until you have a full load to run the dishwasher and clothes washer, and use cold water when possible.
8. Unplug old refrigerators that aren't being used. Old refrigerators can use three times the electricity of modern ones.
9. Many electronic devices use power when they are turned off. This is called “standby power,” “phantom load,” or “vampire power.” Studies show that 5 to 10% of electricity use in the average home is due to phantom loads. Shut off the following items when they are not in use: computers, monitors, printers, speakers, stereos, TVs, DVD and video game players, and anything with a

⁵ U.S. Department of Energy Midwest Regional Office, “Midwest Weatherization Best Practices Field Guide for the US Department of Energy Weatherization Assistance Program,” May, 2007.

⁶ Martin Schweitzer, “Estimating the National Effects of The U.S. Department of Energy’s Weatherization Assistance Program with State-Level Data: A Meta Evaluation Using Studies from 1993 to 2005,” Oak Ridge National Labs, <http://www.osti.gov/bridge>.

⁷ Illinois Home Performance, “Certificate of Completion,” www.illinoishomeperformance.org/what-expect/certificate.

power supply (usually a black box in the power cord) such as chargers for cell phones and iPods. It is easier to shut off multiple items if they are plugged into a power strip or a “smart” power strip that automatically turns off loads when they are not in use.

Sarah Darby’s 2006 research suggests that direct feedback interventions such as in-home energy use monitors can generate electricity savings of 5% to 15% on average. Indirect feedback on energy use such as information reports delivered to customers can motivate residents to lower energy use from 0% to 10%.⁸ The Warrenville Library has four Kill A Watt EZ Power Monitors available for checkout. The power monitors can be used to test the quality of a household’s power to see how much electricity appliances and electronics are using, and calculate costs.

Renewable Energy Systems

Renewable energy includes solar, wind, and geothermal systems, among others. While feasible with any building, it should be noted that the cost of a renewable energy system is generally lower when integrated at the time of construction. For more than 100 years, centralized power stations have provided the most efficient method for the creation and distribution of electricity. In recent years, however, distributed generation of renewable energy at a household level has become a viable option as more fuel options and improved technologies have come to market. Appropriate household systems include photovoltaic (PV) panels or wind turbines that can be installed on roofs or in yards, and gas-fired microturbines located in basements. Participating households most likely would connect systems to the electric grid to sell excess power, or if necessary, to purchase power when home systems do not provide sufficient capacity.

On-site renewable energy is challenging because the initial cost to equip a home with a renewable energy system can be high. Without subsidies, tax credits or incentives, the pay-back time is long. However, the potential for energy savings is high. Warrenville homes likely could be equipped to meet almost all of their electricity needs through on-site production and sell excess power back to the grid.

Renewable energy technology and policies change frequently, and the most updated information should be obtained when a system is being considered. For example, one new idea is a solar sharing network called Yeloha, a sort of Airbnb for solar panels. A resident can pay for a solar panel that is placed on a host's house, and both parties get part of the energy savings. Yeloha's mission is to unleash the benefits of solar energy to all people, regardless of where they live and their economic status. Solar Sharing removes the obstacles going solar once presented (including needing your own roof!), changing the way people generate and pay for their electricity. (<http://www.yeloha.com/>)

Solar comes in two basic types, solar electric cells (called photovoltaics, or PV for short) and solar thermal heat and hot water systems. Both types may be eligible for a State of Illinois rebate and/or a federal tax credit. The cost estimates in this section were based on quotes from Solar Service Inc. in 2014 for a 1,750 sq. ft home in Summerlakes. The cost is provided as an example: specific estimates should be obtained for each building that is being considered for solar installation. Costs, rebates and tax incentives change frequently. More information about solar energy can be found at the Illinois Solar Energy Association (ISEA) website (<http://www.illinoissolar.org/>).

The ISEA organizes a free Illinois Solar Tour each fall. It is a free public open house to demonstrate how Illinois homes and businesses are using solar, wind, geothermal, passive solar design, and energy efficiency to be energy independent. The website lists Solar Ambassadors who are available to present

⁸ “The effectiveness of feedback on energy consumption: a review for DEFRA of the literature on metering, billing, and direct displays”, Sarah Darby, Environmental Change Institute at the University of Oxford, 2006, and “Research Study: Residential Energy Use Behavior Change Pilot” (CMFS project code B21383), presented to Joe Plummer, Minnesota Department of Commerce, Office of Energy Security, April 20, 2009, by Ed Carroll (Franklin Energy), Eric Hatton (Franklin Energy) and Mark Brown (Greenway Insights)

information to organizations. They may also make their home or facility available for tours. Solar-Illinois's mission is to connect Illinois homeowners and businesses with the best certified Illinois solar installers. Their website is <http://www.solar-illinois.org/>.

A high tech training facility was built at 28600 Bella Vista in Warrenville by IBEW Local 701 and the National Electrical Contractors Association. This facility trains apprentice and journeyman electricians in many skills, including the installation of renewable energy.

Solar PV converts sunlight to electricity by changing the sun's rays to energy as they strike the module. Silicon wafers coated with chemicals release electrons and send them down wires through the panel to an inverter in the basement. Once through the inverter, the electricity goes directly to a building's circuit-breaker box. If the home or building can use the electricity at that time, it does. Otherwise, that electricity flows back through the meter to the grid where ComEd gives you credit for generating it. PV panels lay flat on the roof and work best in the summer months when the sun is at its highest pitch. The typical cost of PV is around \$5,000 per kilowatt installed (before rebates and tax credits), depending on how much electricity is generated. As more panels are purchased, the price per kilowatt drops. A four kilowatt system may consist of about 14 panels and cost around \$9,000 after incentives. This system may generate about 3,300 to 3,800 kilowatt hours per year for a property, worth about \$400 in the first year. Excess electricity can be credited back to ComEd, which honors a net-metering agreement in Illinois.

The other types of solar (solar thermal for heat and hot water) are automatic and maintenance-free for many years at a time and work in partnership with existing appliances (hot water heater, radiant floor boiler, forced air furnace) to offset energy usage. Solar thermal works by collecting the heat of the sun in glass-covered panels on the roof. A fluid is sent through the panels to bring the heat down to a heat exchanger in the basement. On the other side of the heat exchanger, never touching the fluid that came from the panels, is the domestic water. The water absorbs the heat from the fluid and is stored in a tank that sits next to the existing water heater. That hot water is fed on demand to the hot water heater. For heating the home, the solar can interface with either a forced air furnace or a radiant floor system. All that is needed is enough south-facing roof space for the panels, space in the basement for an additional storage tank and a way to connect the two together.

It is estimated that a hot water system can displace approximately 200 to 250 therms each year, and the heat and hot water system can displace roughly 400 to 450 therms per year. The payback time will vary from home to home, based on the size of the family, the size of the home, how much hot water is used, and the efficiency of the water and space heating equipment. It is estimated that a solar hot water system would cost around \$13,000, or \$6,300 after rebates and tax credits. A system with both solar heat and hot water would cost \$23,500, or \$11,500 after rebates and tax credits.

Solar energy is more expensive than behavior changes or weatherization; however, it may be a cost effective strategy for those who use a higher than average amount of electricity or hot water, and/or those who plan to stay in their house for many years (longer than the estimate payback time).

Purchase Clean Electricity in the Form of Renewable Energy Certificates (RECs)

In May 2012, the Warrenville City Council approved Ordinance 2721 authorizing the Municipal Electrical Aggregation Plan and endorsing the EAC's recommendation that the City purchase electricity generated from renewable sources such as the sun and wind. Power flow with FirstEnergy Solutions began in September 2012, with savings reflected in October ComEd bills. Of the eligible resident and small commercial electric accounts in the City, 2.7% opted out, for a 97.3% participation rate. The average single-family household savings, based on actual reported 2011 load usage data for Warrenville was estimated at \$320 per year (at the 4.86¢ Warrenville aggregation rate vs. the ComEd rate of 8.36¢ per

kWh). The estimated total community-wide savings, based on actual 2011 electric load usage data for Warrenton, was \$1,200,000 per year. Savings varies as the aggregation rate and the ComEd rate changes.

Warrenton's 100% renewable energy selection is in the form of Renewable Energy Certificates (RECs). A REC (pronounced: rĕk) represents the property rights to the environmental, social, and other non-power qualities of renewable electricity generation. Renewable energy generators serve the grid along with non-renewable energy generators produced by coal, nuclear and natural gas. Once in the grid, the actual electrons cannot be differentiated, thus the positive non-power qualities of energy generated by renewable resources are stripped and sold separately from the actual electricity – in the form of RECs. One REC represents the production of one-megawatt hour (1,000 kWh) of electricity placed on the grid. They are “Green-e” verified with a specific certificate number and may only be used once to ensure they are not double-sold and the REC claims are accurate. See www.green-e.org

City Promotion of Residential Energy Efficiency

The City of Portland's Block-by-Block Weatherization Program is an example of a successful city program developed to help low income earners weatherize their homes. The program provides free basic weatherization and energy-use education to needy, low-income households not already served by other low-income weatherization programs. See www.smartcommunities.ncat.org/success/block.shtml

The Chevy Chase, MD, CAP has an interesting strategy called Climate Corps, and its expected emissions reduction is 23%. The town will select, train, equip, and supervise a Climate Corps, comprised of high school students and/or scouts or block captains to make home visits and provide recommendations to residents about how to save energy. Such recommendations might include setting programmable thermostats, reducing phantom loads on plugs, reducing hot water use, maintaining HVAC equipment, installing weather-stripping, changing lighting, car maintenance, etc. They would also help homeowners track their energy use and calculate their carbon footprint. Climate Corps members would receive training, a tool kit (with equipment to do their job as well as some giveaways) and t-shirts. The Climate Corps would communicate the results using creative means (YouTube videos, science fair projects, hands on activities) and create a buzz around home energy habits. The Climate Protection Committee will work with schools to assure that the Climate Corps work is eligible for

Table 3. Residential Energy Strategies

Strategy	Potential GHG Reduction (MTCO ₂ E)	Initial cost	Potential Yearly Savings
Energy Efficiency Retrofits to All Houses (Electricity and natural gas reduced 7% per house. Examples : efficient light bulbs, fixtures, appliances, increasing insulation, replacing windows, & upgrading HVAC)	9,990 (all houses); 2 per house	Negligible to \$1.5 (per sq ft)	\$315 (per household)
Behavioral Changes (Electricity and natural gas reduced 7% per house)	9,990 (all houses); 2 per house	None	\$315 (per household)
Solar Electric Cells (Photovoltaics, or PV)	Minimum of 3 per house	\$9,000	\$400 (per house)
Solar Hot Water System	Minimum of 2 per house	\$6,300	\$300 (per house)
Solar Thermal Heat and Hot Water System	(not in CAPP)	\$11,500	\$500 (per house)
REC Purchases (Municipal Aggregation Program: 97% of households)	37,234	\$168 (per household)	\$457 (per household)
Actions to Implement the Strategies	Status	Partners for Implementation	
Promote energy assessments, CUB energy saving program, and energy efficiency grant programs	Ongoing	Residents, EII, Nicor HES, EAC, Warrenville Public Library, HOAs, congregations	
Form a "Climate Corps" and/or a Block by Block Weatherization Program	To Be Considered	High School, EAC, SCARCE, NICOR	
Work with local realtors and HOAs to promote energy assessments in properties on the market to receive the Illinois Home Performance Certificate	Ongoing	Residents, local realtors, EAC, Western DuPage Chamber of Commerce	
Hold energy efficiency workshops at the public library, HOA meetings, or other locations	Ongoing	Residents, EAC, Warrenville Public Library, EII, Nicor HES, CUB, HOAs, congregations	
Host energy efficiency "impact parties" to promote energy assessment programs in each neighborhood or HOA	Ongoing	Residents, EII, Nicor, HOAs	
Create a "competition program" to encourage residents (or wards) to reduce their energy use	To Be Considered	Residents, EAC, EII, CUB Energy Savers	
Prepare information about energy audits, insulation, and air sealing improvements available in the form of handouts at the Building Department front counter and on the City website	Ongoing	EAC, Community Development Department	
Consider adopting ordinances for renewable energy, if necessary (solar panels, wind turbines, etc.)	To Be Considered	EAC, Community Development	
Highlight and publicize best practices for on-site renewable energy production	To Be Considered	EAC	
Publicize Illinois Solar Tours and other renewable energy info; organize presentations by Solar Ambassadors.	To Be Considered	EAC, Warrenville Public Library, HOAs, congregations	
Continue Warrenville's municipal electrical aggregation program with 100% renewable energy	Ongoing	Residents, City Council, Administration Department	

3.B. Commercial Sector

According to the Warrenville Energy and Emissions Profile, 72% of the electricity consumption and 43% of the natural gas consumption occurred in the commercial/industrial sector. This section begins with general information about how and why some well-known businesses made efforts to make their operations more sustainable, followed by descriptions of strategies that may be applicable to reducing energy consumption in the Warrenville commercial sector.

Here are some examples of local businesses that have taken steps to improve efficiency and/or use renewable resources:

- Two Brothers Brewing Company was founded in 1996 by Ebel brothers. Today, they operate a microbrewery and three brewpubs focused on sustainable and organic practices, such as using wind-generated electricity from a local power company; taking steps to conserve water; installing a high-efficiency boiler; using local ingredients (some from a rooftop garden); using recyclable plastics and Greenware®, which are recycled by the company across the street. Additionally, a local farmer feeds the spent grain to cattle.
- The International Brotherhood of Electrical Workers (IBEW) Local #701 installed a wind turbine and they provide tours and education.
- Maple Terrace Subdivision, constructed by New Orleans Home Builder, was featured in a Chicago newspaper for its very efficient homes.
- MI Homes, a developer constructing a subdivision along Herrick Road, provides energy-efficient and low-maintenance features in their Herrick Woods Subdivision.

According to the 2014 IPCC Working Group III Summary, the energy intensity of the industry sector could be directly reduced by about 25% compared to the current level through the wide scale upgrading, replacement and deployment of best available technologies. Additional energy intensity reductions of about 20% may potentially be realized through innovation. Barriers to implementing energy efficiency relate largely to initial investment costs and lack of information. Information programs are a prevalent approach for promoting energy efficiency, followed by economic instruments, regulatory approaches and voluntary actions.

The following general strategies may be applicable to reducing energy consumption in the Warrenville commercial sector: conduct an energy audit; promote green building rating systems; reduce wasted energy; green building design; and commercial building energy reporting. These strategies are described in the following subsections.

Conduct an Energy Audit

Like the residential sector, the best place to begin reducing emissions in the commercial sector is with an energy audit. Building owners cannot manage what they do not measure. Owners can turn to utilities and green building rating systems for assistance.

For example, ComEd offers free energy-savings opportunity assessments or energy audits to businesses that evaluate the efficiency of the lighting, HVAC system, chillers, and motors. Their recommendations include estimated energy savings, cost savings, project cost, potential incentives and simple payback. ComEd offers programs and incentives in lighting, retro-commissioning, HVAC, new construction, custom projects, variable speed drives, refrigeration, and commercial real estate.

Promote Green Building Rating Systems

Green building rating systems can also help commercial building owners better understand their energy use and identify opportunities for savings. For example, the EPA's Energy Star Label is awarded each year to those buildings that rank in the top 25% of energy efficiency when compared to buildings of the same

type, size, and location in the same climate region. As of 2015, five commercial buildings earned the Energy Star label in Warrenville: 1) Cornerstone I at Cantera, 2) Cornerstone II at Cantera, 3) Keystone at Cantera, 4) Liberty/Warrenville LLC, and 5) Target.

The LEED (Leadership in Energy and Environmental Design) green building rating system was developed by the U.S. Green Building Council and the certification process uncovers opportunities for saving energy. These include the use of reflective roofing material and other means to reduce the energy load of air conditioning an indoor space. A recent study of 195 LEED certified office and retail buildings found they ranked in the top 11% in energy efficiency. As of 2015, there are four LEED certified commercial buildings in Warrenville: 1) BP Cantera III, 2) Cornerstone I at Cantera, 3) Cornerstone II at Cantera, and, 4) Liberty Mutual.

Reduce Wasted Energy

Small Business Energy Efficiency

Small businesses may lease space and therefore may not control decisions about building efficiency, but building occupants may be able to change their actions, such as turning off appliances and lights, and setting the thermostat lower in winter and higher in summer, which can significantly reduce energy costs and greenhouse gas emissions. Section 3.A describes other behavioral changes (similar to homeowner actions) that small business owners can do.

Commercial Buildings/ Energy efficiency retrofits

A tax deduction for commercial buildings may be available for businesses that improve the performance of three building elements: 1) Lighting; 2) Building envelope; and 3) Heating, ventilation and air conditioning (HVAC) systems.

1. Commercial Lights Out at Night/Motion Sensors/More Efficient Lighting: Lighting is typically the largest use of electricity in commercial buildings. Much energy is wasted by lights left on when no one is using them. Looking at the urban skyline, one can see many office buildings lit up at night, after everyone has left work for the day. A policy of turning lights off throughout buildings at the end of the work day eliminates this waste of energy. A lights out policy can use a combination of education and technology such as timers and motion sensors.
2. Building Envelope: The building envelope or shell is the boundary between the conditioned interior of a building and the outdoors. The energy performance of the external walls, floors, roofs, ceilings, windows and doors determines how much energy is required for heating and cooling. Improvements can include adding insulation, air sealing, energy efficient windows, and a reflective roof. A reflective roof can significantly reduce electricity use by air conditioners by reducing the heat entering the building through the roof. Energy Star-certified reflective roof products can lower the roof temperature by up to 100°F. Reflective roofs cost about the same as traditional roofing products, so installing one during construction, or when a roof needs to be replaced anyway, involves no extra cost. Reflective roofs and paving materials mitigate the urban heat island effect, reducing energy required to cool all buildings in a city, and contribute to LEED certification.
3. HVAC: Heating, ventilation, and air conditioning consume approximately 40% of the energy within buildings. This makes HVAC systems an important target for energy efficiency improvements. Air conditioning is a close second to lighting for electricity use in most commercial buildings.

Retro-Commissioning of Commercial Buildings (HVAC retrofit/Equipment Upgrade)

Retro-commissioning is a process that seeks to improve how building equipment and systems function together. Retro-commissioning can often resolve problems that occurred during design or construction, or address problems that have developed throughout the building's life. It can improve operations and

maintenance procedures to enhance overall building performance. It may identify malfunctioning or poorly sized equipment, inefficient timing of processes, and other opportunities for saving energy.

Green Building Design

In the U.S., buildings account for 40% of total energy use and about 35% of GHG emissions. Design and construction of new buildings, or major renovation of existing ones, provides an opportunity to implement energy saving measures. Green building design views buildings as a complete system in order to maximize health, comfort, and productivity of occupants while minimizing resource use for construction and operation. For example, windows, insulation, and lighting systems can be chosen to minimize the cooling load, allowing for a smaller cooling unit to be used for savings in both capital and operations costs.

Commercial Building Energy Reporting

EPA's Energy Star for Buildings has developed a number of tools that can help plan and track the energy consumption of new and existing buildings. EPA's Target Finder and Portfolio Manager are other tools that may help track/improve energy efficiency.

Chicago, New York City, San Francisco, Philadelphia, and Seattle have passed building energy reporting laws also known as benchmarking laws requiring non-residential buildings to report their energy usage. The ultimate purpose is to increase energy efficiency by making the energy usage transparent and giving clients an opportunity to consider that factor in the process of selecting a building to lease or purchase. It is hoped that building owners and managers will see this as an opportunity to gain an edge on their competition and increase the lease and sale value of their property.

Renewable Energy Systems

Information about solar systems was presented in Section 3A. On-site renewable energy could provide some of the energy needed for the commercial and industrial sector. Additional types of renewable energy systems include large-scale, multiple site distributed generation and combined heat and power. The energy and cost savings for these systems are assessed on a case-by case basis.

Electricity Supply Agreements with 100% Renewal Energy

The Northern Illinois Municipal Electric Collaborative (NIMEC) is the leading municipal aggregator of electricity in northern Illinois, having managed 100 municipal aggregations with a population base approaching 2,000,000. Through the aggregation effort, communities, such as Warrenville, have been able to secure electricity supply agreements with 100% renewal energy. NIMEC can also assist businesses in exploring the option of purchasing electricity generated from renewable sources.

Table 4. Commercial Energy Strategies

Strategy	Potential GHG Reduction (MTCO2E)	Initial cost	Potential Yearly Savings
Retro-Commissioning of Commercial Buildings (Energy audit/HVAC retrofit/Upgrade to energy efficient equipment/Evaluate whether building components are working together) (assume 50% of 1,500,000 sq ft)	1,126	Varies	\$146 (per 1000 sq ft)
Strict Commercial Energy Code (assume 10% electricity and natural gas savings in 100% of 1,500,000 sq ft)	2,339	\$1500 (per 1000 sq ft)	\$146 (per 1000 sq ft)
Commercial Lights out at Night/ Motion Sensors/ Efficient Lighting (assume 75% of 1,500,000 sq ft)	2,361	\$60 (per 1000 sq ft)	\$189 (per 1000 sq ft)
Reflective Roofs & Paving Materials (assume 33% of 1,500,000 sq ft modified)	417	\$250 per 1000 sq ft incremental cost	\$77 (per 1000 sq ft)
Actions to Implement the Strategies	Status	Partners for Implementation	
Promote energy assessments/audits and energy efficiency grant programs	Ongoing	DCEO, Green Building Council, Businesses, EII, Nicor HES, EAC, Warrenville Public Library, local and social media	
Promote Energy Star and LEED certification or the like to encourage businesses to reduce their energy consumption.	To Be Considered	Local realtors, EAC, Warrenville Public Library, EII, Nicor HES, Western DuPage Chamber of Commerce	
Prepare handouts to be available at City Hall, and on the City's website with information about Energy Star, LEED certification, green building reporting, and energy codes.	To Be Considered	EAC, Community Development Department	
Continue Warrenville's municipal electrical aggregation program with 100% renewable energy (for small commercial electric accounts)	Completed	Small businesses, City Council, Administration Department	
Consider whether to promote commercial building energy reporting to increase energy efficiency by making the energy usage transparent	To Be Considered	Businesses, EAC	
Actively enforce the most current version of the State of Illinois Energy Conservation Code (see additional renewable energy strategies in Table 3)	Ongoing	Community Development Department	

3.C. Government Sector and Other Organizations

The government sector in Warrenville includes the following entities:

- City of Warrenville
- Warrenville Park District
- Warrenville Library District
- Warrenville Fire Protection District
- Community School District 200

Other entities include congregations and other non-governmental organizations. Congregations can cut energy use by using the Energy Star Resource program offered by the US EPA for improving the energy efficiency of their buildings. There are guides available for various types of buildings. More can be read at the following website: http://www.energystar.gov/buildings/owners_and_managers/congregations. In Illinois, over 44 congregations have taken the Energy Star pledge to reduce energy use by 10%. According to the EPA, most congregations can cut energy costs by up to 30% by investing strategically in efficient equipment, facility upgrades and maintenance.

Like the residential and commercial sector, the following general strategies may be applicable to reducing energy consumption in the Warrenville government sector and other organizations: conduct an energy audit; reduce wasted energy; green building design; and commercial building energy reporting. These strategies are described in Section 3.B. Following are examples of the strategies of some local government organizations:

Warrenville Library District

The Warrenville Public Library Green Team has moved forward with several strategies, including replacing the more than 25 year-old air conditioner condensing unit and air handler with a more energy efficient one. The library's HVAC system is on automated controls so that the temperature adjusts automatically when the library is closed, including holidays. Also there was a partial roof replacement in 2008, and the ballasted roof was replaced with white reflective EPDM, an extremely durable synthetic rubber roofing membrane (ethylene propylene diene terpolymer) widely used in low-slope buildings. The library's many green initiatives include energy conservation, water conservation, and materials conservation, and opportunities for involvement of their employees.

Community Unit School District 200

Community Unit School District 200 educates over 13,400 students in school buildings encompassing over 2,500,000 square feet of floor space and covering more than 25 square miles. It has made outstanding achievements in energy efficiency and other green initiatives that are briefly described here. The District has been recognized by EPA as an Energy Star Leader for improving energy efficiency by more than 20% compared to a 2008 baseline and as a Top Performer for earning an average Energy Star energy performance score of 85 across its portfolio of buildings. The district's Board of Education appointed a district-wide Energy Operations Manager to develop and implement a comprehensive energy management plan which utilizes a building audit system. The Energy Operations Manager uses software to track energy data, identify energy savings opportunities, and oversee improvements. Successful efficiency measures have included an increased focus on maintenance of energy systems and equipment; upgrading lighting systems; reviewing and modifying both indoor and outdoor lighting schedules and thermostat set points; and purchasing Energy Star qualified office equipment and appliances whenever possible. The district estimates that it prevents the emissions of more than 3,931 metric tons of carbon dioxide and that it saved more than \$605,000 from January 2009 through December 2012 for the four sites it maintains in Warrenville (the Woodland Facility Services site, Hubble Middle School, and Johnson and Bower Elementary Schools) which encompass 48 acres of land and over 387,000 square feet of conditioned space.

Although all Community Unit School District 200 sites are in the Energy Program and are Energy Star certified, **Hubble Middle School** is unique in that it is a Leadership in Energy and Environmental Design or **LEED certified site**, the only Middle School to be so recognized in DuPage County. There are **dozens of sustainable features incorporated into the design** of Hubble Middle School, including the following: the mechanical system is 20% more efficient than the standard HVAC systems; the natural landscaping is drought-resistant; a permeable paver parking lot reduces water runoff; bioswales filter the run-off before it enters the storm water system; a 5-acre drainage ditch with wetland plants that clean and soak up the water; there is preferred parking for the teachers with the most fuel-efficient vehicles; a green roof can be used as a classroom utilizing sedum to filter rain water and create oxygen as well as being a living classroom for students; the remaining roof is a white "cool roof" which reflects sunlight, allowing savings on air conditioning; low-flow plumbing fixtures help reduce water consumption; an enhanced lighting environment, called a "daylight harvesting system," allows sunlight instead of artificial light to be used in gyms, commons, choir and orchestra rooms as well as halls and classrooms. Because of these features, Hubble Middle School has been recognized with the Award of Merit, Illinois Association of School Boards; Middle School Citation, American School & University magazine; and Project of the Year, K-12 category, and Midwest Construction magazine.

Warrenville's neighborhood schools provide an excellent opportunity to bring change within each household as students learn "green practices" reducing waste and conserving energy. Schools at all levels from preschool through the high schools can support Warrenville's efforts at sustainability in many ways including the following possibilities:

- Bring "no waste" lunches to school: use reusable containers.
- Sort lunchroom waste by compost, recyclables, and garbage.
- Provide recycle containers for waste paper in each classroom and have teacher leadership supporting this program.
- Have student organizations at each level with adult sponsorship to train youth leaders to support these green practices within the buildings. The high school currently has such a group that makes videos for use within the school. Sharing these types of creative programs on local television would give them further impact on others within the community as well as share the activities of local school children.
- Institute a lights out practice by staff after hours to reduce energy used by the district. This would include computers as well as closing blinds to reduce heat loss, especially over weekends.
- Institute a green and healthy transportation program to get students to walk or ride bikes to school reducing the use of cars or buses.
- Encourage creative thought by staff and parent groups to initiate any other practices possible within the school environment such as: A compost area, a vegetable garden to be planted in the spring and harvested for student consumption, writing grants for a small solar station.

Through instruction, these types of practices will help students see that they can make a difference within the school setting and take these practices to their homes helping their families to reduce their carbon imprint and save family funds at the same time. With the combined efforts of students from pre-school through high school many homes will benefit in the Warrenville area.

Warrenville's Franchise Agreement with ComEd

The City of Warrenville's franchise agreement with ComEd, allows the utility to use the City right-of-ways to install their power lines while the City is not billed for electricity usage at City Hall, the Police Department, the Public Works building, and the Cerny Park shelter. Therefore, if solar systems were installed, there would be no pay back at those facilities. EPA Region 5 funded a study examining municipal franchise agreements across the Region. The results state that franchise agreements "represent a largely unused opportunity for municipalities to promote energy efficiency and renewable energy, and

that some franchise agreements even create disincentives for energy efficiency.” The current ComEd franchise agreement does not expire until the year 2054. The study may be something to be kept in mind to review when the opportunity to renew the agreement arrives.

(2011 Kane County 2040 Energy Plan)

Downers Grove Hybrid Solar and Wind Powered Street Lighting System

One local example of harnessing electricity through renewable technologies for street lights is a Downers Grove project in which the Village installed a hybrid solar and wind powered street lighting system - the first of its kind in the nation. The 25 lights in the Prentiss Creek subdivision boast an expected lifetime 10 times beyond standard lighting, or 100,000 hours and are expected to save more than 500,000 kWh of electricity, as the wind/solar mix is expected to produce nearly all electricity consumption. 45% of the \$283,000 project was funded through Community Development Block Grant dollars. Traffic lights, similar to streetlights, have great cost and energy savings potential for municipalities, especially because they are essentially “on” 24 hours a day. LEDs (light emitting diode) already in place in our region use anywhere from 80-90% less energy and require considerably less maintenance. (2011 Kane County 2040 Energy Plan)

Kane County Conversion to LED Traffic Signals

In Kane County, the City of Elgin recently converted traffic signals at 69 intersections over a period of two years. The cost per LED fixture and pole installed was approximately \$10,000 and basic fixture replacement about \$5,000. The city expects to save an estimated 85-90% in energy cost savings, which does not include savings attributed to reduced maintenance, including manpower and vehicle usage.

(2011 Kane County 2040 Energy Plan)

Retrofitting Lighting in Municipal Buildings

Types of lighting retrofits can vary greatly depending on existing lights and lighting needs. Municipalities can take advantage of the Illinois Smart Energy Design Assistance Center (SEDAC) free energy audit services and technical assistance. A comprehensive energy audit will analyze energy consumption and offer recommendations or ECMs (Energy Conservation Measures) that may include options for more efficient lighting. Each type of lighting offers a particular energy savings potential and corresponding return on investment (or payback period.) Lighting retrofits and upgrades may include:

- Replace fluorescent T12 lamps/magnetic ballasts with T8 or T5 lamps/electronic ballasts
- Replace incandescent light bulbs with compact fluorescent light bulbs (CFLs)
- Use LED lighting for signage
- Use occupancy sensors for lighting in break rooms, bathrooms, conference rooms, etc. (City Hall currently has many areas that have occupancy sensors already installed)
- Replace metal halides with high-bay fluorescent fixtures
- Daylighting (harvesting natural daylight) through the use of skylights when feasible (use with automatic/manual daylighting controls for more savings).
- (2011 Kane County 2040 Energy Plan)

IMEA Plans Utility Sized Solar Demonstration Project in St. Charles

A November 3, 2015 press release indicates that the Illinois Municipal Electric Agency plans to build its first utility-scale solar project within St. Charles. The ground-mounted solar panel array and energy storage system, which will cover approximately four acres, will be located on a city-owned lot in the Legacy Business Center on South Kirk Rd. & Legacy Blvd. in St. Charles. The facility is expected to produce enough electricity to power 75 homes. IMEA and Convergence estimate the total useful life of the project to be 20 years. Construction is expected to be completed in early 2016. The city won't incur any ownership, maintenance or construction costs related to the project.

“While IMEA has a long history using carbon-free wind energy from a large project in Lee and DeKalb counties, we are excited to bring this leading-edge solar and storage project on line in 2016,” said IMEA President and CEO Kevin Gaden. “St. Charles is an ideal location for this investment and the city and its leadership are to be commended for their work in securing this for the city. And while the city will receive the direct output of the carbon-free energy, the project’s benefits will flow to our entire membership.” IMEA procures wholesale power and energy from a variety of owned and contracted sources and delivers that wholesale electricity across the state’s transmission system to its members and purchasers. IMEA, which supplies wholesale electric power to 32 municipal electric systems and one rural electric cooperative in Illinois, has been in the wholesale energy business since its creation in 1984. (https://www.stcharlesil.gov/sites/default/files/news/press_release_imea_commissions_solar_pv_demostration_in_st_charles.pdf)

Table 5. Government Sector Energy Strategies

Strategy	Potential GHG Reduction (MTCO2E)	Initial cost	Potential Yearly Savings
Retro-Commissioning of Government Buildings: Energy audit/HVAC retrofit/Upgrade to energy efficient equipment/Evaluate whether building components are working together (assume 100% of 450,000 sq ft retro-commissioned)	676	Varies	\$146 per 1000 sq ft
Government Lights out at Night/ Motion Sensors/ Efficient Lighting	944	\$60 per 1000 sq ft	\$189 per 1000 sq ft
Reflective Roofs & Paving Materials (assume 50% of 450,000 sq ft)	187	\$250 per 1000 sq ft incremental cost	\$77 per 1000 sq ft
Green Buildings Hubble Middle School and Warrenville Library (built since 2007 - have contributed to emissions reduction)	896 (estimated reduction since 2007)	\$50 per 1000 sq ft	\$366 per 1000 sq ft
Actions to Implement the Strategies	Status	Partners for Implementation	
Conduct energy audits of all buildings	Ongoing	Warrenville government organizations	
Consider retro-commissioning/retrofit upgrades, including upgrade of lights, roofs, paving materials	Ongoing	Warrenville government organizations	
Review Warrenville's franchise agreement with ComEd in the renewal year 2054, to eliminate disincentives for energy efficiency, if possible.	To Be Considered	City Council, City of Warrenville	
Provide knowledge gained/lessons learned to other organizations and businesses	Ongoing	EAC, Warrenville government organizations	
(see additional renewable energy strategies in Table 3)			

4.0 Transportation Strategies

The strategies described in this section may be applicable to residents, businesses, governmental agencies, and non-governmental groups. The **DuPage County Green Grid** includes information on electric vehicle charging stations, ethanol stations, biodiesel stations, compressed natural gas stations, liquefied petroleum gas stations, and car share programs within DuPage County.

4.A. Reduce Vehicle Miles/Increase Walking & Biking

There are many benefits to walking and biking, such as reduced noise, congestion and fuel emissions. Walking and biking are good for a person's health, and individuals may also be able to save money. For shorter trips, especially during rush hour, cyclists may be able to get to their destination faster than drivers.

Many cities now have various types of car share programs (i.e., ZipCar) for people, businesses, or other organizations that do not want to own a car but need one only occasionally. It is similar to car rental, but for short periods of time (as little as an hour).

4.B. Alternative Fuel Vehicles

Alternative fuel vehicles include biodiesel, ethanol, compressed natural gas (CNG), propane, hydrogen, electric, and hybrid. The Chicago Area Clean Cities Coalition website has detailed information about these vehicles, incentives (vouchers/rebates) for purchasing them, and information from local businesses and cities about their experiences with various types of alternative fuel vehicles at <http://chicagocleancities.org/>. One of the strategies to promote such vehicles is to have designated parking spaces for customers and/or employees.

Hybrid vehicles use both an electric motor and an internal combustion engine to obtain the best of both worlds. They combine the driving range of an internal combustion engine with the fuel efficiency and emissions-free characteristics of an electric motor. They are less expensive to operate than gasoline vehicles, and maintenance and fuel savings are expected to outweigh the cost of battery replacement. Regular hybrids do not need to be plugged in because the battery is recharged by regenerative braking. When the battery is heavily taxed by a lot of electric motor usage without a lot of braking, the internal combustion engine picks up the slack while the battery comes back up to charge.

The maximum efficiency of regular hybrids (and electric cars) is obtained by the use of regenerative braking. The energy efficiency of a conventional car is only about 20%, with the remaining 80% of its energy being converted to heat through friction. Regenerative braking may be able to capture as much as half of that wasted energy and put it back to work, which reduces fuel consumption. The added efficiency of regenerative braking means hybrids with electric motors and regenerative brakes can travel considerably farther on a gallon of gas, some achieving more than 50 miles per gallon at this point. These types of brakes also extend the driving range of fully electric vehicles.

Electric Vehicles (EV) must be plugged in to recharge the battery. The effect on GHG emissions depends on the source of the energy used. If most of the electricity is from coal, an electric vehicle may produce more emissions than a gasoline or diesel vehicle. If the source is renewable (such as solar power), emissions are zero.

In order to increase electric motor cruising time, some manufacturers are creating plug-in hybrids that have more powerful batteries which can be recharged by "plugging in" the vehicle to normal household current. This feature allows the vehicle to perform more like a true electric car and less like a conventional gasoline car, all the while delivering exceptional fuel mileage. One strategy could be promoting installation of EV charging stations and educating businesses on available grants and resources. According to the PlugShare.com map, there is a free EV charging station in Warrenville at Two Brothers which is available for public use.

Compressed Natural Gas (CNG) is the same natural gas that is used in home heating, except that it has been compressed to 3600 psi in a high-pressure tank for use in a vehicle. It is domestically produced and cost effective (less expensive than diesel). Bi-fuel and dedicated vehicles are available. Fracking technology allows the low cost, which is an environmental negative unless strict regulations are enacted. According to information at the Chicago Area Clean Cities website, pricing is projected to be flat for 10

years (according to government sources) or to 25 years (according to industry). There is an estimated overall 20% reduction in GHG emissions.

Flex Fuel Vehicles (ethanol and biodiesel) are generally not recommended due to several concerns. According to an article in the *Economist* dated June 24, 2011, "a broad consensus has now thrown its weight behind the environmentalists' view that using home-grown ethanol—as a replacement for imported oil—squanders far too much energy and water in the process, and is not a particularly good way at reducing greenhouse gases anyway. Indeed, given the intensive use of energy in agribusiness, it is debatable whether replacing petrol with ethanol breaks even in terms of the “wells-to-wheels” energy consumed, or even produces a net reduction in carbon emission. Even if America's entire corn crop were to be devoted to ethanol production, it would still only supply 4% of the country's oil consumption."

Propane, or liquefied petroleum gas (LPG) is basically the same type of gas that is used in home barbeques. For automotive applications, it is a mixture of propane gas and butane gas. The LPG mixture is kept as a liquid under heavy pressure in a special tank in the vehicle. LPG assures a very clean combustion. That's because before entering the engine, LPG is converted from liquid to gas, so it can be perfectly mixed with the air, unlike gasoline. The exhaust emissions of engines running on LPG are low; however, it is still a petroleum product.

Hydrogen-fueled vehicles are expected to play an important role in sustainable transportation in the future. A *Chicago Tribune* article noted that Toyota, Hyundai, and Honda are testing and producing hydrogen fuel cell vehicles for 2015. It says that fuel cells combine the best of electric and gasoline cars without the downsides: they drive like electric cars—quietly, with tons of off-the-line power—but can be refueled just like gasoline-powered cars, writes Jerry Hirsch for the *L.A. Times*. Fuel-cell cars use a stack of cells that combine hydrogen with oxygen in the air to generate electricity, which powers the motor that propels the car. The only emission is water vapor and, with a 300-mile range can run three or four times longer than the most capable electrics. Infrastructure and cost are barriers. (<http://cars.chicagotribune.com/fuel-efficient/news/chi-hydrogen-or-electric-vehicles>)

Fuel efficiency can be achieved by using a smaller higher-mileage vehicle when possible. For example, it may be possible to use a compact car rather than a SUV for most uses.

4.C. Reduce Vehicle Idling

Reducing the amount of time that drivers idle their engines can reduce fuel costs, engine wear, emissions, and noise. Drivers idle their vehicles for a variety of reasons, such as to keep warm, or operate radios or power equipment. Idle reduction strategies can dramatically reduce GHG emissions and other pollutants. The U. S. EPA Smart Way Program and the U.S. Department of Energy (DOE) have evaluated the fuel-saving benefits of various idle reduction technologies. Both agencies provide information about grant funding that may be available for installation of qualifying equipment. EPA's Smart Way Program offers a list of Verified Idling Reduction Technologies at <http://www3.epa.gov/smartway/forpartners/technology.htm>

Many parents still idle their car engines in front of schools when they are waiting for their children, even though most Warrenville schools (including Bower, Johnson, St. Irene's, Four Winds, and Hubble Middle School) have “No Idling” signs on the side of the building where parents pick up their children. There are no signs at the Montessori school on Rt. 59. Bus drivers idle the bus engines even though Illinois Public Act 094-0845 was passed in 2006 to prevent excessive idling "...to protect public health and the environment by reducing emissions while conserving fuel and maintaining adequate rest and safety of all drivers of diesel vehicles." There are no "No Idling" signs on the sides of the schools where the buses wait.

Creative approaches are being tried to address the question of compliance with anti-idling policies. For example, a middle school in San Antonio created a Green Patrol to help drivers remember to turn off their engines while waiting to pick up students. The program is featured in a Clean Cities video (<https://www.youtube.com/watch?v=4vGmRd2kDBo>), and a handbook about how to establish a Green Patrol squad at a local school is available at: [http://cleanairdrive.com/greenpatrol/gpdocuments/GPStarter Kit.pdf](http://cleanairdrive.com/greenpatrol/gpdocuments/GPStarterKit.pdf)

In addition to waste of fuel and air pollution on school properties, air quality within schools can be impacted. In some situations, vehicle exhaust may enter the school through air intake vents located near the areas where vehicles idle. The neighboring community of Lombard noted that when they increased their awareness campaign, city workers installing new signs internalized the mentality and city vehicle use incorporated these practices as well; saving gas and reducing emissions. Argonne National Lab has anti-idling information, a Green Fleet footprint calculator, 2014 Clean Cities Vehicle Buyer's Guide, Clean Cities Guide to Alternative Fuel and Advanced Medium- and Heavy-Duty Vehicles.

In 2015, Kane County passed an idling reduction policy for county vehicles which limits vehicle idling to 30 seconds except under certain, well defined circumstances. The policy applies to the 280 vehicles in their fleet. The Kane County Division of Environmental and Water Resources estimated that reducing idling by only five minutes per week for each vehicle could save \$2,000 each year in the county's fuel costs and prevent 15,800 pounds of CO₂ from entering the atmosphere - all from educating county staff and asking them to make some simple behavior changes. The full policy can be viewed at: http://countyofkane.org/sustainability/Documents/additionalResources/Kane%20Idling%20Reduction%20Policy_2015.pdf

Change Driver Behavior

For passenger cars, the primary idle reduction strategy is to turn the vehicle off when parked or stopped for more than a few seconds, except in traffic. Drivers can also:

- Avoid using a remote vehicle starter, which encourages unnecessary idling.
- Avoid using drive-thru windows at fast-food restaurants and banks. Walk inside instead.
- Obey no-idle zones at schools and other locations.

Adopt Idle Reduction Technologies

Light-duty vehicles include passenger cars, and fleet vehicles like livery vehicles and taxis. For passenger cars that must stand for long periods, such as cabs, limousines, and police cars, auxiliary power systems and air heaters are good alternatives to idling.

Auxiliary power systems are useful for police cars, which often require extensive comfort, radio, or computer support while stopped. Such systems can consist of batteries, fuel cells, or small engines. Auxiliary power systems can provide heating, cooling, and electronic device power without running the vehicle's engine. Drivers more concerned with passenger compartment warmth - such as taxi and limousine drivers - might prefer air heaters. Although they operate on engine fuel, air heaters are separate, self-contained units that blow hot air directly into the vehicle interior. Air heaters use very little fuel. Power management systems reduce idling by monitoring battery power levels while the engine is turned off. When battery levels get low, the power management system restarts the engine and keeps it running until battery power returns to an appropriate level. These systems allow the driver to use battery power to run the vehicle's HVAC and other accessories without worrying about battery depletion.

Another option for keeping a vehicle warm is an energy recovery system, which uses the vehicle's heat-transfer system. A very small electric pump is connected to the water line, which keeps the vehicle's cooling system and heater operating after the engine is turned off, using engine heat that would otherwise dissipate. Energy recovery systems keep the passenger compartment warm. (<http://www.afdc.energy.gov>)

Table 6. Transportation Energy Strategies

Strategy	Potential GHG Reduction (MTCO ₂ E)	Initial cost	Potential Yearly Savings
Walking: 100 trips per week replacing car (1 mile each)	2	\$0	\$924 (total)
Biking: 100 trips per week replacing car (10 miles each)	25	\$0-500 (per bike)	\$9,239 (total)
Reduce Light Vehicle Idling (5,000 cars avoid idling 5 min. per day)	461	\$0	\$169,269 (total)
Hybrid vehicles and EV 500 hybrid vehicles for community 15 hybrid vehicles for city	1,700	\$2,500 (per vehicle)	\$1,225 (per vehicle)
Actions to Implement the Strategies	Status	Partners for Implementation	
Continue to implement the City's Bikeway Implementation Plans approved by City Council as opportunities arise.	Ongoing	BPAC, City Council, Public Works	
Increase number/locations of bike racks	Ongoing	BPAC, businesses, Public Works	
Consider replacement of vehicles with alternative fuel vehicles and encourage and educate businesses to consider alternative fuel vehicles	Ongoing	City Departments, EAC, Western DuPage Chamber of Commerce, Park District, Fire District	
Initiate a community awareness campaign at waiting locations such as schools, park districts, ball fields, community buildings, shopping areas and industrial street locations to encourage people to stop idling	Ongoing	EAC	
Encourage "no idling" for all vehicles. Provide education about "no idling" policies. Encourage compliance with laws for vehicles that use diesel fuel	To Be Considered	EAC/Schools	
Provide information about vehicle idling emissions in newsletters, newspapers, City website, public access channel, and e-mail blasts	To Be Considered	EAC	

5.0 Waste Management Strategies

In this section, the following strategies to reduce GHG emissions are described in detail:

- Reducing Wasted Food/Composting
- Recycling (curbside, commercial, government, non-government, construction)
- Waste Reduction/Sustainable Materials Management/Cradle-to-Cradle Design

5.A. Reducing Wasted Food/Composting

When food, paper, wood, and yard waste are placed in landfills, they decompose anaerobically (i.e., without oxygen) and produce methane. Methane is a GHG that is 21 times more powerful than CO₂. About 12% of municipal solid waste is food scraps, and 12% is yard waste. Collecting and composting this organic waste prevents the emissions it would have produced in a landfill. Composting produces fertilizer that can be used for farms or gardens, returning nutrients to the soil that were removed by food production. This reduces the amount of fertilizer produced by fossil fuels.

Did you know?

- More than 36 million tons of food waste was generated in 2011, 96% of which was thrown away into landfills or incinerators

- 14.9% of households in the U.S. were food insecure in 2011, meaning they did not know where their next meal would come from
- Wasted food means wasted money for businesses and residences

Compost is organic material that can be used as a soil amendment or as a medium to grow plants. Mature compost is a stable material with a content called humus that is dark brown or black and has a soil-like, earthy smell. It is created by: combining organic wastes (e.g., yard trimmings, food wastes, manures) in proper ratios into piles, rows, or vessels; adding bulking agents (e.g., wood chips) as necessary to accelerate the breakdown of organic materials; and allowing the finished material to fully stabilize and mature through a curing process. Natural composting, or biological decomposition, began with the first plants on earth and has been going on ever since. As vegetation falls to the ground, it slowly decays, providing minerals and nutrients needed for plants, animals, and microorganisms. Mature compost, however, includes the production of high temperatures to destroy pathogens and weed seeds that natural decomposition does not destroy.

Residential Strategies

Ways to Reduce Wasted Food

- Shop your refrigerator first! Cook or eat what you already have at home before buying more.
- Plan your menu before you go shopping and buy only those things on your menu.
- Buy only what you realistically need and will use. Buying in bulk only saves money if you are able to use the food before it spoils.
- Be creative! If safe and healthy, use the edible parts of food that you normally do not eat. For example, stale bread can be used to make croutons and beet tops can be sautéed for a delicious side dish.
- Nutritious, safe, and untouched food can be donated to food banks to help those in need.
- Freeze, preserve, or can surplus fruits and vegetables - especially abundant seasonal produce.
- At restaurants, order only what you can finish by asking about portion sizes and be aware of side dishes included with entrees. Take home the leftovers and keep them for your next meal.
- At all-you-can-eat buffets, take only what you can eat.
- Compost food scraps rather than throwing them away.

Composting/Natural Decomposition of Grass Clippings & Leaves

Backyard or onsite composting can be conducted by residents and other small-quantity generators of organic waste on their own property. This method should not be used to compost animal products or large quantities of food scraps. The conversion of organic material to compost can take up to two years, but manual turning can hasten the process considerably (e.g., 3 to 6 months). The resulting natural fertilizer can be applied to lawns and gardens to help condition the soil and replenish nutrients.

Grass clippings can be left on the lawn where the cuttings will decompose naturally and return some nutrients back to the soil. Leaves can be left under trees to naturally decompose.

Using red worms (not nightcrawlers or field worms found in gardens) to break down food scraps, paper, and plants into a high-value compost called castings is called vermicomposting. Worm bins are easy to construct (they are also commercially available) and can be adapted to accommodate the volume of food scraps generated. Vermicomposting can be ideal for apartment dwellers or small offices that want to derive some of the benefits of composting and reduce solid waste. It is frequently used in schools to teach children conservation and recycling. One pound of mature worms (approximately 800-1,000 worms) can eat up to half a pound of organic material per day. It typically takes three to four months for these worms to produce

harvestable castings, which can be used as potting soil. Vermicomposting also produces "compost tea," a high-quality liquid fertilizer for house plants or gardens.

Commercial/Government/Non-Government Organizations Strategies

Ways to Reduce Wasted Food

Businesses and other organizations can participate in the U.S. EPA's Food Recovery Challenge through prevention, donation and recycling in order to:

- Improve your bottom line through cost savings from improved purchasing and preparation practices and reduced waste disposal fees
- Support your community by using food to feed people, not landfills
- Reduce your environmental footprint and greenhouse gas emissions
- Get recognized for your achievements
- Access free technical assistance for your baseline assessment and food recovery activities

Reduction and Prevention Strategies

- Do a Food Waste Assessment - The first step to reducing food waste is to measure and track the amount, type, and reason for its generation. Knowing how much and why food waste is generated will help a business create targeted food waste prevention strategies. This baseline information also serves as a marker for measuring the diversion rate and change in spending. Depending on a person's goals, there are a variety of free EPA tools available to conduct a wasted food assessment.
- Reduce Your Food Waste in the Kitchen:
 - *Reduce over-purchasing of food* - Create guidelines or implement a system that ensures only what is needed is purchased. This could include a "just-in-time" ordering system or a new purchasing policy.
 - *Reduce prep waste and improperly cooked food* - Look at production and handling practices and consider strategies for reducing prep waste including: improving knife skills of staff, purchasing pre-cut food, reducing batch sizes when reheating foods like soups or sauces, and training staff to reduce improperly cooked food.
 - *Consider secondary uses for excess food* - Leftover bread can become croutons, excess rice can become fried rice, leftover fruit can be a dessert topping, and vegetable trimmings can help form a base for soups, sauces, and stocks.
 - *Ensure proper storage techniques* - In order to reduce spoilage, food products should be stored in proper condition (e.g. temperature) and organized easily to track inventory levels and ensure that older products are used first.
- Reduce Plate Waste - Consumer kitchen waste includes all food wastes generated once the food reaches the customer. This includes food left uneaten by customers and garnishes.
 - *Modify menu to increase customer satisfaction and reduce food left uneaten* - Food frequently left uneaten or sent back by customers can be identified by tracking wasted food. Based on this information, managers can modify the menu and better satisfy the customers.
 - *Change serving sizes and garnishes* - Even small garnishes and improper serving sizes quickly add up to a significant amount of food waste. Strategies to reduce this waste include avoiding inedible or rarely eaten garnishes, reducing the scoop or serving size while still satisfying a customer's appetite, and using an "ask first" policy for sides.
 - *Encourage guests to order or take only the food they can consume* - Food service managers can post informational signs at buffet-style food service venues that encourage customers to take only enough food to match their appetite.
 - *Go Trayless* - A 2008 study of 25 college campuses conducted by the food services provider Aramark found that removing trays at dining halls results in as much as 25 to 30% less wasted food. Discourage customers from wasting food by going tray-less or by switching to smaller trays.

Composting/Natural Decomposition of Grass Clippings & Leaves

Aerated (Turned) Windrow Composting: Organic waste is formed into rows of long piles called “windrows” and aerated by turning the pile periodically by either manual or mechanical means. The ideal pile height, which is between four and eight feet, allows for a pile large enough to generate sufficient heat and maintain temperatures, yet small enough to allow oxygen to flow to the windrow's core. The ideal pile width is between 14 and 16 feet. This method can accommodate large volumes of diverse wastes, including yard trimmings, grease, liquids, and animal byproducts (such as fish and poultry wastes), but only with frequent turning and careful monitoring. This method is suited for large quantities, such as that generated by entire communities and collected by local governments, and high volume food-processing businesses (e.g., restaurants, cafeterias, packing plants). This method will yield significant amounts of compost, which might require assistance to market the end-product.

Aerated Static Pile Composting: Organic waste is mixed together in one large pile instead of rows. To aerate the pile, layers of loosely piled bulking agents (e.g., wood chips, shredded newspaper) are added so that air can pass from the bottom to the top of the pile. The piles also can be placed over a network of pipes that deliver air into or draw air out of the pile. Air blowers might be activated by a timer or a temperature sensor. Aerated static piles are suitable for a relatively homogenous mix of organic waste and work well for larger quantity generators of yard trimmings and compostable municipal solid waste (e.g., food scraps, paper products), which might include local governments, landscapers, or farms. This method, however, does not work well for composting animal byproducts or grease from food processing industries. This method produces compost relatively quickly-within three to six months.

In-Vessel Composting: Organic materials are fed into a drum, silo, concrete-lined trench, or similar equipment where the environmental conditions-including temperature, moisture, and aeration-are closely controlled. The apparatus usually has a mechanism to turn or agitate the material for proper aeration. In-vessel composters vary in size and capacity. Conversion of organic material to compost can take as little as a few weeks. Once the compost comes out of the vessel, however, it still requires a few more weeks or months for the microbial activity to stabilize and the pile to cool.

Commercial establishments, and institutions (i.e. universities, schools, and hospitals) can leave grass clippings on the lawn where the cuttings will decompose naturally and return some nutrients back to the soil. Leaves can also be left to decompose under trees.

5.B. Recycling

There are several key benefits to recycling (<http://www2.epa.gov/recycle/recycling-basics>):

- Protects and expands U.S. manufacturing jobs and increases U.S. competitiveness in the global marketplace.
- Reduces the need for landfilling and incineration.
- Saves energy and prevents pollution caused by the extraction and processing of virgin materials and the manufacture of products using virgin materials.
- Decreases emissions of greenhouse gases that contribute to global climate change.
- Conserves natural resources such as timber, water, and minerals.
- Helps sustain the environment for future generations.

Recycling not only makes sense from an environmental standpoint, but also makes good financial sense. For example, creating aluminum cans from recycled aluminum is far less energy-intensive, and less costly, than mining the raw materials and manufacturing new cans from scratch. Because recycling is clearly good for human health, the nation's economy, and the environment, many people wonder why the federal government does not simply mandate recycling. The primary reason is that recycling is a local issue—the success and viability of recycling depends on a community's resources and structure. A community must

consider the costs of a recycling program, as well as the availability of markets for its recovered materials. In some areas, not enough resources exist to make recycling an economically feasible option.

Waste and materials that are commonly recycled include consumer electronics, household hazardous waste, food waste, yard and wood waste, paper, scrap tires, used oil, aluminum, antifreeze, automotive parts, batteries, disaster debris, glass, plastics, steel, and textiles. Warrenville's pay-as-you-throw program provides a financial incentive for people to reduce the amount of waste they generate. These programs encourage recycling, reuse of items, and choosing items with less packaging. The City collects an extensive list of materials for recycling, and there are local recycling efforts at the Warrenville Public Library, and Ace Hardware. Areas for improvement include textiles, plastic bags, and food waste.

5.C. Waste Reduction/Sustainable Materials Management/Cradle-to-Cradle Design

Residential Strategies

Consumers can take steps to reduce the environmental impact at each stage of the life cycle of their stuff. Some examples of how residents can reduce GHG emissions by reducing waste:

- Use reusable cups and drinking glasses (when appropriate)
- Use eco-friendly take-home containers instead of using #6 Styrofoam
- Order a menu item that is designated as organic
- Purchase resale items
- Purchase items that are made, created, or designed using eco-friendly products
- Purchase an item that is designated organic or fair trade
- Purchase an item that is made from recycled materials
- Use eco-friendly options for transportation to and from your business/event
- Recycle
- Use re-usable bags for groceries instead of plastic

Strategies for Businesses, Universities, Governments

Sustainable Materials Management is a systemic approach to using and reusing materials more productively over their entire lifecycles. It refers to the use and reuse of materials in the most productive and sustainable way across their entire life cycle. Sustainable Materials Management conserves resources, reduces waste, slows climate change, and minimizes the environmental impacts of the materials we use. EPA's Sustainable Materials Management Program seeks to reduce the environmental impact of materials through their entire life cycle, including how they are extracted, manufactured, distributed, used, reused, recycled, and disposed.

- Know and reduce the life cycle impacts across the supply chain. Conduct a life cycle assessment.
- Use less toxic and more renewable materials.
- Increase Industrial Materials Recycling

The following U.S. EPA tools and programs can help promote waste reduction, recycling and resource conservation.

- Comprehensive Procurement Guidelines help businesses purchase recycled materials, including recommendations for recycled-content levels.
- Tools for Local Government Recycling Programs: Provides tools and information for local governments and community leaders seeking to create or maintain a residential recycling program.
- Full Cost Accounting provides a common-sense approach to identifying the cost of managing solid waste operations and measures for streamlining and improving operations.
- Recycle on the Go: Encourages recycling in public places such as parks, stadiums, convention centers, airports and shopping centers.

- Recycling Measurement: A standardized methodology for measuring the effectiveness of recycling in a community.
- Materials and Waste Exchanges: Markets for buying and selling reusable and recyclable commodities.

Manufacturing systems of the Industrial Revolution are based on a one-way, cradle-to-grave stream of materials - a model that takes, makes, and wastes. **Cradle-to-Cradle Design** is an approach to sustainability that rejects the assumption that human industry inevitably destroys the natural world, or that the demand for goods and services is the cause of environmental ills. The application of cradle-to-cradle principles to industry creates cyclical material flows. Rather than thinking about "minimizing damage" and shrinking a "footprint," this approach encourages designing industrial/manufacturing systems to direct innovation and leadership towards a "positive footprint."

Cradle to Cradle Principles (<http://www.mbcc.com/cradle-to-cradle/c2c-framework/>):

- Material Health: Value materials as nutrients for safe, continuous cycling
- Material Reutilization: Maintain continuous flows of biological and technical nutrients
- Renewable Energy: Power all operations with 100% renewable energy
- Water Stewardship: Regard water as a precious resource
- Social Fairness: Celebrate all people and natural systems

Table 7. Waste Management

Strategy	Potential GHG Reduction (MTCO2E)	Initial cost	Potential Yearly Savings
Composting Food Scraps 300 lb/person/yr x 14,000 people	51	None	
Expand Recycling (300 lb/person/yr x 14,000 people) <ul style="list-style-type: none"> • Expand business recycling • Expand construction recycling • Expand government/other organizations recycling • Waste Reduction 	90		
Actions to Implement the Strategies	Status	Partners for Implementation	
Promote residential composting	Ongoing	EAC	
Consider revising the Property Maintenance Code regarding commercial composting	To Be Considered	EAC, Community Development	
Encourage use of local recycling options (County/library/Ace Hardware/SCARCE/DART)	Ongoing	EAC	
Promote textile recycling	To Be Considered	EAC	
Promote use of reusable grocery bags	To Be Considered	EAC	
Reduce solid waste	To Be Considered	Residents, businesses, government organizations	

6.0 Water Conservation Strategies

The average family spends \$1,100 per year in water costs, but can save \$350 from retrofitting with WaterSense labeled fixtures (low-flow faucets, shower heads) and Energy Star qualified appliances. Also, when more water is used efficiently, the need for costly investments in water treatment and delivery systems is reduced. It takes a considerable amount of energy to deliver and treat the water used every day. For example, letting a faucet run for five minutes uses about as much energy as letting a 60-watt light bulb run for 22 hours. Heating water for bathing, shaving, cooking, and cleaning also requires a lot of energy. Homes with electric water heaters, for example, spend one-quarter of their electric bill just to heat water. By using a little "water sense" people can all save water, energy, and money. (*WaterSense-a U.S. EPA Partnership: www.epa.gov/watersense*)

Low maintenance landscaping can also save a lot of water, as described in Section 7. Most automatic irrigation systems for lawns and landscaped areas are controlled by a timer that waters whether plants need it or not, wasting much water. Controls using either soil moisture or weather sensors save water by only irrigating when plants need it. Irrigation sensors save an average of 26% on irrigation water use. (*CAPPA-ICLEI*)

Water pumping (transport, treatment and distribution), as well as wastewater treatment, can represent a large portion of municipal energy use. Using more efficient equipment for these systems, pump system optimization, preventive inspection and maintenance, and controlling leaks can provide energy savings and emissions reductions.

Table 8. Water Conservation

Strategy	Potential GHG Reduction (MTCO2E)	Initial cost	Potential Yearly Savings
500 Faucets Replaced	9	\$8 (per faucet)	\$13 (per faucet)
Irrigation control sensors- 10 acres of lawn	5.2	\$500 (per 10 acres)	\$424 (per 10 acres)
Water System Efficiency (pumping) (improve 20% for population of 14,000)	1,691	\$200,000 (cost of upgrade)	\$152,402
Actions to Implement the Strategies	Status	Partners for Implementation	
Encourage use of WaterSense and Energy Star appliances, including low-flow faucets, shower heads, and toilets	Ongoing	Residents, EII, Nicor HES, EAC, businesses, governmental facilities, and other organizations	
Encourage water conservation	Ongoing	EAC	
Consider amending City Code to require irrigation control sensors for commercial areas	To Be Considered	Public Works/Community Development Department	
Reduce wastewater	To Be Considered	Residents, businesses, government and other organizations	

7.0 Natural Landscaping (Residential/Commercial/Governmental/NGO)

7.A. Emissions Due to Irrigation, Mowing, Fertilizers, Pesticides

Much of the information in this section is based on information from *Protecting Nature in Your Community - A Guidebook for Preserving and Enhancing Biodiversity* by the Northeastern Illinois

Planning Commission (NIPC). Note: Northeastern Illinois Planning Commission became the Chicago Metropolitan Agency for Planning (CMAP) in 2005.

The current predominant landscape of the Chicago region is the turf grass lawn which requires irrigation, frequent mowing, fertilizers, and pesticides. Nitrogen, phosphorus, and potassium are the primary major nutrients required for plant growth and are the main components of most fertilizers. These chemicals are energy intensive to produce, create vast amounts of waste, and contribute to GHGs during manufacture, transport, and application. Energy inputs associated with insecticide manufacture include the raw materials themselves, which are typically petroleum or natural gas, and the transformation of these materials into insecticides using a variety of energy-intensive industrial processes. According to the EPA, “To the extent that compost may replace or reduce the need for these substances, composting may result in reduced energy-related GHG emissions.” (<http://www.cool2012.com/cool/fertilizer/>)

Turf grass maintenance is not only expensive but also contributes to adverse environmental impacts, including air and water pollution. Small engines on lawn mowers and other yard equipment such as leaf blowers are much more polluting than cars. One mower can produce as much pollution in a year as 43 cars. (CAPP-ICLEE) Water pumping and purification, as well as wastewater treatment, can represent a large portion of municipal energy use.

Turf grass is a monoculture, which means that it is a single species over a large area. This is the opposite of biodiversity, and it offers little habitat for native species. Replacement of some areas of turf grass with natural landscaping would offer many benefits, including the following:

- Low maintenance cost. Natural landscapes require much less time, money and effort to maintain once they are established. Long term needs for irrigation, fertilizers, pesticides and herbicides are virtually eliminated. Instead, controlled burning or mowing may be needed every one to three years.
- Wildlife habitat and biodiversity protection and restoration. Natural landscaping serves to protect and restore habitats and biodiversity: it can serve as a buffer for sensitive natural areas and can be used to connect adjacent habitat areas via vegetated greenways. The introduction of native plants can enhance the populations of birds, insects, and animals which are essential components of healthy ecosystems.
- Protection of downstream wetlands and water bodies. Protection is accomplished, in part, by the deep, extensive root systems of native plants that (1) improve the infiltration and filtering of precipitation and stormwater runoff, and (2) hold soil in place, thus greatly reducing erosion and siltation of water bodies. Thus natural landscaping leads to improved water quality and the stabilization of runoff in comparison to conventional landscapes.
- Conservation education and scientific study. Natural landscaping puts people in touch with nature close to home, work, and other nearby locations. Municipalities, school districts, park districts, and forest preserve and conservation districts can use natural landscaping as an educational and environmental monitoring tool.
- Beautification and property enhancement. Natural landscaping provides aesthetic richness with seasonally changing color and texture that significantly contributes to the beauty of sites and communities.
- Creation of a distinctive community image. High quality natural features such as river corridors and woodlands strengthen the identity of a community or neighborhood. Distinctive natural landscaping that preserves the unique characteristics of a community is a unique community asset.
- Reduced cost of stormwater management. Natural landscaping slows and reduces the amount of stormwater runoff and enhances infiltration. This helps reduce infrastructure costs and downstream flooding, and replenishes groundwater. Stormwater conveyance and detention facilities that replicate natural systems are generally less expensive to build and almost always more economical to maintain.

- Reduced soil erosion. Native plants appropriately used on sloped sites, stream banks, drainage-ways, and shorelines can effectively hold the soil and reduce erosion due to their deep and fibrous root systems. The initial cost and long term maintenance costs are less expensive than traditional hard engineered structures such as rip rap.
- Improved water quality. Native vegetation in drainage-ways enhances the infiltration of contaminated stormwater. Vegetated buffers along streambanks and shorelines intercept surface runoff and subsurface water pollutants. The reduced use of fertilizers and other chemicals is also an important factor in protecting water quality and public health.
Passive recreation. Natural landscapes are ideal locations for bird watching, photography, walking and hiking, and simply enjoying the quiet and beauty of nature.
- Reduced Pollution. Due to greatly reduced reliance on lawn mowers for maintenance, natural landscapes can reduce noise pollution and air pollution, including greenhouse gases.

7.B. Biodiversity Value of Residential Areas

The information in this section is based on the Chicago Wilderness web site: <http://www.chicagowilderness.org/>

Developed areas play an important role in preserving biodiversity. Native birds and mammals tend to do well in urban residential areas, while amphibians and reptiles do well where ponds, detention basins, and stream corridors exist. The diversity of animal species depends largely on the presence of wetlands, open water (streams, ponds, and detention basins), and a wide diversity of native vegetation (especially older and larger native trees and shrubs as well as prairie plants and other smaller vegetation), indicating that the provision of such features by developers will benefit biodiversity. Proximity to forest preserves and other natural areas increases the likelihood that animals will use residential and other developed properties, making those properties part of the continuum of habitat necessary for animal survival. Local ordinances, such as one allowing natural landscaping, are important to making these features part of the developed landscape. Planners and developers working together to protect and provide habitat features improves the chances that developed areas will support biodiversity. Recently developed conservation subdivisions, such as Prairie Crossing, Mill Creek, Hybernia, and the Sanctuary, incorporated open water into the development designs, which increased the overall level of biodiversity for these areas. In fact, improved biodiversity was used as part of the promotional materials for these developments.

The guidebook and slideshow *Protecting Nature in Your Community: A Guidebook for Preserving and Enhancing Biodiversity* provides guidelines and actions for local governments to control and manage growth and development in an environmentally-sensitive manner. The materials present the benefits of protecting nature (quality of life, aesthetics, recreation, public demand, economic value, environmental benefits, and spiritual values.) The materials also present the essential role of local government in the effort to protect natural resources and nine specific ways local governments can take action: comprehensive land use planning; compatible zoning and subdivision regulations; improved stormwater management; stream, lake and wetland protection; natural landscaping; improved wastewater management; open space preservation; natural area management and restoration; and education. The materials present background for these practices, specifically recommended approaches for implementing the practices, the benefits of doing so, local examples of the practices in use, and lists of sources to consult for more information.

Table 9. Natural Landscaping Strategies

Strategy	Potential GHG Reduction (MTCO ₂ E)	Initial cost	Potential Yearly Savings
Low Maintenance Landscaping 10 acres (public) 100 residences, 0.3 acre lot	4 13	Low-Medium	6,520,000 81,500,000 (gallons of water)
Gas Lawnmower replacement: 500 residences	5	Low	
Actions to Implement the Strategies	Status	Partners for Implementation	
Encourage natural landscaping for the following components of new development or redevelopment: drainage swales, around detention basins, and along the edges of streams, lakes, and wetlands.	Ongoing	Community Development Department	
Encourage the use of native plants for private landscaping by revising ordinances, if necessary, according to guidance in NIPC's Natural Landscaping Sourcebook.	Completed	Community Development Department, EAC	
Promote the use of natural landscapes on public properties such as City property, schools, parks, and various types of rights-of-way such as utility corridors.	Ongoing	EAC, Public Works Department, other government organizations, utility companies	
Provide information about natural landscaping to citizens, business owners, developers, and civic organizations. Educate upstream communities in order to reduce flooding in Warrenville.	Ongoing	EAC, DuPage County, Conservation Foundation, U.S. EPA, Chamber of Commerce	
Encourage use of rain barrels.	Ongoing	EAC, Warrenville in Bloom, The Conservation Foundation	
Encourage removal of invasive species of concern (i.e., buckthorn, non-native honeysuckle, autumn olive, tree of heaven, barberry, burning bush, non-native thistle, teasel, garlic mustard, etc. (http://invasive.org/illinois/SpeciesofConcern.html))	To Be Considered	EAC, Warrenville in Bloom, The Conservation Foundation, Illinois Prairie Path (IPP)	

8.0 Urban Forest and Natural Areas Strategies

8.A. Warrenville's Urban Forest

The information in this section is based on information from the City's Public Works Department, the City's Arboricultural and Open Space Manual (updated in 2011), and the City of Warrenville Urban Forestry Management Plan that was prepared by Natural Path Urban Forestry Consultants, dated October 2012. The Forestry Plan was completed through a grant from the Illinois Department of Natural Resources.

The City's urban forest provides multiple economic and environmental benefits to the community. The estimated benefits of Warrenville's City-owned trees are measured in energy conservation (\$409,000), carbon dioxide capture (\$52,000), air quality enhancement (\$66,000), stormwater retention (\$453,000), and aesthetic value (\$435,000). Therefore, the total annual benefit that residents of Warrenville derive from their street trees was approximately \$1,414,000. The replacement value (the appraised value of the 6,069 public trees) was estimated to be \$12,698,000. (This report was prepared in 2012, prior to removal of ash trees due to the emerald ash borer.)

In the City's forestry management plan, the ecosystem services benefits were estimated using the U.S. Forest Service's "Midwest Community Tree Guide" and *Streets* software. The benefits are described as follows:

- **Energy Conservation** is an estimate of contributions of the urban forest in terms of reduced natural gas use in winter and reduced electricity use for air conditioning in summer.
- **Carbon dioxide capture** is an estimate of the annual reductions in atmospheric CO₂ due to storage by trees and reduced emissions from power plants due to reduced energy use. The model accounts for CO₂ released as trees die and decompose as well as CO₂ released during the care and maintenance of trees. Trees remove CO₂ from the air through photosynthesis and store (sequester) the carbon in their roots, trunk, branches, and leaves. Trees can provide shade for buildings, resulting in reduced energy usage for heating and cooling buildings.
- **Air quality enhancement** quantifies the air pollutants deposited on tree surfaces and reduced emissions from power plants due to reduced electricity use. Also reported are the potential negative effects of trees on air quality due to biogenic volatile organic compound emissions.
- **Stormwater Retention** is an estimate of the reductions in annual stormwater runoff due to rainfall interception by trees.
- **Aesthetic value** presents the tangible and intangible benefits of trees reflected in increases in property values.

Streets (part of the larger *iTREE* suite of urban forestry analysis programs) is a user-friendly software tool for municipal street trees. It was used to define the species composition, age distribution, species importance values, and canopy cover of the City's urban forest to help managers anticipate future planting needs and the potential impact of pest threats. The analysis of the tree inventory showed the following (as of 2012):

- Five tree species (Green Ash, American Elm, Silver Maple, Norway Maple, and Colorado Spruce) were over-represented in Warrenville (i.e., they each represented more than 5% of the street tree population). In order to maintain diversity, the long-term population targets for high-quality species should be approximately 5% of the total population. Certain species should be avoided due to high maintenance costs, short life expectancy, high storm damage and/or hazard potential. There were 75 total species represented in Warrenville.
- A total of 6,069 trees, 746 planting spaces, and 118 stumps were inventoried and mapped on the City's public streets.
- Of the 6,069 trees, 594 were in poor or worse condition. Although 136 ash trees (of 594) were in poor condition at the time of the inventory, the Federal government predicted that all ash trees would be lost in infested areas within a few years.
- There were 877 ash trees (14.5% of the City-owned trees). Most of these have been removed and replaced with other types of trees.
- Native long-lived low-maintenance species (including Bur Oak, Swamp White Oak, Kentucky Coffeetree, Black Gum, Silver Linden, and Hackberry) should receive increased presence in Warrenville. Each species should make up 5% of the tree population.

The City of Warrenville Public Works Department trims, removes, and replaces City-owned trees in accordance with the Parkway Tree Policy. Residents may purchase a tree for the parkway through the City program, and the City will plant it free of charge. In the case of damage by the emerald ash borer, the City will replace the parkway tree without charge if the resident agrees to water it. From 2012 to summer of 2015, Public Works had removed 355 dead or declining City-owned trees. Fourteen residents declined to receive a replacement tree; 346 new trees were planted.

Residents are responsible for trees growing on their property. For every 500 trees planted to shade buildings, there is an estimated annual savings of \$8,048 (by reducing cooling-related energy use) and an annual reduction of 89 MTCO_{2e}, according to the CAPP tool estimates.

8.B. Natural Areas in and Around Warrenville

The benefits of natural landscapes are described in Section 7. This section summarizes information about the importance of the high quality natural areas in and near Warrenville, including the DuPage County Forest Preserves (Warrenville Grove, Blackwell, St. James Farm, Herrick Lake, McDowell Grove, West DuPage Woods and West Chicago Prairie), Fermilab Natural Areas, and the Ferry Creek Wetlands at Summerlakes Park. These natural areas are important because: 1) Carbon is sequestered (stored) in the trees and other plants, and 2) These areas are of significant biodiversity. The first item indicates that natural areas affect climate change, and the second item implies that climate change can affect natural areas.

Combating Climate Change with Natural Open Space

The value of protected open space for recreation and wildlife conservation is well established. But protecting natural areas also provides benefits to humans that are sometimes harder to see. One of those benefits is that natural areas sequester carbon that would have been released into the atmosphere as carbon dioxide. According to Chicago Wilderness, by preventing the destruction of native habitats, preliminary calculations indicate that land protection in the Chicago Wilderness region has prevented the release of 53 MTCO_{2e}.⁹ The amount of carbon stored on these lands is equivalent to emissions from 5 million cars for a year, or electricity from 7.1 million households for a year, or a coal-fired power plant operating for approximately 6.5 years

While there are many uncertainties about climate change impacts, the cost of doing nothing at all is likely to be far greater in the long-term than waiting until those uncertainties diminish. Ignoring climate change may result in the failure to reach biodiversity recovery management objectives. Functioning natural systems are tools for adaptation and should be a high priority. The adverse effects of climate change on wildlife and their habitats may be minimized, or even prevented in some cases, through adaptation actions that are initiated now.

While many natural areas are or will be protected through acquisition by forest preserves or other agencies, the actions of the local government is critical to accomplishing natural preservation objectives because local government can control and manage growth in a sensitive manner. In particular, there is a need for public policies, strategies, and regulations to protect and enhance biodiversity, such as land use planning, compatible zoning, setbacks and buffers, natural landscaping, local parks acquisition, natural area management, and watershed management.

Regional and local government programs are especially critical to the protection and restoration of streams, lakes, and wetlands that are dependent on water inputs from their surrounding watersheds. Past experience indicates that if the watersheds are not well protected the biodiversity of existing high quality

⁹ Precise carbon estimates for most Chicago Wilderness habitats are lacking in the scientific literature, so regional data were used to calculate this figure. Further research is needed to calculate standing carbon pools more precisely for the regional protected area system. Advancing the science of carbon sequestration in Chicago Wilderness is a strategy of the Climate Action Plan for Nature.

streams, lakes, and wetlands almost surely will be lost. The responsibility to protect these resources appropriately falls largely to regional and local governments. (*Protecting Nature in Your Community: A Guidebook for Preserving and Enhancing Biodiversity*, March 2000, prepared by Northeastern Illinois Planning Commission)

Climate Change Impacts on Regional Biodiversity

This section is based on the Chicago Wilderness *Climate Change Impacts on Regional Biodiversity Plan* (*The Chicago Wilderness consortium - 2008. Climate Change and Regional Biodiversity: A Preliminary Assessment and Recommendations to Chicago Wilderness Member Organizations. The Chicago Wilderness consortium, Chicago IL.*)

As explained in the *Climate Update to the Biodiversity Recovery Plan*, plants and animals (especially at-risk species) face many direct and indirect impacts as a result of the changing climate. From wild flowers to mighty oaks, climate change will affect familiar regional plant species. For example, the rich, plant-filled wetlands of the region could suffer. The Chicago Wilderness region has one of the most diverse and highest quality collections of wetlands in North America, which are home to threatened, endangered and even globally rare plant and animal species. Wetlands are important habitat areas, but they also provide services for people and communities. Wetlands have great capacity to store excess water and can reduce flooding damage. Wetlands also can filter pollutants from water, which can improve water quality.

Yet, as a result of climate change, increased storm intensity and flooding may increase pollution from agricultural and urban areas, threatening the wetlands' water quality. Additionally, there is a possibility that some wetlands may begin to dry out as temperatures rise, evaporation rates increase, and there is more pressure on groundwater resources; this could create a feedback loop that further fragments and stresses the remaining wetland habitats.

Scientists predict that climate change will also impact the region's animals. For example, a number of bird species will experience significant changes in their range. As many as 44 species of birds that currently breed in Illinois may no longer breed in the state by the end of the century. The area could lose such familiar species as tree swallow, black-capped chickadee, white breasted nuthatch, house wren, gray catbird, red-eyed vireo, yellow warbler, ovenbird, scarlet tanager, chipping sparrow, Baltimore oriole and American goldfinch.

Some research has suggested that climate change may also negatively impact pollinator species like bees, butterflies and bats. As temperatures change, plants may open earlier in the year, before bees emerge or butterflies leave their chrysalis. This could make it harder for animals and insects to remain in our region if they missed their primary food supply because the plants changed to a different schedule. Also, in general, many kinds of pest insects prefer warmer weather; therefore, warmer weather earlier in the year may result in greater damage from insect pests.

Because some species depend on rare natural areas that are fragmented by roads and developments in this region, their ability to move within or to a new habitat in response to climate change will be limited. Climate warming will be a particular challenge for endangered, threatened, highly specialized, and other at-risk species because climate change will compound the stresses these species already face, and may push them beyond their ability to cope.

The Chicago Wilderness *Climate Action Plan for Nature* identifies strategies that organizations can implement to help humans and nature respond and adapt to changes in the climate. It is the first regional analysis of how to navigate the complexities of conservation in a world with a changing climate. Residents can help implement the goals of the Climate Action Plan for Nature in their own community through the following ways:

1. Climate-Friendly Gardens and Lawns
2. Water Conservation
3. Monitoring
4. Stewardship
5. Climate Change Education

These community action strategies are designed to assist individuals and communities to mitigate, or lessen the future impacts of climate change by reducing GHGs as well as help plants and animals adapt to climate change. For example, converting lawns into native plant gardens can help people, plants, and animals both mitigate and adapt to climate change. Native gardens do not require mowing or fertilizers and can provide natural habitat (homes) for birds, butterflies, and other insects.

Important Biological and Ecological Principles

Protecting nature requires an appreciation for a number of biological and ecological principles:

- ***Large, intact blocks of natural areas are most effective for protecting a diversity of habitats and wildlife and for protecting large populations of wildlife.*** While every little bit of preserved habitat contributes to the protection of biodiversity, the aim should be preserving and expanding large patches whenever possible. Where this is not possible, the smaller patches of habitat should be connected to larger ones to facilitate the movement of species.
- ***Natural corridors and greenways that link larger patches of habitat are essential.*** Localities should endeavor to create “greenway” linkages connecting local natural areas and areas in surrounding communities. Rivers, streams, trails, utility rights-of-way and unused railroad rights-of-way provide good linking opportunities.
- ***Where connections between larger natural areas are not possible, small patches can act as stepping stones for wildlife movement.*** Small patches of habitat are very helpful where breaks in the network of habitats occur. This is especially true for mobile animals, such as birds, and plants that are able to disperse over long distances via the wind or animals. For these species, patches of habitat provide refuge while moving between larger natural areas. Examples include small parks and residential lots landscaped with natural vegetation.
- ***Rare landscape elements, significant or unique natural features, and threatened and endangered species and habitats should be prioritized for protection.*** Communities should examine the natural areas within their jurisdiction, and inventory the plant and animal species found there. Communities in which rare habitats or species exist should endeavor to protect these landscape elements first and development should be directed to other areas. This does not mean that common habitats are not important, but that if the choice between the two must be made, then the rare or endangered areas should be prioritized for protection. Common habitat should be second priority, followed by disturbed areas, such as farm fields, that have potential for restoration. Currently, there are no laws requiring a natural area inventory prior to development; however, an inventory is required if the few remaining important habitats are to be protected.

Illinois Natural Areas Inventory (INAI)

The Illinois Natural Areas Inventory (INAI) was initially conducted from 1975 to 1978. The INAI is a record of high quality forests, prairies, wetlands, and other significant natural features. It documented 1,089 sites (high quality grasslands, woodlands, and wetlands) encompassing 25,723 acres (0.07% of all the land area of Illinois) that still retained their original plants and animals. This inventory was the first of its kind in the nation. The INAI has been an important tool in the conservation of Illinois’ vanishing natural habitats and their unique plants and animals. More information is available at the INAI web site at <http://wx.inhs.illinois.edu/research/inai/snay>.

The list of INAI sites dated February 2010, shows that Fermilab, Herrick Lake Forest Preserve, McKee Marsh, and West Chicago DuPage Forest Preserve are Category II sites, which means that they are suitable habitat for state-listed species or state-listed species re-locations. West Chicago Prairie is shown as Categories I, II, and III, which indicates that it is a high quality natural community or natural community restoration, and that it is a state-dedicated nature preserve, land and water preserve, or natural heritage landmark.

The list of INAI sites has been updated several times by IDNR since the first inventory was conducted. Many changes have occurred: some INAI sites have been destroyed and others added. To date, the reevaluation of high quality natural communities has found that 95% of the natural areas on the original list are still present and, though facing problems caused by externally generated factors, can be retained and improved by implementing strong ecological management and restoration programs and by the acquisition and restoration of buffer lands.

When the inventory was updated, the majority of the remnants reflecting minimally disturbed conditions were concentrated in the six-county Chicago Region. This was expected, as one third of the natural areas reported in the previous inventory were found in this area. The vast majority of the natural areas examined had been somewhat disturbed, but not sufficiently degraded to be considered of less quality than in pre-settlement times. Those in the best condition were intensively managed primarily by public landowners or private owners for whom conservation was their principal function. Diligent management by landowners and dedicated volunteers included prescribed burning and removal of non-native brush. In many cases these prairies are expanding due to restoration of adjacent disturbed communities.

Many remnant forests have retained some of their original quality but those dominated by oaks are succeeding to sugar maple dominated stands, as the latter are very shade tolerant and prolific seed producers. In the absence of maple thinning and periodic fires, these oak forests are decreasing in diversity at an accelerating rate. Deer browsing and increased shade has greatly reduced the abundance of summer-blooming woodland wildflowers and shrubs. Some deer management programs have helped to reverse this trend.

Northeast Illinois has the largest, most numerous, and most diverse wetlands in the state. Most are still present, but they show a decline in the extent of high quality acreage compared to the late 1970s study. This is particularly true for marshes and some sedge meadows, as they have been or are being overrun by tall dense stands of hybrid cattail and common reed, both of which thrive on the excessive concentration of nutrients and salt in storm water runoff from adjacent development. According to the INAI, creating or expanding buffer lands around high quality wetland communities and diverting storm water away from them, as well as selective application of herbicides to invading cattails and reed, are needed to reverse this trend.

An update of the INAI is underway to systematically search for new high quality terrestrial natural communities and to assess all existing high quality natural areas to determine their current status.

Illinois Sustainable Natural Areas Vision (SNAV)

An Illinois Natural Areas Plan was written in 1980 following the completion of the first INAI. The primary goal of this first plan was to protect existing INAI sites and manage them to sustain them into the future. The Illinois Sustainable Natural Areas Vision (SNAV) is the corollary to the Illinois Natural Areas Plan written in 1980. It is a vision for an approach to ensure that Illinois' natural areas persist into the future. Given the many challenges facing natural areas today - invasive species, degradation and fragmentation, urban/suburban development and the most daunting - climate change, SNAV goes beyond this first plan. The primary goal of SNAV is to set forth a workable, implementable framework for creating a sustainable,

connected system of natural areas. In the short term, efforts will be made to protect natural areas as they exist today, encompassing all the current ecological functions and biodiversity of these sites. In the long-term, however, efforts will be needed to create larger, resilient, connected systems that may adapt to changing environmental conditions, even if that means changes in ecological function and biodiversity. Secondary goals include the identification of the potential roles of all stakeholders in this effort, and to consider the many challenges and opportunities that exist in protecting natural areas and creating sustainability.

A central theme has emerged in developing the SNAV – “the conservation of connectivity,” where natural areas are connected with their surrounding landscapes; conservation organizations and agencies are connected to become an energized and effective force in sustaining natural areas; and people are re-connected with the land. This emphasis on connectivity is vital to the future of natural areas. The IDNR hopes to ensure that Illinois’ natural areas persist into the future by engaging a much broader spectrum of organizations, political leaders, and individuals in the natural areas movement than have been active in the past.

So what shape will this vision take? The principles of conservation biology, a discipline that did not even exist when the original INAI was done, provide guidance on some of the broad outlines. Many natural areas are too small to support effective populations of the species now using them as habitat over the long term: their effective size must be expanded by adding buffer areas around them. Buffers will develop ever greater capacities to support native species as they are restored to higher natural quality. Given the nature of threats like climate change, plants and animals must be allowed to migrate to new areas where the climatic conditions needed to support their populations are available. The vision is to connect buffered natural areas by corridors, preferentially oriented in northerly-southerly directions. Because of issues of scale, complexes of natural areas that will be more sustainable than individual natural areas should be connected to form networks of sustainable natural areas, which should in turn be even more sustainable. Continuing to increase the connectivity between networks should, in theory, provide increased probability for the sustainability of the system as a whole, as well as all of its individual parts. Of course, connecting all networks may not be feasible. Note that the corridor usable by a bird may be very different from the corridor needed for a salamander.

One important point: building more sustainable networks of natural areas does not imply that all these lands need to be publicly owned. It does imply that landowners understand the natural resource benefits their lands provide, and that those landowners make a conscious decision to contribute to the effort. The foreword by Dr. Brian Anderson, Director of the Illinois Natural History Survey, to the final report for the Illinois SNAV states that, “when you read the phrase “creating sustainable natural areas,” please recognize it as shorthand for “employing the best science and management available to increase the probability of sustaining the adaptive capacity of Illinois’ natural communities and the survival of Illinois’ flora and fauna into the future.” In the SNAV, a set of actions that IDNR could undertake was recommended for the future that will help achieve connectivity of the landscape, planning processes, among conservation organizations, and of people and the land. The following related actions may be applicable to the City of Warrenville's Climate Action Goals:

- Build and strengthen a partnership with IDNR to ensure that the natural areas in and around Warrenville persist into the future.
- Work with IDNR to implement more sustainable development practices that are compatible with the goals of the SNAV.

- Send City representatives to workshops that would provide the forum for professionals to share successes, learn from the efforts of others, and provide the energy and momentum that is important to meeting the daunting challenge of meeting the goal of creating the sustainable networks of natural areas.
- Keep updated about IDNR plans to establish a Comprehensive Landowner Contact Initiative.
- Work with IDNR to get assessments of potential INAI sites such as Warrenville Grove, St. James Farm, and Ferry Creek Wetlands at Summerlakes Park.

Table 10. Warrenville’s Urban Forest/Natural Areas Strategies

Strategy	Potential GHG Reduction (MTCO2E)	Initial cost	Potential Yearly Savings
Trees to Shade Buildings 500 trees planted	89	\$200 (per tree)	\$8048 (total)
Mature Tree CO ₂ absorption (500 trees)	128	\$0 (added cost)	\$0
Actions to Implement the Strategies	Status	Partners for Implementation	
Continue to proactively manage City-owned trees following City policies in the Urban Forestry Plan.	Ongoing	Public Works Department	
Maintain Warrenville’s “Tree City USA” status.	Completed	Public Works Department	
Support policies, ordinances, and codes that incorporate the urban forest guidelines to prevent unnecessary tree removal, building codes and zoning ordinances that include strong landscaping, and green space standards for new construction and rehab of older buildings.	Ongoing	Public Works and Community Development Departments	
Optimize tree planting and protect existing trees for maximum carbon storage/sequestration and energy savings. As an ongoing strategy, the City can consider planting trees in open spaces.	To Be Considered	Public Works Department	
Continue to provide incentives for residents to plant parkway trees.	Ongoing	Public Works Department	
Encourage residents to plant trees in appropriate locations to increase total ecosystem services benefits.	To Be Considered	EAC; WIB; The Conservation Foundation	
Promote residential/commercial/governmental/non-governmental landscaping with native plants.	Ongoing	EAC	
Publish educational information about the importance of the natural areas.	Ongoing	EAC	
Provide information about opportunities to volunteer to help restore natural areas (such as collecting/planting seeds, removal of invasive species)	Ongoing	EAC, DuPage County Forest Preserves, Fermilab	
Inform and advise developers about how they can implement sustainable development practices	Ongoing	EAC, Community Development, DuPage County, The Conservation Foundation, Forest Preserve, Fermilab	
Attend IDNR workshops to stay up-to-date on the INAI and SVAC activities	To Be Considered	EAC, DuPage County, The Conservation Foundation, Forest Preserve, Fermilab	
Promote outdoor education and recreation programs to reconnect people to nature	Ongoing	EAC/ Park District/ Forest Preserve	

9.0 Voluntary Carbon Offset Programs & Local Programs

Voluntary Carbon Offset Programs

Offsets do not erase emissions: they are basically a donation to an environmental project. They fund projects like forest planting, conversion to renewable energy sources or GHG collection and sequestration. Offsets support both large-scale and community projects. A community might restore a forest in Uganda and support the construction of efficient stoves in Honduran villages. Offset programs should be evaluated closely.

As people, organizations, and businesses become more aware of their own contributions to global warming, some turn to carbon offsets as a way to go neutral. Offset companies first estimate a customer's personal carbon output. Their websites include carbon calculators that determine the total GHG produced by a year's worth of electricity or driving, an event or even a round-trip flight. Offset companies then charge an amount based on their own GHG price per ton. The money funds programs that offset an equal amount of emissions. Some offset companies allow customers to choose their projects; others do not.

Aside from the physical benefits of offset projects, voluntary commercial offsets make customers look beyond the limits of their own households or businesses. The best thing that residents, organizations, and companies can do is first reduce their own emissions before they consider offsets. They may limit travel, choose energy-efficient appliances or convert to renewable energy. After they cannot reduce any more, or if they find it uneconomical to do so, carbon offsets help make up for the rest.

Local Programs

Since a carbon offset is basically a donation to an environmental project, it may be worthwhile to consider investing directly in local renewable energy projects or environmental groups. This would eliminate the intermediary offset program, and it may be easier to find information about a local project or group. GHG emissions reductions and costs associated with carbon offsets and local programs depend on the kind of project funded.

10.0 Summary

Table 11 is a summary of the estimated emissions reductions, relative cost, and additional benefits of each strategy that was described in detail in previous sections. The calculations demonstrate that significant GHG emissions reductions can be achieved at negligible cost by behavioral changes in our homes, businesses, government buildings, and vehicles. In fact, behavioral changes can reduce GHG emissions by the same order of magnitude as installation of solar panels, for the average energy user.

For homeowners, businesses, or others who use higher than average amounts of electricity and/or natural gas, it may be cost effective to install solar systems.

Weatherization is another low cost action that can reduce emissions by a large amount. An audit can point out the areas that require sealing or more insulation, for example. Homeowners may be able to save more money by doing the work themselves. It is often assumed that weatherization means expensive actions, such as replacing windows, but it generally does not.

Many actions pay for themselves with energy savings over time. The payback time for weatherization may be only one or two years or less. Some actions could be taken when equipment needs to be replaced: for example, if a lawnmower has to be replaced, it does not cost much more to buy an electric one than a gas mower.

Retro-commissioning of buildings is another important step toward reducing emissions. It may involve evaluating whether building components are working together properly, and it may also include an energy audit, HVAC retrofit, and/or an upgrade to energy efficient equipment. An evaluation of building components may be required more often (after a power outage, for example); but it is likely that more efficient equipment would only be installed when existing equipment has to be replaced.

The strategies that focus on reducing emissions from lighting are generally no or low cost actions that make a big difference. It doesn't cost anything to shut off the lights when they are not in use. Energy efficient lighting generally has a short payback time.

Green building design, including reflective roofs and paving materials, also significantly reduces GHG emissions by reducing the amount of energy used.

The emissions reduction estimates show that transportation strategies that reduce idling, and switching to hybrid, EV, (or other alternative fuel) vehicles reduce emissions significantly. There is no cost to not idle most vehicles. There are technologies available for certain situations where idling is necessary.

Other strategies that may significantly reduce emissions include waste reduction, efficient pumps, planting trees to shade buildings, and protecting mature trees.

Table 11. Summary-Emissions Reductions, Cost & Benefits of Each Strategy

Strategy	Potential GHG Reduction (MTCO ₂ E)	Relative Cost	Benefits (in addition to GHG reductions)
Residential Energy Strategies			
Weatherization/Retrofits to all houses	9,990 (or 2 per house)	Low	Cost savings/comfort/ audits can point out safety issues
Behavioral Changes	9,990 (or 2 per house)	None	Cost savings/comfort
Solar Electric Cells (Photovoltaics, or PV)	At least 3 per house	High	Cost savings (longer payback)
Solar Hot Water	At least 2 per house	High	Cost savings (longer payback)
Solar Thermal Heat and Hot Water	Not calculated	High	Cost savings (longer payback)
REC Purchases (Municipal Aggregation Program)*	37,234*	--	--

Strategy	Potential GHG Reduction (MTCO2E)	Relative Cost	Benefits (in addition to GHG reductions)
Commercial Energy Strategies			
Retro-Commissioning of Commercial Buildings (assume 750,000 sq ft, or half of the buildings)	1,126	Varies	Cost savings
Strict Commercial Energy Code (assume 10% electricity and natural gas savings in 1,500,000 sq ft - all buildings)	2,339	High	Cost savings
Commercial Lights out at Night/ Motion Sensors/ Efficient Lighting (assume 75% of all buildings comply)	2,361	None or Low	Cost savings
Reflective Roofs & Paving Materials (assume 1/3 of commercial area is modified)	417	Medium	Cost savings
Government Energy Strategies			
Retro-Commissioning of Government Buildings: Energy audit/HVAC retrofit/Upgrade to energy efficient equipment/Evaluate whether building components are working together (assume 100% of 450,000 sq ft retro-commissioned)	676	Varies	Cost savings
Government Lights out at Night/ Motion Sensors/ Efficient Lighting	944	Low	Cost savings
Reflective Roofs & Paving Materials (assume 50% of 450,000 sq ft)	187	Medium	Cost savings
Green Buildings Hubble Middle School and Warrenville Library (built since 2007 - have contributed to emissions reduction)	896 (estimated reduction since 2007)	Low	Cost savings
Transportation Strategies			
Walking: 100 trips per week replacing car (1 mile each)	2	None	Cost savings/health
Biking: 100 trips per week replacing car (10 miles each)	25	Low	Cost savings/health
Reduce Light Vehicle Idling (5,000 cars avoid idling 5 min. per day)	461	None	Cost savings/health
Hybrid vehicles and EV 500 hybrid vehicles for community 15 hybrid vehicles for city	1,700	Medium	Cost savings/ quieter/ electric motors deliver their maximum torque rating instantaneously

Strategy	Potential GHG Reduction (MTCO2E)	Relative Cost	Benefits (in addition to GHG reductions)
<i>Waste Management Strategies</i>			
Composting Food Scraps (300 lb/person/yr x 14,000 people)	51	None	Compost for yards/gardens
Expand Recycling (300 lb/person/yr x 14,000 people) by expanding business recycling, construction recycling, government/other organizations recycling, and waste reduction	90	Varies	Cost savings
<i>Water Conservation Strategies</i>			
500 Faucets Replaced	9	Low	Cost savings
Irrigation control sensors - 10 acres of lawn	5	Medium	Cost savings
Water System Efficiency (pumping)	1691	High	Cost savings
<i>Natural Landscaping Strategies</i>			
Low Maintenance Landscaping: 10 acres (public)	4	Low-Medium	6,520,000 gallons water
Low Maintenance Landscaping: 100 residences	13	Low-Medium	81,500,000 gallons water
Gas Lawnmower replacement: 500 residences	5	Low	Less noise, less maintenance
<i>Warrenville's Urban Forest Strategies</i>			
Trees to Shade Buildings: 500 trees planted	89	\$200/tree	Ecological
Mature Tree CO2 absorption: 500 trees	128	None	Ecological
<i>Carbon Offset & Local Program Strategies</i>			
GHG emissions reductions (depends on project)*	--	--	--

* RECs and carbon offsets may not have a local impact; therefore, they are not counted toward meeting the emission reduction goal.

11.0 Putting the Emissions Reduction Goal in Perspective

The Warrenville CAP presents strategies to reduce the City's global warming pollution to meet the emission reduction goals of the U.S. Conference of Mayors Climate Protection Agreement. The target is to reduce total Warrenville emissions from approximately 231,000 to 203,300 MTCO2e by the end of 2015. That is a reduction of 27,700 MTCO2e. Assuming the population remains approximately the same (13,140), the average annual emissions for each person in Warrenville would be reduced from 17.6 MTCO2e/person/year to 15.5 MTCO2e/person/year.

To put this goal in perspective, the World Bank lists CO2 emissions/person/year for each country. (<http://data.worldbank.org/indicator/EN.ATM.CO2E.PC/countries?display=default>) For example, the emissions from three countries, and the average world emissions, are listed in the following table.

Table 12. Per Capita Emissions for Selected Countries and the World

Location	MTCO ₂ e/person/year	
	2004	2010
United States	19.8	17.6
United Kingdom	9.0	7.9
China	4	6
World	4.5	4.9

Although China has emitted more GHGs (6,018,000 MTCO₂) than the U.S. (5,903,000 MTCO₂) since 2007, China's per capita rate is still much lower than that of the U.S. That indicates that China is a fast-developing country with a lot of people. (<http://www.theguardian.com/environment/datablog/2009/sep/02/carbon-emissions-per-person-capita>)

An MIT class estimated the carbon emissions of Americans in a wide variety of lifestyles - from the homeless (8.5 MTCO₂e) to multimillionaires and compared them to those of other nations. The bottom line is that in the U.S., even the people with the lowest usage of energy are still producing, on average, approximately double the global per-capita average. Whether a person lives in a cardboard box or a luxurious mansion, anyone who lives in the U.S. contributes more than twice as much GHG to the atmosphere as the global average, and those emissions rise steeply from that minimum as people's income increases. This is due to the many government services that are available to everyone in the U.S. These basic services including police, roads, libraries, the court system and the military - were allocated equally to everyone in the country in this study.

The MIT study accounted for often-overlooked factors, such as the "rebound effect." That's when someone makes a particular choice--for example, buying a hybrid car instead of a gas-guzzler--but then uses the money saved from their reduced gasoline costs to do something else, such as take a long trip by airplane, which may increase carbon emissions. In general, spending money on travel or on goods that have substantial energy costs in their manufacture and delivery adds to a person's carbon footprint, while expenditures on locally based labor-intensive services--whether it's going to a therapist, taking an art class, or getting a massage - leads to a smaller footprint. But the biggest factors in most people's lives were the obvious energy-users: housing, transportation and food. (Massachusetts Institute of Technology (2008, April 28). *Carbon Footprint of Best Conserving Americans Is Still Double Global Average. ScienceDaily*. Retrieved January 12, 2012, from <http://www.sciencedaily.com/releases/2008/04/080428120658.htm>)

A study of 434 municipalities across England, Wales, Scotland and Northern Ireland, showed that the carbon footprints of municipalities in the UK are determined by socio-economic rather than geographical and infrastructural factors. The findings highlight that while the carbon footprints were slightly lower for urban areas compared to rural areas, the researchers showed that there was no general trend, which indicated that the carbon footprint may be determined by how people live rather than where people live. Indeed, they showed that the carbon footprint increased with an advanced education of the population, increased with the number of cars a household owns, and increased with increasing income. The municipalities with the highest and lowest carbon footprints in the UK are situated in the same area. The carbon footprint of local areas mainly depends on the socio-economic profile and associated lifestyles of the residents. (Jan Minx, Giovanni Baiocchi, Thomas Wiedmann, John Barrett, Felix Creutzig, Kuishuang Feng, Michael Förster, Peter-Paul Pichler, Helga Weisz, Klaus Hubacek. "Carbon footprints of cities and other human settlements in the UK". *Environmental Research Letters*, 2013; 8 (3): 035039 DOI: 10.1088/1748-9326/8/3/035039)

12.0 Conclusions

The information in this report shows that the most emissions reductions in Warrenville could be achieved by focusing on the following strategies:

- Increase the energy efficiency of all buildings (residential, commercial, government, and non-government) by conducting an audit of each building and completing weatherization/retrofits
- Educate people and business owners to change behavior (shutting off computers, proper thermostat settings, etc.)
- Encourage Lights out at Night and install motion sensors and efficient lighting
- Use hybrid or electric vehicles in place of standard gasoline vehicles
- Increase the water system efficiency (pumping) and implement actions to decrease electrical usage (if necessary)
- Reduce idling of vehicles (residential, commercial, government, and non-government)
- Encourage low maintenance landscaping with native plants
- Maintain and enhance the urban forest by planting trees to shade buildings and prohibiting destruction of mature trees where possible
- Continue the municipal aggregation program with 100% renewable energy credits

Some of these strategies are easy to implement, cost nothing or next to nothing, and can be done immediately. Residents and small businesses can continue to choose the municipal aggregation program; change their behavior to reduce energy use; shut off lights when not needed; stop idling vehicles; stop using leaf blowers, and grow low maintenance native plants where possible. Energy audits cost little and provide information about important actions that are required to make buildings energy efficient.

There is an initial cost associated with many strategies; however, the savings will often make up for the initial cost in a short time. Building weatherization, some retrofits, efficient lighting, and reflective roofs may be in this category. Large purchases (such as hybrid vehicles) or upgrades (such as efficient pumps) may be more cost effective if they are completed when a replacement is required.

Some strategies have significant other benefits in addition to GHG emission reductions. Some examples include providing/using local food, biking, and planting trees and native plants.

When the City asked for input from residents, "listed among the advantages to living in Warrenville were Natural Settings, Location, Trails & Paths, Friendliness of Residents, Safety, and Small Town Character." The strategies are consistent with the Strategic Plan which states, "The City's 2015 Strategic Plan is intended to be a practical guide that articulates goals and identifies objectives to move the community forward through sustainable initiatives, which are proactive, flexible and responsive to changing forces and environments." This Climate Action Plan is a living document which will change and adapt to different circumstances as we move forward. Many goals have already been achieved, and many new measures have been identified.