DuPage County Energy Conservation & Air Quality Improvement Plan

DuPage County's Plan to implement a Sierra Club Cool County Strategy
10% greenhouse gas reduction from 2007 levels by 2020 & 20% by 2030

DuPage County
Daniel J. Cronin, County Board Chairman
421 N. County Farm Rd., Wheaton, IL 60187
(630) 407-6700; www.dupageco.org/coolcounties

DuPage County Green Government Council

DuPage County Board Chairman Daniel J. Cronin appointed the Green Government Council in 2013 as a special advisory group. The Council assists the County by identifying ways to effectively conserve natural resources, reduce regional environmental impacts, develop sustainability initiatives and promote economic opportunities for businesses, community organizations and residents. One of the Council's projects is the implementation of the Cool Counties Initiative to reduce greenhouse gas emissions. This plan serves as the roadmap to the success of this effort to improve countywide air quality.

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The Conservation Foundation

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City of Elmhurst

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Branch General Manager Energy Solutions Americas
Johnson Controls, Inc.

James Jerozal
Managing Director, Energy Efficiency
Nicor Gas

Michael Kearney
Senior Director, Energy Environmental Solutions
Siemens Industry, Inc.

Todd Thornburg
Energy Efficiency Portfolio Manager
ComEd

Kris Bachtell
Vice President of Collections and Facilities
Morton Arboretum

Brett Thomas
Marketing Manager
Calamos Family Partners

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Executive Summary

Energy is part of our everyday lives. It is the lights we turn on, the thermostat that we set and the fuel used in the modes of transportation that move us around locally and globally. The packaging, products, and shipments we depend on are all made possible by energy. Today, new technologies and consumer habits are changing rapidly. New types of energy are creating new competition in the marketplace, creating green jobs, and producing lower levels of pollution. We cannot turn on the television or computer without hearing about a greener, cleaner alternative that lessens environmental impacts, saves us money, and drives new opportunities for the future.

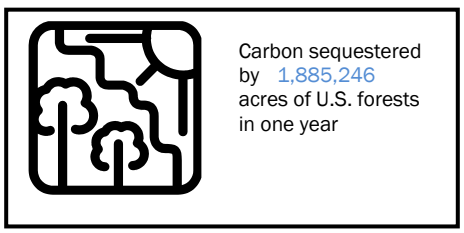
DuPage County government has a rich history of leading the way environmentally by taking advantage of new technologies and practices. Years ago, the county created its own power plant for heating and cooling the county complex, which reduced the use of dangerous refrigerants while continuing to operate efficiently. More recently, the County has installed a vegetated and a solar roof, purchased over 30 alternative fuel vehicles for county operations, and begun to retrofit our aging mechanical equipment.

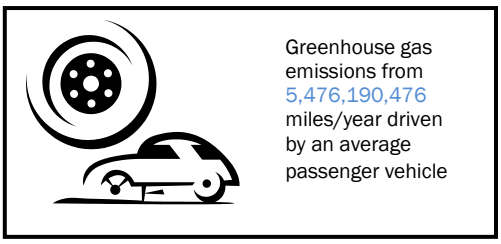
The County is continuing to measure the resources being used by county operations and the community as a whole. By working with the utility companies and energy consultants, it will be promoting new technologies that will impact natural gas usage, electricity usage, and lower emissions from vehicles. One initiative that looks at energy consumption and its associated costs is the Cool Counties and Cool Cities Programs. Adopted by many Illinois communities, the programs focus on creating energy smart strategies that will keep DuPage County a thriving and sustainable place to live and work.

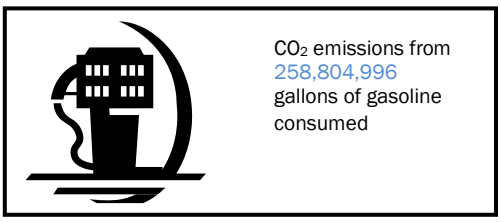
BACKGROUND

In 2012, DuPage County approved the Cool Counties Initiative as a way of accepting new environmental challenges. The Cool Counties plan set goals of reducing greenhouse gases from 2007 levels by 10 percent by the year 2020 and by 20 percent by 2030. To move these goals forward, The County brought together the DuPage Green Government Council (GGC). An entity comprised of utility and energy efficiency experts and community members to draft this plan of action. This project will continue to put the County at the forefront of saving energy through the continued pursuit of newer technologies.

According to the U.S. EPA's Greenhouse Gas Equivalencies Calculator[1], the success of the calculated 20% countywide reduction would result in the equivalent savings illustrated below.







[1] U.S. EPA Greenhouse Gas Equivalencies Calculator updated April 2014
http://www.epa.gov/cleanenergy/energy-resources/calculator.html

On the surface, reducing energy consumption seems like a concept that would be easy to implement. Many programs are as simple as replacing appliances, programming thermostats, switching to a new light bulb and turning lights off when they are not needed. This Plan; however, requires comprehensive measures that will achieve aggressive objectives and goals. It will guide the County, stakeholders and partners in providing programs and services that will truly impact emissions and create economic benefits in the process. By sharing new ideas and practices among all these entities, energy savings increases exponentially creating larger benefits for the entire DuPage community. This Plan's success is furthered by the seven (7) cities that have approved the Cool Cities goals and have been making great strides in reducing energy consumption – Aurora, Bolingbrook, Carol Stream, Elmhurst, Lombard, Westmont and Villa Park. These cities are models for implementation at the local level. The strategies in this Plan should serve to augment existing programs while encouraging new entities to join in this effort.

A tangential benefit of this program is that energy efficiency creates jobs and suports economic stability for residents and businesses within the county. A $1 million dollar investment in a building efficiency improvement will initially support approximately 20 jobs throughout the economy[2]. In comparison, the same $1 million dollar investment put in the economy as a whole supports 17 jobs. In addition to the greater increase in job creation through energy efficiency investments, the savings on energy bills provide more dollars that can be spent elsewhere in the economy. According to a study by the City of Chicago, residents and businesses of northeastern Illinois spend more than $3 billion a year on energy bills. Shifting a portion of spending on energy efficiency would stimulate growth in employment and business expansion.

This document will cover commercial and residential information with strategies to reduce energy consumption. The commercial sector is made up of a very complex and diverse set of users including, but not limited to, industrial, retail, medical providers, office space, convenience and grocery stores, hotels, restaurants, manufacturers, education, non-profits and governmental entities. Energy efficiency offerings must be diverse to serve these different categories and their unique operations.

2. GOALS

In addition to creating jobs and lowering fuel and utility bills, this Energy Plan will help create cleaner air by reducing emissions in our region. DuPage County will reduce what are commonly known as greenhouse gases (GHG) which can have ill effects on our health and environment. GHGs consist of Carbon Dioxide- CO_2, Methane- CH_4, Nitrous Oxide- N_2O and varying fluorinated gases. When fuels are burned for energy, the emissions produced negatively impact breathing especially for children, the elderly, and those with medical conditions. Nitrous Oxide, for example, comes from industrial manufacturing plants, electric utilities, and motor vehicle exhaust. When N_2O mixes with volatile organic chemicals (VOCs) such as gasoline vapor, the two gases create ozone pollution which is responsible for ozone action days. Once released into the environment, Nitrous Oxide gas molecules stay in the atmosphere for an average of 120 years.

For the purposes of this project, the County will be utilizing a standard CO_2 equivalent for the entire mix of GHG. By achieving the goal of a 20% reduction below 2007 levels by 2030, this Plan would result in keeping approximately 2.3 Million Metric Tons of CO_2 out of the air.

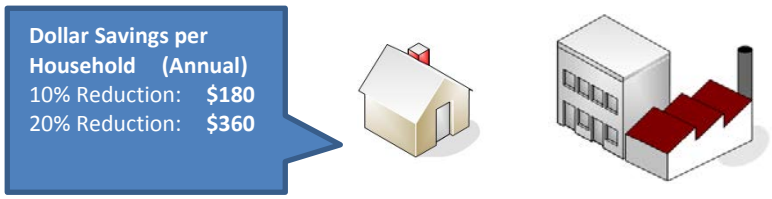
The U.S. EPA has determined that the majority of greenhouse gases come from burning fossil fuels to produce energy (electricity & natural gas) with transportation (trucks, cars, buses, trains) being the second highest contributor[3]. It is important to note that different fuel sources generate varying levels of the gases. For example, traditional electricity production contributes more GHG than natural gas production on a per unit basis. Therefore, more program efforts will be placed on reducing traditional forms of electricity consumption within this plan. Savings will be calculated using the reduction in greenhouse gases and energy costs.

[2] American Council for an Energy Efficient Economy (ACEEE, fact sheet)
[3] U.S. EPA http://www.epa.gov/climatechange/ghgemissions/sources/transportation.html

As noted in Figure 1 below, the projected savings from this effort are significant from an air quality perspective in addition to the financial benefit when prices fluctuate.

Figure 1. Estimated monetary savings from achieving the goals in this plan.

Target Annual Savings from 2007 Energy Consumption Levels



Goal	Residential			Commercial/Industrial		
10% Reduction by **2020**	Electricity	$34.7	million	Electricity	$52.7	million
	Natural Gas	$25.2	million	Natural Gas	$14.8	million
	Total	**$59.9**	**million**	**Total**	**$67.5**	**million**
20% Reduction by by **2030**	Electricity	$69.5	million	Electricity	$105.4	million
	Natural Gas	$50.4	million	Natural Gas	$29.7	million
	Total	**$119.9**	**million**	**Total**	**$135.1**	**million**

Data provided from the report "DuPage Energy and Emissions Profile" provided by Elevate Energy, November 22, 2013 Values rounded for simplicity.
The energy cost used in the above table are $0.114/kWh and $0.804/therm for residential and $0.059/kWh and $0.552/therm for commercial/industrial.

3. CONSUMPTION DATA - 2007 THROUGH 2012

In order to establish a baseline set of numbers to measure energy and emissions from total electricity, natural gas, and vehicles miles traveled, DuPage County worked with Elevate Energy (formerly CNT Energy) to aggregate communitywide data from both 2007 and 2012 consumption records. Once the numbers came in, the County was surprised to find an actual reduction in 2012 levels when compared to 2007 levels. The contributing factors include an economic downturn, significant invest by the Federal Government in energy, an increased participation in U.S. EPA's ENERGY STAR benchmarking program; legislative requirements around benchmarking & transparency; growth in the U.S. Green Building Council's LEED designed buildings; energy code trends toward efficiency codes; utility rebates & incentives; and, sustainability through the recognition in the real estate market on MLS listings.

Table 1 - Total Natural Gas Consumption (Therms), 2007 & 2012

DuPage	2007	2012	2020 Target	2030 Target
Residential	313,707,381	263,468,701	282,336,643	250,965,905
Commercial & Industrial	268,672,694	239,149,653	241,805,425	214,938,155
Total	582,380,076	502,618,354	524,142,068	465,904,061

Table 2 - Total Electricity Consumption (kWh), 2007 & 2012

DuPage	2007	2012	2020 Target	2030 Target
Residential	3,046,756,030	2,779,395,133	2,742,080,427	2,742,080,427
Commercial & Industrial	8,931,290,066	8,255,502,646	8,038,161,059	7,145,032,053
Total	11,978,046,096	11,034,897,780	10,780,241,486	9,582,436,877

Vehicle Miles Traveled (VMT) is also an important component of the DuPage County effort. The DuPage County Department of Transportation concluded that if you are able to reduce the VMT by 10% you will reduce the fuel used or burned by 12.5 – 13% and emissions (grams/hour VOC) by 13-15%. This is based on using a congested intersection such as the intersection of North Avenue and Bloomingdale Road in Glendale Heights, for example. Reducing VMT and vehicles on the road will result in a better traffic flow which will enable the traffic signals to work in optimal efficiency mode as designed which results in reduced idling time for county travelers and less pollution being emitted locally. Each of these outcomes equals better quality of life in our daily routines. The information above was calculated by Elevate Energy and derived from travel statistics provided by the Illinois Department of Transportation (IDOT) based on Illinois Environmental Protection Agency (IL EPA) odometer and population data. Since 2007, there was only a slight decrease of 2% in total vehicle miles traveled and the average household in the County drove 19,833 miles totaling 6.6 billion miles (illustrated below). "On-road" travel captures trips only within county boundaries.

Table 3 - DuPage County Vehicle Miles Traveled (VMT), 2007 -2012

VMT	2007	2012
Total On-Road VMT	8,633,562,650	8,424,261,955
Household VMT	6,862,947,547	6,639,375,551
GHG Emissions	3,780,905 Metric Tons CO_2e	3,689,246 Metric Tons CO_2e

4. REGIONAL CONSUMPTION COMMERCIAL SECTOR

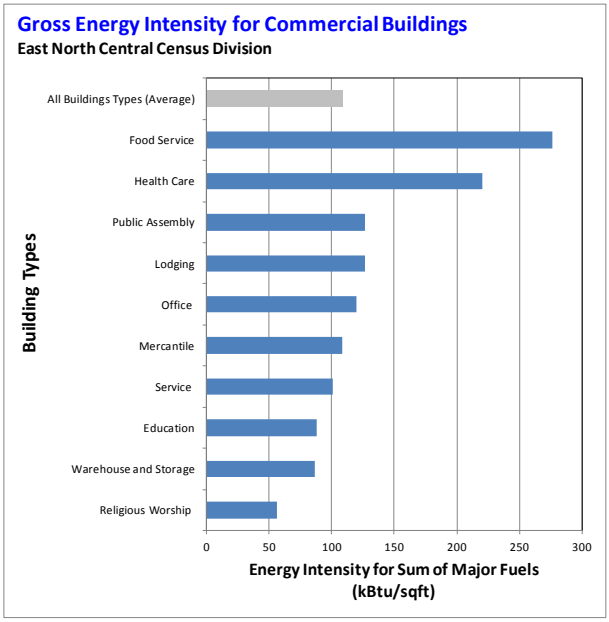
One of the largest energy consumers is the commercial sector. The energy used to heat and cool a large scale buildings and the task of manufacturing, serving food or provide other services is significant. In an effort to further understand the hierarchy of users and to prioritize strategies, the GGC reviewed the Energy Information Administration (EIA) data for our region[4]. The group also recognized that not every sector held an equivalent opportunity for savings. The EIA is compiling data from a survey of 2010 data. According to the EIA, the preliminary results show that there were 5.6 million commercial buildings in the United States in 2012, comprising 87.4 billion square feet of floor space. They calculated that this is a 14% increase in the number of buildings and a 22% increase in floor space since 2003.

The U.S. Energy Information Administration obtains voluntary data from buildings throughout the country. It includes energy usage data from a vast amount of commercial buildings (schools, hospitals, office buildings, stores, restaurants, warehouses etc.) for the purpose of comparing and establishing benchmarking data. The State of Illinois is located in Zone 2 (IL, IN, OH, MI).

Figure 2 on the following page contains excerpted information showing consumption by building type. While this information is pertinent for planning purposes, it does not take into account the energy necessary to accomplish critical tasks in areas such as health care to operate medical equipment. This information is helpful when benchmarking buildings against similar users in similar climates. It also provides guidance to the GGC and the County in prioritizing strategies with commercial users.

[4] U.S. Energy Information Administration CBECS data, Table C10

Figure 2 – U.S. Energy Information Administration CBECS data



East North Central
Illinois
Indiana
Michigan
Ohio
Wisconsin

Source: Energy Information Administration, 2003 Commercial Buildings Energy Consumption Survey. Consumption and Gross Energy Intensity by Census Division for Sum of Major Fuels: Part 1 Census Division = East North Central. CBECS does not provide energy intensity data specific to Food Sales, Public Order and Safety, Vacant, and Other building types for this Census Division, therefore they were not included in the this chart

5. EMISSIONS PROFILE FOR DUPAGE COUNTY

DuPage County also worked with Elevate Energy to calculate GHG emissions from the use of natural gas, electricity and gasoline and diesel fuels for the baseline year 2007 and a status measurement for the year 2012. The data is provided in the figures and tables below.

Emissions attributed to electricity consumption are different from those attributed to natural gas consumption because of differences in the production of energy from different sources. Greenhouse gases listed in this plan include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). For purposes of this document, the aforementioned were calculated to an industry standard CO_2 equivalent. This calculation takes into account the differing levels of emissions from the different energy sources, as is standard practice in the industry and the federal level. The County did not normalize to account for weather fluctuations. This type of study is recommended to be completed every five (5) years during the time frame for implementing this Plan.

Below is a comparison breakdown of the County's emissions by sector which represents a reduction of approximately 7% from 2007 to 2012. It is important to note that the reduction in the electricity sector is the largest contributor to these carbon reductions. When compared to the U.S. overall, the carbon emissions from the electricity sector decreased 15% over the same time period due to lower demand following economic downturn, greater use of natural gas for power production and the increase in renewable energy as a percentage of the overall supply mix (Information provided by Elevate Energy DuPage County Emissions Profile 2007 – 2013). Additional information can be found in Appendix E which includes the entire report generated by Elevate Energy.

Figures 3 & 4 indicate that the consumption of electricity far exceeds other categories. Since electricity is the largest contributor to GHG, its reduction will be a priority in implementing the goals.

Figure 3 – DuPage County Emissions 2007 in million metric tons of CO2 equivalent

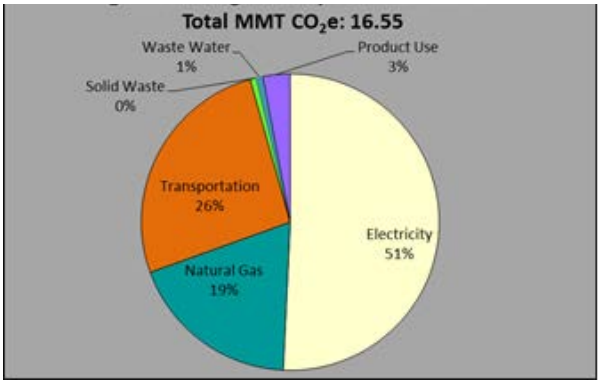


Figure 4 – DuPage County Emissions 2012 in million metric tons of CO2 equivalent

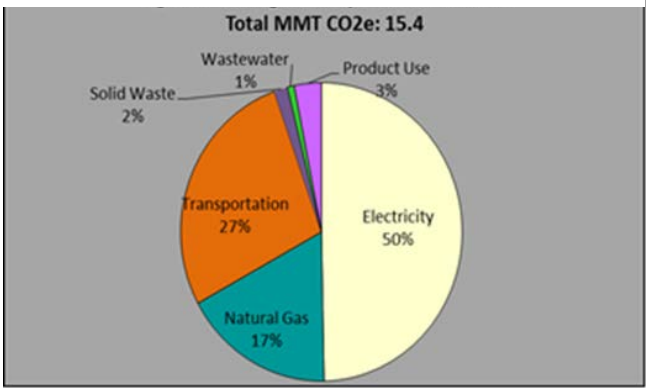


Table 4 below depicts a comparison in the emissions during the first 5 years post baseline. It indicates that the biggest opportunities to make an impact are with electricity, natural gas and transportation consumption. The other four uses will be considered from a sustainability standpoint but are not the critical reductions in this Cool Counties Initiative.

Table 4. Emissions by Sector, County and Region, 2007 – 2012

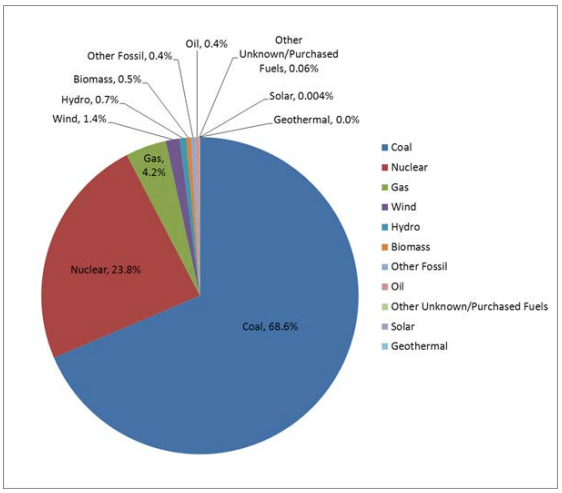
Sector	2007 MMT CO_2e	2012 MMT CO_2e
Electricity	8.40	7.65
Natural Gas	3.10	2.67
Transportation	4.33	4.23
Solid Waste	0.11	0.24
Waste Water	0.12	0.12
Product Use	0.49	0.48
TOTAL	16.55	15.39

The above information reflects a reduction from 2007 levels which has varying contributing factors. The residential population was reduced by 1% during the time frame. An argument could be made that the significant Federal investment in energy efficiency and an overall movement toward reducing operating costs had a larger impact. The GHG emissions do not take into account variances in weather or any other factors that may affect energy consumption and subsequently greenhouse gas emissions. These reported emission levels are a real outcome based on a detailed survey of emissions within the County and 2014 emission standards. While the data is positive and as an aggregate the County is trending to meet the 2020 goal, it is the next level of savings that are expected to be more difficult to achieve. Increasing energy efficiency standards for residential lighting and appliances may lead to a diminishing pool of savings in the residential market. For example, replacing a common 60 watt incandescent light bulb with an equivalent 13 watt compact fluorescent light bulb (CFL) will save 75% in energy usage. However, replacing the same 13 watt CFL light bulb with an equivalent 10 watt LED light bulb saves only 20%. This will prove to be a challenge in the later years of the goal.

6. ENERGY STABILITY & DEMAND

Another benefit of this effort is to ensure long-term access to energy for a growing population and business community. The GGC reviewed the U.S. EPA's eGRID, which is a comprehensive source of emissions data related to electricity generation in the United States. Information provided by eGRID is commonly used by many organizations for estimating avoided emissions from programs and projects that reduce consumption of grid-supplied electricity. As you can see, the majority of electricity is produced by non-renewable resources. While this plan will promote a strategy of becoming more efficient before the pursuit of renewable energy, it is important to note the amount of conventional fuel sources of electricity that would need to be displaced by other power supplies depicted in the graph below.

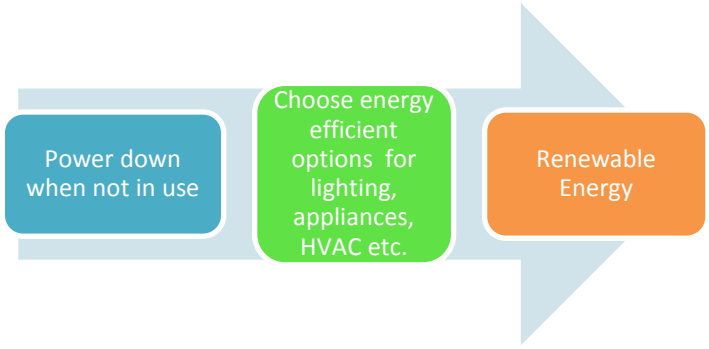
Figure 5. Energy Resource Mix U.S. EPA eGRID 2010 DuPage County



Annually, the EIA provides an Electric Power Table Series which tabulates the number of electric power customers. The most recent data reflects an increasing demand for energy in the U.S. Since 2002, the U.S. has seen an increase of 9% in the number of customers. This decade long increase in demand is consistent with population growth and underscores the importance of identifying methods to decrease consumption.

When embarking upon the reduction effort, DuPage County reviewed the typical protocol to follow in achieving savings. The energy efficiency hierarchy below promotes that entities first become as efficient as possible and then consider alternative energy sources. The County has pursued this philosophy and recommends that others follow this methodology.

Figure 7. DuPage County Energy Efficiency Steps



7. ENERGY SECURITY

DuPage County is adopting practices and measures that can help mitigate the aforementioned risks. Through energy efficiency, diversifying fuel sources, and supporting upgrades to the existing energy distribution systems, The County can meet these challenges and strive to advance its energy security.

7A. Energy Efficiency

Commercial buildings and homes account for 40% of all the energy use in the U.S. This is more than either the transportation or industry sectors. Energy efficiency reduces energy consumption and associated costs, helping to mitigate risk due to energy price fluctuations. It lessens the need for additional generation and distribution assets and reduces the amount of greenhouse gas emissions produced that can contribute to climate change. Specific to electricity, energy efficiency lowers peak demand, reducing the stress on the local electrical grid and enhancing its reliability.

7B. Smart Grid

The existing electrical grid is over a hundred years old and although it has been updated as technology advanced through each decade, it is in need of a comprehensive upgrade to handle the increasing complexity and power needs of the 21st Century. Smart Grid is a modernization of the existing electric infrastructure to provide a stronger, more connected and therefore more reliable electrical grid by linking supply and system demand. Smart grid technology merges the power of computers with the electric grid to create a more stable electrical distribution system that provides fewer outages, quicker power restoration and more reliable power. In addition, it allows the end users to manage their energy use economically through the use of smart meters.

7C. Hybrid and Energy Efficient Modes of Transportation

Hybrid vehicles use less fuel and produce fewer greenhouse gas emissions than their conventional counterparts. More than a third of the energy consumed in the U.S. comes from petroleum based fuels, which is more than any other energy source. The transportation sector consumes 71% of all petroleum based fuels. Energy efficient vehicles such as hybrids, plug-in electric hybrids, electric and natural gas powered vehicles help reduce the dependence on petroleum based fuels. In addition, plug-in hybrid and electric vehicles can produce even lower emissions if the electricity supplied comes from renewable energy.

Further reductions in the consumption of petroleum based fuels can be achieved with initiatives such as reducing the amount of single occupancy vehicles (SOVs) on the road, improving the convenience of public transit, encouraging carpool or vanpool systems and building bicycle-friendly infrastructure such as bicycle sharing programs, bicycle lanes, off-street paths, and bicycle parking. In addition, fleet vehicles that support our freight movement, public transportation, waste removal and other related operations can leverage natural gas to replace petroleum based fuels and contribute to lower carbon emissions. The fuel delivery infrastructure required to supply the transportation sector as well as vehicle engine technology are making great strides in the areas of fleet transportation.

7D. District Energy and Combined Heat and Power

District Energy and Combined Heat and Power (CHP) plants supply locally produced electricity, heating and cooling. CHP represents approximately 8% of the current U.S. electric generating capacity and over 12% of the total electricity generated. A variety of fuel sources such as natural gas, biomass, biogas and oil can be used as a fuel source in CHP applications. Generating electricity at the site reduces reliance on the grid, avoiding potential outages and transmission energy losses, inherent to electrical distribution systems. In CHP systems, the waste heat created from the production of electricity is recovered to provide useful heating and cooling. This contributes to the high efficiency of CHP systems and reduces greenhouse gas emissions.

7E. Renewable Energy Sources

Less than 3% of the electricity created in the region comes from renewable energy sources. Almost 74% of the electricity is generated from fossil fuels (coal, natural gas, etc.) and 24% from nuclear energy. Renewable energy sources such as solar, wind, and geothermal reduce the demand on the electrical grid and decrease the reliance on fossil fuels. Incorporating these clean sources of energy will displace fossil fuel consumption and will lead to a reduction in greenhouse gas emissions. In addition, diversifying the locally used fuel mix with renewable energy will provide some economic protection against potential price volatility in traditional fossil fuels due to supply disruptions and high market prices. The State of Illinois has a reasonably aggressive renewable energy portfolio goal of 25% by 2025 which requires approximately three times more renewable energy be produced vs current levels. This is a state level mandate that supports the County's overall carbon emissions reduction goals and should provide opportunity to show leadership in the growth and application of renewable technology.

Many municipalities have supported renewables through the use of electricity aggregation. Nine municipalities in the County have elected to go 100% renewable. Such activities show preference for renewable energy and can boost their market share.

7F. Energy Research

Local research in the areas of energy conservation, green technologies and renewable energy can provide immediate and long-term benefits. For example, according to the National Solar Jobs Census 2013, solar employment grew 10 times faster than the national employment rate of 1.9 percent. Through government support of local colleges and startups through grants and other mechanisms, the results of such research can provide a continued path towards energy sustainability and security, while stimulating the local economy.

8. STRATEGIES

The previous sections highlight the goals, actual consumption, the importance of pursuing this effort but we have not addressed our roadmap to make these countywide changes. This section is broken into six (6) categories including (1) Landscaping for Efficiency; (2) DuPage County's Green Building Incentive Program; (3) an overview of County Campus efforts; (4) County campus recommended strategies followed by (5) Commercial & residential strategies.

8A. Landscaping for Efficiency

Alternative landscaping decreases greenhouse gases in the atmosphere through the reduced use of high emission tools, such as lawn mowers, and by storing GHGs in woody plant tissue. The use of native vegetative planting in open areas instead of grass lawns reduces emissions by 18 tons/year over 1,000 acres. It is calculated by the Illinois Environmental Protection Agency that in the Chicago area alone, the use of lawn equipment accounts for 50 tons of emissions per day in the summer. This is massive compared to the roughly 2 tons of emissions produced per day by industries like an auto assembly plant.[5]

Trees play an especially important part in improving air quality, reducing energy costs, removing pollutants from the air and storing carbon. A study conducted in Baton Rouge, Sacramento and Salt Lake City found that four shade trees planted by a home resulted in decreased CO2 emissions of 16,000; 41,000 and 9,000 tons respectively[6]. They expand that these savings do not include the cooling benefits which can be substantial. Evaporation from an individual tree can produce the cooling effects of 10 room sized air conditioners operating 24 hours per day and three or more trees planted on the sunny side of a house will provide enough shade to reduce air conditioning costs by as much as 30%.[7]

[5] Nowak, D., Rosenthal, S., and J. Vaughan. (2004, December) Exploring the Environmental, Social and economic Benefits Conference. Chicago, IL. http://www.epa.gov/greatlakes/greenacres/conf12_04/conf_knwldge.html

[6] Akbari, H. Shade trees reduce building energy use and CO2 emissions from power plants. Environmental Pollution 2002.

[7] Trees Reduce Energy Costs. Urban Forestry Network

In a 2010 survey and analysis conducted by The Morton Arboretum in cooperation with the U.S. Forest Service of the seven-county Chicago region, DuPage County has an estimated tree population of 17,300,000. This is about 11% of the 157 million trees in the Chicago region. These trees combined store 16.9 million tons of carbon at a value of $349 million and sequester 677,000 tons of carbon annually. These trees reduce energy usage by $44 million annually. The trees and shrubs across the Chicago region remove 24,170 tons of pollution from the air for an annual value of $183 million.[8]

Invasive species such as European buckthorn, which is the most abundant tree species identified in the County in the 2010 survey, and emerald ash borer pose a significant threat to our trees and green spaces. Efforts to control and replant from such effects should be considered high priority with a focus on species diversity**.** Guidance on replanting can be found in Appendix G, The Morton Arboretum's Northern Illinois Species List and Tree Selector.

The Conservation Foundation developed the Conservation@Work and Conservation@Home programs. Both provide hands on education about value of native planting and sites can receive certification highlighting the accomplishment. These programs, along with their new Pollinator Meadow Mix, are especially important on large plots of land on commercial, government and large developments. One of the other environmental benefits includes reduced water usage which can also lower energy consumption in the purifying and delivery water to the consumer.

8B. Green Building Incentive Program

DuPage County is home to more than 100 U.S. Green Building Council LEED certified buildings(Leadership in Efficiency and Environmental Design). The County's Office of Emergency Management received LEED for commercial interiors designation in January 2013 and the Children's Advocacy Center has been constructed to meet LEED Gold standard. In early 2015, the County considered an incentive program to raise the number of these types of eco-friendly buildings.

The County supports the construction of more efficient and less impactive buildings through the Green Building Incentive Program. The program is designed to enable private sector developers or property owners who implement "green design standards" into their projects to receive the following development incentives: (1) Expedited Building Permit Review Time (25% time reduction); (2) Expedited Stormwater Review Time for Incorporated/Unincorporated (25% time reduction); (3) Reduction of Building Permit, Zoning and Plat application fees (10% fee reduction); (4) Expedited Zoning (ZBA) and Plat process.

The opportunity to participate in the *DuPage County Green Building Incentive Program* is available to all types of construction and developments that meet the U.S. Green Building Council or equivalent Gold or Platinum criteria. The program was developed in partnership with Choose DuPage and is an economic development tool as well as a conservation effort. More information on the program can be found at the County's website dupageco.org/greenbuildingincentive.

8C. DuPage – A History of Energy Efficiency

For several decades DuPage County has been working to improve its campus by reducing energy consumption and piloting the use of renewable technology. Listed on the following pages are several of the projects that the County has completed and the results of an assessment to continue these improvements.

[8] Nowak, D., Hoehn, R.E., Bodine A.R. Crane, D.E., Dwyer, J.F., Bonnewell, V., Watson, G. Urban Trees and Forests of the Chicago Region, U.S. Forest Service 2013.

8C. DuPage – A History of Energy Efficiency cont'd

DuPage County replaced 1,040 high pressure sodium fixtures in the two four level parking garages with LED for an estimated immediate electricity savings of 50%. The program reduced energy consumption and improved lighting quality. In the photo to the left, the bottom floor shows the LED lighting and the 2nd and 3rd floors show the older high intensity discharge lighting.

In 2010, DuPage County re-optimized traffic signal system timing at 111 intersections on major arterial roadways and expressway interchanges. The program yields an estimated savings of more than 763,500 gallons of fuel/year.

The County converted 106 county-maintained traffic signals and 6 flashing beacons from incandescent bulbs to LED saving 85% of energy previously consumed, reducing maintenance costs while improving visibility and reliability.

DuPage County replaced 81 appliances at the Convalescent Center. The existing appliances ranged from 25 to 40 years in age and are located in the existing kitchen, laundry and physical therapy areas of the building. The energy savings ranged between 10% and 35% per appliance.

DuPage County installed an ENERGY STAR white roof in place of the existing black asphalt roof in four locations: ancillary covers above two stairwells, one above a pedestrian bridge, the roof of the Office of Emergency Management building and the roofing over the auditorium. The white roof lowered the roof temperature reducing the energy demand when cooling the building. The new roof also has a longer life expectancy and is expected to reduce the demand on the existing HVAC system.

8C. DuPage – A History of Energy Efficiency cont'd

DuPage County exchanged 163 existing incandescent exit signs with energy efficient LED signs throughout the Convalescent Center. The project enabled the Center to standardize the signs for consistency and safety of the staff and residents. Due to the longer life span of LEDs, the Center will also see a savings in resources used replacing bulbs.

DuPage County removed high pressure sodium lighting and metal halide fixtures at the County's Highway Maintenance Garage and installed high output fluorescent fixtures. The County replaced the 400-watt lighting fixtures with efficient 168-watt fixtures with occupancy sensor controls. This project reduced energy consumption and increased lighting levels.

DuPage County installed occupancy sensors in the Administration, Judicial Office Facility and JOF Annex buildings. The sensors allow the County to turn off lighting that had previously remained on in the evenings when cleaning crews were working in the building. The new control system lights the area only when it is occupied.

DuPage County Department of Public Works implemented a facility wide lighting retrofit at the underground maintenance garage, Woodridge Greene Valley and Knollwood wastewater treatment plants. The retrofit included installation of compact fluorescent, tubular fluorescent, LED fixtures and exit signs. A total of 1056 fixtures were upgraded saving 55 kilowatts or 242,600 kilowatt-hours of electricity.

8C. DuPage – A History of Energy Efficiency cont'd

DuPage County utilized the Illinois Dept. of Commerce & Economic Opportunity's energy efficiency incentive program and funding from the Illinois Clean Energy Foundation to retrofit the lighting at the jail. The existing T12 lamps were removed and replaced with the more energy efficient T8 lamps. The project included the replacement of 2,023 fixtures and 5,283 lamps. With the aforementioned funding mechanisms, there was zero cost to the County.

The Child Advocacy and Neutral Exchange Center located at DuPage County's campus houses a 15 kW solar photovoltaic system installed over a fully-adhered roofing system, 60-mil thick reinforced thermoplastic polyolefin membrane. The roofs reflective surface measures a Solar Reflective index of 100 and is U.S. EPA Energy Star certified. The solar modules applied directly over the roof membrane are CIGS thin film technology on a flexible substrate and are extremely light weight weighing 0.7 lb/ per square foot. The solar photovoltaic array covers almost 1,400 square feet of the roof and is adhered with adhesive allowing for very few penetrations.

DuPage County has begun a retro commissioning program using DCEO incentives. The first project was the JTK Administration Building. Implemented measures include duct static pressure reset, reduce fan speed on AHU's at night, implement a night temperature setback, close outside air dampers for night operation and adjust minimum damper position. The cost to the County to implement was $10,000 producing $60,081 in savings and a simple payback of 2 months.

DuPage County transitioned the existing data center to cutting edge technology utilizing 208V servers instead of 120V. This updated version operates more efficiently and effectively. The data center was enclosed to encapsulate the cooling energy within a smaller footprint. The units were fitted with a filtering hood system to minimize particulate matter entering the equipment which maintains the optimum operation and reduces dust related failures. The renovated data center is lit by LED fixtures with occupancy sensors.

8D. DuPage County Campus Recommendations

While DuPage County has made significant reductions in its energy consumption, the County recognizes that there is still opportunity to make improvements. The County will conduct energy assessments in the remaining buildings as necessary to maximize the efficiency of operations. When metering is installed, the County will track energy consumption in the U.S. EPA's ENERGY STAR Portfolio Manager system[9]. The benefits are two-fold; this will enable the County to benchmark its buildings against similar users and will open the door to apply for ENERGY STAR certifications on qualifying buildings. In 2013, the County worked with ComEd to provide a third-party assessment of four campus buildings – Convalescent Center, Administration Building, Central Plant and Jail B. Additional strategies that apply in multiple categories have also been included.

Strategy #1 - Building Envelope - Insulation, air sealing, windows, roofs, etc.

Continue the ENERGY STAR roofs as they need to be replaced. When windows require replacement, the County will install ENERGY STAR. As technology improves and maintenance becomes necessary, the County will make the choice for greener insulation products.

Strategy #2 - HVAC/Building Controls - Heating, venting, air conditioning and associated controls for the indoor climate

The campus utilizes a centralized plant to heat and cool campus buildings. The ComEd assessment made multiple recommendations about how and when to operate the HVAC system. Over the course of this initiative and as funding becomes available; the County will work on the following improvements:

- installing variable speed drives;
- convert hot water system to variable flow;
- mount demand ventilation controls in the kitchens;
- investigate retro-commissioning strategies to make all buildings operate as efficiently as designed.

Strategy #3 - Lighting – Indoor, exterior, street

The County will continually monitor technology advances in the lighting industry. The majority of the campus has been retrofitted where practicable. Several buildings require an entirely new lighting control system and will be considered if/when funding becomes available. Currently there is opportunity in the utility tunnel system to replace high pressure sodium fixtures and potentially install occupancy sensors. When additional opportunities are identified to replace fixtures or bulbs, the County will investigate the use of the most efficient bulb including, but not limited to, LEDs. This may include street lighting.

Strategy #4 - Competition/Reward – On campus and satellite locations

When metering and tracking becomes available, the County will start charging and tracking use by buildings. A building competition could be launched to encourage ongoing innovation in building efficiency. All County buildings that are eligible should obtain ENERGY STAR rating once the necessary data is metered.

Strategy #5 - Review potential for the use of renewable energy

As the County gets lower on the hierarchy or when opportunities to be a pilot location become available, it will pursue renewable energy technologies. The County continues to monitor the potential for all sources of renewable energy and will address their feasibility on a case by case basis.

[9] U.S. EPA Energy Star Portfolio Manager - user tracks energy & water consumption and GHG generated.

8E. Commercial Strategies

Commercial and industrial sites consume 40% of all energy and 71% of electricity produced in the United States. They also are responsible for 38% of the carbon dioxide emissions and 36% of all greenhouse gas emissions according to the U.S. Energy Information Administration. As such, the Green Government Council of DuPage County recommends the following strategies in working toward achieving the goals identified in the Cool Counties Initiative. From the following strategies, programs, workshops and other outreach based events will be developed to assist in the implementation. Additional projects may be pursued as opportunities become available.

Outreach & Marketing Strategies

The County should endeavor to educate small, medium and large commercial customers from varying industries about existing ComEd and Nicor Gas efficiency programs. Currently, both utilities have a vast array of programs that offer incentives toward energy efficient improvements. Some programs are supported by incentives and some by site design.

- Provide energy efficiency leadership in County government buildings & operations.
- Partner with ComEd, Nicor Gas and the Illinois Department of Commerce & Economic Opportunity (DCEO) to promote existing energy efficiency programs including assessments, incentives, rebates and loan programs. Serve as a liaison connecting users with these opportunities.
- Enhance the County's website to connect users with practical and implementable options.
- Develop case studies of successful commercial users for website and marketing material.

Building Tune Up & Lighting Strategies

Buildings can be recalibrated to operate in the manner in which they are being used. Many buildings are no longer used as they were originally constructed. Some start as large office areas and then turn into separated meeting spaces, storage and walled offices. As building use changes, they do not function as efficiently and HVAC systems may have to work harder to maintain air quality and temperature.

ENERGY STAR rated fixtures are available and can be utilized. To the extent practicable, commercial users should convert to energy efficient bulbs and fixtures. ComEd and DCEO operate incentive programs for users to lessen the financial impact of these types of conversions. Additionally,

energy efficiency companies offer performance contracting programs where the energy saved directly funds the capital investment. This type of approach can result in swift returns on investment.

The County can encourage municipalities to participate in the DCEO programs through the Smart Energy Design Assistance Center (SEDAC). SEDAC is available to conduct energy assessment that provide an expert evaluation of consumption and opportunities.

Transportation Strategies

This category maintains a diverse set of opportunities from land uses to traffic signal coordination. This plan encourages mixed use developments that include transit oriented designed downtowns with higher density residential homes.

The County has maintained a traffic signal coordination program when funding has been available which has saved millions of gallons of gasoline, money and time spent commuting. The County should continue to pursue close coordination between agencies for the efficient movement of traffic which also reduces avoidance of signals through longer trips. Businesses could incentivize employee ride share and/or mass transit options through preferential parking, gift cards or other types of recognition. The County has also implemented an alternative fuel fleet including compressed natural gas trucks, hybrids and electric maintenance carts. A dual electric car charging station was installed in 2014 for employees and the public.

Employers could incentivize carpooling and could participate in pre-tax public transit programs. The County should encourage businesses to seek out opportunities to connect to non-motorized transportation systems including trails, sidewalks and paths.

A few other strategies that employers could institute are telecommuting or alternative work schedules. Some private businesses may be able to pursue a 4 day work week allowing the building to shut down an additional day which has the added benefit of reducing on-road commuting traffic. These may not be viable options for some employers but should be considered when practicable.

Industrial & Manufacturing Processes

The County has previously partnered with the Illinois Sustainable Technology Center (ISTC) and the Illinois Manufacturing Excellence Center to audit manufacturers in the categories of energy, efficiency and economy. This program should be replicated as funding becomes available.

The County should support a 21st century energy efficiency workforce through partnerships with organizations like the Midwest Energy Efficiency Alliance to make training available to DuPage building operators.

Businesses can contact the utilities; a private energy efficiency company or ISTC to engage in energy assessments. Both ComEd and Nicor offer incentives but savings can also be derived from the private energy efficiency company and ISTC. The County can assist in outreach to connect DuPage businesses with these opportunities. Businesses can also work with private energy efficiency companies that can also provide energy assessments with return on investment information.

Leadership

The County's Regulatory Services staff will continue to enforce the State of Illinois Energy Code to ensure new and remodeled buildings meet the standards. The County could partner with the Better Buildings Challenge to host a local competition and could identify and host a best practices workshop to highlight successful commercial projects. The County has pursued varying levels of projects and will continue to share the pros and cons with inquiring entities.

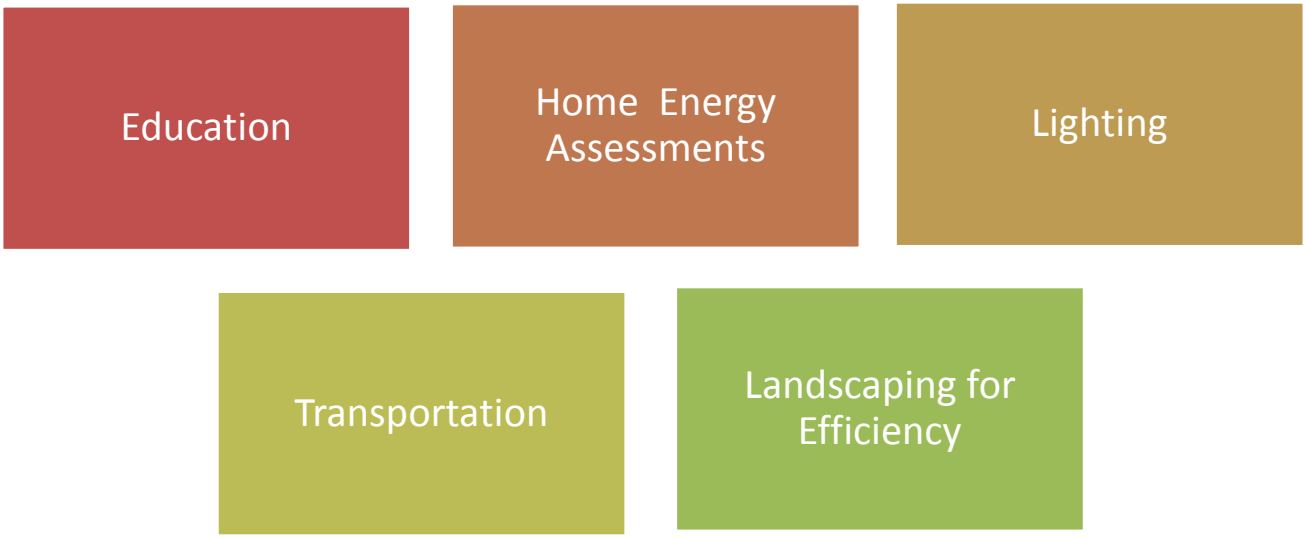
With the County's ongoing pursuit of efficiency, it will continue to serve as a role model for local government. Many projects have been completed with incentives and grant funding with minimal returns on investment. The County will continue to pilot new ideas and share lessons learned.

Landscaping for Efficiency

The County works closely with The Conservation Foundation to expand their Conservation@Work program which encourages commercial properties to reduce the amount of managed green lawn in their property. When possible, native landscaping should be used and wooded sites retained or regenerated to prevent the costly maintenance of chemicals, water and emissions used in typical lawn care. *Retrofitting Large Landscapes for Sustainability*, a guide developed by The Morton Arboretum, assists in these efforts and a link can be found on the County's website. Additional emission reduction strategies include; shaded parking areas, permeable pavers, and stormwater Best Management Practices (BMPs).

8F. RESIDENTIAL STRATEGIES

The EIA has announced that the average nationwide use of energy in households has shifted. For decades, the largest consumption was for heating and cooling, but their recent 2010 & 2011 poll found that appliances and technologies have taken over as the biggest draw. They attribute the shift to more efficient HVAC equipment, better insulation, more efficient windows and population shifts to warmer climates.



Education

DuPage County staff should work with local utilities to promote available incentives to residents geared towards improving their energy efficiency. Educational outreach programs on the topics of energy efficiency and conservation could be utilized in the outreach efforts. The County could conduct demonstrative projects to display sustainability practices to the public including, but not limited to, supporting their environmental education partnership with S.C.A.R.C.E. Participate in hardware stores educational promotions which highlight insulation opportunities and efficient lighting fixtures and bulbs.

The County should connect homeowners with existing ComEd, Nicor and Elevate Energy on energy efficiency programs through the use of education and the website.

Home Assessments

In cooperation with Nicor Gas and ComEd, the County should encourage residents to schedule home energy assessments. Nicor Gas and ComEd offer customers a free home energy assessment, which includes the installation of energy saving products such as a programmable thermostats and CFLs. The energy assessment also includes a customized report detailing additional ways to save.

In addition, Nicor Gas and ComEd offer rebates for energy efficient heating and cooling equipment, such as furnaces and central air conditioners. Residents may also qualify for significant rebates for weatherization improvements completed by a qualified contractor. ComEd also offers refrigerator and freezer recycling. Rebates and offerings are subject to change. The 2014/2015 program year is attached as Appendix A. New offerings are rolled out annually by both entities and offer significant return on investment.

Lighting

In contrast to the EIA date, ComEd conducted a study in 2012 in their service territory for residential customers and found that lighting consumed the most electricity at 19%. The nationwide trend has been toward the use of compact fluorescent lamps and with the cost of LEDs starting to become more competitive, the County should promote energy efficient lighting as a lower cost viable option. ComEd has offered in-store discounts on CFLs and LED lighting and maintains the Smart Ideas energy efficiency program which supports the purchase of low energy bulbs and fixtures.

Landscaping for Efficiency

A less well known solution that can be used in a residential setting is the location of an air conditioning unit. Most homeowners have not been given a choice in the location of the air conditioning unit and the preferred location is on the north side of the home where it receives the least amount of sunlight during summer months. A more viable technique for homeowners with existing construction is to provide trees or bushes to homes to decrease cooling loads/effective landscaping. Additional energy reduction actions include; adding deciduous trees, those that lose their leaves in the fall, on the west side of a house to reduce the direct sunlight in the summer months, reducing energy usage to cool a house, and providing direct sunlight in winter months to aid in heating a house. An evergreen hedge row away from the house but placed on the north side assists in blocking wind during the winter months. These planting strategies have the added benefit of carbon storage within the tree or bush. The County will continue to communicate this as a low cost and practical activity to reduce residential consumption and assist with providing links to the Arbor Day Foundation's Energy-Saving Trees website. Again, additional resources can be found at the Morton Arboretum and The Conservation Foundation's Conservation@Home program.

Transportation

DuPage County is currently serviced by two different Metra train lines and has Pace bus service in locations throughout the County. These mass transit options can aid the County in reducing vehicle miles travelled. Some additional recommendations include living in a walkable/bikeable community. Many DuPage developments are situated far from grocery stores and schools. The new trend is to utilize transit oriented design when developing to increase convenience and minimize traffic.

The County is home to more than 500 miles of trails & bikeways that are an integral part of our identity and a valued amenity for runners, cyclists, and nature lovers. The trail system connects residents from all corners of the county to popular destinations and public transit stations. Trails serve as an

alternative corridor for non-motorized transportation, providing those who wish to reduce automobile travel with a safe, alternative means of transportation. Most residents can easily bike to nearby communities, shopping centers, Metra stations, museums, parks and forest preserves. In fact, more than 75 percent of residents live within 1 mile of the regional trail system. Since most suburban trips are less than 2 miles, having popular destinations accessible from residential neighborhoods via bicycle and pedestrian facilities allows people to live a less car-dependent lifestyle.

The County maintains mobile apps and a trail mapping software (GoBike) to assist non-motorized traffic in getting places. Residents should be encouraged to walk or bike whenever practicable and safe.

Another solution to reduce vehicle traffic is to organize traveling in a manner to reduce on-road time. When parking is located in a centralized area, it enables drivers to stay parked and visit multiple locations. Tele-work options could be pursued by employees and carpooling is always encouraged. Modifying work schedules to avoid traveling during peak times can also aid in emissions due to congestion.

9. CONCLUSION

Over the next 15 years, DuPage County will continue to push forward with an energy savings plan that makes sense while having a lasting impact on our air quality. The aforementioned strategies will serve as the roadmap to implement these lifestyle and business operation changes. Periodic measurements will be taken to measure our achievements. With an entire county participating, we can meet and exceed these goals.

GLOSSARY OF ACRONYMS IN THE DOCUMENT

ACEEE	American Council for an Energy Efficient Economy
AHU	Air Handling Unit
Btu	British Thermal Unit
CBECS	Commercial Building Energy Consumption Survey
CHP	Combined Heat and Power
CNT	Center for Neighborhood Technology
DCEO	Department of Commerce and Economic Opportunity (Illinois)
DOE	U.S. Department of Energy
GGC	DuPage Green Government Council
GHG	Greenhouse Gas
HVAC	Heating Ventilation Air Conditioning
IDOT	Illinois Department of Transportation
IL EPA	Illinois Environmental Protection Agency
JTK	Jack T. Knuepfer (Administration Building)
kWh	Kilowatt Hour
LED	Light Emitting Diode
LEED	Leadership in Energy & Environmental Design
MLS	Multiple Listing Service
MMCF/d	Million Cubic Feet per Day
MMT	Million Metric Tons
PACE	Property Assessed Clean Energy
SCARCE	School and Community Assistance for Recycling and Composting Education
SUV	Single Use Vehicle
US EIA	United States Energy Information Administration
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
VMT	Vehicle Miles Traveled

LIST OF APPENDICES

The documents below are provided as background to the development of this plan in addition to providing case studies and opportunities to the reader.

Appendix A - ComEd 2014/2015 Programs

Appendix B - Nicor Gas 2014/2015 Programs

Appendix C - IL Dept. of Commerce & Economic Opportunity 2014 Program

Appendix D - Case Studies (Nicor Gas, ComEd, Johnson Control, Siemens, TRANE)

Appendix E - Elevate Energy 2007-2012 Emissions Data (fka CNT Energy)\

Appendix F - DuPage County Board Resolution EN-0001-12
Resolution of Commitment to Sierra Club Cool Counties Program

Appendix G - The Morton Arboretum's Northern Illinois Species List and Tree Selector

APPENDIX A

ComEd 2014/2015 Energy Efficiency Programs

SMART IDEAS FOR YOUR BUSINESS®
INCENTIVE PROGRAMS

June 1, 2014 through May 31, 2015

PROGRAMS	SAMPLE PROJECTS	ELIGIBILITY	BUSINESS EXAMPLES
SMART IDEAS OPPORTUNITY ASSESSMENT			
An on-site facility assessment conducted by an engineer to identify energy-efficiency opportunities eligible for *Smart Ideas*® incentives.	» Industrial facility » Office building » Hospital » Museum » Private university » Shopping center	All commercial and industrial customers	Office buildings, grocery stores, manufacturers, warehouses, hospitals, private universities
STANDARD INCENTIVES			
Cash incentives for common energy-efficiency improvements to commercial and industrial lighting, HVAC, refrigeration and other systems.	» T8 and T5 lighting » Indoor and outdoor LED fixtures » Building automation systems » Controls and sensors » Chillers » Lighting control systems » VSDs	All commercial and industrial customers	Light industrial facilities, warehouses, office buildings, healthcare facilities, retailers
CUSTOM INCENTIVES			
Cash incentives for large, complex energy-efficiency projects, such as industrial process or system improvements not covered by Standard Incentives.	» Process and/or system improvements » Process automation » New technologies (e.g., geothermal)	All commercial and industrial customers	Manufacturers, warehouses, large grocery stores, office buildings
BUSINESS INSTANT LIGHTING DISCOUNTS (BILD)			
Energy-efficient lamps and high-efficiency electronic ballasts available to businesses at a reduced price from participating electrical distributors.	» Screw-in LED lamps and trim kits » Screw-in CFLs » Reduced wattage T8 and T5 lamps » Reduced wattage CMH » 2-, 3- and 4-lamp high-efficiency electronic ballasts	All commercial and industrial customers; contractors that purchase lamps for maintenance and replacement	Office buildings, warehouses, large restaurants, large grocery stores, retailers
NEW CONSTRUCTION			
Cash incentives and technical assistance, such as energy modeling, to support architects and engineers in designing high-performance buildings.	» Industrial headquarters » Grocery store » Hospital surgery wing » Student life and recreation center	Commercial and industrial customers planning a new building or renovation that is greater than 20,000 square feet	Office buildings, grocery stores, manufacturers, warehouses, hospitals, private universities
INDUSTRIAL SYSTEMS			
System assessments and financial incentives to reduce electricity used by compressed air, industrial refrigeration and process cooling systems.	» Compressed air » Industrial refrigeration » Process cooling	Commercial and Industrial customers with demand ≥ 500 kW and Compressed Air ≥200 hp, Industrial Refrigeration ≥500 hp, Process Cooling ≥500 tons	Large manufacturers

SMART IDEAS FOR YOUR BUSINESS
INCENTIVE PROGRAMS

PROGRAMS	SAMPLE PROJECTS	ELIGIBILITY	BUSINESS EXAMPLES
BUSINESS PRODUCTS DISCOUNTS (BPD)			
Energy efficient battery chargers and transformers available at reduced pricing to business customers through participating distributors.	**Battery Chargers** » 3 phase, high frequency battery chargers for electrical vehicles » 5 year product warranty » 92% power conversion efficiency	Commercial and industrial customers with forklifts and other battery powered vehicles	Warehouses, distribution centers, manufacturers, universities, wholesalers, industrial facilities
	Transformers » Single or three phase » Low voltage (<600) » Dry transformer (air cooled, no oil as coolant) » ≥ NEMA premium efficiency transformer requirements at 35% load » Utility owned are not eligible	Commercial and industrial customers with varying voltage requirements within their facilities.	Warehouses, distribution centers, manufacturers, universities, wholesalers, industrial facilities
RETRO-COMMISSIONING			
Expert analysis of building systems that identifies no-cost and low-cost operational improvements to optimize electricity and gas usage.	» Update system operating schedules to improve energy efficiency and provide a comfortable indoor environment » Reduce supply air temperature and fan speed in air handling units » Optimize chiller or other equipment operation	Commercial and industrial customers with demand ≥500 kW	Office buildings, hospitals, educational facilities
DATA CENTERS			
Technical assistance and cash incentives for installing energy-efficient equipment and systems in new or existing data centers.	» Cooling optimization measures, including central plant upgrades, VSDs, high density cooling solutions and economizers » Power delivery improvements, including UPS and PDU upgrades » IT optimization measures, including virtualization, consolidation, thin provisioning and solid state storage	Commercial and industrial customers with data centers	Office buildings, manufacturers, co-location facilities, corporate data centers, hospitals
SMALL BUSINESS ENERGY SAVINGS (SBES)			
Free energy usage assessments and cash incentives for projects that reduce electricity in small businesses.	» T12 - T8 lighting retrofits » CFLs » Lighting occupancy sensors » LED exit signs and lamps	Commercial and industrial customers with demand <100 kW; qualified Small Business Trade Allies guide customers through SBES program	Small retailers, small restaurants, offices, light industry, convenience stores, dry cleaners

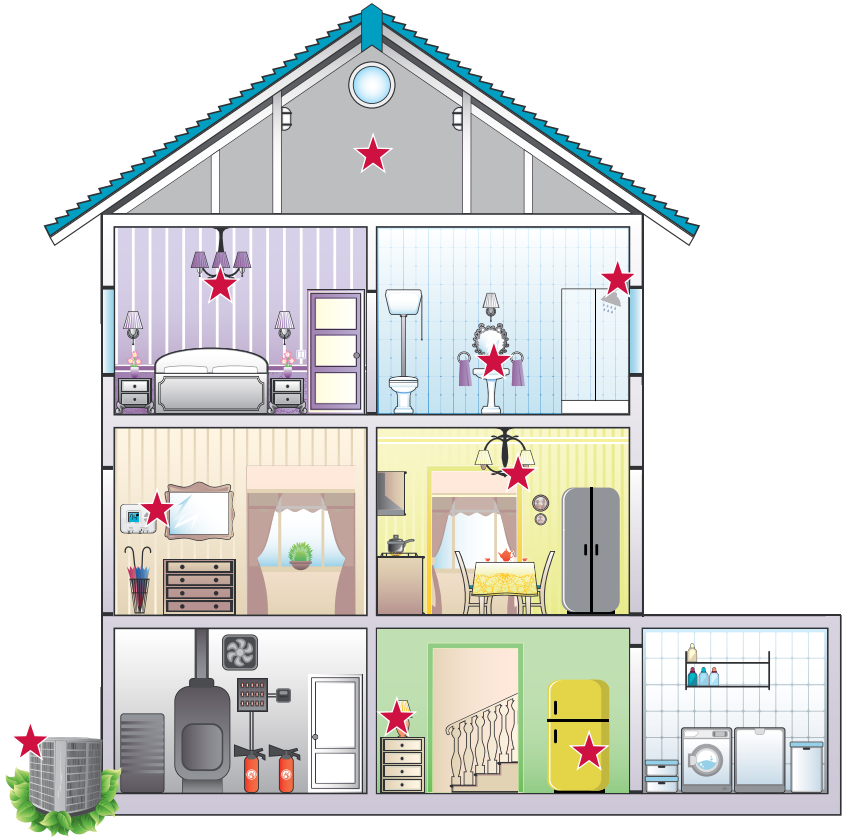
Smart Ideas for Your Business offers cash incentives, technical services and whole-building solutions to help businesses use energy more efficiently. For more information, visit **ComEd.com/BizIncentives**, call **855-433-2700** during normal business hours to speak with a *Smart Ideas* service representative or email us at **SmartIdeasBiz@ComEd.com**.

ComEd®
An Exelon Company
powering lives

smart ideas

YOU'VE GOT THE POWER TO SAVE

We've got the ideas to help



ComEd®

An Exelon Company

powering lives

Take advantage of these **money** and **energy-saving** programs:

LIGHTING DISCOUNTS

Instant in-store discounts on select ENERGY STAR® certified light bulbs. Look for the ComEd "Lower Price" sticker at participating retailers.

HOME ENERGY REBATES

Rebates for installation of qualifying, high-efficiency equipment and services, such as weatherization and central air conditioning systems.

HOME ENERGY ASSESSMENTS

FREE energy assessments including installation of energy-saving products and customized energy-efficiency recommendations.

FRIDGE & FREEZER RECYCLING

ComEd offers FREE pick up and recycling of old, working refrigerators and freezers, and will also pay you for participating.

CENTRAL AC CYCLING

Bill credits of up to $40 for allowing ComEd to remotely and safely turn the compressor off and on for brief periods during times of high demand for electricity.

MULTI-FAMILY ENERGY SAVINGS

Tenants of multi-family buildings should encourage their landlord to call 855-IDEAS-00 to schedule the installation of FREE energy-saving products.

ENERGY EFFICIENCY LOANS

Energy Efficiency Loans provide special financing for the purchase and installation of qualified energy-efficiency products and services. Eligible homeowners may apply. Your loan payment is conveniently added to your monthly electric bill.

For more information, visit ComEd.com/HomeSavings or call 855-IDEAS-00 (855-433-2700).

Learn more. Save more.

Tips to Save Energy

Visit **ComEd.com/HomeSavings** for low-cost, no-cost energy saving tips.

My Energy Tools

Online access to home usage comparisons, information on which items in your home use the most energy and personalized ways to save – all available when you log in to your online account at ComEd.com/MyAccount*.

**Watch for the new version of your ComEd.com online account and enhanced mobile access to these great energy-management tools.*

Learn how ComEd's Energy-Efficiency Programs can save you money. Visit ComEd.com/HomeSavings or call 855-IDEAS-00 (855-433-2700).

ENERGY STAR PARTNER

ComEd®
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Smart Ideas® programs are funded by ComEd customers in compliance with Illinois law.
Must be a ComEd residential delivery service customer to participate.
Other eligibility requirements may apply. Programs are subject to change.
SIPROGRAMBIFOLD0514

APPENDIX B

Nicor Gas 2014/2015 Energy Efficiency Programs

Find your path to energy efficiency

energySMART can help you take sensible steps to smart savings

Assessments

Understand your opportunities to save energy

Conduct your own, or receive a free professional assessment of your home or multi-family building to understand ways to save energy. Free products will be installed afterward to help you start saving right away. The assessment may also recommend applying for rebates to complete the energy-saving improvements suggested for your home.

Free products

Start saving energy in your home today

Free energy-saving products, such as a programmable thermostat, faucet aerators for your kitchen and bath (and CFLs for ComEd customers), are available to homeowners and renters to start saving natural gas.

Rebates

Replace your heating equipment and insulate your attic

Cash rebates of up to $600 are available to homeowners for the purchase and installation of qualified high-efficiency equipment, including attic insulation, furnaces, programmable thermostats and more. Owners and renters of multi-family buildings are also eligible for rebates for energy-saving improvements.

Loans

Loans to help cover your energy efficiency project

Financing is available to cover the cost of energy efficiency equipment and improvements in homes and multi-family properties. Installments on the loan are applied to monthly Nicor Gas bills.

Visit **nicorgasrebates.com** or call **877.886.4239** to learn more.

energySMART, a Nicor Gas program, is funded by Nicor Gas customers in compliance with Illinois law.
071614_umbrella-flyer

Nicor Gas™
An AGL Resources Company

energySMART
A Nicor Gas™ program

Making energy smarter for business

Earn cash incentives when you make natural gas-saving investments

Assessments

Building evaluations yield savings

Complete an assessment of your building and receive a report with suggested energy-saving improvements including calculated savings, estimated cost, available incentives and payback period. From small business assessments, to opportunity assessments for larger businesses and facility assessments for industrial customers, you're sure to find the assessment that best fits your business.

Rebates

Replace your natural gas equipment with energy efficient models

Up to $7,500 in cash rebates are available for the purchase and installation of qualified high-efficiency equipment. We have rebates for every type of business and multi-family building, including heating equipment, commercial kitchen equipment and smaller improvements such as boiler tune-ups and steam traps.

Free products

Products to help you save, at no cost to you

Start saving today with free professionally installed energy-saving products, such as pipe wrap, water heater setback controls and low-flow showerheads, available for small businesses and multi-family properties.

Optimization

Tune-up your equipment to boost performance

Building optimization services help commercial and industrial facilities identify low and no-cost ways to improve efficiency of existing systems to achieve optimum efficiency. Team up with our energySMART engineers to tune up your existing equipment and achieve the best performance.

Custom

Rebates customized for your business

Custom incentives are available to businesses that install qualifying energy efficiency projects that are not eligible for rebates through other offerings. To qualify for incentives, projects must be pre-approved; contact us before you get started.

Visit **nicorgasrebates.com** or call **877.886.4239** to learn more.

energySMART, a Nicor Gas program, is funded by Nicor Gas customers in compliance with Illinois law.
071614_umbrella-flyer

Nicor Gas™
An AGL Resources Company

energySMART
A Nicor Gas™ program

APPENDIX C

IL Dept. of Commerce & Economic Opportunity Energy Efficiency Programs

Illinois
Department of Commerce
& Economic Opportunity
Pat Quinn, Governor

Illinois Energy & Recycling Office Programs
January 2014

The Illinois Energy Office demonstrates economic development benefits, including job creation, of energy efficiency, renewable energy, and recycling through a variety of programs and services. Further, Office programs demonstrate that economic development, sustainable energy, recycling practices, and environmental protection go hand in hand.

In addition, the Office continues to promote the leadership of the State of Illinois, through its own energy and recycling policies and practices at state facilities. Individually tailored programs are available to assist Illinois citizens, communities, non-profit organizations, businesses, industry, and other government agencies in an effort to achieve the Offices' mission.

Energy Efficiency Programs: Illinois Energy Now

Under Public Act 95-0481, DCEO, ComEd, and Ameren Illinois have developed and sustained a portfolio of electric energy efficiency programs to achieve certain annual energy savings goals. Over $55 million is available for the DCEO electric Illinois Energy Now programs. DCEO is responsible for 25% of the total portfolio and the utilities 75%. DCEO will utilize approximately 58% of funds on public sector programs, 24% on low income programs, and 10% on market transformation programs. ComEd and Ameren Illinois electric portfolio programs will be focused on residential, commercial and industrial sectors.

The Natural Gas Energy Efficiency Program authorized by Public Act 96-0033 started June 1, 2011. Over $25 million is available for incentives to the public sector and low income sector. DCEO is offering an integrated natural gas and electric portfolio. Ameren Illinois, Nicor, Peoples and North Shore natural gas companies offer natural gas energy efficiency incentives to the commercial, industrial, and residential sectors.

A. Public Sector Electric and Natural Gas Efficiency

The following energy efficiency programs are offered to the Public Sector:

- Local Government (county, township, municipal, public safety, water and park districts)
- Public K-12 Schools
- Community Colleges
- Public Universities
- State and Federal Government

1. Standard and Custom Incentive Programs

The Standard and Custom Incentive Programs provides grants and rebates to public sector entities for electric and natural gas system efficiency improvements. The Standard Incentive Program provides set incentive levels for common retrofits for lighting, HVAC, variable

frequency drive controls, motors and refrigeration. The Custom Incentive Program provides incentives for electric and natural gas efficiency improvements not listed in the Standard Incentive Program.

Website: www.ilenergynow.org
Contact: Sally Agnew, 217-785-5081, Sally.Agnew@illinois.gov

2. New Construction Program

The New Construction Program provides grants to public sector entities to encourage applicants to design new or rehabbed buildings to achieve the greatest level of energy efficiency. The program offers $/square foot incentives for facility design improvements beyond code, with incentive levels increasing for additional percentages beyond code. Estimated electricity and natural gas savings must be documented by energy modeling and/or supporting calculations. This program is administered by the Smart Energy Design Assistance Center (SEDAC) at the University of Illinois.

Website: http://smartenergy.illinois.edu/new-construction-incentive-program.html
Contact: Kristine Chalifoux, 217-244-1315, kmchalif@illinois.edu

3. Retro-commissioning Program

The Retro-commissioning Program provides funding to identify and implement low cost tune-ups and adjustments that improve the efficiency of existing public buildings' operating systems by returning them to intended operation or design specifications, with a focus on building controls and HVAC systems. Retro-commissioning services will be delivered through a network of commissioning providers that have been trained in program protocols and participation processes. This program is administered by the Smart Energy Design Assistance Center (SEDAC) at the University of Illinois.

Website: http://smartenergy.illinois.edu/retro-commissioning.html
Contact: Ashley Collins, 312-267-2864, Ashley@360eg.com

4. Lights for Learning Fundraiser

The Illinois Lights for Learning Fundraiser is a unique educational opportunity for Illinois students to earn money for their school or organization by selling money saving, energy efficient Compact Fluorescent Light bulbs (CFLs). Participating schools keep 50% of the proceeds, and presentations are provided to educate students and their community about the environmental and financial benefits of using CFLs. This program is administered by the Midwest Energy Efficiency Alliance (MEEA).

Website: www.lights4learning.org
Contact: Bruce Selway, 217-785-2023, Bruce.Selway@illinois.gov

5. Self-Directing Customer or Exempt Customer

Customers seeking to be designated by the Department as a self-directing customer (SDC) or as an Exempt Customer under the Natural Gas Energy Efficiency Programs shall submit an application on or before February 1, 2010. A new customer that commences taking service from a natural gas utility after February 1, 2010 may apply up to 30 days after beginning service. Thereafter, applications may be made not less than 6 months before the triennial filing date of the gas utility energy efficiency plans.

Website: www.ilenergynow.org
Contact: Wayne Hartel, 217-785-3420, wayne.hartel@illinois.gov

B. Low Income Energy Efficiency programs

1. Energy Efficient Affordable Housing Construction Program

DCEO believes that affordable housing must be energy efficient to be truly affordable. DCEO has led this effort through the Illinois Energy Efficient Affordable Housing Program initiated in 1988. Under this Program, grants are provided to Illinois based non-profit and for-profit housing developers to include energy efficient building practices in the rehab or new construction of affordable housing units. Average energy savings range from 50% to 75%.

Website: www.ilenergynow.org
Contact: Don Falls, 217-785-1997, don.falls@illinois.gov

2. Residential Retrofit

This program provides funding to leverage existing low income weatherization and home improvement programs to maximize electricity savings. DCEO will partner with Program Implementers such as state agencies, local government, lending institutions, housing authorities, and affordable housing developers for direct installation or funding of electric efficiency measures in low income households. This program is part of the Illinois Energy Efficiency Portfolio.

Website: www.ilenergynow.org
Contact: Ed Hosey, 217-785-3984, Ed.Hosey@illinois.gov

3. Efficient Living: Illinois Public Housing Authority Energy Program

This program provides funding for electric and gas efficiency measures in buildings owned and managed by Public Housing Authorities to reduce energy consumption and utility costs while maintaining affordable, comfortable homes for residents.

Website: www.ilpha.org
Contact: Kate Brown, 217-244-6769, cbrown4@illinois.edu

C. Market Transformation: Technical Assistance, Education and Training

1. Building Industry Training and Education (BITE) Program

This program provides funds to organizations to train professionals from all aspects of the building industry in energy efficient practices and about energy efficient products and equipment, in order to develop the robust energy efficiency services market necessary to achieve the energy savings goals in future years. Grantees will organize and coordinate workshops and training for all sectors throughout the state in order to educate the industry on state of the art energy efficiency practices for building construction, rehab, operation, and maintenance. This program supports efforts such as the Illinois Energy Conservation Code for Commercial and Residential Building training, Illinois Home Performance with Energy Star(IHwES) training, Building Performance Institute (BPI) training and the Building Operator Certification (BOC) program.

Website: www.ilenergynow.org, www.ildceo.net/energycode
Contact: Bruce Selway, 217-785-2023, Bruce.Selway@illinois.gov

2. Smart Energy Design Assistance Center (SEDAC)

DCEO partners with SEDAC, housed within the University of Illinois School of Architecture, to provide technical assistance services to businesses, federal, state and local government, public schools, community colleges, public universities and colleges to assist clients who are considering energy efficiency improvements at existing facilities or to enhance baseline design of new facilities.

Website: www.SEDAC.org
Contact: Kristine Chalifoux, 217-244-1315, kmchalif@illinois.edu

3. Energy Performance Contracting Program

Energy Performance Contracting is an innovative arrangement for designing, installing and financing energy improvement projects where the savings achieved by the project are guaranteed to amortize the cost of the project over the term of the agreement.

Website: www.ilenergynow.org
Contact: Wayne Hartel, 217-785-3420, wayne.hartel@illinois.gov

Renewable Energy Programs

Illinois boasts significant potential for renewable power and heating: wind, solar and biogas offer both economic and environmental benefits. DCEO administers the Renewable Energy Resources Program (RERP) to foster investment in and the development and use of renewable energy resources within the state of Illinois. DCEO strongly believes that the facilitation of such investment in renewable energy projects in Illinois brings strong economic development benefits to the state: new income streams for farmers, new jobs, new investment, and new property tax revenues for local governments.

A. Solar and Wind Energy Rebate Program

The focus of the Solar and Wind Energy Rebate Program, through the State's Renewable Energy Resources Program, is to encourage utilization of smaller-scale solar and wind energy systems in Illinois. Eligible applicants include homeowners, businesses, public sector and non-profit entities that are customers of an electric or gas utility that impose the Renewable Energy Resources and Coal Technology Development Assistance Charge. Maximum rebates for all solar and wind energy projects are $10,000.00 for homeowners, $20,000 for businesses, and $30,000 for public sector and non-profit entities. Maximum percentage and per watt caps also apply. Please refer to the website for details.

Website:
http://www.illinois.gov/dceo/whyillinois/KeyIndustries/Energy/Pages/RenewableEnergy.aspx
Contact: Wayne Hartel, 217-785-3420, Wayne.Hartel@illinois.gov

B. Large Distributed Solar and Wind Grant Program

The focus of the Large Distributed Solar and Wind Grant Program is to support the development and implementation of larger-scale distributed solar thermal, solar photovoltaic, and wind energy systems in Illinois. Eligible applicants include businesses, public sector and non-profit entities that are customers of an electric or gas utility that impose the Renewable Energy Resources and Coal Technology Development Assistance Charge. The maximum grant amount allowed under this program is $250,000.

Website:
http://www.illinois.gov/dceo/whyillinois/KeyIndustries/Energy/Pages/RenewableEnergy.aspx
Contact: Wayne Hartel, 217-785-3420, Wayne.Hartel@illinois.gov

Recycling and Waste Reduction Programs

DCEO's Recycling programs support the very relevant public policy concern of sustainable economic development by effectively addressing environmental challenges and business competitiveness issues, while offering public economic benefits such as job creation.

DCEO's Division of Recycling and Waste Reduction provides technical assistance and access to capital for projects involving source reduction, waste reduction, recycling and reuse. DCEO's efforts help the Illinois recycling industry continue to expand, enhancing statewide economic growth while helping Illinois businesses; schools, local governments and not-for-profit organizations advance their waste reduction and recycling initiatives.

A. Illinois Recycling Grants Program (IRGP)

Through a competitive process, the IRGP concentrates on projects that develop or expand recycling collection and processing efforts in Illinois. A priority goal of the program is to reduce the amount of recyclable commodities entering the municipal solid waste stream while maximizing the economic benefits of recycling, including job creation. While most funding from this program has historically supported "traditional (fiber, plastic, metal, and glass) recycling" efforts such as curbside and drop-

off recycling, the program has the flexibility to also seek applications designed to target specific non-traditional recyclables. For example, over the past several years the program solicited and funded projects that capitalized on the economic benefits associated with the development of an infrastructure in Illinois to collect and process computer and other electronic discards.

Grants are available to assist local governments, for-profit, and not-for-profit businesses and organizations with their recycling efforts. Grant funds may be used to purchase project-related capital equipment such as collection, processing or handling equipment and project-related expansion and modernization costs.

Website: www.illinoisrecycles.com
Contact: David Ross, 217-782-7887, David.Ross@illinois.gov

B. Recycling Expansion and Modernization Program (REM)

The REM Program provides funding for projects that involve a) improving an organization's solid waste management practices through source reduction and waste reduction, including recycling and reuse activities; b) improving product packaging practices to reduce waste; and c) modernizing and expanding a business that manufactures recycled content products. While the REM Program regularly funds numerous successful projects, the demand for REM services continues to increase as Illinois organizations tout the benefits (both environmental and business performance) of improved waste management practices and increased recycling. REM grant funds (from $10K to $250K) can be used for capital equipment and/or consultant services.

Waste Management Modernization project grants provide funding for a business or organization that plans to improve its approach to solid waste management through modernization activities. Projects involve best practices in solid waste management including (a) source reduction activities that prevent the generation of solid waste, and (b) waste reduction activities that recycle or reuse industrial byproducts or other solid waste materials.

Market Expansion Modernization project grants provide funding to modernize key functions in a business or organization that manufactures recycled-content products or uses recyclable commodities in providing a service. The purpose is to increase the use of recyclable commodities, thereby expanding markets for these materials. Projects may also involve technical issues that are unique for companies planning to convert their operations to use recyclable commodities in manufacturing or service delivery.

Website: www.illinoisrecycles.com
Contact: Mike Motor, 217-524-5859, Michael.Motor@illinois.gov

C. Food Scrap Composing Revitalization & Advancement Program (F-SCRAP)

The DCEO commissioned report, Illinois Commodity/Waste Generation and Characterization Study (May 2009) revealed that food scraps are the single largest material category of municipal solid waste (MSW) landfilled in Illinois. In fact, food scraps, generated from such diverse sources as households, grocery stores, farmer's markets, restaurants, college dining facilities, and food packaging operations account for 12% of all MSW landfilled in Illinois. This fact, coupled with

Governor Quinn's recent signage of Public Act 96-418 that relaxes how food scrap composting facilities are regulated, are the genesis for this new program.

Composting has been shown to create up to 4 times as many jobs as landfilling the same amount of material and could help businesses and institutions reduce their waste disposal costs. This new initiative solicits projects that will advance Illinois' food scrap composting infrastructure. DCEO may award grants up to $125,000 to any one project and grant funds may be provided to support cost related to project necessary equipment and/or site improvements.

Website: www.illinoisrecycles.com
Contact: David E. Smith, 217-785-2006, David.E.Smith@illinois.gov

Alternative Transportation Programs

A. Alternate Fuel Research and Infrastructure Grant (AFRIG) Program

This grant program funds ethanol fuel research and alternate fueling infrastructure (for E85 blend, propane, at least 20% biodiesel blending fuel, and compressed natural gas) to promote the use of alternate fuel in vehicles as a means to improve air quality in the State and to meet the requirements of the federal Clean Air Act Amendments of 1990 and the federal Energy Policy Act of 1992. The minimum grant award is $25,000, and the maximum grant award is $350,000.

Website: www.illinoisenergy.org
Contact: Rajiv Narielwala, 217-785-2638, Rajiv.Narielwala@Illinois.gov

B. Electric Vehicle (EV) Infrastructure Rebate Program

The purpose of this rebate program is to encourage the installation and utilization of a network of electric vehicle charging stations throughout the state. Eligible applicants include units of government, businesses, educational institutions, non-profits, and individual residents. Rebates cover 50% of equipment and installation (materials and labor) costs up to certain maximum caps; please refer to the program website for details.

Website: www.illinoisenergy.org/ev
Contact: Kate Tomford, 312-814-1985, kate.tomford@illinois.gov

C. Electric Vehicle (EV) Industry and Infrastructure Development Grant Programs

These programs fund projects that support the production and deployment of electric vehicles and electric vehicle charging stations, or their components, such as batteries. Eligible expenditures include the purchase and installation of machinery, equipment and new industrial systems and/or the conversion and improvement of existing processes.

Website: www.illinoisenergy.org/ev
Contact: Kate Tomford, 312-814-1985, kate.tomford@illinois.gov

APPENDIX D

Case Studies

Nicor Gas – *Marianjoy Rehabilitation Hospital, Nation Pizza and Foods, Wheaton College, Adventist Hinsdale Hospital*

ComEd – *Adventist Hinsdale Hospital, Thorntons LED Lighting Project*

Johnson Controls – *University of Hawai'I Community Colleges, Middleton-Cross Plains Area School District*

Siemens – *Woodland Primary School, Adlai E. Stevenson High School*

TRANE – *Hopital Cite de la Sante, Gunderson Health System*

energySMART in your neighborhood

Stories from DuPage County businesses

Marianjoy Rehabilitation Hospital

Marianjoy Rehabilitation Hospital replaced an old, inefficient burner with a new high-efficiency model. Their efficiency upgrade resulted in 39,943 therms saved annually, and the hospital received an incentive of $39,943 from energySMART.

Nation Pizza and Foods

Nation Pizza and Foods implemented an energy efficiency overhaul when they installed boiler controls, pipe insulation and heat exchangers throughout their plant. They save 22,612 therms annually and received a $27,503 rebate check from energySMART.

Wheaton College

Wheaton College engaged energySMART when they replaced 20 failing steam traps and RTUs. They are saving 22,955 therms each year compared to their old system, and they received an $8,815 rebate to help offset the cost of the improvements.

Adventist Hinsdale Hospital

After replacing an old, inefficient burner with a new model, Adventist Hinsdale Hospital saved 60,682 therms annually. The hospital also received a $60,682 rebate check from energySMART for the upgrade.

Visit **nicorgasrebates.com** or call **877.886.4239** to learn more.

energySMART, a Nicor Gas program, is funded by Nicor Gas customers in compliance with Illinois law.
081814_energySMART-in-Dupage-County

Nicor Gas™
An AGL Resources Company

energySMART
A Nicor Gas™ program

energySMART in your neighborhood

Homeowners on their journey to energy efficiency

Armando Soto

After a professional contractor visited his home, Armando received some unexpected but valuable advice. His contractor recommended he replace both his air conditioner and his 22-year-old furnace to maximize the efficiency of the systems.

Last winter, Armando's natural gas bills averaged $150 to $170 a month. After installing the new furnace, Armando is saving an average of 33 percent.

Nara Bradshaw

Nara was looking for ways to reduce her family's energy use and have a positive impact on the environment. She received an energy-saving kit from energySMART, which included a kitchen faucet aerator, bathroom aerators, and a low-flow showerhead. After a quick 30-minute installation that they did themselves, Nara's family was on their way to conserving up to 40 percent of their water use for every shower her family takes, resulting in saving energy and money on heating water.

Shannon Stark

Shannon was worried. Her house was built in 1956 and was built for an oil furnace. Her natural-gas furnace was close to 20 years old and she knew that eventually it might break down.

Shannon learned about the offers available to Nicor Gas customers through energySMART and upgraded her furnace to a high-efficiency model. Shannon received a $300 rebate from energySMART and continues to save approximately $50 on her natural gas bill each year.

Visit **nicorgasrebates.com** or call **877.886.4239** to learn more.

energySMART, a Nicor Gas program, is funded by Nicor Gas customers in compliance with Illinois law.
081814_energySMART-in-Dupage-County

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energySMART
A Nicor Gas™ program

smart ideas®

THE POWER OF
ENERGY EFFICIENCY IN WAREHOUSES

Lighting accounts for 37 percent of electricity used in the average warehouse.

ENERGY MANAGEMENT IN WAREHOUSES AND DISTRIBUTION CENTERS

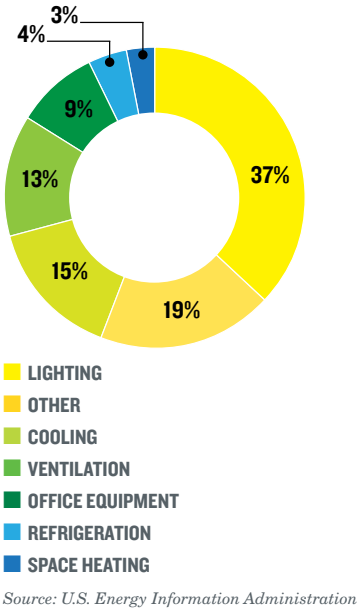
Savvy warehouse managers looking for ways to reduce energy use start with lighting. Increasing the efficiency of a lighting system is relatively simple and can reduce energy, maintenance and cooling costs while enhancing the quality of light in the space. Replacing high-intensity discharge lighting with a linear fluorescent high-bay or LED system can cut energy use by as much as 40 percent while delivering even illumination and nearly doubling the amount of light on vertical surfaces.

Whatever strategy you choose to reduce energy use in your warehouse, ComEd's *Smart Ideas for Your Business*® program offers **cash incentives** and **free technical assistance** to help you get started.

SMART IDEAS® FOR REDUCING ENERGY USE

Smart Ideas for Your Business offers cash incentives, technical services and whole-building solutions to help warehouses, distribution centers and other businesses use energy more efficiently. *Smart Ideas* cash incentives reduce the cost of an energy-efficiency project by about 20 percent, on average. When projected energy savings are added to the payback calculation, an impossible project can become possible.

ELECTRICITY CONSUMPTION BY END USE—WAREHOUSES



Source: U.S. Energy Information Administration

INDOOR AND OUTDOOR LIGHTING INCENTIVES

- T8 and T5 fluorescent lamps and fixtures
- LED lamps, fixtures and signage
- LED trim kits
- Pulse-start and ceramic metal halide fixtures
- CFL lamps and fixtures
- Bi-level stairwell/hall/garage fixtures
- Occupancy sensors
- Daylighting controls
- Time clocks
- Lighting control systems

HVAC INCENTIVES

- Building energy management system
- Demand controlled ventilation (interior and parking garage)
- Air-side economizer
- ECM on fan-powered box
- Cogged V-belts for HVAC fans
- Restroom exhaust fan occupancy sensors
- Wireless DDC thermostat
- VSD on HVAC chiller, fan or pump
- Chilled water reset controls on chillers

SMART IDEAS OPPORTUNITY ASSESSMENT

- A free, on-site facility assessment conducted by a ComEd engineer to identify energy-efficient opportunities eligible for *Smart Ideas* incentives

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REFRIGERATION INCENTIVES

» EC motor for walk-in cooler or freezer

» EC motor with evaporator fan controls for walk-in cooler or freezer

» Evaporator fan controls on EC motor

» Evaporator fan controls on shaded-pole motor

» Demand defrost controls on walk-in coolers and freezers

» Efficient refrigeration condensers

» Floating head pressure controls

» Snack machine controls

RETRO-COMMISSIONING INCENTIVES

» Expert analysis of building systems that identifies no-cost and low-cost operational improvements to optimize electricity and gas usage

BATTERY CHARGER INCENTIVES

» New or replacement 3-phase, high-frequency battery chargers for electric vehicles

PROJECT SNAPSHOT
→ HOLLANDER INTERNATIONAL STORAGE AND MOVING COMPANY

MEASURES IMPLEMENTED
→ LED, T8 and T5 fixtures; exit signs

TOTAL PROJECT COST
→ $42,940

ESTIMATED ANNUAL ENERGY SAVINGS
→ 196,982 kWh

ESTIMATED ANNUAL COST SAVINGS
→ $14,774*

SMART IDEAS INCENTIVE RECEIVED
→ $14,190

ESTIMATED PAYBACK PERIOD WITHOUT SMART IDEAS INCENTIVE
→ 2.9 years

ESTIMATED PAYBACK PERIOD WITH SMART IDEAS INCENTIVE
→ 1.9 years

PROJECT SNAPSHOT
→ COMBINED WAREHOUSE

MEASURES IMPLEMENTED
→ T8 fixtures, occupancy sensors

MEASURES IMPLEMENTED
→ $45,383

ESTIMATED ANNUAL ENERGY SAVINGS
→ 322,739 kWh

ESTIMATED ANNUAL COST SAVINGS
→ $24,205*

SMART IDEAS INCENTIVE RECEIVED
→ $$22,691

ESTIMATED PAYBACK PERIOD WITHOUT SMART IDEAS INCENTIVE
→ 1.9 years

ESTIMATED PAYBACK PERIOD WITH SMART IDEAS INCENTIVE
→ 0.9 years

FOR MORE INFORMATION

For more information about *Smart Ideas* incentives, visit **ComEd.com/BizIncentives**, call **855-433-2700** during normal business hours to speak with a *Smart Ideas* service representative or email us at **SmartIdeasBiz@ComEd.com**.

*Estimated annual cost savings are based on an electricity rate of 7.5 cents per kWh.

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THE POWER OF
ENERGY EFFICIENCY IN HEAVY INDUSTRY

Resource-intensive manufacturers are applying lean management intelligence in new ways to reduce the amount of energy used in production and increase resource productivity.

ENERGY MANAGEMENT IN HEAVY INDUSTRY

Lean manufacturing principles help manufacturers reduce waste by eliminating inefficiencies and activities that do not provide value to customers. Leading companies, especially manufacturers with energy costs that represent a significant share of total production costs, are applying lean thinking to energy usage to help reduce their energy bills by as much as 30 percent.

SMART IDEAS FOR REDUCING ENERGY USE

ComEd Smart Ideas for Your Business® offers cash incentives, technical services and whole-building solutions to help businesses use energy more efficiently.

ComEd Smart Ideas® cash incentives reduce the cost of an energy-efficiency project by about 20 percent, on average, and can cover as much as 100 percent of the project cost. The incentives and services listed below are especially suited for heavy industrial businesses.

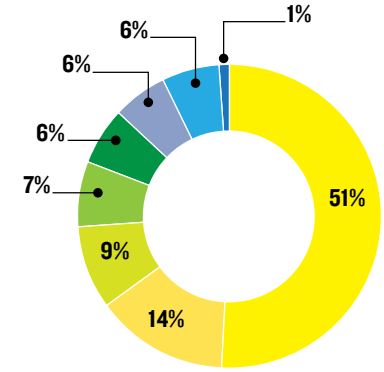
INDOOR AND OUTDOOR LIGHTING INCENTIVES

- » T8 and T5 fluorescent lamps and fixtures
- » LED lamps, fixtures and signage
- » Pulse start metal halide fixtures
- » Induction fixtures
- » CFL lamps and fixtures
- » Bi-level stairwell/hall/garage fixtures
- » Sensor-controlled wall pack fixtures
- » Occupancy sensors
- » Vacancy sensors
- » Daylighting controls
- » Photocells
- » Time clocks
- » Lighting control systems

HVAC INCENTIVES

- » Building energy management system
- » Demand controlled ventilation (interior and parking garage)
- » Demand controlled ventilation (kitchen exhaust hoods)
- » Air-side economizer
- » ECM on fan-powered box
- » Restroom exhaust fan occupancy sensors
- » Wireless DDC thermostat
- » Water- and air-cooled chillers
- » VSD on HVAC chiller, fan or pump
- » VSD on industrial process fan or pump
- » Chilled water reset controls
- » High-efficiency water pumps and retrofits

ENERGY CONSUMPTION BY END USE—HEAVY INDUSTRIAL



Source: U.S. Energy Information Administration

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COMPREHENSIVE INDUSTRIAL SYSTEMS STUDIES

» System assessments and financial incentives to reduce electricity used by compressed air, industrial refrigeration, and process cooling systems

COMPRESSED AIR INCENTIVES

» High-efficiency air nozzles
» Low-pressure drop filters
» No-loss condensate drains
» Refrigerated cycling dryer
» VSD on air compressor
» New air compressor with integrated VSD

SMART IDEAS OPPORTUNITY ASSESSMENT

» An on-site facility assessment conducted by a ComEd engineer to identify energy-efficiency opportunities eligible for ComEd Smart Ideas incentives

NEW CONSTRUCTION SERVICE

» Cash incentives and technical assistance, such as energy modeling, to support architects and engineers in designing high-performance buildings

DATA CENTER INCENTIVES

» Technical assistance and cash incentives for installing energy efficient equipment and systems in new or existing data centers

CUSTOM INCENTIVES

» Cash incentives for complex energy-efficiency projects, such as industrial process or system improvements

PROJECT SNAPSHOT
→ STERLING STEEL

MEASURES IMPLEMENTED
→ Replaced MG sets with DC power supplies

TOTAL PROJECT COST
→ $949,069

ESTIMATED ANNUAL ENERGY SAVINGS
→ 3,712,117 kWh

ESTIMATED ANNUAL COST SAVINGS
→ $278,409*

SMART IDEAS INCENTIVE RECEIVED
→ $259,848

ESTIMATED PAYBACK PERIOD WITHOUT SMART IDEAS INCENTIVE
→ 3.4 years

ESTIMATED PAYBACK PERIOD WITH SMART IDEAS INCENTIVE
→ 2.5 years

PROJECT SNAPSHOT
→ INGREDION

MEASURES IMPLEMENTED
→ Optimized chiller plant sequence, replaced two chilled water pumps, piping changes

TOTAL PROJECT COST
→ $159,568

ESTIMATED ANNUAL ENERGY SAVINGS
→ 1,169,301 kWh

ESTIMATED ANNUAL COST SAVINGS
→ $87,698*

SMART IDEAS INCENTIVE RECEIVED
→ $81,851

ESTIMATED PAYBACK PERIOD WITHOUT SMART IDEAS INCENTIVE
→ 1.8 years

ESTIMATED PAYBACK PERIOD WITH SMART IDEAS INCENTIVE
→ 0.9 years

FOR MORE INFORMATION

For more information about ComEd Smart Ideas incentives, visit **ComEd.com/BizIncentives**, call **855-433-2700** during normal business hours to speak with a ComEd Smart Ideas service representative or email us at **SmartIdeasBiz@ComEd.com**.

*Estimated annual cost savings are based on an electricity rate of 7.5 cents per kWh.

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THORNTONS
LED LIGHTING PROJECT

PROJECT SNAPSHOT	
Customer	**Thorntons, Inc. Various locations, Illinois**
Measures implemented	**LED lighting**
Total project cost	**$82,144**
Estimated annual energy savings	**224,168 kWh**
Estimated annual cost savings	**$22,417**
Smart Ideas incentives received	**$16,085**
Estimated payback period without *Smart Ideas* incentive	**3.7 years**
Estimated payback period with *Smart Ideas* incentive	**3 years**

PROJECT SUMMARY

When you pulled into the first Thorntons gas station back in 1971, a full-service attendant greeted you with a cheerful, "Fill 'er up?" Today, Thorntons Inc. is one of the leading independent gasoline and convenience chain retailers in the U.S., with more than $1.4 billion in annual revenue.

Thorntons operates 165 gasoline and convenience stores, car washes and travel plazas in five states in the Midwest. Customers fuel up, then grab a sandwich or stock up on groceries. The gas station attendant from the seventies probably never dreamed of Facebook pages or gasoline price alerts via mobile phone apps. But while the medium has changed, Thorntons' message is the same: fast, friendly service at a community-oriented company.

At Thorntons, there are free hot chocolate Saturdays, National Hot Dog Day celebrations and a team that delivers sandwiches and drinks to Red Cross emergency workers cleaning up after deadly storms.

There's also the Thorntons' Green Promise, the company's environmental program. Thorntons uses eco-friendly cleaning products inside and outside its stores and separates trash with recycling dumpsters. The company "thinks green" by choosing ENERGY STAR® appliances and using natural light when possible in its stores to save on electricity.

LED lighting plays a major role in the Green Promise plan. LEDs are used in all new Thorntons stores and older stores are being retrofitted. Highly efficient light-emitting diode (LED) lighting has unique characteristics that make it a good choice for Thorntons' properties:

- LEDs are breakage resistant
- LEDs operate well in cold weather
- Turning LEDs on and off frequently will not shorten their service life
- LEDs can help reduce energy and maintenance costs

"It makes the best sense in the world," said Brian Argabright, CPA, manager financial reporting, at Thorntons Inc. "With LEDs, there are energy savings and other benefits, like a lot of maintenance savings."

Thorntons started testing LEDs at its Cincinnati stores and then moved on to Illinois. The Chicago area is the third market to get the new lighting. "We're halfway done on the older stores, with 50 to go," said Argabright. "Our goal is to finish all the LED retrofit projects by September 30."

THE SOLUTION

Working with the *Smart Ideas for Your Business*® program, Thorntons had finished installing energy-efficient LED outdoor lighting at three typical properties in the Chicago area at the time of this case study. A combination of custom and standard incentives provided more than $16,000 to help pay for the updates.

Outdoor lighting must provide safety and security for customers. At a high-traffic business like Thorntons, the fixtures must also be rugged. The LED perimeter lamps, wall packs and fuel pump canopy lighting that Thorntons chose met those requirements nicely.

Out went the old high-intensity discharge metal halide lamps (HIDs); in came new LEDs. The new fixture heads for the LED perimeter lighting were able to make use of existing poles, while the old wall packs were completely removed and replaced with new LED wall packs to light staff entrances and restrooms.

The new LED fuel pump canopy lights are directional fixtures that can be focused right on the fuel pumps. "The LEDs are a lot brighter and give off a stronger light and they fit well under the canopy," said Argabright. Energy savings with the new LEDs are so dramatic that payback for the three stores described above is calculated at just under three years. When all LED updates are combined for the three projects, energy savings are estimated to be more than 200,000 kWh annually.

"When we first started testing LEDs, they were really expensive and not cost-effective for retrofit projects," said Argabright. "But the price tag has slowly dropped, and with incentives, the return on investment is down to less than three years."

PROJECT BENEFITS

Now that the old fixtures have been replaced, the new look at Thorntons is attractive and modern. LEDs have also helped Thorntons cut down on light pollution. The old metal halide lamps scattered light outward and upward instead of focusing it down, like the new lamps do. "LEDs put out zero light pollution," said Argabright. "If you look above the store, you can see the stars."

The *Smart Ideas for Your Business* team streamlined the application and payment process for Thorntons, which Argabright said made it easier for him to keep track and saved him time.

"I thought this would be a painstaking process, filling out applications, but I didn't have to spend hours and hours," he said. The incentives were paid in a timely fashion, which Argabright appreciated. "The *Smart Ideas* team did a fabulous job. We're ready to move on to the next store."

> *With LEDs, there are energy savings and other benefits, like a lot of maintenance savings.*
>
> - Brian Argabright, CPA, manager financial reporting

NOT SURE WHERE TO START?

Ask for a FREE *Smart Ideas* Opportunity Assessment. A *Smart Ideas* Opportunity Assessment identifies energy-efficiency projects at your facility that may qualify for *Smart Ideas* incentives. A ComEd energy engineer will spend approximately two hours onsite to identify energy-efficiency opportunities. Within two weeks, you will receive a letter detailing recommended energy-efficiency projects, with estimated energy savings, estimated cost savings, project costs, potential incentives and simple payback for each one. A *Smart Ideas* outreach account manager will follow up with a consultation to discuss your options and answer your questions.

To schedule a *Smart Ideas* Opportunity Assessment, call *Smart Ideas* at **(888) 806-2273** or email **SmartIdeasBiz@ComEd.com**.

ABOUT COMED'S SMART IDEAS FOR YOUR BUSINESS PROGRAM

Smart Ideas for Your Business offers cash incentives, technical services and whole-building solutions to help businesses use energy more efficiently. For more information, visit **www.ComEd.com/BizIncentives**, call **(888) 806-2273** during normal business hours to speak with a *Smart Ideas* representative or email us at **SmartIdeasBiz@ComEd.com**.

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Case study

University of Hawai'i Community Colleges

Hawai'i

$80 million in energy costs to be saved while enhancing education programs

The challenge: Investing in quality education in the face of America's highest energy costs

The University of Hawai'i Community Colleges have grown from a few technical schools in 1964 to today's seven-campus system which provides quality education to more than 34,000 students, 94 percent of whom are from Hawai'i. Their challenge is that Hawai'i's energy costs are among the highest in America. Every dollar spent on utility costs is a dollar that can't go to educational programs. Johnson Controls is working with the colleges to significantly reduce their energy costs and develop sustainability education programs for students, faculty and local communities.

The solution: A 20-year performance contract to improve energy efficiency at campuses and save $80 million in the process

Johnson Controls began working with the University of Hawai'i Community Colleges in 2010 to improve energy efficiency of their facilities. The improvements are projected to deliver $80 million in energy savings over a 20 year period. The results, which Johnson Controls guarantees, will offset the cost of the improvements and enable the colleges to continue investing in their educational programs.

Johnson Controls

At a Glance:

University of Hawai'i Community Colleges

$80 million

- Projected energy cost savings resulting from facility and equipment improvements over the 20-year performance contract with Johnson Controls.

Five (5)

- Campuses in Hawai'i's seven-campus community college system whose classrooms, labs and other facilities are being made more comfortable, efficient, and sustainable including Honolulu Community College, Kapi'olani Community College, Leeward Community College, Windward Community College, and UH Maui College.

28,500

- Students who enjoy the improved learning environments at these five campuses and have the opportunity to learn about energy efficiency and sustainability to prepare for green jobs of the future.

5,200

- Metric tons of carbon emissions reduced through project, complementing Hawai'i's respect for the land.

The improvements include:

- High efficiency lighting
- Upgrading heating, ventilation and air conditioning systems
- Upgrading central plants at Maui College and Leeward Community College
- Expanded chilled water system
- Metasys® building management system to monitor and optimize equipment and system performance throughout the campuses
- Renewable energy sources such as solar photovoltaic arrays and solar hot water systems

By increasing energy efficiency and reducing fossil fuel consumption, these improvements make the campuses more sustainable and eco-friendly. That is particularly important to Hawaiians, whose culture fosters such a deep respect for the land that they bless it before any building construction can commence.

Educational support

Johnson Controls supports the University of Hawai'i Community Colleges' sustainability education efforts by developing learning modules that are integrated into their curriculum. Local experts speak on energy efficiency and conservation as part of a fellows program. Plus, the facility improvements provide students with a campus living lab that demonstrates how technologies reduce energy consumption. These educational resources raise knowledge and awareness among students, faculty and facility managers with regard to sustainability and also help prepare students who are interested in pursuing green jobs.

Results and Benefits

The five campuses across the University of Hawai'i Community Colleges are expected to save $80 million over 20 years. The results generated by these projects are guaranteed by Johnson Controls under the terms of the contract. Student and faculty are enjoying more comfortable learning environments, while the university system is able to direct more of their financial resources towards quality education.

Johnson Controls

Case study

Middleton-Cross Plains Area School District

Middleton, Wisconsin

School district and community optimize energy savings

Progressive school districts throughout the country are taking steps to review operational practices and develop energy efficiency programs. In south-central Wisconsin, the Middleton-Cross Plains Area School District (MCPASD) is building on its efficiencies and working with Johnson Controls to develop innovative approaches that are resulting in an estimated $2.6 million in savings. A similar energy efficiency project with the city is providing additional benefits. Together, these projects demonstrate the community-wide commitment Middleton has made to taxpayer accountability and sustainability.

"Best Place to Live" finds growth challenging

Located close to the Wisconsin state capitol in Madison, Middleton is highly ranked in CNN/*Money Magazine's* "Best Place to Live" for cities with populations of 50,000 and under.

The city's 17,400 residents enjoy low unemployment, many cultural and recreational attractions, a charming downtown, and many other amenities. As more people choose to live in this friendly Midwestern municipality, city and school district leaders are striving to keep pace with the growth while keeping an eye on environmental impact.

Audit uncovers district savings

MCPASD has spent years working to keep its facilities operating efficiently, led by Tom Wohlleber, assistant superintendent of business services for MCPASD, Bill Eberhardt, director of buildings and grounds, and Neal Bickler, energy manager.

Johnson Controls

An ultra-high efficiency heating and cooling system is installed at the school district administration center.

"The innovation is significant for this forward-thinking community, but saving money is even more important. It's vital that we show fiscal responsibility to local taxpayers so they know every penny is well-spent."

Tom Wohlleber, assistant superintendent of business services for MCPASD

With 6,000 students in 10 school buildings, including eight facilities that are at or over capacity, it's been a challenge. A number of aging facilities also needed extensive capital maintenance for which funds are limited. The district had just completed a four-year upgrade that provided $2.5 million in cost avoidance through new lights and boilers when Johnson Controls offered to perform an energy audit.

"When Johnson Controls came in and said they could find even more savings for us, I didn't think they could come up with much," says Wohlleber. "I'm impressed and pleased with the breadth of ideas they developed."

Johnson Controls completed a preliminary audit of 12 buildings, including administrative and operational facilities, two high schools, two middle schools, and six elementary schools. Together with the district, they developed a comprehensive, $2.6 million plan including:

- Replacing interior lighting with T8 and T5.
- Replacing exterior HPS lighting with CFLs.
- Installing LED parking lot lights.
- Removing lights from some hallways.
- Replacing inefficient boilers, including one 1937 unit, at three schools.
- Providing a new heat pump system at the district office.
- Developing a solar thermal system for a high school pool.
- Installing solar thermal for domestic hot water at two schools.
- Supplying low flow water faucets and toilets.

Performance contract pays

The project is utilizing a program that offsets the costs of improvements for the upgrades through the resulting savings. It's called performance contracting, and it allows money that would otherwise go to pay utility bills to be re-directed back into funding the project. Johnson Controls worked with district leaders to secure $2 million in Build America Bonds, $500,000 in Qualified School Construction Bonds and $200,000 in rebates from Wisconsin Focus on Energy.

"By bundling the entire project, we were able to include loose ends that hadn't been addressed in earlier upgrades," says Wohlleber.

The expected savings during the 14-year contract include about $180,000 each year in reduced electricity, natural gas and water and sewer bills; improved operational efficiencies; and avoided capital expenditures. District leaders are pleased with the process.

"Johnson Controls was an incredible partner with our school district. They provided a wide range of alternatives to improve our facilities and systems. Included in this analysis was an evaluation of costs, return on investment, opportunities for federal or state support through matching funds/grants, and an on-going willingness to re-evaluate," says Don Johnson, Middleton school superintendent.

"They met promised timelines, responded to necessary changes, and followed up to fine tune the systems that were installed to increase efficiencies. They also provided clear and concise data regarding cost savings and system performance after the projects were completed," he says.

Triple-Bottom-Line benefits

In addition to the dollar savings, the project brought environmental and social advantages to the community. The district's annual carbon footprint is expected to be reduced by over 1.5 million pounds of CO_2 during the next 14 years.

The project also brought about 60 jobs to the community during the construction period. Since Johnson Controls provides education and training on energy efficiency and renewable energy to its contractors, if they're not already experienced, those local businesses are now ready to install green technologies for other clients.

MCPASD 's environmental performance is recognized through the federal government's ENERGY STAR® program. All school buildings have been benchmarked, and several have received the prestigious ENERGY STAR label, indicating they are in the top 25 percent of all similar buildings in the country.

City sustainability

When city leaders learned about the school district's success, they also met with Johnson Controls to determine how to expand the project to municipal efforts.

"Our common goal is to develop and implement an efficiency and sustainability program that is practical, transparent and meaningful, that maximizes cost-effectiveness and available grants, and provides an educational experience that extends to the entire community," according to the project mission statement.

Through another performance contract that utilized available state and federal funds, the City of Middleton developed an energy savings project that included several hundred efficient LED street and parking lot lights, more efficient lighting at the public library and variable frequency drives (VFDs) on municipal water pumps – again, paid back through the savings.

"Middleton prides itself on being a sustainable community, and energy conservation is one of the most important components of sustainability," says Mike Davis, City Administrator.

School superintendent Johnson agrees, saying, "We are establishing a long-range strategy to maximize dollars for student learning in comfortable, safe, quality facilities. Energy conservation, we believe, is a strategy that everyone in the community recognizes as a prudent measure to take. We will continue to monitor new technologies, strategies, and changing market conditions that might allow for more innovation to conserve."

All-America city finalist

The project helps the city meet the goals set out in its Sustainable City Plan, which was clearly noted in its recognition as a 2010 finalist in the National Civic League's All America City Awards for outstanding civic accomplishments.

"Johnson Controls has been an effective partner in energy-saving solutions with the City of Middleton. Jeff Mangan joined our All-America finalist trip to Kansas City to present for national honors, and he and other Johnson Controls employees

"The extraordinary energy savings projected for the utility's VFD are probably the most noteworthy improvement, but my favorite is the new LED lights in our decorative fixtures for our historic Downtown."

Mike Davis, Middleton City Administrator

"Although many organizations and businesses may think that they can act on any conservation projects on their own, I recognize that without the expertise that Johnson Controls brings to the table, we would be spending hundreds of thousands of dollars unnecessarily. This project was clearly a "no-brainer" for the district. Clearly it was a win-win!"

Don Johnson, Middleton School Superintendent

worked with us to advise and guide our successful implementation of a program that will save energy and taxpayer dollars," Davis says.

On to more savings

After the contract expires, the city and school district will continue to accrue the benefits through the new and efficient equipment. MCPASD is considering geothermal heat pumps at several schools, converting remaining pneumatics to DDC controls, converting low-efficiency exterior lighting, and replacing some windows and roofs.

"The innovation is significant for this forward-thinking community, but saving money is even more important. It's vital that we show fiscal responsibility to local taxpayers so they know every penny is well-spent," says Wohlleber.

Woodland Primary School – Building a Sustainable Future

What is LEED?

LEED™ – Leadership in Energy & Environmental Design – is the most recognized green building rating system in the marketplace today. Developed by the United States Green Building Council (USGBC), LEED provides building owners and managers with a framework for identifying and implementing practical and measurable green building strategies, from design and construction through the ongoing operations and maintenance of given facilities. LEED for Existing Buildings: Operations & Maintenance certification ensures that the facility adheres to a set of rigorous green building policies and practices, ranging from energy and water conservation to optimal indoor environmental quality and waste reduction.

Woodland Primary School is one of only a handful of LEED EB: O&M certified public elementary schools in the country and the **1st** in the state of Illinois to receive Silver Certification.

LEARNING...TO FIND SOLUTIONS
Woodland District 50

U.S. GREEN BUILDING COUNCIL
USGBC

SIEMENS

Green Building Facts

Why is LEED important?

LEED is a globally recognized symbol of green building excellence. It provides independent, third party verification through technical experts that ensure building certification meets the highest levels of quality and integrity and improves human and environmental heath.

How is LEED for Existing Buildings: Operations & Maintenance Certification achieved?

The LEED rating system consists of seven credit categories that address the entire spectrum of green building performance and operations. These include Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Innovation in Operations, and Regional Priority.

For the certification process, Siemens and Woodland worked hand in hand to document the impact of efficiency improvements and identify additional sustainability measures that would help achieve LEED certification. The final application and supporting information were submitted to the USGBC for final review and approval.

How did Woodland Primary School obtain this level of success?

Prior to applying for LEED certification, a variety of facility and energy efficiency improvements were completed at Woodland Primary to increase overall building performance. These projects were implemented in multiple phases as part of a 13-year partnership with Siemens. "By taking a proactive approach to aging assets and equipment, we've been able to increase efficiency and reduce electric, gas and water usage in a facility that is nearly 60 years old," says Associate Superintendent of Finance and Operations, Bob Leonard.

In addition, Woodland's facilities staff has adopted a range of green and sustainable policies in recent years, including waste management, procurement and cleaning. "It's a matter of documentation and having an overall awareness of how your buildings are operating" says Director of Operations & Facilities, Don Selzer. "The stamp of approval by the USGBC isn't about a plaque on the wall – it's a validation of achieving the highest level of building performance."

What are the benefits for Woodland Primary School?

Through the process of becoming LEED certified, Woodland Primary School has improved the indoor environment quality for students and faculty, aided the conservation of water and other natural resources, and increased the energy efficiency of its operations. District 50's Operations & Facilities team along with the leadership team at Woodland Primary School have already seen a quick return on investment. "Our electric usage has decreased by 10% or 88,000 kWh and natural gas by 15% or 9,300 therms respectively," adds Leonard. "To put that in perspective, it is the equivalent of operating 817 flat screen TVs, 4,343 laptop computers, or eliminating the average electricity used by 32 homes in an entire year."

Greening schools, decreased energy consumption, lower operating costs and a greater carbon footprint is the truest model of sustainability. The environmental benefits are somewhat staggering considering a 25% drop in electricity and natural gas usage will avoid sending 48.6 tons of waste to the landfill. "As stewards of the community, we have a social responsibility to do the right things for our entire community and the environment," states Superintendent, Dr. Joy Swoboda.

As District 50 teaches its youngest students about respect for the environment, the school building itself becomes a learning tool for this important lesson. Swoboda adds, "By adopting green building strategies and procedures, it is our hope that our accomplishments at Primary school will serve as a blueprint for not only our district but for our neighboring schools in and around Lake County."

LEED Profile

Facility:
Woodland Primary School

Classification:
LEED Existing Buildings: Operations & Maintenance

Certification Level:
Silver (51 points achieved)

Certification Date:
September 2013

SIEMENS

Adlai E. Stevenson High School

Siemens helps Illinois school become the first high school in the country to achieve LEED-EB Gold Certification.

Answers for infrastructure.

Facility improvements generate $100,000 in annual energy savings.

"Earning LEED Gold status is a validation of our 'Green Initiative' to reduce the school's carbon footprint, and an achievement we all share, including the faculty, staff, and especially the students."

Mark Michelini
Adlai E. Stevenson High School
Assistant Superintendent
for Business

Located in the northern suburbs of Chicago, Illinois, Adlai E. Stevenson High School is home to some 4,600 students, faculty, and staff. Since opening its doors in 1965, Stevenson High School has become one of the leading high schools in America, and has received the President's Award for Excellence in Education five times. Stevenson's 76-acre campus encompasses more than 1 million square feet of state-of-the-art facilities.

Client Objectives

In 2007, Adlai E. Stevenson High School in Lincolnshire, Illinois, set a goal to achieve the U.S. Green Building Council's LEED Certification. Looking to focus their efforts on becoming a green, energy-efficient, and sustainable school, Stevenson sought help from Siemens Building Technologies, including assistance with reducing natural gas and carbon usage, and energy efficiency.

Siemens Solution

Through a full assessment and comprehensive understanding of the technical and operational aspects of the campus' building automation, HVAC, lighting, and other systems, Siemens was able to help the Stevenson Green Initiative Committee develop a broad operational plan to systematically reduce electricity and natural gas usage after hours.

Among key deliverables, Siemens provided full transparency of CO_2, energy consumption, and pricing through the company's Energy Monitoring and Control (EMC) platform. Highly skilled energy technicians also delivered an existing building continuous commissioning program through on-going monthly energy analysis. Siemens also installed an interactive touch screen that displays energy consumption data from the Siemens APOGEE® building automation system.

The U. S. Green Building Council presents Adlai E. Stevenson High School with their LEED Gold Certification plaque.

Left to right:
Doug Widener – U.S. Green Building Council IL President, Merv Roberts – Stevenson High School Board, Lori Lyman – Stevenson High School Board, Mark Michelini – Stevenson High School Assistant Superintendent of Business, Bob Dold – Illinois Congressman, Dave Wilms - Stevenson High School Sustainability Coordinator

To promote a green lifestyle in all areas of their lives, Siemens also worked to provide opportunities for Stevenson students to integrate sustainability into their classroom curriculum. This included a web-based energy dashboard and assistance in the development of the net zero environmental science lab by coordinating the effort to connect and monitor the solar photovoltaic and thermal energy sources, as well as the green roof.

Client Results

With the help of the Siemens Building Technologies Division, Stevenson recently achieved their goal by becoming the first high school in America to be certified LEED Gold for Existing Buildings (EB).

"In collaboration with Siemens and support from partners Cannon Design and Sodexo, our facilities team created a master plan to address campus energy and resource consumption," said Adlai E. Stevenson High School Assistant Superintendent for Business, Mark Michelini, who coordinated the effort. "We've met and exceeded those targets and the result is our LEED certification - a national benchmark and an achievement we all share."

As a result, Stevenson was able to achieve its first set of energy consumption reduction targets set forth in its sustainability mission statement: 7% lower electricity use and 5% less natural gas consumption. According to Stevenson officials, those measures have saved the school over $100,000 annually. The energy reduction targets were also seen in a 9 point increase in Stevenson's ENERGY STAR® score after Siemens' work with the school.

Since obtaining LEED Gold Certification, Siemens has continued to provide ongoing maintenance and operational efficiencies to uphold Stevenson's current certification and ensure they will qualify for recertification in five years. This includes maintaining the school's score and providing quarterly updates to ENERGY STAR; ongoing energy optimization; and implementation of Stevenson's Building Operating Plan and Preventative Maintenance, which was documented for initial certification.

In addition, Siemens recently began a Performance Contracting project which includes a handful of energy-saving measures. Siemens also implemented improvement measures identified during the Smart Energy Design Assistance Center (SEDAC) energy assessment process and completion of switchgear breaker testing and troubleshooting through the Siemens electrical services offering.

Siemens regularly participates in sharing information on career opportunities in the Science, Technology, Engineering, and Mathematics (STEM) professions and supports the District's Green Committee by participating and sponsoring both faculty and student sustainability events. This is particularly important to the student body, as many of them have become very aware of the importance of becoming green and sustainable in their own lives. Because of this, Stevenson students played a big role in the LEED process, including managing the transportation and occupant surveys, and assisting with water conservation calculations. Students have continued to provide their time and efforts to keeping Stevenson sustainable.

Siemens Industry, Inc.
Infrastructure & Cities Sector
Building Technologies Division
1000 Deerfield Parkway
Buffalo Grove, IL 60089
Tel: (847) 215-1000
Fax: (847) 215-1093

Answers for infrastructure.

Our world is undergoing changes that force us to think in new ways: demographic change, urbanization, global warming, and resource shortages. Maximum efficiency has top priority – and not only where energy is concerned. In addition, we need to increase comfort for the well-being of users. Also, our need for safety and security is constantly growing. For our customers, success is defined by how well they manage these challenges. Siemens has the answers.

"We are the preferred partner for energy-efficient, safe, and secure buildings and infrastructure."

www.siemens.com/buildingtechnologies

October 2012

Spectrum Health

Trane high performance solutions for better healthcare • Grand Rapids, Michigan

Spectrum Health is the largest not-for-profit health care system in West Michigan with nine hospitals, more than 180 service sites and 1,983 licensed beds system-wide. As the region's leading health care system, Spectrum Health touches thousands of lives each year and continues to grow and build on its strengths by renovating existing facilities and opening new ones, including a state-of-the-art cancer pavilion and a new children's hospital; bringing leading-edge technology and medical treatments to the region; and supporting exciting new initiatives for medical education and research. In addition, Spectrum Health was named a Top 10 Health System in the U.S. by Thomson Reuters.

One of Spectrum Health's nine hospitals, Helen DeVos Children's Hospital has achieved LEED Gold certification.

Challenge

Spectrum Health's vision is to be the national leader for health by 2020. With this vision comes responsibility, not only for the health of their patients, but also for the health of the environments they impact. Their mission, therefore, includes a commitment to sustainability, which refers to meeting present needs without compromising the ability of future generations to meet their needs. To sustainably provide the kinds of buildings and facilities needed to efficiently and economically deliver the best in healthcare and patient outcomes, Spectrum Health required a building systems partner with solid experience in providing systems expertise, high-efficiency and reliable equipment, controls, service and parts to the health care industry.

Solutions and results

Trane has earned Spectrum's trust through many years of providing high-performance equipment and outstanding service. After Trane became an awarded supplier of Novation, the leading health care supply contracting company for the members of VHA Inc., UHC and Provista LLC, Trane and VHA-member Spectrum Health signed a formal business relationship agreement. Its full offering, long list of health care references and status as a Novation-awarded supplier made Trane an ideal partner.

Optimized for energy efficiency, a centrifugal chiller replaced the Butterworth absorption chiller.

Trane has provided systems and services for numerous Spectrum Health projects, including:

Butterworth Hospital Chiller Plant

In-depth analysis by Trane engineers identified a chiller plant and controls upgrade that is providing Spectrum Health $127,000 in annual energy savings. The upgrade included modifications to two existing chillers to increase efficiency, installation of variable speed drives on existing chilled water pump and cooling tower fan motors, and installation of a Trane chiller plant sequencing and control system to coordinate and optimize the operation of multiple chillers throughout the facility.

Butterworth Hospital Energy Center

Spectrum Health decided to significantly reconfigure the infrastructure in the energy center. Once again, Spectrum maintained a focus on increased energy efficiency and reduced operating cost. The project included an extension of the Trane Tracer Summit® building automation system (BAS) and installation of a new high-efficiency Trane CenTraVac® centrifugal chiller. The new chiller was optimized to take advantage of an existing cooling tower to provide exceptional energy efficiency, and qualified for over $50,000 in utility rebates. Trane also provided a 1,000-ton rental chiller for backup purposes during construction. Energy savings from all of the upgrades are estimated to be $300,000 per year.

Butterworth Hospital Absorber

As part of a previous project, Spectrum Health had eliminated a cogeneration turbine that provided low-cost steam to an absorption chiller. Consequently, operation of this chiller was no longer cost effective. Spectrum selected Trane to provide a complete turnkey project to replace the existing absorption chiller with a new high-efficiency centrifugal chiller. The project included engineering design, construction management, and mechanical and electrical installation, as well as new equipment and controls. The entire project was purchased through the Novation agreement to leverage the purchasing power of the Spectrum Health organization. As before, the new chiller was optimized for energy efficiency, qualified for over $50,000 in utility rebates, and is estimated to save $150,000 per year.

Helen DeVos Children's Hospital

After extensive research, Spectrum Health and Turner Construction selected Trane controls over another well-known supplier, along with Trane CenTraVac® chillers and other equipment for this $300 million facility. The building features a high performance HVAC system, including heat recovery chillers and numerous other energy-saving measures. This facility has achieved LEED Gold certification.

Blodgett Hospital

As part of a $98 million renovation and expansion project, Spectrum Health replaced the existing control system with a new Trane Tracer Summit building automation system (BAS). As with all of Spectrum's new facilities, the addition to Blodgett hospital is designed to LEED standards. Estimated energy savings of $300,000 per year have been realized to-date in the renovated portion of the facility as well.

Blodgett Hospital Chiller Plant

In addition to the renovations and expansion of the Blodgett facility, Spectrum Health upgraded the existing chiller plant. These upgrades included installation of two new Trane high-efficiency CenTraVac chillers to supplement one existing Trane chiller, variable speed pumping, a Trane chiller plant sequencing and control system, and a free cooling system to utilize cool outdoor temperatures during cold weather. An ice storage system was installed to provide additional energy savings for Spectrum Health. A Trane chiller builds ice during the night when electricity costs are low. During the day, when electricity costs are high, the ice is used to provide air conditioning for the building. Energy savings from the chiller plant upgrades are estimated to be $200,000 per year.

Lemmen-Holton Cancer Pavilion

This facility opened in 2008 and has been certified to a LEED Gold level by the U.S. Green Building Council. Spectrum selected Trane high-efficiency CenTraVac chillers, Trane factory-installed controls on the HVAC equipment, and a Tracer Summit™ building automation system. The factory-mounted controls saved significant jobsite installation and testing costs while meeting the engineer's requirements for an open protocol, integrated, user-friendly, Web-based graphical interface. The building is also extensively submetered to provide Spectrum with detailed information on energy and utility consumption.

The Blodgett Hospital chiller plant includes free cooling during cold weather and an energy-saving ice storage system.

A Trane Tracer Summit building automation system provides an integrated graphical interface with HVAC equipment.

Spectrum Continuing Care

In response to a request for updating an existing control system, Trane engineers reviewed the building systems and determined that by installing a heat recovery system in the kitchen exhaust and makeup air systems, enough energy savings could be achieved to pay for replacing the existing control system with a new Trane building automation system -- with a payback of less than two years. Annual energy cost savings are projected to be approximately $50,000.

Trane Service Agreement

Spectrum Health also selected Trane as their long-term service provider for both equipment and controls. The agreement was finalized through Novation and provides select coverage for Spectrum's chillers as well as service and support for both Trane and non-Trane building automation systems.

Systems and services

- Trane high-efficiency CenTraVac® centrifugal chillers
- Trane Tracer Summit building automation systems
- Trane controls
- Trane turnkey contracting services
- Trane Service Agreement

The Spectrum Health facilities team

Seated from left: Josh Miller, Sustainability Program Manager; Tom Theoret, Director, Facility Support Services; Brian Crum, Manager, Plant Operations
Standing from left: Jim Karas, Energy Management Coordinator; Neil Hikade, Sr. Facilities Engineer

"The knowledge, experience and progressive thinking of Trane align well with our organizational priorities and drive value throughout our health care system," said Tom Theoret, director, facility support services, Spectrum Health. "Their solutions strike a balanced approach that enhances safety and quality, reduces operating expenses, augments environmental conditions and most importantly, provides exceptional experiences for our patients and staff. It's great to have a trusted partner assisting our team in achieving our mission, vision and values."

Ingersoll Rand

Ingersoll Rand (NYSE:IR) is a world leader in creating and sustaining safe, comfortable and efficient environments in commercial, residential and industrial markets. Our people and our family of brands—including Club Car®, Ingersoll Rand®, Schlage®, Thermo King® and Trane®—work together to enhance the quality and comfort of air in homes and buildings, transport and protect food and perishables, secure homes and commercial properties, and increase industrial productivity and efficiency. We are a $14 billion global business committed to sustainable business practices within our company and for our customers. For more information, visit www.ingersollrand.com.

CASE-SLX266-EN October 15, 2012

Case study

March 2014

Hopital Cité de la Santé, Laval

Central geothermal system lowers energy costs, reduces greenhouse gas emissions, helps achieve LEED certification • Quebec, Canada

The Laval Health and Social Services Centre (CSSS Laval) was created in 2004 as part of a government reform that brought together hospitals, local community services centers and residential care facilities in ninety-five territories in Quebec. With eighteen facilities located across Île Jêsus, the CSSS Laval is the largest in Quebec. It includes one hospital with an integrated cancer center, four local community services centers (CLSCs), five residential care centers and an integrated first line care center. The CSSS Laval works in cooperation with Laval's medical clinics and public and private partners to facilitate access to healthcare services, while also promoting energy performance in its facilities.

Challenge

As the Hopital Cité de la Santé, Laval, made plans for an extension to its existing hospital building, facility managers outlined their criteria for a new HVAC system. To reduce energy consumption and carbon emissions, a geothermal system was specified. The hospital also required a boiler, for redundancy and back up, due to the critical nature of the facility's operation.

Solution

Having good knowledge of geothermal systems, but without similar installation in their other facilities, it was critical for the hospital to select a knowledgeable systems supplier. The job was bid to established manufacturers with geothermal experience. Based on the best product performance with the geothermal application, the company's reputation for service excellence and a previous successful relationship, Trane was selected as the hospital's project supplier. Trane worked with the engineers to select a system that would provide the cold evaporator temperatures required for the application.

Central geothermal system offers energy efficiency

Geothermal systems use the earth's renewable thermal energy for heating and cooling. These systems can generate significant operating cost savings and reduce carbon emissions. The Trane central geothermal system, designed for the hospital, combines the energy efficiency of geothermal with the benefits of a centralized heating, cooling and air handling system to provide an even more efficient and comfortable solution than traditional geothermal systems.

The expansion at Hopital Cité de la Santé, Laval, houses cancer treatment centers, high-technology medical equipment rooms and a specialized oncology pharmacy.

The Trane central geothermal system consists of two chillers coupled with a closed, ground geothermal loop which exchanges heat with the earth. The system offers high energy efficiency, and with all major equipment centrally located in the mechanical room, provides the additional benefit of centralized service and maintenance. In addition, the quiet operation of the system helps to ensure a restful environment for patients and staff.

Chillers provide high-performance and heat recovery

After reviewing a variety of options, two Trane low-temperature Series R™ Helical Rotary Water-Cooled Chillers (RTWD), with water-to-water heat pump controls and heat recovery capability, were installed. The proven reliability and flexible design of the Trane rotary chiller makes it a perfect match for high-performance applications, such as the hospital's geothermal system.

With fewer moving parts and a low-speed/direct drive compressor, the advanced helical rotary chiller improves energy efficiency and requires less maintenance. The chiller also provides consistent performance to enable the hospital's mission critical operations.

The RTWD is engineered to maintain tight tolerances for precise temperature control. The chillers can be configured to produce leaving-evaporator solution temperatures as low as 10°F (-12°C), making it ideal for the geothermal application. The RTWD is also well suited for energy-saving heat recovery.

Control application enables optimal system performance

A Trane® Tracer Summit™ building automation system (BAS) provides integrated control, allowing the building operator to perform daily tasks, such as responding to alarms, viewing reports and trends, and custom programming. Facility managers use the Chiller Plant Control application to commission an extensive sequence of operations to achieve the highest level of system performance and ensure optimal energy management. Trane-provided training on the operation and programming of the BAS enables operators to take advantage of their control system's full capabilities.

Able to maintain tight tolerances and produce low leaving evaporator solution temperatures, the Trane Series R™ Helical Rotary Water-Cooled Chillers are well-suited for the hospital's geothermal application.

Service keeps systems running at their best

The geothermal chillers include a five-year parts and labor warranty, and a service contract. Under the agreement, factory authorized technicians perform periodic maintenance needed to keep the systems running at their best, eliminating unplanned downtime for the critical hospital operations and helping to avoid costly emergency service calls.

Results

The Trane central geothermal system installed for the extension of the Hopital Cité de la Santé, Laval, is keeping patients, staff and visitors comfortable, while helping the CSSS Laval achieve its energy performance and sustainability objectives. The system has lowered energy costs and reduced greenhouse gas emissions, achieving points for LEED certification. The efficient geothermal system has operated without failure, making use of the hospital's backup system unnecessary, even at temperatures as low as -28°C (-18°F) in the Montreal Region.

Ingersoll Rand

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Ingersoll Rand (NYSE:IR) advances the quality of life by creating comfortable, sustainable and efficient environments. Our people and our family of brands — including Club Car®, Ingersoll Rand®, Thermo King® and Trane® — work together to enhance the quality and comfort of air in homes and buildings; transport and protect food and perishables; and increase industrial productivity and efficiency. We are a global business committed to a world of sustainable progress and enduring results.

 CASE-SLX361-EN March 06, 2014

APPENDIX E

Elevate Energy 2007-2012 Emissions Data for DuPage County

DuPage County Energy & Emissions Profile

Prepared for:
DuPage County Green Government Council
Joy Hinz, Environmental Specialist

Submitted by:
CNT Energy and the
Center for Neighborhood Technology

November 29, 2013

CNT Energy
1741 N. Western Avenue
Chicago, Illinois 60647

Contact:
Lindy Wordlaw, AICP, Energy Program Manager
Phone: (773) 269-4012
E-mail: lindy@cntenergy.org
www.cntenergy.org
www.cnt.org

DuPage County Energy and Emissions Profile, 2012 Baseline

About the Project

In 2009-2010, the Center for Neighborhood Technology and CNT Energy created community energy profiles for every municipality in the seven county Chicago metropolitan region as part of the Municipal Energy Profile Project (MEPP). The goal of MEPP was to provide all municipalities with an energy and emissions profile and corresponding tools and resources to help each community best utilize the information presented in the profile.[1] The project was meant to provide communities with a crucial starting point to discuss energy issues within their community. MEPP was funded by the Illinois Clean Energy Community Foundation and relied on support from ComEd, Nicor, Peoples Gas, North Shore Gas, and Illinois Department of Transportation.

In 2013, CNT Energy was hired by DuPage County to take that same dataset to create a 2007 County Baseline Profile and then create a 2012 comparison profile that will be used to help measure the County's progress in meeting emissions reductions goals set forth in its Cool County commitment.

The Value of This Profile

The 2012 Baseline profile includes annual countywide electricity and natural gas consumption, vehicle miles traveled, and a greenhouse gas emissions profile as compared to the 2007 Baseline. Further analysis of these differences will take place in Phase 3 of this project in 2014, however a brief initial summary has been provided in each section. There are some datapoints in this 2012 analysis that are different from the 2007 profile which are described in the Methodology section.

Regardless of these data collection and analyses differences, having this aggregate baseline data at the local level is important because it makes it possible to accurately benchmark energy use. Simply put, you cannot measure energy savings without first knowing your actual energy consumption. Further, pinpointing the county's energy trends will help you target the most effective programs to reduce energy use and costs, and their associated emissions.

[1] CNT Energy developed a corresponding MEPP guidebook held workshops and provided free technical assistance.

What's in This Energy and Emissions Profile?

The original MEPP profiles included five sections that feature introductory components for each dataset to familiarize readers with a few key concepts. The new report features two additional sections. A sixth section – Moving Forward – has been added to this profile. Within sections one through five there is a brief "moving forward" discussion on the focus of further analysis for each respective section, and Section 6 highlights these and other next steps. Finally, Section 7 explains the methodology and differences in data collection between the 2007 and 2012 Profiles.

Section 1: Using Your Profile
Section 2: Electricity Consumption in DuPage County
Section 3: Natural Gas Consumption in DuPage County
Section 4: Transportation - Vehicle Miles Traveled in DuPage County
Section 5: Emissions Profile for DuPage County
Section 6: Moving Forward
Section 7: Methodology

Section 1: Using Your Profile

The aggregate data and information provided in this profile can help in strategy development in the following ways:

1) Baseline Metrics**:** Serves as a starting point from which to measure the progress of strategies and programs.

2) Accurate Data and Measurements**:** Provides a more accurate picture of your community's average energy consumption based on actual utility data instead of national or regional averages. This will help you better calculate the potential for strategy savings, both individually and at scale.

3) Data Indicators**:** May assist in identifying some areas for targeting strategies. For example, a municipality whose average household energy consumption is significantly higher than the county may want to investigate the reasons why and identify potential residential energy saving strategies. (e.g. Is our average higher due to larger houses? Is it because we have an older, less efficient housing stock?)

More detailed examples are provided in the Guidebook for the Municipal Energy Profile Project.

Guidebook for the Municipal Energy Profile Project

In the initial MEPP project, CNT Energy developed a Guidebook to assist municipalities in further investigating how profiles might be uses. The Guidebook is provided as an addendum to this 2007 Baseline Profile for DuPage County. The initial draft of the Guidebook remains useful with this 2012 profile as DuPage County Green Government Council begins to identify strategies to reduce emissions. The Guidebook includes the following topics:

- Understanding your profile
- Municipal energy strategies
- Community-wide energy strategies
- Funding resources and technical assistance
- Glossary of energy terms and acronyms

Section 2: Electricity Consumption in DuPage County

Introduction to Electricity

Electricity consumption in both the residential and commercial/industrial (C & I) 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. In the commercial/industrial sector, increasing consumption is driven by telecommunication and network equipment along with specialized technologies such as medical imaging advancements.[2] Electricity is measured in kilowatt (kWh) hours.

Total Consumption

In 2012, the amount of electricity consumed in DuPage County was 11.03 billion kWh, which represents a 7.8% reduction from 2007. (Table 1). Like 2007, 25% of the county's electricity consumption occurred in the residential sector; the remaining 75% was consumed in the C & I sector. Figures 1 and 2 compare electricity consumption by sector in DuPage County for 2007 and 2012.

Table 1. Total Electricity Consumption (kWh), 2007-2012

DuPage	2007	2012
Residential	3,046,756,030	2,779,395,133
C & I	8,931,290,066	8,255,502,646
Total	11,978,046,096	11,034,897,780

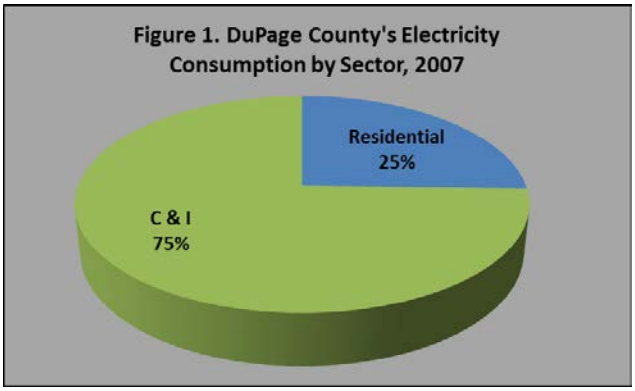


Figure 1. DuPage County's Electricity Consumption by Sector, 2007

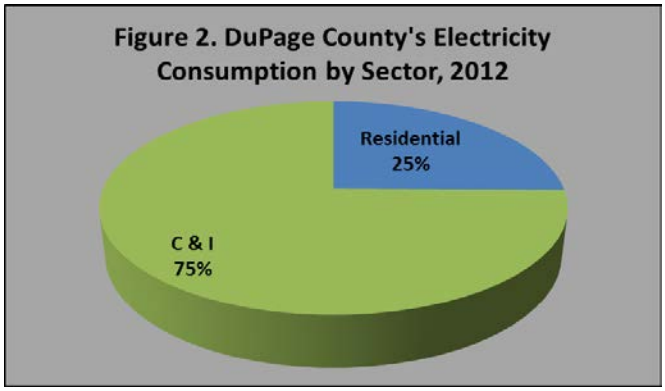


Figure 2. DuPage County's Electricity Consumption by Sector, 2012

Residential Consumption and Costs

In the residential sector, the county's average annual consumption per household was 8,303 kWh in 2012, compared to 9,013 kWh five years earlier. Factors that affect electricity usage include square footage,

Table 2. Residential Electricity Consumption & Costs, 2007-2012

DuPage	2007	2012
Number of Households	338,050	334,764
Average kWh per Household	9,013	8,303
Average Annual $ per Household*	$970	$1,043

***Calculated using average residential sales per kWh (ICC Utility Sales Statistics 2007; 2012)**

[2] Energy Information Administration: "Miscellaneous Electricity Services in the Buildings Sector", AEO2007 http://www.eia.doe.gov/oiaf/aeo/otheranalysis/mesbs.html

presence and efficiency of air conditioning, efficiency of lighting, appliances and systems, and occupant behavior. Despite the reduction in average household energy consumption, increasing utility rates resulted in a higher average cost per household. Table 2 compares 2007 and 2012 average annual electricity consumption and cost per household.

Moving Forward – Analyzing 2007 and 2012 Electricity Consumption

CNT Energy will further analyze this decrease in consumption in the analysis phase of the project to be conducted in 2014. The total number of households decreased by just 1%, so there appears to be a legitimate decrease in consumption, barring any major differences in data collection that could impact the totals. In Phase 3 this will be examined, as well a more detailed look at the breakdown with residential and non-residential sectors, which may change slightly after a deeper look at the City of Naperville's total consumption.[3]

[3] As a municipal utility, ComEd accounts for Naperville electricity as commercial usage, while the actual breakdown between residential and nonresidential sectors is information that can only be provided by Naperville.

Section 3: Natural Gas Consumption in DuPage County

Introduction to Natural Gas

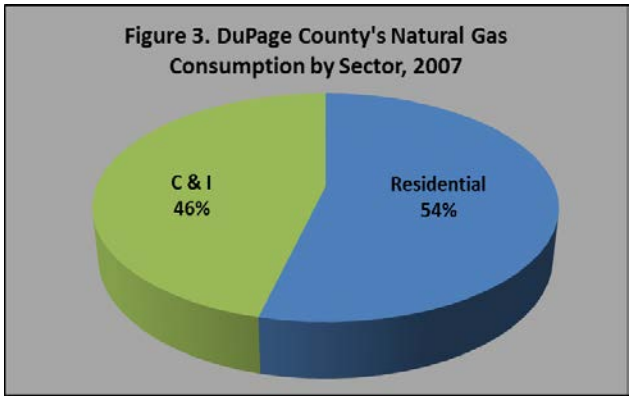
In Northern Illinois, natural gas is the primary space heating fuel. In addition to space heating, natural gas is commonly used for hot water heaters, clothes dryers, and cooking in the residential sector. However, natural gas consumption has been decreasing slightly over time in both the residential and commercial/industrial sectors as homes and buildings become more efficient and de-industrialization occurs. Natural gas is measured in therms.

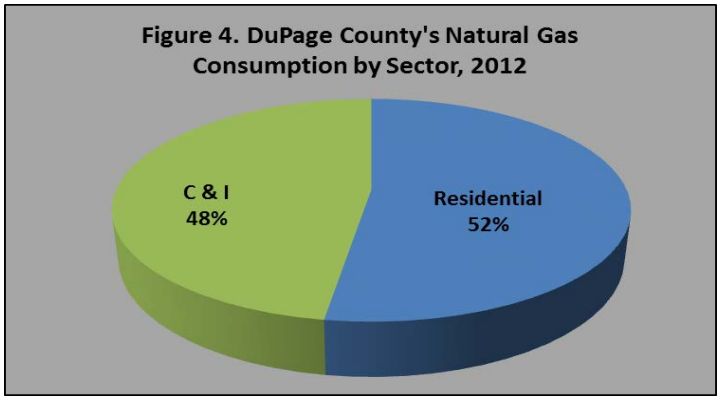
Total Consumption

In 2012, the amount of natural gas consumed in DuPage County was 502 million therms, which represents a 13.6% reduction from 2007. (Table 3). 52% of the county's natural gas consumption occurred in the residential sector; the remaining 48% was consumed in the C & I sector, only slightly different from 2007. Figures 3 and Figure 4 depict natural gas consumption by sector in DuPage County for 2007 and 2012.

Table 3. Total Natural Gas Consumption (Therms), 2007-2012

DuPage	2007	2012
Residential	313,707,381	263,468,701
C & I	268,672,694	239,149,653
Total	582,380,076	502,618,354





Residential Consumption and Costs

In the residential sector, the county's average annual consumption per household is 787 therms compared to 928 therms five years earlier. Factors that affect natural gas usage include building size, building age, building envelope efficiency, efficiency of the furnace, boiler and water

Table 4. Residential Natural Gas Consumption & Costs, 2007 - 2012

DuPage	2007	2012
Number of Households	338,050	334,764
Average Therms per Household	928	787
Average Annual $ per Household*	$824	$465

*Calculated using average residential sales per them (ICC Utility Sales Statistics 2007; 2012)

heater, as well as occupant behavior and building operations and maintenance. Table 4 compares 2007 and 2012 average annual natural gas consumption and cost per household. Costs have dramatically decreased due to falling prices for natural gas.

Moving Forward – Analyzing 2007 and 2012 Natural Gas Consumption

CNT Energy will further analyze this decrease in consumption in the analysis phase of the project to be conducted in 2014. While the numbers point to a sizeable decrease, there may be the omission of "transport gas" in the 2012 data that will result in a smaller decrease. In Phase 3 this will be examined, as well what national trends can be attributed to a decrease in overall consumption.

Section 4: Transportation – Vehicle Miles Traveled in DuPage County

Introduction to Transportation/Vehicle Miles Traveled

Typically, transportation accounts for the second largest portion of energy usage after buildings. For this report, vehicle miles traveled (VMT) was tabulated from travel statistics provided by the Illinois Department of Transportation (IDOT) based on Illinois Environmental Protection Agency (IL EPA) odometer and population data. However, a second and even more useful number is provided which is the VMT that can be attributed to households, also called non-commercial transportation. This is often deemed more useful for strategy planning purposes of local government whose transportation policies likely only affect the transportation choices of its residents, and not business decisions made by commercial-related travel.

Total Consumption

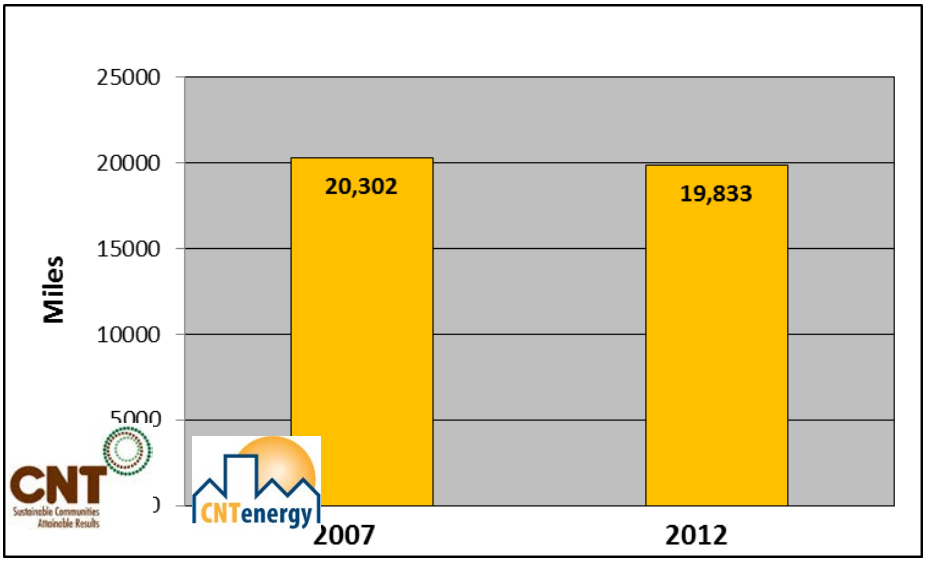
In 2012, total on-road travel on DuPage County roads accounted for 8.42 billion miles (Table 5), which captures trips only within county boundaries. Since 2007 there is a slight decrease of 2% in total vehicle miles traveled. The average household in DuPage County drove 19,833 miles (Figure 5), totaling 6.6 billion miles for all DuPage County households.

Table 5. Vehicle Miles Traveled (VMT), 2007 -2012

VMT	2007	2012
Total On-Road VMT	8,633,562,650	8,424,261,955
Household VMT	6,862,947,547	6,639,375,551

Factors that affect 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.

Figure 5. Average Vehicle Miles Traveled per Household, 2007 - 2012



Moving Forward – Analyzing 2007 and 2012 Vehicle Miles Traveled

CNT Energy will further analyze this decrease in the analysis phase of the project to be conducted in 2014. It is important to note that nationally, VMT has gone down due to factors including unemployment, high gas prices and changing travel patterns. Some of that has and will continue to bounce back, as may well be the same phenomenon in DuPage County.

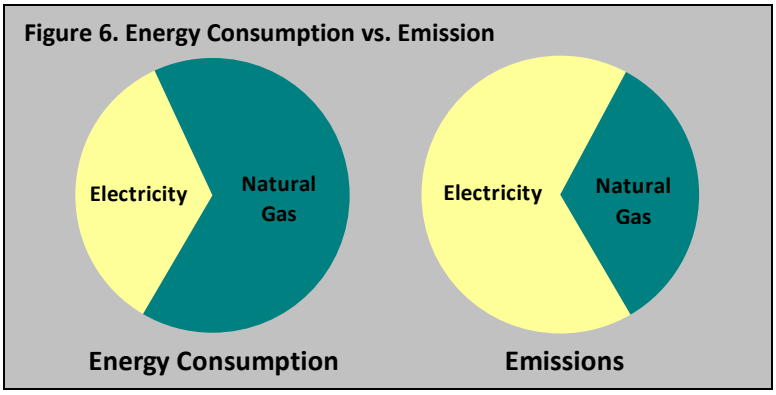
Section 5: Emissions Profile for DuPage County

The Connection between Energy and Emissions

In addition to understanding energy consumption, it is important to recognize the relationship between energy and greenhouse gas emissions. Emissions attributed to electricity consumption are different from those attributed to natural gas consumption because of differences in the production of energy from different sources.

Most of the world's energy originates from the burning of fossil fuels including coal, petroleum, and natural gas. Fossil fuels consist of hydrogen and carbon, and when burned, the carbon combines with oxygen to create carbon dioxide.

However, all energy is not created equal. The amount of carbon dioxide produced for a given unit of energy depends on the carbon content of the fuel source. For example, coal (used to produce electricity) emits nearly two times the carbon dioxide per unit of energy compared to natural gas. Understanding this off balanced relationship is important when calculating emissions and identifying strategies to reduce emissions. Figure 6 illustrates this off balanced relationship between energy consumption and emissions, using data from the Chicago metropolitan region. Understanding this off balanced relationship is important when calculating emissions and identifying strategies to reduce emissions.



Emissions Calculations

Greenhouse gas emissions in this profile were calculated using United Nations Intergovernmental Panel on Climate Change (IPCC) methods and local data sources in combination with modeling of national data to local demographics. All data presented are measured in metric tons (tons) or million metric tons (MMT) CO_2e (carbon dioxide equivalent), to enable comparison internationally.

Emissions were calculated for the six major categories of greenhouse gases regulated under the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Emissions were converted into CO_2e using global warming potentials from the IPCC Fourth Annual Assessment Report. Activity data were translated into emissions using standard emissions factors and global warming potentials.

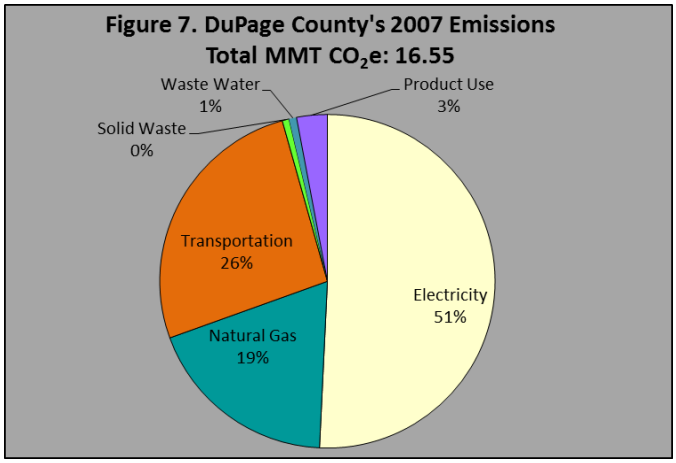
Emissions Profile for DuPage County

An energy profile in the community serves as the basis for conducting a community greenhouse gas emissions profile. In addition to energy and transportation, which are by far the biggest contributors to greenhouse gas emissions, this emissions profile includes estimates for solid waste, waste water, and product use based on regional totals previously analyzed for a regional profile developed for the Chicago Metropolitan Agency for Planning (CMAP).

Below is a comparison breakdown of county's emissions by sector in 2007 and 2012. (Table 6; Figures 7 and 8) which represents a reduction of approximately 7%.

Table 6. Emissions by Sector, County and Region, 2007 – 2012

Sector	2007 MMT CO_2e	2012 MMT CO_2e
Electricity	8.40	7.65
Natural Gas	3.10	2.67
Transportation	4.33	4.23
Solid Waste	0.11	0.24
Waste Water	0.12	0.12
Product Use	0.49	0.48
TOTAL	16.55	15.39



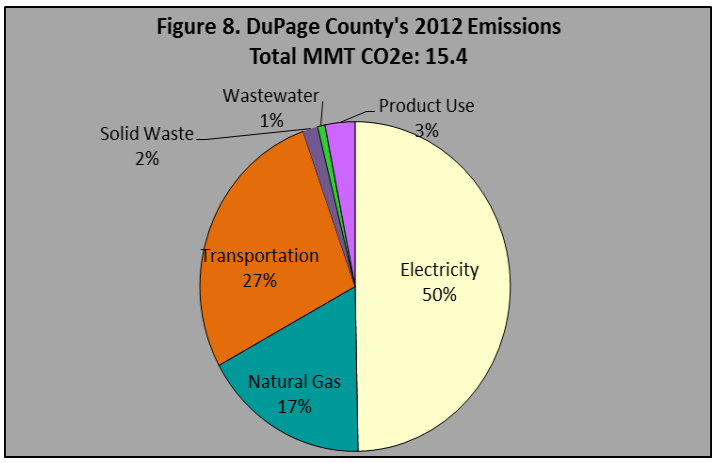
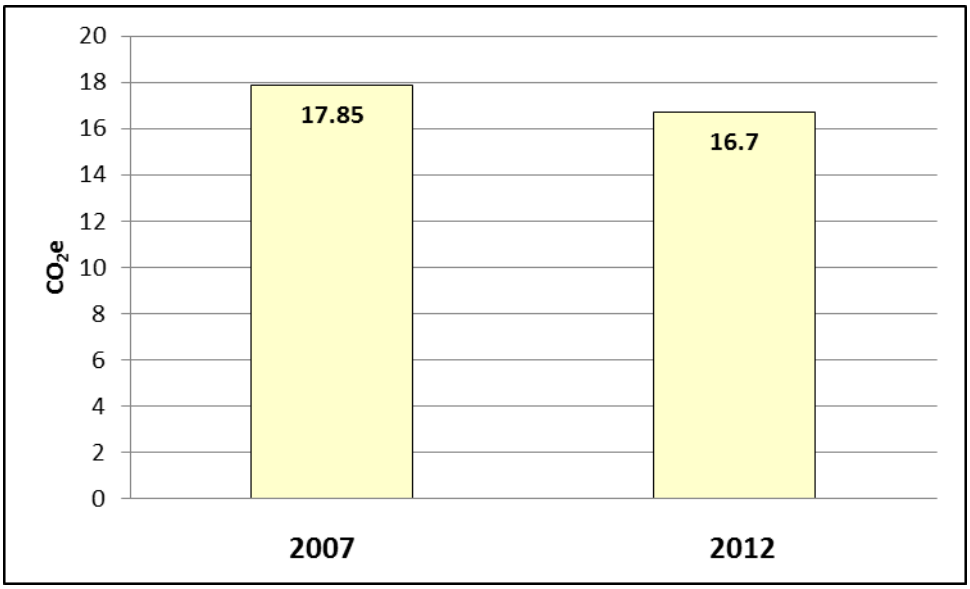


Figure 9 provides another context through comparison of DuPage County's 2007 and 2012 emissions per capita.

Figure 9. DuPage Per Capita Emissions, 2007 - 2012



Moving Forward – Analyzing 2007 and 2012 Emissions

CNT Energy will further analyze this slight decrease in emissions and per capita emissions in the analysis phase of the project to be conducted in 2014. Aside from the apparent reductions in electricity consumption, natural gas consumption and vehicle miles traveled, we will consider the impact of larger decarbonization trends such as improved miles per gallons in cars and the reduced share of electricity produced with coal, which comes as a result of an increase in renewables and natural gas.

Section 6: Moving Forward

Understanding the difference between 2007 and 2012 data sets

Each section of this report provides a brief comparison analysis between 2007 and 2012 data. Table 7 serves as a recap to the initial findings and topics for more detailed analysis that was intended for this project and is scheduled to be funded in 2014. This deeper analysis will include a closer look at data sources and potential factors for these reductions. If fully funded, the analysis will also include an energy forecast for both 2020 and 2030, and briefly identify the types of common community-scale strategies that would assist DuPage County in achieving its emissions reduction goals by 2020 and 2030.

Table 7. Recap of Initial Findings and Next Steps by Sector

Sector	Findings and Next Steps
Electricity	• Decrease of 7.8% for overall consumption • Future analysis: detailed sector breakdown, data collection differences • Inclusion of Naperville municipal utility sector breakdown numbers, currently accounted for as "commercial" • National trends in electricity consumption/reductions
Natural Gas	• Decrease of 13.6% for overall consumption • Future analysis: data collection differences, particularly whether or not "transport gas" included in 2007 data was left out for 2012 • National trends in natural gas consumption/reductions
Transportation	• Decrease of 2.4% for total on-road vehicle miles traveled • Decrease of 3.2% for total household vehicle miles traveled • Future analysis: whether or not national trends in VMT attributed to fewer jobs and changing travel patterns due to high gas prices are the likely cause of these small reductions
Emissions (overall)	• Findings: Decrease of 7% for total emissions • Future analysis: impact based on consumption reduction versus larger decarbonization trends such as improved MPG in cars and the changing production of electricity (from coal to renewables or natural gas) • National trends in emissions reductions

Further, another goal of this report and pending analysis is to equip the county with the appropriate resources and tools to further conduct its own analyses in future years. With this report and corresponding data spreadsheet, CNT Energy will have done its share to achieve this goal. DuPage County should continue to engage with the utilities as trusted partners who can provide vital energy data in aggregate form for future analyses.

APPENDIX F

DuPage County Board Resolution EN-0001-12
Resolution of Commitment to Sierra Club, Illinois Chapter Cool Counties Program

R E S O L U T I O N

EN-0001-12

RESOLUTION OF COMMITMENT TO SIERRA CLUB, ILLINOIS CHAPTER COOL COUNTIES PROGRAM

WHEREAS, DuPage County ("COUNTY") has adopted the DuPage County Environmental Policy ("POLICY") brought forth by the DuPage County Environmental Commission; and

WHEREAS, the POLICY provides that the COUNTY should provide incentives for energy conservation in both public and private buildings and should establish and maintain for monitoring and analyzing energy consumption; and

WHEREAS, the Sierra Club, Illinois Chapter has asked the COUNTY to consider participating in the Cool Counties program which is a nationwide movement of local governments committing to reducing greenhouse gas emissions; and

WHEREAS, the COUNTY has a unique role in reducing greenhouse gas emissions and preparing for the impacts of climate change through their regional jurisdiction over policy areas such as air quality, land use planning, transportation, zoning, water conservation and solid waste management; and

WHEREAS, the program requires that the COUNTY take measurable steps to reduce greenhouse gas emissions at both county-owned assets as well as at all properties within the County's boundaries; and

WHEREAS, the majority of comparative emissions in DuPage County and across the Chicago metropolitan region can be attributed to electricity, natural gas and vehicle miles traveled; and

WHEREAS, the Environmental Committee has reviewed this program and finds that the COUNTY has an opportunity to be an example in the community and can make an effort to reduce internal energy consumption; and

WHEREAS, the COUNTY has limited authority to regulate energy consumption it can serve as an advocate to encourage voluntary reductions; and

NOW, THEREFORE, BE IT RESOLVED by the DuPage County Board that the COUNTY support the Cool Counties program and the CMAP GO TO 2040 PLAN by recommending the following:

a. Reduce greenhouse gas emissions to 10% below the 2007 levels by 2020 and 20% below 2007 levels by 2030.

b. Form an energy efficiency partnership with key entities including corporate and governmental partners.

c. Continue to lower the COUNTY's campus wide energy consumption.

d. Encourage non-motorized transportation opportunities and mass transit in an environmentally friendly manner.

e. Educate consumers about the benefits of buying locally grown food and other items and shopping locally.

f. Act as a clearinghouse for energy efficient tax-credits and grant opportunities.

g. Support the State of Illinois' Energy Conservation Code by continuing to enforce the efficient standards.

BE IT FURTHER RESOLVED, that the COUNTY will work on a plan for energy reduction which will specify programs and anticipated costs to reduce energy consumption and such plan will be brought back to the Environmental Committee within one year of this resolution.

BE IT FURTHER RESOLVED, that the Chairman of the County Board is hereby authorized and directed to authorize the COUNTY's participation in the Cool Counties program.

Passed this 11th day of September, 2012, at Wheaton, Illinois.

Daniel J. Cronin, Chairman
DuPage County Board

ATTEST:

Gary A. King, County Clerk

Ayes: 16
Absent: 2

APPENDIX G

The Morton Arboretum’s Northern Illinois Species List and Tree Selector

The Morton Arboretum

Selecting and Planting Trees

White Oak, *Quercus alba*

The Morton Arboretum has developed these two companion publications to provide current, scientifically based tree selection and planting advice. Selecting and Planting Trees is the result of decades of research on the key issues to consider when planting a tree, including planting site characteristics, purchasing a quality tree, planting the tree, and maintaining a newly planted tree. The Northern Illinois Tree Species List describes species that grow well in the area and recommends best planting sites. This list emphasizes the importance of site characteristics and is a tool for broadening the diversity of our regional forest to promote resiliency.

Selecting and Planting Trees
Editor: Gary W. Watson
Photographs: Gary W. Watson
Illustrations: Bryan Kotwica

Northern Illinois Tree Species List
Editorial Review Panel: Kris Bachtell, Gary W. Watson, Melissa Custic, Lydia Scott, John Dwyer, Joseph Rothleutner, Doris Taylor, Sharon Yiesla, Nicole Cavender, Gerard T. Donnelly

Acknowledgments
Special thanks to all those who provided significant input and direction on the species list, especially John Lough and the City of Chicago Bureau of Forestry; Sarah Surroz of Conserve Lake County; the Illinois Landscape Contractors Association; and the Ornamental Growers Association.

We also thank other key contributors, including Stephanie Adams, Jim Anderson, Andrea Dierich, Kurt Dreisilker, Kunso Kim, Stephen Lane, Cherie LeBlanc Fisher, Angela Levernier, Suzanne Malec-McKenna, Loren Nagy, Judy Pollock, Rob Sperl, and Doug Tallamy.

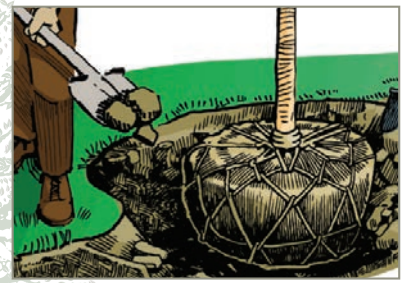
The Morton Arboretum

Chicago Region Trees Initiative

This publication was developed in collaboration with the Chicago Region Trees Initiative, a partnership of organizations working together for a healthier regional forest.

Selecting and Planting Trees

It takes only a short time to plant a tree, but how it is done can have a lasting influence on the tree's future growth. Mistakes made when planting trees usually cannot be corrected later. Improper planting can cause the tree to fail after a short time or to struggle for many years and never reach its full potential as a healthy addition to the urban forest.

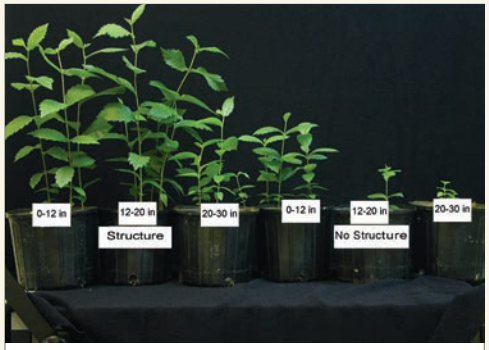


Planting Site Evaluation

ABOVEGROUND ENVIRONMENT. Environmental conditions in urban landscapes can differ widely over short distances. The amount of sunlight a tree receives and the time of day the sunlight is received can limit the kind of tree that can be planted. For example, the environment can be too harsh for some species on sites where heat and light are reflected from nearby buildings or pavement. An area with morning sun and afternoon shade often provides adequate sunlight early and protection during the hottest part of the day. An area with morning shade and direct sun during the hot afternoon hours may be more suitable for trees that are tolerant to heat or drought stress. The intensity of all-day shade can vary from open shade on the north sides of fences or low buildings to very dense shade under low tree branches.

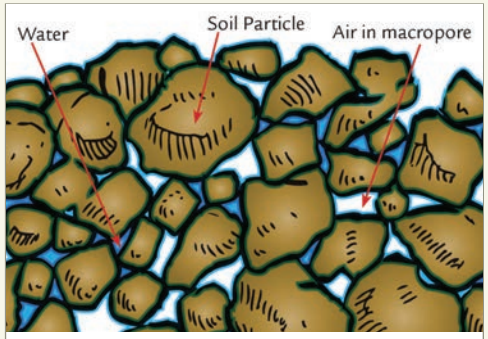
Aboveground space restrictions may need to be considered. Overhead utility wires may limit the size of trees that can be planted. It is a common mistake to plant a young tree too close to a building without sufficient room to grow. Species with aggressive root systems may also heave nearby pavements or contribute to damage to shallow foundations.

IMPORTANCE OF SOILS. Tree species are adapted to the environment in which they are found in nature. Few urban sites match any natural site or provide optimum conditions for tree growth. Poor soil conditions frequently limit planting success. Poorly drained soils with a high clay content, typical of many urban developments, require special planting procedures to improve survival and establishment.



Soil structure is important. When it is damaged, plant growth is reduced dramatically. Note that growth in the deepest subsoil with structure maintained is as good, or better, than any of the soil layers with structure destroyed.

Soil texture refers to the ratio of different particle sizes in a soil. Sandy-textured soils are composed mostly of large particles, while clayey soils contain many microscopic particles. Soil structure refers to the size and shape of soil aggregates (soil particles held together in groups by organic compounds). Between the aggregates are spaces that allow movement of air and water through the soil. As a result of compaction, urban soils are often poorly aggregated, with smaller spaces. Incorporation of composted organic matter can help improve structure.



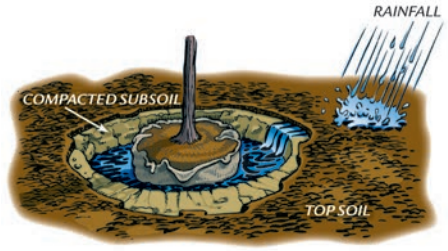
Water held in the micropores by capillary action is held tightly enough to be present in the root zone for extended periods, yet loosely enough for the plant to extract it. Water drains quickly from the larger pore spaces. All of the pores can be filled with water when the soil is too wet, eliminating the air in the soil that roots need.

Well-aggregated soils provide optimum aeration and water for plant roots. Soil water and oxygen availability are interrelated. If the majority of the pore spaces are filled with water, there will be insufficient oxygen available for the living roots. Trees killed by too much water are found most frequently in compacted clayey soils.

Drainage affects oxygen and water in the soil and is controlled by a number of factors including precipitation; soil texture and structure; permeability; infiltration characteristics; and landscape position. In the poorly drained, compacted soils typical of urban areas, drainage may need to be improved.

There is a very effective way to determine if soil has adequate drainage. After digging the planting hole, fill it full of water. If the water that fills the hole has not drained appreciably after an hour or two, drainage will be problematic, especially during wet seasons. If the soil is very well-drained, it may be difficult to fill the hole with water because it soaks into the soil so quickly.

Soil (chemical) reaction, known as pH, is a general indicator of nutrient availability. In slightly acid to neutral soils (pH between 5.5 and 7.2), most nutrients are available at optimal levels. Some nutrients, such as iron and manganese, become less available in alkaline soils (pH above 7.2) because of chemical changes caused by the alkalinity. Alkaline soils are common in urban landscapes and can result in nutrient deficiencies in certain species such as pin oak and river birch. These trees will exhibit yellow leaves, a condition known as chlorosis. Other nutrients also become less available in highly acid soils (pH less than 5.5), but these soils are not often encountered in urban landscapes.



Water that cannot penetrate compacted subsoil flows laterally to the lowest point. Planting holes can fill up with water and damage the root system.

SALT DAMAGE. De-icing salts from airborne deposits and runoff from melting snow on pavements can accumulate in the soil. High levels of soil salts can dehydrate tree roots and damage the entire plant. Excess sodium leads to poor soil structure, resulting in reduced soil permeability and poor aeration.

ROOT SPACE. Just as a potted plant can grow too large for the volume of soil in the container, a landscape tree can grow to a size where it becomes too large for the available root space. Roots typically spread further than the branches and most urban sites restrict root spread to at least some degree. Buildings are obvious restrictions to root spread, but pavement also limits root development. The compacted soil required to support a stable pavement surface and the impervious nature of the pavement itself severely limit root growth underneath the pavement. Growth of trees will be restricted in less than 20 years if there is less than 200 square feet of open soil around them. Smaller spaces will reduce growth sooner and to a greater extent.

Site Evaluation Checklist

Carefully evaluating the site in advance is critically important for successful tree selection and planting. Many trees fail because the site characteristics are either improperly evaluated or ignored entirely.

Above Ground

- ☑ Sunlight exposure (hours of sunlight, reflected light, and heat load)
- ☑ De-icing salt usage
- ☑ Pollution
- ☑ Overhead wires
- ☑ Proximity to buildings, structures, light fixtures, and signs
- ☑ Potential for vandalism

Below Ground

- ☑ Soil pH
- ☑ Soil texture and structure
- ☑ Soil compaction
- ☑ Drainage
- ☑ Soil salinity and other soil contaminants
- ☑ Root space restrictions

When to Plant

Survival is likely to be greatest and aftercare least demanding when a tree is transplanted while dormant. Spring and fall also have the advantage of moderate temperatures and plentiful rainfall. Summer planting is possible if a judicious watering program is followed, particularly if the tree was dug from the nursery in spring, or grown in a container.

All tree species can be dug from the field successfully in early spring. Some species, but not all, can be dug successfully in the fall. Those that cannot be dug in the fall can be dug in the spring and held for fall planting with proper care. The optimum time for fall planting is when there are several weeks of warm soil temperatures (above 50°F) that can support active root growth. Evergreens may benefit from a longer duration of warm soil to promote root regeneration after fall planting because they can lose considerable water through their foliage during fall and winter months.

Choose a Quality Tree

Choosing a high-quality tree contributes to planting success. It is important to know the source of the trees you purchase. If the tree was grown in a local nursery for several years, there is a good chance that it is adapted to the local climate.

NURSERY STOCK TYPE. Many choices of nursery stock are available from the nursery or garden center. Choosing the best nursery production method for each situation is essential. Each method has certain advantages and none is best for every situation.

> Bare-root plants are moved without soil, so the roots are exposed and must be protected to keep them from drying out. Bare-root trees are usually less than two-inch caliper and should be planted in late winter or early spring to allow as much time as possible for fine root development before the leaves emerge.
>
> Ball-and-burlap (B&B) is the most common method of transplanting field-grown trees. A ball of soil containing a portion of the root system is wrapped in burlap and twine or wire basket and moved with the tree. These materials stabilize the root ball during transport.
>
> Container-grown plants are grown in specially designed plastic containers. Because no digging is involved, container plants do not suffer substantial root loss during transplanting. However, container soils are very well-drained and the trees will still require frequent irrigation in the landscape to avoid water stress until their roots can spread into the surrounding soil. Cold winter temperatures that kill roots in above-ground containers limit container production of trees in northern Illinois unless additional root protection is provided. Trees in larger containers sold in local garden centers may be shipped from warmer climates and may not be hardy.

TREE HEALTH. Trees should exhibit vigorous growth during the most recent two to four years and have well-formed buds. Normal twig growth may vary from six to 24 inches annually and should be characteristic of the species. Trees should be vigorous specimens, free from insects and diseases. The trunk's bark should be firm, with no indication of disease, insect galls, wood borers, dieback, frost cracks, sun scald, or mechanical injury.

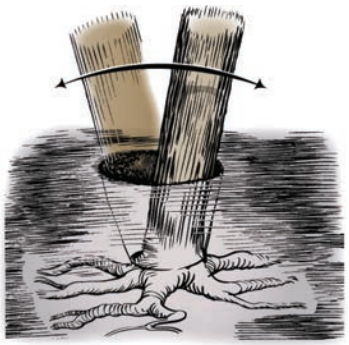
Avoid trees with codominant stems and included bark.

BRANCH STRUCTURE. Branches should be well spaced, both vertically and around the circumference of the trunk, for strong attachments and unrestricted flow of water and nutrients. Branches should diverge from the trunk at a wide angle except in cultivars that normally grow in narrow, upright forms. Ideally, a tree will have a single central stem. Two vertical trunks or stems that are nearly equal in diameter are known as codominant stems and are weaker in structure. Trees with codominant stems or included bark (bark imbedded between codominant stems or between branch and trunk) should be avoided.

CHECKING STRUCTURAL ROOT DEPTH. As a general rule for young nursery-grown trees, the large woody roots should be no more than an inch or two below the soil surface and should be well-distributed in all directions.

If you can see the roots emerging from the base of the trunk at the soil surface, it is an indication that the roots are at the correct depth. Some soil may have to be removed to see the top of the roots. Movement of the lower portion of the trunk, forming a gap between the trunk and the surrounding soil, is a sign that the roots are too deep. Many nursery-produced trees are grafted, with the trunk and branches of one species grafted onto the root system of another. These trees will have a bud union that should be visible about one to two inches above the soil.

In some production systems, liner stems are cut back during production, creating a visible wound and crook in the stem. If visible, this is an indication that the tree is planted at the same depth as originally planted in the nursery.



As the trunk moves in the wind, a gap forms around it if the roots are too deep. The deeper the root flare is buried, the wider the gap will be at the surface.

Planting

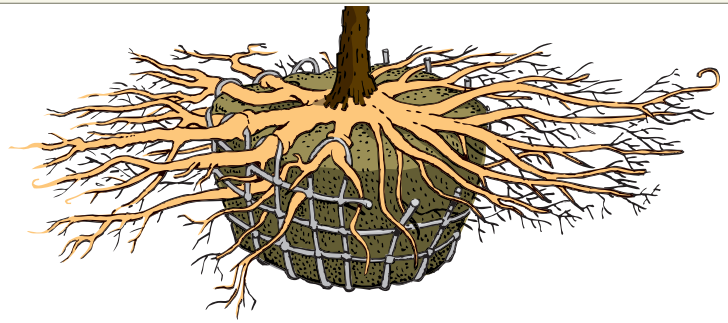
Attention to detail at planting time will pay dividends for many years. Mistakes made when planting trees usually cannot be corrected later.

PLANTING HOLE DEPTH AND WIDTH. On sites with poor quality soil that is compacted, clayey or poorly drained, the planting hole should be ***at least twice*** the width of the roots to accommodate root development during the first year. If the roots are unable to grow into the compacted subsoil, a hole with sloped sides will direct them back up toward the better-quality surrounding surface soils so they can spread beyond the planting hole. If a tree spade is used to transplant the tree, a similar effect can be achieved by cultivating the soil around the root ball to a depth of at least eight to 12 inches in a circle that extends at least half the width of the root ball. On sites with high-quality soil, the planting hole needs to be only wide enough to facilitate planting. If the sides of the hole dry out before you fill the hole back in, use a hand tool to break up the surface.

The planting hole should be only as deep as the root ball. A hole with sloped sides is easier to dig and provides an increased volume of friable soil for vigorous root development from the upper half of the root ball. Breaking down the sides of a traditional hole can reduce the work involved.

Roots of bare-root plants should be spread out so they do not circle or kink in the hole. The planting hole for B&B stock should be slightly shallower than the root ball to allow for flattening and settling of the root ball. Planting with the top of the root ball two inches above the surrounding grade is adequate for a two- to three-inch-caliper tree. The root ball should be placed on a stable subgrade to minimize settling.

STRUCTURAL ROOT DEPTH. The uppermost large woody lateral roots of bare-root stock should be planted within one to two inches of the soil surface. If the roots are slightly deeper in the root ball, the planting hole should be shallower to account for it. Do not remove the extra soil until the planting hole is backfilled. In some situations it may be preferable to leave the extra soil in place and allow it to erode away. Mulch can be used to cover the protruding root ball and make a more gradual slope.



If the upper half of the basket is removed before backfilling, most future root problems will be prevented.

REMOVING ROOT BALL WRAPPING MATERIALS. Remove all basket wires down to four to six inches below the top of the root ball so that the structural roots can grow above the wires and not be constricted in the future. Low-profile baskets are designed so that no wire needs to be removed. If synthetic materials, such as nylon twine or plastic burlap, are used, they should be removed completely. Natural burlap and twine usually decompose in the first season, but it still is preferable to remove them from the upper half of the root ball to be sure there is not a second layer of synthetic burlap or twine underneath that needs to be removed.

ELIMINATING ROOT DEFECTS. Container-grown plants can have many root defects. Because the natural spread of the root system is restricted by the container, lateral roots reaching the sides are deflected and can circle, ascend, descend, or kink. All these abnormal roots can eventually affect tree health and stability.

Shaving the container root ball is the best way to eliminate roots growing along the container wall.

The best way to eliminate root defects on the exterior of the root ball is to shave off a thin layer of the entire outer surface of the root ball. This will allow new roots to grow radially from the trunk, as they do in nature. Defects can also be present in the interior of the root ball from smaller containers used earlier in the production process. These cannot be corrected and this poor-quality stock should be avoided.

BACKFILLING THE PLANTING HOLE. Soil amendments may be added to the soil used to backfill the hole on sites with poor quality soil. They can improve soil structure, water-holding capacity, and drainage for better root growth. Add approximately 10 percent composted organic matter by volume, depending on the material. On sites with high-quality soil, there is no need to add any amendments. Compact some of the excavated soil around the base of the root ball to stabilize it. The rest of the soil should be tamped only lightly in the hole or left to settle on its own. Watering will assist in settling the soil naturally. Excessive tamping, especially when the soil is wet, can compact the soil and slow water penetration and root growth.

TRUNK PROTECTION. Plastic guards can help to protect trunks from mowers, weed whips, and other mechanical injuries. If used, they must be removed before the trunk grows large enough to be damaged by constriction. Trunks of trees with thin or smooth bark are sometimes wrapped to prevent sunscald injury from winter sun. Wraps should be light in color, porous to water, and biodegradable. The wrap should be applied in late fall from the bottom up so that it overlaps like roof shingles, and removed in the spring. A helpful way to remember is to apply the wrap around Thanksgiving and remove it around Easter.

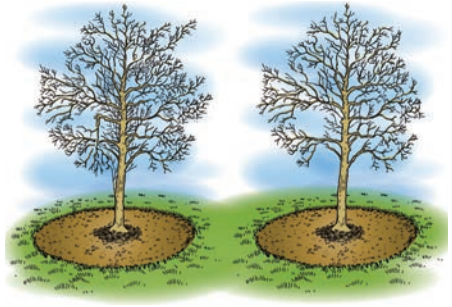
STAKING. Staking, guying, or bracing refer to mechanically supporting the trunk of a planted tree to keep it in an upright position. Container-grown and bare-root trees may require support until lateral or anchor roots develop. ***Staking is not usually necessary for properly handled and planted B&B stock.*** If the root ball is in good condition and has been stabilized by compacting soil around the base, the tree is not likely to lean or shift. There may be a few exceptions, such as very windy sites or sandy root balls. Two stakes with separate flexible ties are commonly used but three stakes will provide better support. Supports should be removed after one year to avoid trunk girdling.

WATERING. Water the root ball thoroughly after planting. Ten to 15 gallons is sufficient.

MULCHING. Properly applied mulch can increase tree growth in the first few years after planting. Apply mulch in an even layer over the planting hole and slightly beyond it. The mulch layer should be one to three inches deep after settling. Mulch should not be allowed to contact the base of the trunk. Avoid the common practice of applying mulch in a small, deep ring around the base of the trunk.

FERTILIZATION. Do not fertilize a newly planted tree. Until the root system can grow large enough to absorb more water, adding fertilizer is ineffective.

PRUNING. It is important to ensure the best possible branch structure while a tree is young. A central leader with adequately spaced lateral branches is the strongest structure a tree can have. Trees that are correctly pruned during production in the nursery should not require substantial pruning when planting. Because of the fast growth rate in the nursery, even high-quality nursery stock may benefit from minor structural corrective pruning to promote good branch structure. Cut back rapidly growing, upright, lateral branches that might compete with the central leader for dominance. Also remove all crossing branches and any twigs that were broken during transport.



Broken, weak, and interfering branches should be removed at the time of planting. Maintain the typical form of the species.

Checklist

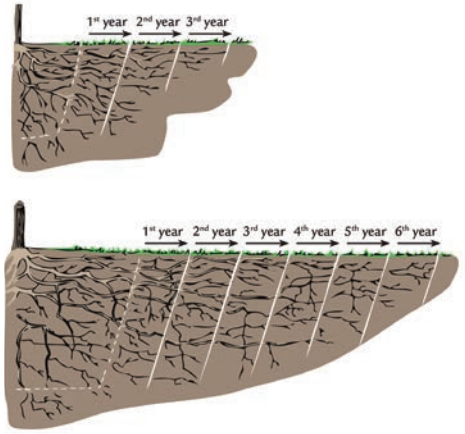
The final step in the planting process is inspection. There are many items that need to be checked:

- ☑ Is the planting depth correct?
- ☑ Have the upper portions of the root ball wrapping materials been cut away?
- ☑ Have the roots growing against the inside of the container been eliminated?
- ☑ Is the trunk straight?
- ☑ Has the tree been pruned to correct structural defects?
- ☑ Has mulch been applied in a light layer over the entire planting hole?
- ☑ Has the mulch been pulled away from the trunk of the tree?
- ☑ Were the root ball and backfill soil watered thoroughly?
- ☑ If the tree needed staking, do the ties allow for growth and movement of the trunk?

Why Trees Are Stressed by Transplanting

When a field-grown tree is dug from the nursery, most of the root system remains behind. The amount of water available to the partial root system in the root ball is a small fraction of what was available before digging. Even though root loss of container-grown plants is minimal when planted, their roots are confined to an abnormally small soil volume in the container, so the situation is very similar to a B&B tree. Initially after planting, both container and field-grown plants face the same challenge of marginal or insufficient water absorption by the root system. Until they can grow a normal spreading root system, newly planted trees are dependent on frequent irrigation. Water stress is a common cause of planting failure.

Roots grow at an average rate of approximately 18 inches per year in the Midwest climate. A three-inch-caliper tree will require approximately three years to completely replace the roots that were lost in transplanting. Root growth rates are similar for large and small trees, but the distance that roots must grow to redevelop the full spreading root system is much greater for a larger tree. A larger tree will require more annual root growth increments to replace the original root system after planting.



Several years of root growth are required for a newly planted tree to fully reestablish its root system. Roots grow at a similar rate regardless of tree size, but for a larger tree, roots must grow over a longer distance to redevelop a normal root spread after transplanting. This requires more years of growth and results in a longer establishment period for a large tree.

Until the root system is established, stress and reduced growth are common. The annual twig growth can be reduced substantially for the first year or two after transplanting. Stressed trees are susceptible to some serious disease and insect problems, such as wood borers and canker diseases, that don't usually affect established, vigorous trees. Proper maintenance helps minimize stress and increase natural resistance, but chemical control may be necessary at times. When attempting to manage pests, it is important to distinguish serious problems that justify chemical treatment from cosmetic ones for which chemical applications are unnecessary or even harmful. For example, wood borers would be considered a serious problem, whereas most late-season leaf diseases would not.

Maintaining Newly Planted Trees

Trees need maintenance throughout their lives but it is particularly important during the period of establishment after transplanting. As long as there is only a fraction of the tree's normal root system present to absorb water, the tree will require extra care.

WATERING. Proper watering is the single most important aspect of maintenance of transplanted trees. In the first year or two, it is important to keep the root ball moist but not over-watered. The root ball soil is the major source of water for the tree until the root system redevelops. Surrounding soils where there are few roots absorbing moisture often stay moist, while the root ball quickly dries out. During this time, monitor the moisture in the root ball. Throughout the warm, summer weather, the tree will

probably need water about twice each week. Approximately 10 to 15 gallons of water is sufficient to moisten the 24-inch diameter root ball of a two-inch-caliper tree.

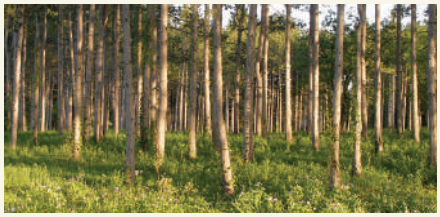
Tree watering bags, which have pinholes to allow water to drip into the soil near the trunk, are gaining popularity. One advantage is that they deliver water directly to the root ball. Little is known, however, about possible heat buildup on the trunk under an empty bag. An empty bag could also deflect rainwater away from the base of the tree where it is most needed.

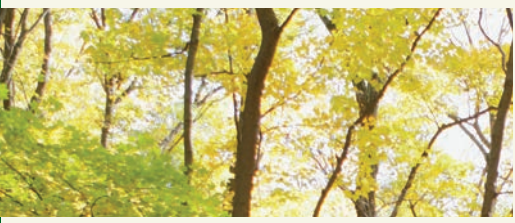
Sugar maple (Acer saccharum) root density is greater under mulch than when in competition with grass.

MULCHING. The mulched area should be expanded as the new roots spread beyond the planting hole. New organic mulch must be added periodically as the older mulch decomposes. Mulch eliminates competition from aggressive lawn grasses for soil moisture and nutrients. Compatible plantings may be added to enhance the landscape appearance. Most trees can tolerate root competition from woody shrubs, groundcovers, and perennials.

FERTILIZING. Fertilization should be delayed until a season or two after the tree is planted (longer for trees larger than two-inch caliper). Always apply fertilizers evenly over the entire root zone and remember that the roots can grow well beyond the branches in only a few years. Once vigor is regained, fertilize trees with a nitrogen fertilizer at a rate of up to $^{2}/_{3}$ pound of actual nitrogen per 100 square feet per year (approximately $1^{1}/_{2}$ to 2 cups of fertilizer for most high-nitrogen formulations, spread over a 10-foot-diameter circle). The amounts of potassium, phosphorous, and other nutrients in soils vary and these nutrients may not need to be added. A slow-release form of fertilizer should be used so that the nutrients are available throughout the season. Lawn fertilizers containing broadleaf weed killers and other herbicides should not be used in the vicinity of any tree–including over the root zone. Fertilization in the fall may stimulate new growth and reduce cold hardiness.

PRUNING. Proper tree selection will eliminate the need for major pruning to control size in the future. Planting a tree in the proper location will minimize the need for pruning to clear buildings and walkways as the tree grows. Pruning small trees for proper branch architecture should continue in the years after planting. Maintaining a strong central leader is important for most tree species. Even trees that were properly pruned in the nursery, or at planting, can revert back to an undesirable form in just a few years following planting. Prune out upright stems in the upper crown that could grow to compete with the main leader, and reduce large lateral branches to slow their growth.



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The mission of The Morton Arboretum
is to collect and study trees, shrubs,
and other plants from around the world,
to display them across naturally beautiful landscapes
for people to study and enjoy,
and to learn how to grow them
in ways that enhance our environment.

Our goal is to encourage
the planting and protection of trees
and other plants for
a greener, healthier, and more beautiful world.

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