

Building a Green Capital City: The Natural Step to Madison's Sustainable Design and Energy Future

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ABSTRACT

The City of Madison, WI launched a program in 2004 to become a green capital city and a leader in sustainable design and energy. The city is leading by example and encouraging businesses and residents to follow suit. Madison adopted The Natural Step (TNS) --a scientific, systemwide approach, to create a common understanding of sustainability and is using the TNS framework to inform decisions and foster interdepartmental collaboration. The city began by greening its own operations. Programs include establishing a fleet fuel efficiency standard, implementing green purchasing and cleaning, installing solar systems on city properties, certifying new and existing buildings to LEED, purchasing electric hybrid buses, improving bus ridership among city employees, and creating baselines, measurement protocols and standards for energy use and CO₂ emissions. Madison incorporated sustainability into the hiring and specifications for the zoning code rewrite and a low income housing development project. They are partnering with the County on developing light rail.

Madison received a USDOE Solar City grant and is teaming with Focus on Energy and its local utility to facilitate solar installations by homeowners and businesses. The city launched a climate change program to reduce city wide emissions of CO₂ 100,000 tons by 2011. In partnering with 14 organizations, the Mpowering Madison campaign www.mpoweringmadison.com challenges businesses and residents to act and count their actions in 6 areas: purchase renewable energy, improve energy efficiency, install solar systems, reduce car emissions, plant trees and conserve water. Madison's holistic approach toward becoming a sustainable city is noteworthy.

Introduction

The city of Madison is often referred to as 68 square miles surrounded by reality. It's the state capital and home to the University of Wisconsin. It's the state's second largest city, with a population of 220,000 at a density of approximately 3,000 people per square mile. It lies within Dane county with a population approaching half a million. It occupies an isthmus surrounded by three lakes totaling 16 square miles of water. Madison is located at latitude 43.073 and has an elevation of 876 feet. Both the city and the county are experiencing substantial population growth and with it, environmental and social pressures.

The impact of the city government on the environment can be summarized with some of the following statistics: 750 miles of streets; 6,000 acres of parks; 3.7 million square feet of government buildings; 1,000 vehicles and 60,000 tons of garbage and recyclables. Madison's municipal energy use is 54 million kWh of electricity, 1.3 million therms of natural gas and 2.3 million gallons of fuel for buses & fleet.

Madison City government, as both consumer and steward of the environment and its resources, is committed to incorporate the principles of sustainability to ensure that the needs of future generations can be met with, at minimum, the same quality of human and environmental

health and well-being as enjoyed today. It's working toward that goal by integrating sustainability into city decision making and operations as well as by advancing policies and outreach programs to its businesses and residents working with community partners. The objective of this paper is to examine the process as well as the programs that Madison is implementing as it moves toward becoming a sustainable community. The focus is on those initiatives related to energy efficiency, renewable energy and the reduction of harmful greenhouse gas emissions.

Sustainability, Energy and Leadership

In 2003, Madison Mayor Dave Cieslewicz convened a Mayor's Energy Task force, charging it with devising recommendations to make Madison a green capital city and leader in energy efficiency and renewable energy to support the city's economic vitality. This aggressive agenda stemmed from diverse pressures around energy including: discussion of siting new transmission lines, three polluting coal plants within the inner city, a threat of being designated a nonattainment zone for air quality by US EPA, and the need for energy reliability for Madison's growing biotechnology industry and other businesses. Madison imports 85 percent of its energy with over 95 percent from fossil fuels. That, coupled with the volatility and increasing price of natural gas and oil, the environmental and health effects of Madison's electric power production and car traffic (punctuated by the August 2003 power blackout across the eastern US), prompted a systems analysis and comprehensive approach to restructuring energy use and supply and integrating that into a greening of the city.

The forty members of the Mayor's Energy Task Force divided into a Utilities Infrastructure Committee and an Energy Conservation and Green Building Committee. Their resultant recommendations were presented in a document entitled "*Building A Green Capital City: A Blueprint for Madison's Sustainable Design and Energy Future*" (Gruder, Karolides & Deisinger 2004). The report was accepted by the mayor and unanimously passed by the city council that created the Sustainable Design and Energy Committee September 2005 to implement the Blueprint. The Mayor also provided money in his capital budget to implement programs and a new annual line item for energy upgrades and renewables installations for city facilities. In 2007 a new position of Facilities and Sustainability Manager was created to coordinate and oversee the sustainable city initiative.

In addition, Mayor Dave was the fifth mayor of the now more than 800 that signed onto the Mayor's Climate Protection Agreement, pledging to attain the Kyoto standard reducing global warming pollution levels to seven percent below 1990 levels by 2012 (Nickels 2005). The city became recommitted to its climate protection action plan using the ICLEI- Local Governments for Sustainability program and ICLEI software to redetermine its CO2 emissions baseline. This married energy-related initiatives with climate change goals.

Systems Thinking: The Natural Step

As Gaylord Nelson --Wisconsin's former governor and senator and founder of Earth Day -- stated, "The economy is a wholly owned subsidiary of the environment" (Nelson, Campbell & Wozniak 2002). A Sustainable City recognizes that a healthy environment underpins economic and social well-being. In that context, it attempts to balance environment, economy, and social good. To accomplish that, the first recommendation in the Green Capital City Blueprint is to

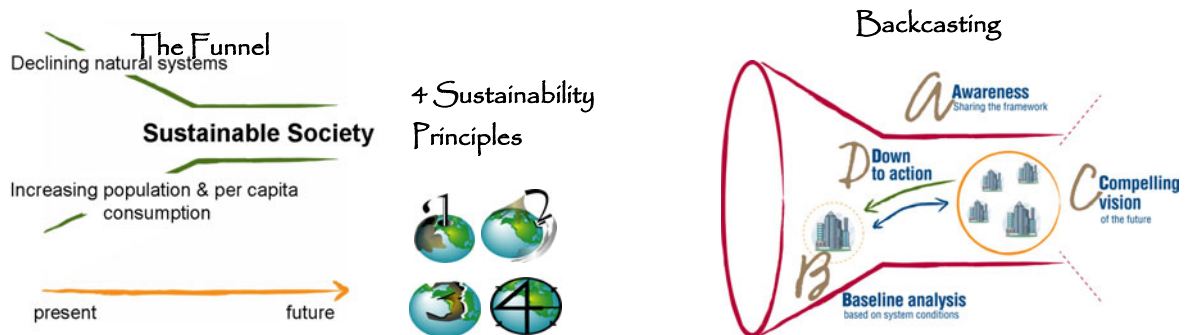
establish a guiding principle on sustainability as a basis from which to evaluate whether decisions and policies are beneficial to Madison in both the short and long term in keeping with its sustainability goals.

This was key. Previously, Madison had undertaken green programs using an issues oriented approach. Madison had been recognized as a leading city in national rankings as a green city, a bicycle city, an arbor city, and for men’s health, working women, etc. Yet, all its green initiatives were scattered throughout city departments with little consistency among them about how or whether they were implemented. There was no person coordinating green city initiatives and related budget and policy development, and no single source of information or measurement protocol.

In December 2005, Madison adopted The Natural Step (TNS) as the guiding framework for the city’s sustainability program. The Natural Step is a science-based, systems approach that creates a common language and measure of sustainability and a framework and process to inform decisions. Figure 1 illustrates the three key concepts of TNS: 1) the funnel that illustrates the unsustainable trends of society; 2) the four systems conditions based on fundamental laws of science that define sustainability; and 3) the strategic planning process of backcasting from sustainability principles –an “ABCD” process that involves assessing the current state relative to compliance with those principles, brainstorming actions and initiatives that can bring us closer to alignment with those principles, then prioritizing those actions and initiatives into an economically strategic plan.

By adopting TNS, Madison is following the eco-municipality model that originated in Sweden, where there is a network of more than 70 eco-municipalities (James & Lahti 2004). Madison was the second municipality in the US to adopt TNS of the now 18 formal eco-municipalities (Gruder et al 2007). Madison is part of a North American Ecomunicipality Network with members from Canada and the US.¹ Also, The American Planning Association (APA) adapted The Natural Step principles as the basis of their *Planning for Sustainability Policy Guide* (APA 2000).

Figure 1. The Three Basic Concepts of The Natural Step: The Funnel, the 4 Systems Conditions or Sustainability Principles, Backcasting as Strategic Planning



Madison adopted a “whole-systems approach” to sustainability with TNS. This requires multiple disciplines and agencies to work together to inform the process and to capitalize on the synergies crossing traditional agency and departmental silos with their heretofore independent

¹ TNS Canada as an organization is a member , <http://www.naturalstep.ca/>

purviews. Staff actively considers the interconnections between systems to seek solutions that address multiple problems at the same time.

Changing "business as usual" across more than 2,700 staff in 25 departments is a challenging and slow process. It requires leadership from the top, including engagement of top staff, assigning responsibility with direct connection to the mayor, expansion of job expectations, and regular reinforcement and reporting. It also requires financial investment and support and outside technical support. In the case of Madison, the city set up staff training on TNS in 2006 with the mayor issuing invitations to 25 high level managers and department heads across 25 departments. TNS Canada was hired to lead the training for several days over three months working with an advisory team of three people from key local nonprofits and the chairs of the Sustainable Design and Energy Committee and the Plan Commission. The training included a train the trainer aspect as well so that the cycle of training would continue in-house to reach across the workforce.

The trainees continue to meet monthly with the Mayor attending every two months, to work on TNS projects in cross agency teams bringing other key staff into the project who became educated in the process. This provides practice in applying TNS and promotes organizational learning at a team level to achieve success. A formalized system was created in which a team leader and cross agency team is identified, a project charter is created,² progress is tracked and results reported. Case studies are presented to the Mayor and community and new projects are chosen. The city Human Resources Department conducts quarterly TNS trainings with staff identified by previous trainees. Currently, 180 key staff has received TNS training.

Energy Efficiency and Renewable Energy

Energy efficiency and renewable energy programs in Madison address government operations as well as community energy use. A combination of approaches is used to implement sustainable energy programs including: interagency TNS projects, prioritized energy efficiency upgrades, policy enactment, targeted renewable energy installations, and community outreach in partnership with businesses and not-for-profits. Through this integrated approach, along with staff trainings on commissioning and retrocommissioning, lighting, HVAC and other energy systems, systematic reduction in fossil fuel use is being achieved.

Madison TNS Projects

Projects using The Natural Step in 2007 and 2008 to improve city government energy efficiency, use of renewable energy and sustainability are diverse. TNS is used to evaluate how and whether each project moves the City toward sustainability by applying three screening questions: 1) is the project improving or achieving each system condition and identifying trade offs involved for each system condition?; 2) does it provide a stepping-stone for future improvements?; and, 3) is it likely to produce sufficient return (social, fiscal and environmental returns) that the City could use to seed future investments? The ABCD process is applied to each project.

² The City of Madison Project Charter is posted on the City's website, www.cityofmadison.com/mayor/

For example, the biofuels conversion of the Rodder Truck-- a giant city sewer roto-rooter, enabled the machine to run on vegetable oil, virtually the same fuel it cleans out of sewer pipes. This conversion and monitoring was chosen as a result of the “B” process or baseline analysis analyzing the impacts of the fuel used in the vehicles in relation to the four systems conditions (TNS Canada 2006) and finding that current practice violated all and was not sustainable.

- *Sustainability Principle 1:* “Is the organization/department/project/ process/product economically dependent on fossil fuels? Are any of the mined materials that we depend upon scarce in nature and, if so, are they safeguarded in ‘tight’ technical cycles or are there substantial leakages anywhere?”
- *Sustainability Principle 2:* “Is the organization/department/project/ process/product economically dependent on substances that are persistent and foreign to nature? Are resources containing chemicals saved throughout the life cycle or are materials used in a dissipative way?”
- *Sustainability Principle 3:* “Is the organization/department/project/ process/product economically dependent on activities that mismanage productive parts of the biosphere? Is it dependent on transportation infrastructure that requires significant encroachment into large natural areas?”
- *Sustainability Principle 4:* “Does the organization/department/project/ process/product rely on inputs that come from regions or companies where authorities create obstacles for people to meet their needs? Does your organization have any practices itself that do so?”

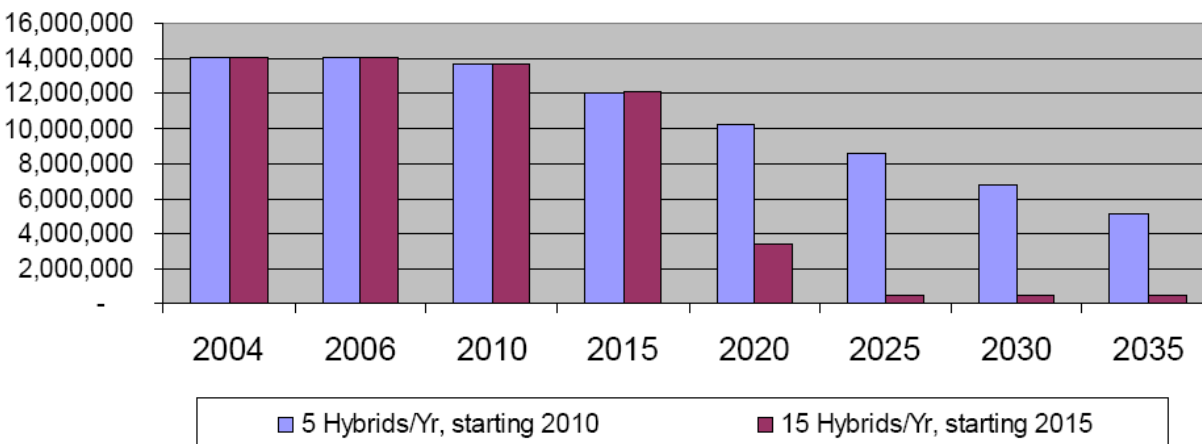
The compelling vision or “C” step that would satisfy each of the sustainability principles was to be fossil fuel free using a product that is part of the natural cycle, i.e. vegetable fuel from food discards. The engine conversion to vegetable fuel reduces particulate matter by 47 percent, carbon monoxide by 48 percent, total unburned hydrocarbons by 87 percent, and sulfates by 100 percent. This improves human health and the environment. Conversion cost \$4500 which will pay for itself in less than seven years. The solution satisfies the screening questions and the triple bottom line. As part of the “D” step or down to action, the two other Rodder trucks will be converted as a result of the positive performance and maintenance of the pilot vehicle once the local biofuels business expands production to meet the demand.

Another TNS project, the zoning code rewrite, involves applying TNS to city operations as well as with the public. This multi-year effort initially focused on the training of relevant City staff in the principles of TNS and the development of the request for qualifications (RFQ) and proposals (RFP) to acquire consultant services for rewriting the zoning code using TNS. TNS will be used as an approach in public meetings and hearings as well as in the code content. The rewrite will incorporate sustainable development standards and approaches including Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND), solar orientation, etc.

Metro transit switched to all ultra low sulfur diesel in 2006 to drastically reduce particulate emissions. As a result of evaluating the most sustainable route to pursue, Metro found hybrid electric buses are preferable to the diesel and to converting to biofuels, which especially impact ecosystems and the ability of people to meet their basic needs. In 2007, Metro purchased 5 new hybrid electric buses or one third of its new bus purchases and evaluated future hybrid

purchases based on CO2 emissions reductions using two scenarios shown in fig 2. This calculation will be used in budget and priority setting deliberations.

Figure 2. Hybrid Electric Bus Acquisitions Impacts on Annual CO2 Emissions (grams per bus mile)



Many TNS projects resulted in creating and adopting government-wide programs and processes replacing the disjointed, agency silo approach. Identifying energy wasters in City government is one such project. This included conducting an inventory of Madison’s buildings and their equipment, and use of electricity and natural gas. Utility Manager software was purchased to help accomplish this. One finding was that each agency had a multitude of lighting types in their buildings and was choosing their own lighting. As one upgraded to efficient fixtures and ballasts, another was replacing their lighting with the old technology that was being changed out next door. As a result, uniform lighting specifications and energy and ventilation standards for all City facilities were formulated.

Similarly, the Green Purchasing Policies: Green Office Initiative involves a printer / multi-functional device assessment for all departments by 2009 budget and creating standards and process for all computer and other electronic purchases, office equipment, furnishings, supplies, etc. Specifics will address purchase, use and disposal of materials.

Another project, public housing energy upgrades to Truax Apartments, served as a demonstration for developing approaches and policies that can apply to all public housing in the City. High efficiency condensing boilers, indirect fired water heaters and an integrated multiple-boiler management control system along with new valves and piping were installed as summarized in Table 1. Annual CO2 reductions are 112.5 tons, or 2,225 tons over the 20 year life of the project. At the same time, Project Home installed faucet aerators, low flow shower heads and compact fluorescent bulbs and insulated attic hatches.

Other TNS projects impacting energy use in city operations include: commuting incentive programs for City employees; reducing fuel consumption and emissions of the City fleet; data center energy reduction; and automated work order system for the City forestry department. TNS projects impacting energy use citywide including residential and business outreach include lower impact lawn maintenance, and solar energy installations.

A systems-wide evaluation of Madison energy use applying The Natural Step ABCD process, and prioritization and execution of city energy projects as a result, has not occurred at this point. This will be attempted later in 2008.

Energy Efficiency Upgrades

Energy efficiency upgrades occur through two channels: they are prioritized as a high impact project and they are incorporated as part of a scheduled repair. Due to the initial capital costs of these projects, only a handful is completed each year. Large projects prioritized for upgrades range from LED traffic signal conversions to lighting retrofits. Beginning in 2007, an energy efficiency assessment has been included as part of facilities repair upgrades so that a project that comes up for a new roof, for example, is assessed for insulation and lighting upgrades at the same time. While the repair costs are paid from the agency's budget whose facility it is, the Mayor's energy capital funds are used for the energy upgrade. Table 1 lists some of the efficiency upgrade projects along with their energy and carbon dioxide savings, costs and return on investment.

Table 1. Madison Energy Efficiency Upgrade Projects

Project	Energy Savings Annually	Costs	Public Benefit Offset	Payback ROI	CO ₂ Saved Annually (tons)
LED Signals 7,000 or 80% conversion	2 million kWh 280kW peak demand		NA	\$240,000/ \$360,00	20,250
Lighting Upgrades					
Streets West	72,796 kWh	\$16,600	\$2,460	121%	58
Streets East	103,414 kWh	\$56,300	\$5,455	33.9%	82.3
Roof Insulation	2,482 kWh	\$30,000	\$971	21.1%	17.8
Traffic Engineering	2,991 therms				
ERV					
Traffic Engineering	1,700 kWh	\$5,000	NA	124.8%	15.2
Sign Shop	2,600 therms				
Lighting Upgrades					
City County Bldg	45,660 kWh	\$28,700	\$3,000	32%	36.6
Municipal Building	33,800 kWh	\$22,750	\$3,000	31%	26.9
Engineering Garage	79,974 kWh	\$19,887	\$3,480	136%	62.8
Boiler Upgrade		\$248,137	\$248,137		112.6
Public Housing					
IT Energy Improvements					
Power Management	200,000 kWh				200

Policies

Madison adopted several policies related to energy efficiency and renewable energy including green building, renewable energy purchase, platinum bike city, infill redevelopment, idling, and water conservation assessment. Madison's green building policy (Gruder 2008) requires that municipal buildings, new construction and major remodels along with existing buildings achieve a minimum LEED silver certification from the US Green Building Council. It also requires that renewable energy be included in energy modeling during design. This ensures that new building stock will at minimum be one third more efficient than code. Currently, there are 5 new building projects being designed and constructed for LEED certification. The Monona Terrace Convention Center earned a LEED for Existing Buildings (LEED-EB) silver

certification in 2007 which paid for itself three times over in the first year through increased bookings.

A renewable energy purchase resolution requires the city to purchase 20 percent of its energy from renewable sources by 2011. In 2007, the city offset 1 percent of its load with renewables. That increased to 14 per cent in 2008.

The City's Common Council passed a resolution to create a Platinum Bicycle Committee to help prepare a plan for Madison to achieve Platinum Bike status. Madison is currently a GOLD Bicycle City through the *Bicycle Friendly Communities program* of the League of American Bicyclists. As of 2000, Madison has 55 miles of off-street designated bicycle and pedestrian paths and 130 miles of signed bike routes on City Streets.

Through its comprehensive smart growth plan, Madison identified opportunities for infill and redevelopment throughout the city; project approvals favor mixed use, transit oriented development, and new urbanism for developing neighborhoods. Among many benefits, these land use policies promote pedestrian, bicycle and transit options to reduce single vehicle car trips.

The idling policy restricts idling of the 1,000 City vehicles to no more than five minutes in a 60-minute period.

The water conservation resolution requires all City agencies and departments to estimate their current water consumption and to come up with a comprehensive list of steps to reduce their water consumption. The water utility is the largest consumer of energy of City operations due primarily to pumping from deep wells

On-Site Renewable Energy: MadiSUN Solar City Program

Madison partnered with Focus on Energy, the state public benefits program, University of Wisconsin-Extension and Madison Gas & Electric (MGE) to secure funding for and implement solar installations. Focus on Energy's Renewable Energy Program, which started in 2002, encourages development of Madison solar supply chain infrastructure with Madison accounting for seventeen per cent of Wisconsin's solar electric capacity funded by Focus on Energy. UW-Extension provides technical assistance and education to the City on sustainable design and energy and sustainable community development and chairs the Sustainable Design and Energy Committee that regularly drafts resolutions and implementation initiatives promoting sustainable energy. MGE supports solar system interconnection and, since late 2007, offers a solar buy-back rate of 25 cents per kWh-- more than double the purchase price for electricity. Madison received grants from the US Department of Energy (US DOE) Million Solar Roofs (MSR) and Solar America City grant programs.

As a result of the MSR grant, Madison hired an energy engineer part time and supported his solar site assessor training. The position was made permanent and full time after one year. He created an inventory of city facilities and determined which would provide the biggest return for solar installations. The inventory and analysis showed that solar thermal installations on city firestations, which are operated and inhabited 24/7, would provide the biggest bang for the buck. Libraries ranked high as candidates for solar electric systems along with some of the most energy efficient city buildings. He wrote RFPs for solar thermal systems for the firestations, worked through the Focus on Energy program to receive state financial incentives to offset approximately one quarter of the cost of systems, and provided oversight for their installation.

The goal of the US DOE Solar America City grant is to double the number of solar installations city-wide from a 2006 baseline to 250kW of electricity from photovoltaics (PV) and 200 solar hot water systems by 2010. It expands the City program to residents and businesses. MadiSUN will address educating and assisting potential solar owners, city decision makers and city staff. Madison hired a Solar Owner’s Agent in April 2008 to provide coordinating services to aid potential solar owners in the decision process regarding systems, installation, financing and permitting. The program will educate institutional gatekeepers as well including architectural review boards, permit office staff, building code and electrical inspectors, property assessors, etc. And, it will include revising building specifications for City buildings using The Natural Step and require energy efficiency and solar applications. Promotion and education city-wide will occur through the Mpowering Madison clean energy challenge campaign described below.

City Solar Installations

Solar thermal installations on all eleven existing firestations will be completed in 2008. Arrays range in size from 96 to 240 square feet with outputs of 94-593 therms (six are 120 square feet and offset 294 therms) depending on the size of the firestations and their occupancy. Total CO2 emissions reductions from on site solar hot water generation will be 17.24 tons annually. A new firestation is under construction as a LEED Gold facility and will also include a solar hot water system.

Solar electric installations or photovoltaics (PV) are evaluated for their visibility to the community as an educational tool as well as for their offsets. Partnering with MGE, the city installed PV on a nine-car parking canopy in the city center next to the Madison Municipal building and two blocks from the state capitol, and on a canopy that provides shade at the public swimming pool. The first city owned PV installation is on an engineering building that is 30 per cent more energy efficient than the ASHRAE 92.1 2004 standard, has been fully commissioned, and will be submitted for LEED-EB certification. Information about some of these systems is presented in Table 2.

Table 2. Solar Installations on City Property

Project	Energy Produced Annually	System Size	CO₂ Tons Saved Annually
Solar Thermal Fire Station 8	422 therms	200 SF	2.24
Solar Electric Parking Canopy	9,300 kWh	8.5 kW	9.3
Shade Canopy At Pool	2,600 kWh	2.1 kW	2.6
Engineering Bldg. Roof -mounted PV	5,250 kWh	4.2 kW	4.2

Community-Wide Clean Energy Challenge: Mpowering Madison

Madison launched a climate change program to reduce city wide emissions of carbon dioxide (CO2) 100,000 metric tons by 2011. The City will reduce its CO2 “footprint” by 25

percent eliminating 15,000 tons of carbon dioxide. The other 85,000 tons will come from residents and businesses. The city partnered with 12 organizations with interest in clean energy and with large constituencies who committed to further develop and promote the program. The Mpowering Madison campaign challenges businesses and residents to act at home, at work, at school and on the go and to count their actions in six areas: improve energy efficiency, purchase renewable energy, install solar systems, reduce car emissions, plant trees and conserve water.

The city and MGE hired a communications firm to work with the partners to develop a media campaign. Called Mpowering Madison (www.mpoweringmadison.com), the campaign was launched October 2007 with a web site, news, radio and magazine ads, bus placards and events appearances.

Within seven months of the launch, 2600 individuals and businesses pledged to reduce their carbon footprint. Of those, 1200 people have signed up for green power for their electricity that came on line January 2008. This is in addition to the existing 4500 subscribers from an old program. Ninety per cent are electing to have all of their electricity come from renewables as compared with twenty per cent previously.

Twenty-five businesses enlisted to be part of an initial pilot of the business program. They range from the UW Credit Union, with its headquarters and four branch banks to a local college, to a remodeling and custom cabinet company and a grocery store. Some of the partners will mentor the businesses to help them achieve the numeric goals of Mpower. Surveys and data collection tools along with a database were developed with testing on a few pilot businesses beginning in April. Active marketing of the program through business associations will occur mid 2008. The business outreach program includes tools, mentoring assistance, communications updates, and recognition.

Utilities Infrastructure

Madison is on the verge of creating a new energy future for the City, working with the state, the University of Wisconsin (UW-Madison) and the public to choose what will replace all five old, dirty, inefficient coal-fired power plants within Madison's downtown. Work started on challenging these plants in 2005 spearheaded by the local Sierra Club. Since then, MG&E has agreed to stop burning coal, the City and the County have committed to reduce their global warming pollution, the Governor has ordered state facilities to maximize efficiency and increase renewables, and a unique coalition of the City, County, UW, State of Wisconsin, and MGE have teamed up to determine the future of Madison's power plants.

The state Department of Administration and UW-Madison held a town hall meeting in February 2008 to help develop the scope for a comprehensive feasibility study to analyze the way the state heats and cools state agency buildings and the UW-Madison campus. It also includes MGE's plant that provides power to residential and business customers city-wide. The state-owned facilities mainly provide steam to heat and cool state agency buildings and UW-Madison. The study will go beyond modernizing the plants to achieve best available control technology to comply with the Clean Air Act to explore more global solutions to address air quality and energy source and systems concerns.

The schedule for this huge study and conversion decision is short, with a town hall meeting addressing study findings in late May-early June, the comprehensive feasibility study completed July 31, 2008, and submittal of applicable construction permits for selected combined

state heat and power options to the Wisconsin Department of Natural Resources no later than November 28, 2008.

Conclusion

The City of Madison uses The Natural Step to integrate sustainability in a systematic way into decision making, policies, operations and capital improvements in all departments. As energy is a common element across many issue areas city-wide, the city has chosen to approach energy in a whole systems community context in keeping with its sustainable city goals. Applying TNS encourages the City to plan strategically for the most sustainable outcomes. Prior to doing so, the City did not have a whole community approach to energy or a vision of a sustainable energy system and it could not assess its fossil fuel use or determine the impacts of its programs to reduce energy use.

Madison's sustainable city program illustrates that many key elements must be woven together to result in whole cloth. These include: leadership on energy from the top, along with designated coordinating staff and clear lines of responsibility and accountability across the organization; partnering with key local businesses, organizations and residents; regular meetings with senior staff across agencies to interact and jointly plan and work toward sustainable solutions; education and capacity-building in sustainability (The Natural Step in Madison's case), energy efficiency, commissioning and retrocommissioning, renewable energy, software, etc.; measurement and reporting, including establishing baselines for city facility energy use, fuel use and CO2 emissions and creating ongoing measurement protocols related to energy and CO2 emissions reductions across agencies; creation of policies and programs that support sustainable planning and development; and telling the story community-wide and eliciting active participation toward reaching goals.

This significant effort requires staff, software, equipment, training, greening of codes and procedures, policy development and time. Madison staff had to be shown and told with regular reinforcement that sustainability is not an added task but an approach to all their work responsibilities and part of their job.

Working collaboratively and facilitating community involvement throughout has been invaluable in creating the plan (40 people on Mayor's Energy Task Force) and in implementing the plan (15 members on the Sustainable Design and Energy Committee and 5 on the TNS planning group). Partnering with the utility, with the Wisconsin Focus on Energy program and with local businesses and organizations on MadiSUN Solar City, the Mpowering Madison clean energy challenge and the coal plant conversions brings diverse input, funds and resources, creates shared values and buy-in, and results in superior and more sustainable solutions.

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