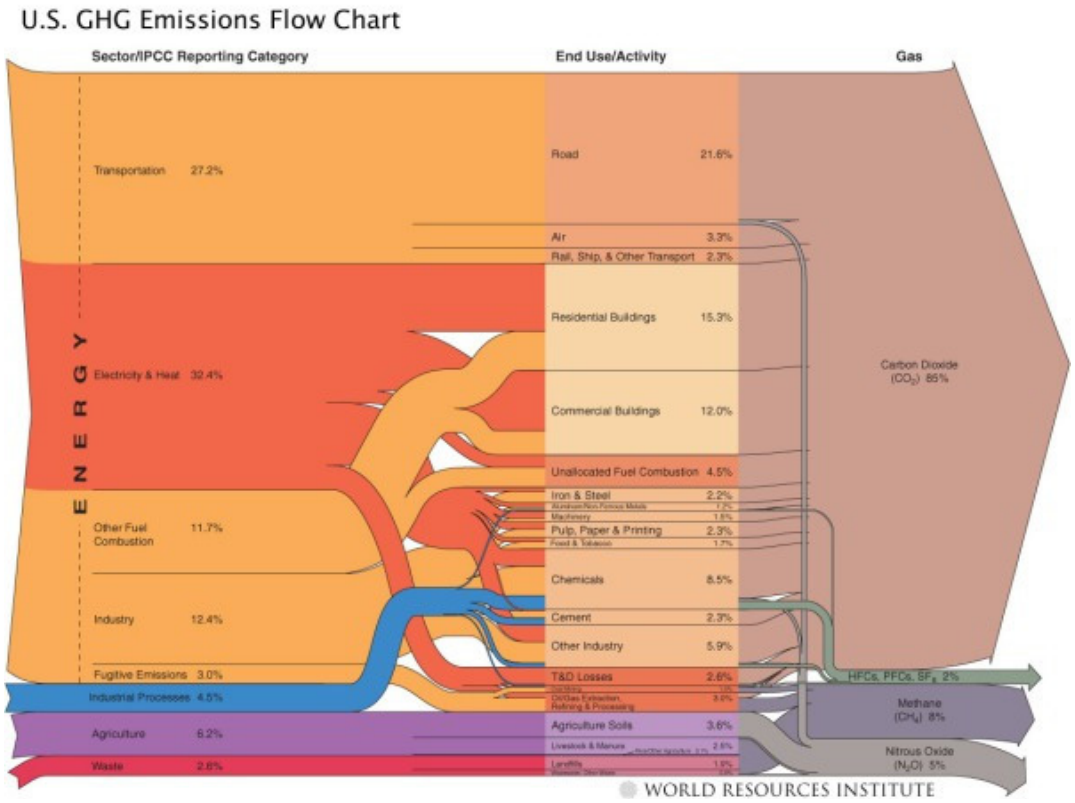

Energy and Climate Change:

Recommendations for the City of Springfield Regarding Buildings, Electricity, and Transportation

Winter • Oregon Leadership In Sustainability (OLIS)

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UNIVERSITY OF OREGON

SCI
Sustainable Cities Initiative

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About SCI

The Sustainable Cities Initiative (SCI) is a cross-disciplinary organization at the University of Oregon that promotes education, service, public outreach, and research on the design and development of sustainable cities. We are redefining higher education for the public good and catalyzing community change toward sustainability. Our work addresses sustainability at multiple scales and emerges from the conviction that creating the sustainable city cannot happen within any single discipline. SCI is grounded in cross-disciplinary engagement as the key strategy for improving community sustainability. Our work connects student energy, faculty experience, and community needs to produce innovative, tangible solutions for the creation of a sustainable society.

About SCYP

The Sustainable City Year Program (SCYP) is a year-long partnership between SCI and one city in Oregon, in which students and faculty in courses from across the university collaborate with the partner city on sustainability and livability projects. SCYP faculty and students work in collaboration with staff from the partner city through a variety of studio projects and service-learning courses to provide students with real-world projects to investigate. Students bring energy, enthusiasm, and innovative approaches to difficult, persistent problems. SCYP's primary value derives from collaborations resulting in on-the-ground impact and expanded conversations for a community ready to transition to a more sustainable and livable future. SCY 2011-12 includes courses in Architecture; Arts and Administration; Business; Economics; Journalism; Landscape Architecture; Law; Oregon Leadership in Sustainability; and Planning, Public Policy, and Management.

About Springfield, Oregon

The City of Springfield has been a leader in sustainable practices for more than 30 years, tackling local issues ranging from waste and stormwater management to urban and suburban redevelopment. It is the first and only jurisdiction in Oregon to create two separate Urban Renewal Districts by voter approval. Constrained by dramatic hillsides and rivers to the north and south, Springfield has worked tirelessly to develop efficiently and respectfully within its natural boundary as well as the current urban growth boundary. Springfield is proud of its relationships and ability to work with property owners and developers on difficult developments, reaching agreements that are to the benefit of both the project and the affected property owners. These relationships with citizens are what continue to allow Springfield to turn policy and planning into reality. Springfield recruited a strong, diverse set of partners to supplement city staff participation in SCYP. Partners include the Springfield Utility Board, Willamalane Park and Recreation District, Metro Wastewater Management Commission, United Way of Lane County, and Springfield School District 19.

Course Participants

Shelley Deadmond, Oregon Leadership in Sustainability Graduate

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Executive Summary

The City of Springfield is interested in learning about its current environmental impacts and ways that it might improve its environmental footprint in the future. The students of University of Oregon course PPPM 607: Energy and Climate Change researched three topics—buildings, electricity, and transportation—related to the City of Springfield's influence on energy use, climate emissions, and quality of life of the community. Based on this research, groups of students made recommendations in these three areas for how the City of Springfield could reduce environmental impacts.

Students also aimed to connect goals of reducing energy use and emissions with goals the City of Springfield has already identified for itself in its own documents, including the city's Strategic Plan and Capital Improvement Program (CIP). Financial responsibility and the effective delivery of government services to promote community livability are two broad goals the City government strives for, and student recommendations are in most cases tied to at least one of these broad goals.

The recommendations are organized based on the three groups of students that worked on each of the three topics — buildings, electricity, and transportation— and the two scopes of influence—municipal (related to the operations of the City government specifically) and community (related to the activities of all of Springfield).The following is a list of students' primary recommendations.

Buildings

Municipal

Perform upgrades to building envelopes, lighting, and equipment to reduce long-term energy use of existing buildings.

Right timing/right sizing: Fold appropriate building efficiency upgrades into the CIP based on already-planned construction and maintenance cycles.

Incentivize employees to use less energy in buildings through increased access to information and programming.

Community

Make information on lowering energy use in buildings more available to the public through trainings, website, and promotional campaigns.

Partner with other agencies such as Energy Trust of Oregon and ENERGY STAR that are already dedicated to reducing buildings' energy use.

Electricity

Municipal

Use advanced metering in city buildings for electricity use feedback.

Use city buildings for renewable energy production.

Community

Foster implementation of “smart grid” technologies in community for modifying electricity demand

Use smart grid technology to facilitate the ability of households and businesses to be ‘prosumers’ (producers for, in addition to consumers of, grid electricity).

Transportation

Municipal

Optimize use of the City’s fleet through appropriate vehicle upgrades, effectively matching vehicle size to use, and replacement of some fuels.

Incentivize City employees to drive less for their commutes through amenities such as bicycle parking and showers, commuter transit passes, preferential carpool parking, and flexible scheduling options for employees.

Community

Incentivize electric vehicle use through development of infrastructure.

Promote “walkability” through intentional planning practices.

Incentivize purchasing of efficient vehicles through “feebate” programs that benefit purchasers of vehicles with good fuel economy.

Introduction

Goals of the Project: The City of Springfield is in the process of implementing and improving its sustainability efforts. City staff members have been working on identifying areas of focus, particularly looking at capital improvement projects. To make more informed decisions regarding sustainability-focused projects, the City is interested in gaining more information regarding its current energy usage and climate impacts, setting up metrics to measure trends in these areas over time, and soliciting ideas from students about potential future actions. This course was the second of two courses aimed at these goals.

Coursework to Support Project Goals: During the fall 2011 term, University of Oregon students in AAA 611: Sustainability Plans and Indictors for Cities, collaborated with City of Springfield staff, with the help of instructor Kelly Hoell of the Eugene-based sustainability consulting firm Good Company, to create a greenhouse gas (GHG) inventory for City of Springfield municipal operations.

There were two main tasks of the City of Springfield Municipal Operations GHG inventory. The first was to compile data regarding the City's energy-consuming operations for the given years studied. This includes direct consumption by the City government, such as combusted diesel fuel in its fleet vehicles, and indirect consuption, such as purchased electricity, employee commuting, and purchased goods. The second task was to translate each of these operations to their associated climate emissions using the Good Company Carbon Calculator (G3C) tool. The outcome of this project was an organized collection of data and the tools and capacity for inputting future data to better understand trends over time.

This effort helped to lay the groundwork for the presently discussed winter 2012 course, PPPM 607: Energy and Climate Change, by developing relationships and building a common sustainability-related vocabulary between City staff, students and instructor, and by generating the inventory of municipal operations GHG emissions.

Starting with this foundation, PPPM 607 students worked in small groups to make recommendations to the City of Springfield regarding future sustainability projects. Students read the book Reinventing Fire: Bold Business Solutions for the New Energy Era by Amory Lovins and the Rocky Mountain Institute (RMI). This book offers a roadmap to move America off of most fossil fuels by the year 2050, and formed a basis for the final project of the course. The project was a series three memos to the City of Springfield regarding energy-related issues in each of the three topics areas of buildings, electricity, and transportation. Students worked in groups of four and five to develop slideshow presentations and memoranda aimed at inspiring and informing City of Springfield staff regarding the themes of Reinventing Fire and their local applicability. As the course name suggests, the memos centered on the topics of energy use and climate change, but they also aimed to support other City goals such as financial responsibility and community livability.

Background: Energy and Climate

Nearly all of the City of Springfield's municipal operations involve energy use and greenhouse gas (GHG) emissions, either directly or indirectly. The vast majority of America's energy usage comes from fossil fuels: coal, oil, and natural gas (Lovins 2011). GHGs primarily enter the atmosphere during fossil fuel combustion, where carbon in the fuel reacts with atmospheric oxygen to form carbon dioxide (CO2), the most common and significant greenhouse gas. A graphical explanation of how energy is used in the United States and how that energy corresponds to GHG emissions can be seen in Figure 1.

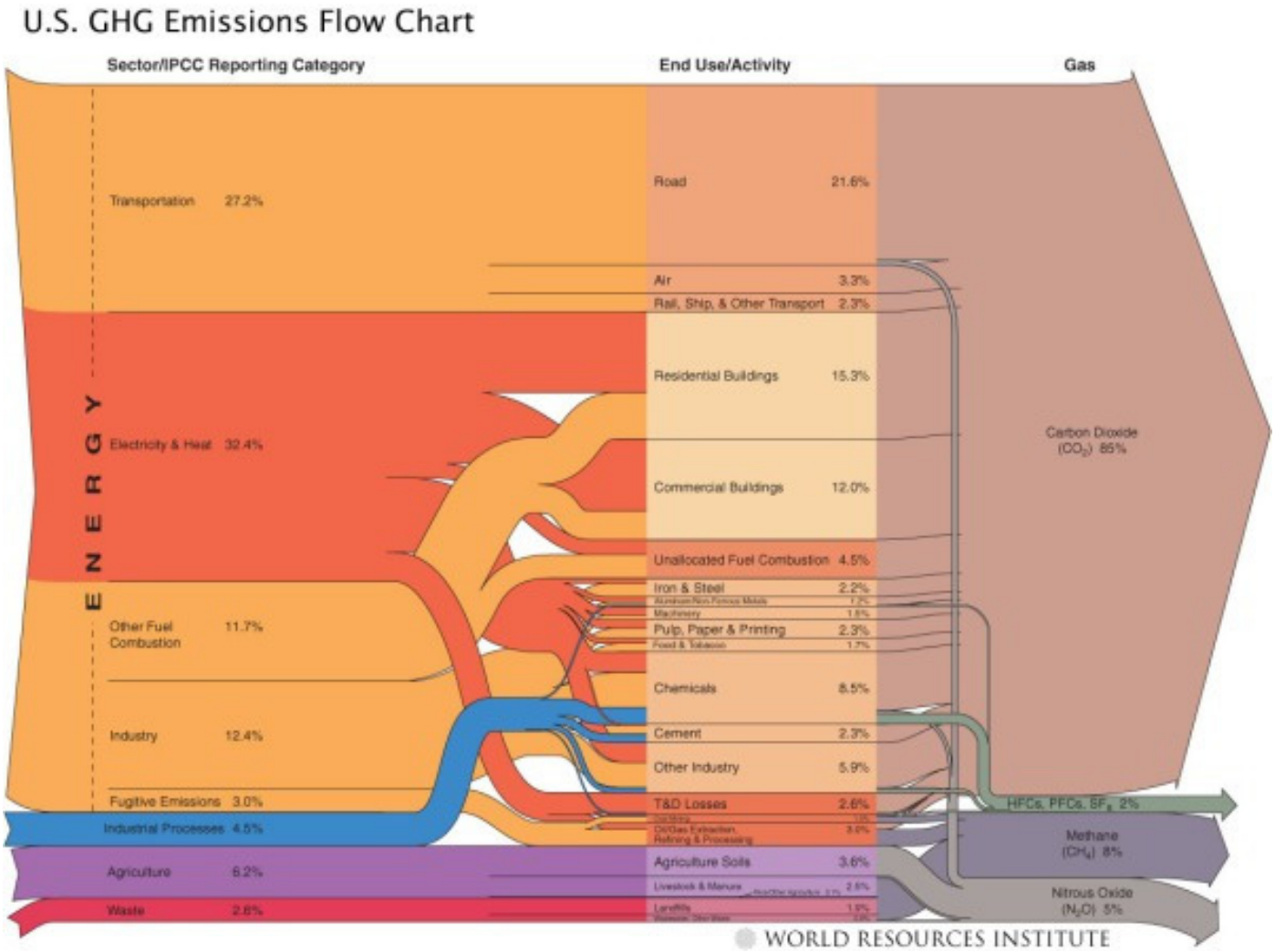

Figure 1: U.S. GHG emissions flow chart. The arrows follow the flows of energy from economic sectors to end uses, and how that energy translates into GHG emissions. Source: www.wri.org.

Given this relationship between the use of energy and the production of GHGs, every therm of natural gas combusted for heat and every gallon of gasoline consumed is associated with a certain amount of GHG emissions, measured in units of Carbon Dioxide equivalents (CO2e). Similarly, as electricity generation involves fossil fuel combustion, every kWh of electricity consumed is associated with a certain amount of CO2e. (While the Pacific Northwest does not rely on fossil fuels as much as many other regions, a portion of Spingfield's electricity does come from fossil fuel combustion). And given that it takes energy to produce, package, and transport consumer goods, from paper clips to sandwiches to asphalt and concrete, everything the City of Springfield purchases is indirectly associated with CO2e emissions.

Major Themes

1. Connected Issues of Energy, Climate, Money, and Livability

All of the recommendations in this report are aimed at reducing Springfield's energy use. While there is a focus in many cases on climate impact, the benefits of reducing energy consumption are far more wide-reaching than just the impact on climate. Efficiency can go hand-in-hand with many of the City of Springfield's organizational goals related to financial responsibility and community livability laid out in the City's Strategic Plan (City of Springfield 2011). Buildings, vehicles, and equipment that use less energy are less expensive to operate, making funds available for other important needs.

Many recommended actions aim to directly improve the lives of City of Springfield staff and community members. For instance, improving the natural lighting in city buildings or making neighborhoods more walkable support people living a more healthy, comfortable lifestyle. In many cases, reduced climate impacts are a by-product of efforts aimed at other goals.

2. The Big Lessons from Reinventing Fire

To drastically reduce America's fossil fuel use, Lovins suggests in Reinventing Fire the three general principles of reduce use, modulate demand, and optimize supply. In Lovins' vision, reducing use means boosting efficiency so that we can get as much or more output from less input of fossil fuel. For example, a well-insulated building requires less fuel to keep it warm in the winter. Modulate demand means better matching the energy we consume to the places and times of higher energy availability. For example, adjusting a business schedule to running machinery at night will cut demand during peak daytime hours. Optimize supply means choosing energy sources that result in fewer GHG emissions, like wind-powered electricity instead of coal-powered electricity, or biodiesel instead of petro-diesel (Lovins 2011). Each of the student recommendations below connects in some way to at least one of these three principles.

3. Two Spheres of Influence: Municipal and Community

The city has influence over two different spheres in regards to energy, emissions, economic activity, and social behavior. First is the municipal sphere: the operations of the city government as an organization, including, for example, government-owned buildings and vehicles. Second is the community sphere: the activities of Springfield's businesses and residents including residential and industrial buildings, local business transactions, and private vehicle traffic.

City government has direct control over decisions pertaining to municipal issues, like whether or not to upgrade lighting in City Hall, or the choice of fuel to use in City government vehicles. While the city government has no direct control over community activities, it can influence energy use, emissions, and economic activities in this realm in a number of important ways through such tools as policy, outreach, and zoning.

Analysis and Recommendations

Note: The following sections of the report are organized based on the three final project groups in the course: the buildings, electricity, and transportation groups. Each group delivered a slideshow presentation and composed a memo to the City of Springfield staff on their particular topic, and the goal of this report is to tie together the work of these three groups from those previous documents. Although some editing has occurred here to maintain clarity, the goal of the following sections is to accurately communicate the ideas of each of these groups.

Buildings

Jennifer Huang, Sarah McNutt, Damond Morris, Brook Waldman, Helen Yang

Background and Analysis

In the City Council approved Strategic Plan, the City of Springfield has developed a broad goal to "promote and enhance our hometown feel while focusing on livability and environmental quality" (City of Springfield 2011). The Buildings Group made recommendations aimed at helping the City address the energy use of buildings to support goals laid out in the Strategic Plan, and towards achieving the vision laid out in Reinventing Fire. As mentioned above, recommendations are organized into two categories of buildings: municipal buildings (those the city government owns) and community buildings (non-municipal buildings within the city boundaries).

The City of Springfield's Strategic Plan and Capital Improvement Program (CIP) do an excellent job of establishing goals, metrics, and baselines. In the actions presented below, the Buildings Group looks at how efficiency measures can relate to the bigger goals of delivering cost-effective government services, maintaining and improving infrastructure, and promoting livability and environmental quality.

The focus is on efficient energy use in buildings, but efficiency is a means towards many goals. Buildings that use less energy are:

Economical: Efficient buildings are less expensive to operate, leaving valuable funds available for other important needs. This relates directly to the City's Strategic Plan goal: "Provide Financially Responsible and Innovative Government Services."

Secure: Fewer energy inputs means better risk management, with more security from rising energy prices, resource scarcity, and disasters.

Comfortable: Efficiency often goes hand-in-hand with adequate heat, cooling, light, ventilation, and indoor air quality, which allows employees to be more comfortable on the job.

Productive: As employees are more comfortable they can be more productive, causing an impact to the organization's bottom line. As stated in Reinventing Fire, "when combined, energy-efficient lighting, indoor air quality, acoustic, and thermal strategies can drive productivity increases of 3-5%, theoretically repaying the initial efficiency investment very quickly and dwarfing the saved energy costs" (Lovins 2011).

While capital improvement costs for making buildings more efficient may seem like large expenditures, it is important to maintain perspective on the potential for long-term savings. The relative cost of construction and capital improvements, as a portion of the overall cost of a typical American building during its useful lifespan, is small compared to the cost of operations (Lovins 2011). Upgrades to lighting, building envelope, and HVAC systems could cost the City up front, but may easily pay for themselves over time. Furthermore, even the combined costs of construction and operations can be dwarfed by the cost of paying the building's employee-occupants over the course of the building's life. Figure 2 shows a simplified comparison of the relative costs of construction, operations and maintenance, and employee salaries and benefits. Understanding these rough relationships may help to put into perspective the costs of efficiency upgrades for buildings.

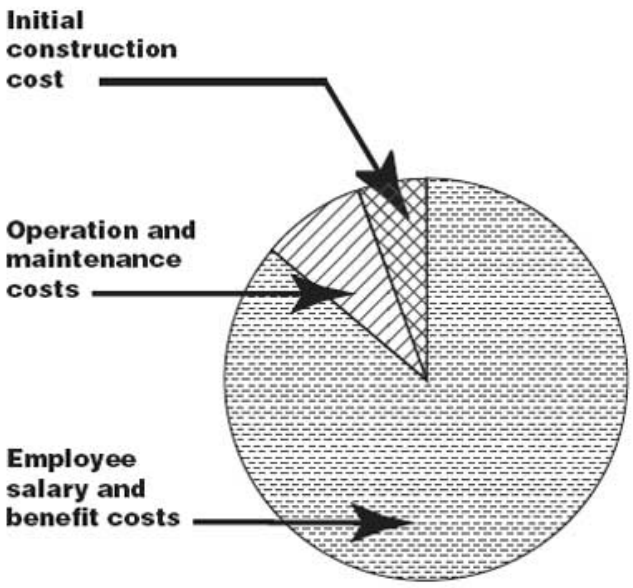

Figure 2: Relative life cycle costs of a typical American office building. While up-front capital costs can feel large, construction upgrades are a relatively small portion of the full lifecycle costs of typical buildings. Investments that improve building performance can generate big savings in the long run by reducing operational costs and increasing worker productivity (Lovins 2011 and United States Forest Service 2010)

Recommendations

Reinventing Fire's stated goal is to make buildings use 54-69% less energy than current projections for 2050 by systematically applying well-known techniques (the first 38% reduction) and capably executing integrative design (the other 16-31%) (Lovins 2011). Springfield can use this recipe to reduce energy costs, saving $83,000 in gas and electricity (38% of the 2010 energy bills from the buildings listed in Figure 3) with relatively simple solutions. If the City can work to create policy that institutionalizes efficiency changes, there is opportunity to save money far into the future. By setting performance standards for each building and constantly seeking new and innovative solutions to meet those standards, energy consumption will drop. The suggestions below are tools and technologies available today, and do not represent the entire toolbox needed to meet performance standards.

Energy use in buildings depends on three basic factors: 1) the building shell, or "envelope"; 2) the equipment inside the shell, including lights, appliances, electronics, and heating, ventilation, and air conditioning (HVAC) equipment; and 3) how all that equipment gets used by the people in the building (Lovins 2011). Each the recommendations below address one of those three factors.

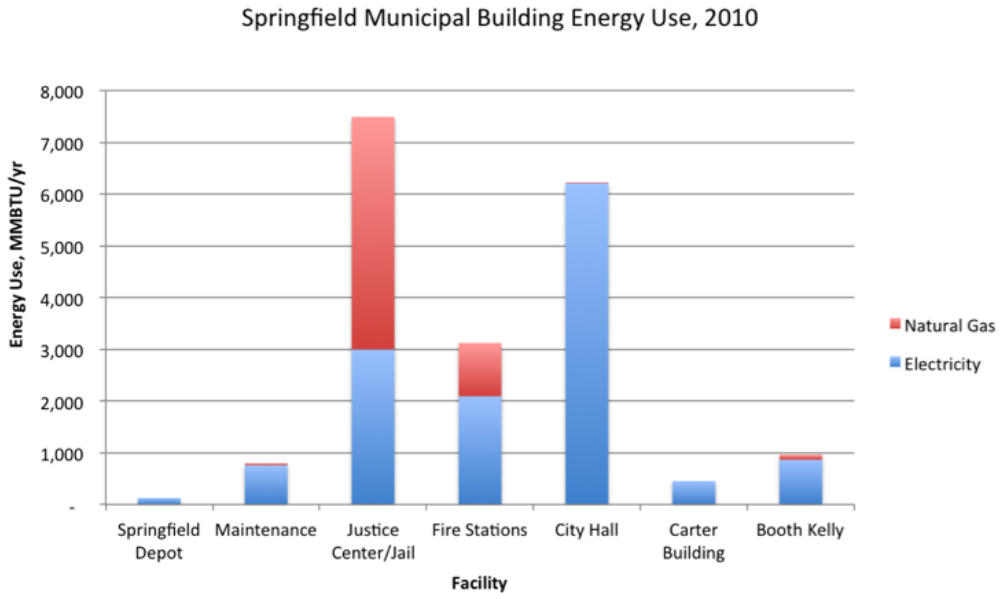

Figure 3: Building electricity and natural gas data is from the City of Springfield's Operations GHG Inventory (Good Company 2012). Conversions from kWh of electricity and therms of natural gas to MMBTU (million BTUs) of energy are based on data from the US Energy Information Administration (United States Energy Information Administration 2012).

Energy use data on a sampling of Springfield's major buildings is shown in Figure 3. Note that while the Justice Center consumes the most energy at the building level, natural gas production and processing is much more efficient than is electricity generation. It takes nearly three units of primary energy (energy spent at the source) to produce one unit of useable electricity, and only

slightly more than one unit of natural gas primary energy to produce one unit of useable natural gas. Therefore, if the graph showed primary energy use, the Justice Center's consumption would be less than that of City Hall, since such a large portion of the Justice Center's energy comes from natural gas (See the US Energy Information Administration at www.eia.gov for more details).

Municipal

Building Improvements: Lighting, Envelope, Mechanical: The CIP discusses lighting and building maintenance and improvements in the Buildings and Property section. According to the U.S. Department of Energy (DOE), 12% of a typical American commercial building's energy consumption is for lighting, and 38% for heating, ventilation, and cooling. Figure 4, from Reinventing Fire, shows similar data on the scale of aggregated national energy consumption of buildings. A simplified strategy to address building efficiency improvements may involve focusing on these two types of needs.

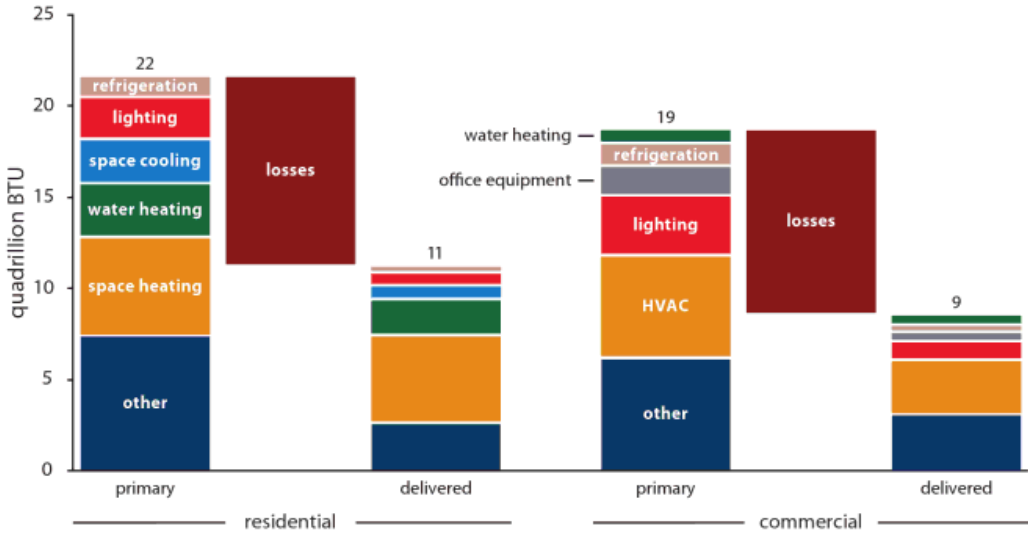

Figure 4: U.S. buildings' 2010 energy consumption by end use. This graph demonstrates the significance of lighting and HVAC in commercial buildings' energy use, and the large amount of waste that happens in converting primary energy to delivered electricity. Source: Lovins 2011

The City of Springfield has already taken advantage of opportunities for building-wide lighting upgrades, utilizing federal grant and stimulus money to replace lighting in City Hall. Similar measures for other buildings, with the eventual goal of replacing all incandescent and outdated fluorescent lighting in all City buildings, could cut the City's lighting electricity consumption significantly.

To address heating and cooling needs, there are two major building systems to focus on: the envelope and the mechanical systems. Building envelope improvements, particularly insulation and air-sealing improvements, can cut building energy use significantly by drastically reducing the amount of wasted heat or cooling the building's HVAC system must produce to keep occupants comfortable. Installing energy efficient windows, doors, and siding can be costly, but if timed correctly (see "Right Timing" note below) the cost of these improvements can be reduced.

As an example of potential upgrades for HVAC equipment, heat pumps, which use a compression cycle similar to that of a refrigerator, are many times more efficient at using energy to produce heat (and cool) than most conventional gas and electric systems. If the City can gradually replace old mechanical systems with new super-efficient systems like heat pumps, this can cut energy use and utility bills greatly in the long run, despite initial investment costs (Lovins 2011.)

Integrative Design: Well-designed buildings that are highly insulated, with proper solar orientation, natural light, and good ventilation can be much less expensive to operate than more conventional buildings. While the previous section discussed measures for retrofitting existing buildings, the design and construction of new buildings offer opportunities for more far-reaching goals of efficiency. As the City prepares to build a new library, it can work with stakeholders and designers to integrate efficiency measures in the new building.

Green Roof: The City of Springfield's CIP discusses goals to more effectively manage storm water runoff, including reducing volume of flows and addressing Total Maximum Daily Load (TMDL) limitations of certain pollutants (City of Springfield 2011). Green roofs are building-related components that reduce runoff volume and filter pollutants. The Environmental Protection Agency (EPA) has outlined how "green infrastructure" development projects, including green roofs, can reduce TMDL levels of pollutants (United States Environmental Protection Agency 2008).

Figure 5: Example of green roof in Chicago. Source: burnhamplan100.lib.uchicago.edu

Besides these storm water effects, green roofs offer a number of additional benefits: they increase the lifespan of roofing membranes by protecting them from ultraviolet (UV) radiation, lower heating and cooling costs through improved insulation, reduce summer ambient air temperatures, and provide aesthetic quality. (United States Department of Energy 2004)

Precedent: The City of Chicago has implemented an aggressive green roof campaign and has seen significant reductions in storm water runoff (City of Chicago 2004).

Right Timing: While a large-scale capital improvement project aimed at improving a building's efficiency, such as a mechanical system or envelope overhaul, is often prohibitively expensive, when timed with other needed maintenance projects, these improvements can be folded in relatively easily. The CIP outlines many needs for its facilities. The City can complete efficiency upgrades in coordination with regular maintenance cycles. With its already-planned capital projects, Springfield will have many opportunities for upgrades in the near future.

As Lovins puts it, "if right-timed, efficiency projects often end up as a small incremental cost on efforts largely undertaken for other reasons, such as new construction, expansion, conversion, or major renovation…If not right-timed, as is often the case in incremental retrofits, you can end up trying to justify the entire cost of a new chiller plant or wall insulation through energy savings, and that seldom works out" (Lovins 2011).

For example, it would likely not make sense to replace old windows and insulation for a City of Springfield building in most given years. But if a major renovation is eventually funded, where the building expands and siding needs to be replaced, it may not cost significantly more to replace insulation and windows.

Right Sizing: As the City makes changes to buildings to make them more efficient, it will become important to pay attention to the sizing of new building systems. When replacing an old HVAC unit for example, simply replacing what was there before with the same size unit may be a missed opportunity. If the City can make a building more efficient, the building would likely require a smaller HVAC system. This could save money in both up-front capital costs and longer-term maintenance and operations costs (Lovins 2011).

Employee Culture: No matter how efficient or inefficient the physical systems of a building are, it is the building's occupants that ultimately have the power to use more or less energy through their actions. Simple concepts like turning off unused lighting and turning down a thermostat involve little or no shift in technology or financial investment, but can involve a shift in culture.

Information Access and Feedback: There can be a negative reaction to the idea of shifting behavior patterns, with the thought that this necessarily means choosing discomfort or privation. The idea is to empower employees to make smarter choices by increasing their access to information. Reinventing Fire offers this example. "Most people are unaware of how much energy they are using—and how much is being wasted. When more than 1,000 guests at a 1997 Interface corporate conference at Maui's Grand Wailea hotel were given daily feedback on how they could save energy, water, and waste by following simple tips without sacrificing comfort, the property's energy use fell 22% in just six days" (Lovins 2011).

Precedent: Raytheon, an aerospace and defense company, created a wide array of energy conservation projects through their Enterprise Energy Team to raise employee awareness on a personal level. The outcome of this initiative is that energy consumption has declined 13% since 2002 (Raytheon 2012).

Friendly Competition: Intra- and inter-organization competition has the potential to help galvanize employees around energy conservation measures. One national-scale example is ENERGY STAR's Battle of the Buildings, where owners and occupants of commercial buildings compete to improve their buildings' energy performance (Energy Star 2012). Reinventing Fire offers this example:

> "Providing just a little bit of information can change behavior. For instance, letting people know how their energy consumption compares to their neighbors' can stir the competitive juices and reduce use markedly. Onpower, a start-up based in Arlington, Virginia, included reports in Sacramento households' bills comparing energy consumption among neighbors and offering recommendations on how to reduce it, such as turning down the heat when you leave the house. Participants cut their energy use by 3% on average….and new technologies, such as smart meters, are making this sort of information more widely available and easy to apply" (Lovins 2011).

Community

There are a number of immediate steps that the City of Springfield can take to encourage energy efficiency in buildings that exist outside its scope of direct control. By influencing the larger community with a few low-cost immediate actions, the city can set the stage for future development and move towards its Strategic Plan goal of "encouraging economic development and revitalization through community partnerships" (City of Springfield 2011).

Residents, small business owners, and industry leaders are often unaware of financial and technical assistance programs for building efficiency upgrades, and are therefore reluctant to initiate new energy efficiency projects that utilize younger technologies. For this reason the city government can serve as an intermediary, putting residents and businesses in contact with those who can provide financial and technical assistance, such as the DOE and the Energy Trust of Oregon. This intermediary position could include a variety of roles and strategies:

Workshops & Training: Inviting energy efficiency experts like the Energy Trust of Oregon to present a series of training workshops and informational panels on how to increase energy efficiency in homes and businesses is a great way to educate residents of potential benefits and opportunities.

Consolidated Energy Efficiency Website: Creating an online and easily accessible database of local resources available to individuals interested in learning more about energy efficiency is another relatively low-cost way to raise awareness. A number of cities, including Portland, Oregon, provide links directly from their community websites to pages that contain useful information highlighting the long-term cost savings and health benefits of energy efficiency in building operations.

Public Service Announcements: The City government has the capacity to use multiple venues such as City Hall, the Springfield Library, or a website, to make announcements that highlight efficiency innovation.

Partnerships with Other Agencies and Efficiency Promotional Campaigns

ENERGY STAR, a joint program of the DOE and the US Environmental Protection Agency, offers programs exclusively targeted at creating partnerships with local government agencies to increase energy efficiency within communities, often helping to create a campaign unique to a community's particular goals. These campaigns are often framed in the context of a competition where local businesses are invited to join and can receive tools to increase their energy efficiency and gain positive marketing. One example of this type of partnership is the Watts to Water program of Denver, Colorado, where the city government partnered with ENERGY STAR to create a program targeting energy efficiency and water conservation efforts in office buildings and hotels. A complete list of all the programs created in 2011 can be found at ENERGY STAR's website, energystar.gov (Energy Star 2012).

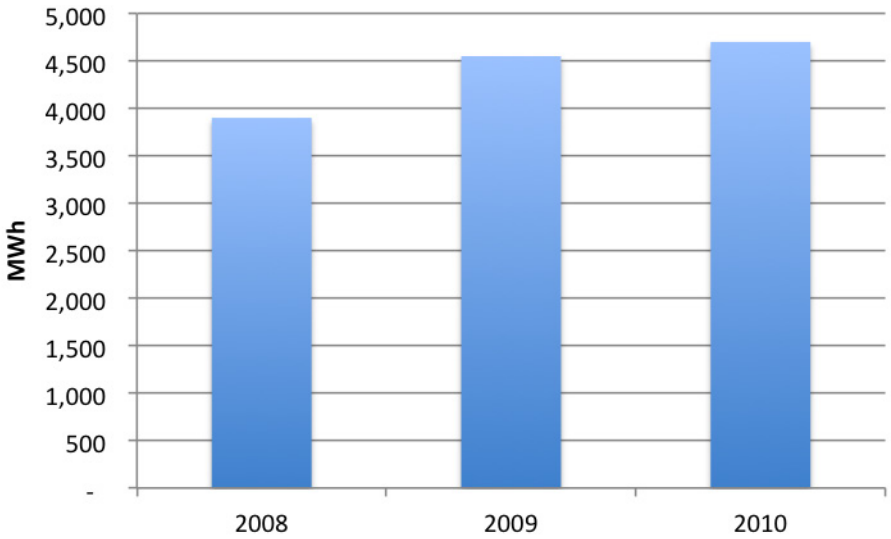

Figure 6: City of Springfield Total Electricity Consumption 2008 – 2010. Source: Good Company's Carbon Calculator v3.2 – City of Springfield Operations GHG Inventory Results.

Electricity

Brandon Grilc, Joe McAndrew, Greg Michaelson, and Stephen Rafuse

Background and Analysis: Springfield Electricity

Big Picture: Reinventing Fire and Electricity

The Rocky Mountain Institute has set an ambitious goal of generating 80% of its electricity from renewable energy by 2050. In Reinventing Fire, Lovins models several possible scenarios for electric generation in the future. These scenarios are based on five evaluation criteria: technical feasibility, affordability, reliability, environmental responsibility, and public acceptability. The “Renew” and “Transform” scenarios offer a bold new vision for the future for cities and power grids.

Renew – This scenario examines a future in which 80% of electricity generated in the U.S. comes from renewables such as wind, solar, geothermal, biomass, and hydro. The Renew scenario also employs the use of smart grid technology to improve demand response through multidirectional flow of communication and energy. This allows customers to monitor energy consumption. At a national level, initial capital investment would be twice the business-as-usual approach - $7.3 trillion. However, capital cost would be offset by lower fuel cost over the next 40 years.

Transform – Building upon the renewable energy strategies laid out in Renew, this scenario calls for a restructuring of our grid’s architecture. Today’s current centralized grid network results in great inefficiencies, costing utilities and customers money while harming the environment. The grid in a Transform future exploits renewables’ geographic and technological diversity to distribute electric generation closer to customers in the form of micro-grids (Lovins 2011).

Local Picture: City of Springfield and Electricity

Current Situation

As a large consumer of electricity, the City of Springfield has an opportunity to save money from energy efficiency measures and diversification of its electricity sources. Figure 6 shows that the City of Springfield has increased its electricity consumption by more than 800 megawatt hours (MWh) from 2008 to 2010 (Good Company 2012).

Figure 7 shows the City's largest consumers of electricity from 2008 to 2011. City Hall is the largest consumer of electricity, followed by an aggregate of all other city-owned buildings, most notably, the Justice Center, the Pump/Lift stations, and the Springfield Museum (Springfield 2010).

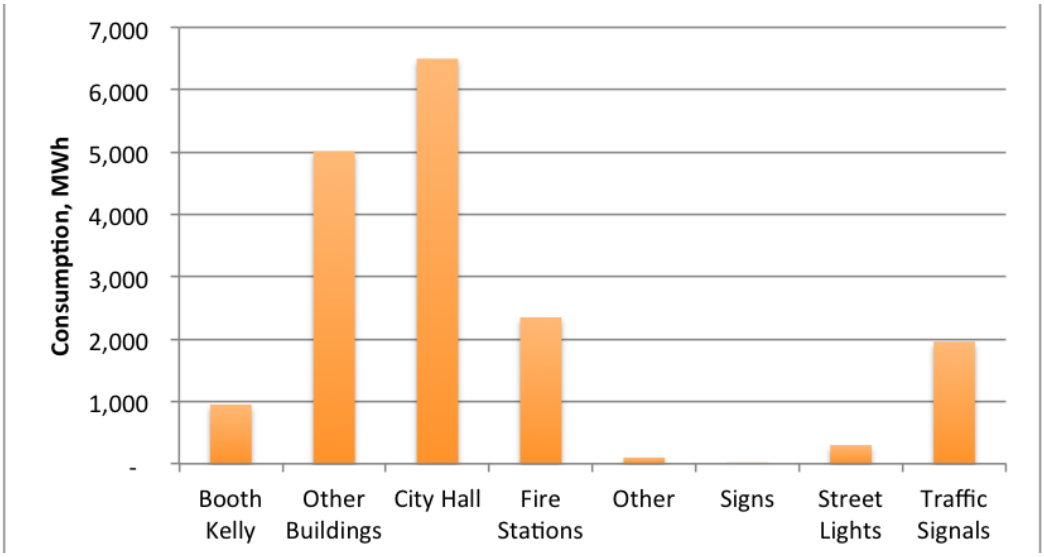

Figure 7: City of Springfield Key Electricity Consumers 2008-2011. Based on the 45 month period January 2008 – September 2011.

The City of Springfield purchases 100% of its electricity from the Springfield Utility Board (SUB), a publicly owned electric utility that acquires all of its electricity from the Bonneville Power Administration (BPA). BPA produced power is part of a regional grid, the Northwest Power Pool (NWPP), as defined by the EPA. BPA is a federal agency that delivers and sells electricity, which is primarily generated from government-owned dams along the Columbia River. Through BPA, SUB acquires over 80% of its electricity from hydroelectric dams, 10% from nuclear power plants, nearly 6% from coal, and the remaining from wind, biomass and natural gas (Springfield Utility Board 2012).

Currently, the City of Springfield is purchasing its electricity from SUB at an average rate of 3.13 cents per kWh. From January 2008 to September 2011, the City of Springfield consumed 17.3 million kWh, at a cost of $5.4 million (City of Springfield 2010). BPA recently increased its electricity rates. This has prompted SUB to pass a 4% rate increase, with another 4.5% increase expected in November 2012 (Dietz 2011). Assuming the City's demand remains constant, the resulting rate increase will cost the City of Springfield, on average, more than $4,500 per month.

Future Uncertainties

According to the Intergovernmental Panel on Climate Change (IPCC), global average temperatures are increasing due to anthropogenic (human-caused) contributions of greenhouse gas emissions to the atmosphere, altering our relationship with our environment.

The effects of climate change, especially those regarding water supplies and hydroelectricity production, may significantly impact City operations. According to the Oregon Climate Assessment Report, published by the Oregon Climate Change Research Institute, “summer water supply will decrease as a result of reduced snowpack and summer precipitation” (OCCRI 2010). This may have direct impacts on electricity production in Oregon. Early planning may help to mitigate some of the potential negative impacts.

Projected Electricity Reliability and Costs

According to the Climate Impact Group, an internationally recognized climate change research organization, projected global climate change will influence precipitation patterns, which will directly affect our region’s hydrology. This change will likely alter patterns of electricity demand within the Pacific Northwest’s hydroelectric power network (The Climate Impact Group 2005). Without proper mitigation, planning, and the will to diversify electricity sources, these effects will reshape the landscape of how the City of Springfield gets its electricity.

Projected climate change is likely to exacerbate competition over water resources and increase water and electric rates. This will increase costs for the City of Springfield and make it more difficult for electricity providers to rely on hydroelectric sources to meet demand (The Climate Impact Group 2005). This may force SUB, BPA, and NWPP to turn to less clean sources for electricity, such as coal and natural gas, which will increase the City of Springfield’s GHG emissions.

Recommendations

Municipal

Reduce: Improve energy efficiencies for all City of Springfield departments through advanced metering and annual benchmarks set by the Administration. This strategy could be included in the City of Springfield's Strategic Plan under the goal "Promote and Enhance Our Hometown Feel While Focusing on Livability and Environmental Quality."

Modify Demand: Provide real-time data to city staff through electricity meter reading displays as well as through a City of Springfield website. Public recognition of the City's operational consumption may influence staff members to alter their electricity use. Additionally, providing this information to the greater community creates a transparent way for residents to follow the City of Springfield's consumption patterns.

Optimize Supply: The City of Springfield could become a producer of renewable energy to minimize future electricity rate increases due to projected effects of climate change. This strategy would support the City of Springfield's Strategic Plan's goal to "Provide Financially Responsible and Innovative Government Services."

Community

Reduce Use, Modify Demand, and Optimize Supply with Smart Grids

The Electricity group suggest that the City of Springfield collaborates with SUB to plan and develop a "smart grid" system. A smart grid energy system provides real-time energy consumption information to residents and businesses. Providing real-time consumption information allows users to understand their demand and turn off high energy-consuming devices when not in use.

Smart grid systems can also modify demand by enabling consumers to become "prosumers", individual producers of electricity who can supply power back to the grid. As a smart grid system could provide multidirectional information and energy flow, a household with rooftop solar panels or a plug-in electric car, for instance, could (a) send electricity into the grid and (b) do so when it is needed most. The dual direction of distribution is matched with real-time energy information that prosumers can use to sell expendable renewable energy to SUB when the price is high and use for personal consumption when the price is low. This modification allows maximum return on renewable energy investments for prosumers, which in turn lowers the return-on-investment period.

Development of a smart grid system is a large step to take, but has many benefits to all community members. Not only can prosumers buy and sell when the price is right, but a smart grid system would be built and serviced by a "clean

and green" workforce. This could create jobs and attract "green" businesses to Springfield, and this workforce would help to create high-quality energy infrastructure, optimizing SUB's energy supply.

Funding

Local – SUB provides three incentive programs available to the City. First, a program is available for commercial rebates for existing lighting. This lighting retrofit rebate can be used at any commercial or industrial facility for up to $1,500. The City may also qualify for the commercial lighting implementation program – a custom program that pays for lighting retrofits. Since the City of Springfield is a major stakeholder and can employ efficiency measures on a large scale, the City may seek to work with SUB to extend the incentive past the $1,500 maximum. The City of Springfield has done a good job utilizing the free energy audits that SUB offers, and the Electricity group recommends that the City continue to utilize this service to further its buildings' efficiencies.

State – The City of Springfield may be eligible for an Oregon DOE tax credit, which covers up to 50% of project costs for renewable energy resource generation. This credit could be used, for instance, to install solar equipment on many of the City's facilities. The tax credit is generally taken over five years at 10% per year. The DOE Business Energy Tax Credit Pass-Through option, which allows public agencies to transfer their credit to an entity with a tax liability in exchange for cash payment upon project completion, may be available for the City to take advantage of. More information about this can be found at the Oregon Department of Energy's website. (See references.)

Incentives and Funding		
Local: SUB	**State: DOE**	**Federal: TIAP**
Free Energy Audit	Resource Generation Credit Covers 50% of Project Cost	Renewable Energy Credit Covers 30% of Project Cost
$1500 Lighting Retrofit		
Custom Lighting Retrofit		

Table 1: Incentives for electricity projects.

Federal – The City of Springfield qualifies for a federal incentive to generate on-site renewable energy. This incentive is available through the TIAP and covers up to 30% of the system's costs for qualified solar water heating, photovoltaic systems, and certain solar lighting system.

By utilizing available incentives and funding, the City of Springfield can take the first steps toward a more energy efficient and productive future. The Electricity group speculates that the money saved from retrofit efficiency upgrades can be reinvested in the community or applied towards future efficiency projects. One way to navigate the complex system of funding is to hire an Efficiency Manager who can apply for grants and conduct energy audits. In a time of scarce resources, it may seem unreasonable to hire additional staff. However, gains in efficiency could offset any additional cost over the long run.

The Electricity group proposes that the City of Springfield consider the creation of the Efficiency Manager Internship/Fellowship position. A Fellowship will not only save the City money, but also familiarize the individual with the City staff and protocol. Gradually, this position can turn into a full-time position as grant funding and cost savings from efficiencies accumulate. As funding becomes available, the Efficiency Manager would be responsible for acquiring his/her own funding. By using a low-cost/no-cost financing mechanism where savings are rolled over in an account for future projects, the position could pay for itself.

A responsibility for the Efficiency Manger would be to document and create a database of the buildings and fleet, and monitor any gains made in efficiency of HVAC, lighting, sub stations, traffic lights and other systems. This could potentially be integrated with the CIP, which already addresses ongoing maintenance and replacement needs. Another aspect of the database would be to track the systems with the worst efficiencies and the costs associated with them. This information could be crucial for future upgrades and could also support a pilot program to actualize potential savings on more efficient systems.

Transportation

Shelley Deadmond, Steven Richter, Jesse Rodenbiker, Rena Schlachter

Background and Analysis: Springfield Transportation

Reinventing Fire and Transportation

In the Reinventing Fire future transportation scenario, the U.S. is almost entirely relieved of its demand for fossil fuels. A complete overhaul of the materials used to produce vehicles will make them ultra-light yet strong, more aerodynamic, and electrically powered. The requisite technology to make this vision a reality exists now, yet the momentum for it to manifest depends on the decisions of policy makers and consumers. These technologies must be supported with innovative policies from government and business leaders to enable them to take root in the U.S. economy.

City of Springfield Transportation Data

Based on GHG emissions data gathered by the City of Springfield, transportation activities constitute a significant portion of total municipal emissions. Of the 40,000 metric tons of carbon dioxide equivalent (MT CO2e) produced from 2008 to 2010, 17% were generated by transportation activities including fleet and commute (Good Company 2012). The City has direct control over emissions from city-owned vehicles, and significant influence over employee commuting patterns.

Fleet: Currently, the City owns 229 vehicles. Of those, 165 use gasoline and 64 use diesel. The median vehicle model year is 2002, although fuel consumption is skewed towards newer vehicles.

Commute: Of participants in the City employee commute survey (Figure 8), the significant majority (84%) of employees drive alone to work. Currently, City of Springfield employees commute an average of 22 miles a day. An estimated 23% of City employees commute 30 or more miles a day. Over 64% of these long-distance commuters, and over 59% of all employees, polled via a city-developed commute survey, said they would be inclined to utilize alternative transportation modes if additional resources were provided such as improved bike parking, showers, emergency ride availability, flexible scheduling, and free bus passes (City of Springfield 2012).

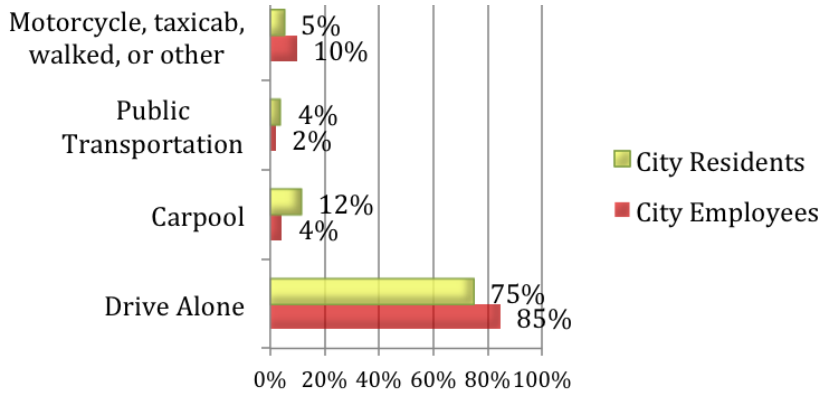

Figure 8: City of Springfield commuter survey results.

Recommendations

The Transportation Group identified four objectives, and many specific action strategies within each objective, that relate to transportation planning and operations and aim to help the City of Springfield meet its 2011 Strategic Plan goals. They have also related each objective with particular Strategic Plan goals. The objectives are:

- Optimize City-Owned Vehicle Use
- Promote City Employee Alternative Transportation Use
- Implement an Electric Vehicle (EV) Public Charging Facility Program
- Adopt Innovative Transportation Policies and Regulations

Municipal

Objective: Optimize City-Owned Vehicle Use

Related Council Strategic Plan Goals

Goal 1: Provide Financially Responsible and Innovative Government Services

Goal 2: Encourage Economic Development and Revitalization through Community Partnerships

Action - Buy Vehicles that Consume Alternative Fuels

There are several viable fuel alternatives to gasoline and diesel fuel, including electricity, biodiesel, compressed natural gas (CNG), and propane. CNG and propane vehicles require costly infrastructure. Hybrid electric and biodiesel are the preferred options for vehicles driven more than 40 miles per day. Hybrid electric vehicles are efficient but require an initial investment. A switch to biodiesel would likely require the least up-front costs, as Springfield's existing diesel vehicles could run on biodiesel and there would be no need for new vehicles or vehicle modifications to make the switch. SeQuential Biofuels is a local provider.

The City can replace vehicles used solely for short trips with electric or hybrid vehicles. These have higher up-front costs compared to conventional vehicles, but, due to reduced fuel expenditure and rising costs, cost less over the life of the vehicle. For estimations of GHG reductions and the accumulated discounted cost of ownership, the City may use the free Alternative Vehicle Decision Tool found at extension.umn.edu/energy/vehicle.

Action - Downsize Vehicles

The City of Springfield could work to ensure the size of a fleet vehicle matches the job specific duties it will need to perform. When possible, the City could replace vehicles with smaller or more compact models, and/or encourage employees to perform tasks on foot or bicycle.

Precedents: Vehicle specifications in Louisville, Kentucky, are based on the minimum power needed for a task, resulting in the purchase of smaller vehicles (Drumheller 2011).

The police department in Dayton, Ohio is saving 2,700 gallons of gasoline and 7.5 tons of CO2 a year by using bicycle patrols instead of police cars (Drumheller 2011).

Action - Use Vehicles Efficiently

Small adjustments to vehicle usage patterns, maintenance practices, and driver behavior can have significant effects on the efficiency of the City's vehicles. Employees can schedule tasks so that multiple duties occur within a single trip, and/or share vehicles among departments. Ensuring that oil is changed regularly and tires are kept at the correct pressure reduces fuel consumption. Finally, preventing vehicle idling (with trucks in particular) is an important step towards efficient vehicle use.

Precedent: The City of Edmonton, Alberta increased average fuel economy by 20% by coaching employees on fuel-efficient driving (Drumheller 2011).

Action - Utilize Routing Software

There are multiple commercially available software packages that use GIS technology to optimize logistics and efficiency. The City can incorporate these tools to estimate stopping and starting, distance travelled, speed changes, and street slopes to minimize fuel consumption.

Precedent: Route optimization for solid waste trucks in Toronto, Ontario, is saving 140,000 gallons of fuel and reducing CO2 emissions by 1,500 tons a year (Drumheller 2011).

Objective: Incentivize City Employees

Related Council Strategic Plan Goal

Goal 4: Foster an Environment that Values Diversity and Inclusion

Action - Flexible Shift Times

Many city departments could implement flexible start and finish times. Employees worry that they are subject to being tardy due to unforeseen issues with the bus schedule, carpool driver, helmet hair, etc. Allowing employees a 15-30 minute "window" for shift times may encourage employees to utilize alternative modes of transportation.

Precedent: The City of Meridian, Idaho allows employees flexible working hours. Employees have the option to adjust the number of days they work in a week, or the number of hours per day, or start and stop time, as long as they work a total 40 hours per week. This allows commute times to change, easing congestion on the roadway during peak hours (City of Meridian 2012).

Action - Preferential Parking for Carpoolers

As a carpooling incentive, several parking places near the front of City buildings can be marked for carpools only. This strategy is used in the Leadership in Energy and Environmental Design (LEED) framework within the "Sustainable Sites" category of credits. For information on this, see LEED's SS Credit 4.4: Alternative Transportation: Parking Capacity (United States Green Building Council 2005).

Action - Paid Parking Programs

Paid parking programs involve paying employees for the value of their parking space and then charging them the market price if they choose to drive their car and park. Staff could choose to keep the funds by coming to work through alternative means such as carpooling or public transport, or they could spend the extra money. This has the potential to increase equity for employees and increase demand for alternative modes of transportation instead of single vehicle occupancy (Victoria Transport Institute 2011, US EPA 2001).

Precedents: The Vancouver Airport offers a $50 rebate to staff that do not travel to work alone (Victoria Transport Institute 2011).

Boise City employees can participate in the Boise Employee Alternative Transportation (BEAT) Program, which provides incentives such as $40 per year for walking shoes for employees who walk to and from work at least 60% of the time between April and October (City of Boise 2012).

Action - Commuter Bus Pass Subsidies

Currently, the City of Springfield participates in Lane Transit District's (LTD) Commuter Club program, which allows employees to purchase monthly bus passes for over 50% off. According to the recent City of Springfield Commute Survey, over 70% of City employees are aware of this program, however only 6% participate in it. In Springfield, 23% of City employees commute over a distance of 30 miles or more (round trip) a day. Over 64% of these long-distance commuters suggested that they would be inclined to take alternative transportation modes with additional resources. If these employees were offered a larger subsidy for monthly bus passes, VMT could be reduced by over 450,000 miles a year, corresponding to nearly 250 MT CO2e.

Precedents: The City of San Diego, CA offers City employees a 75% subsidy for monthly bus passes for those traveling from outside the South Coast area.

Boise City employees can participate in the BEAT Program, which provides free bus passes for all City employees (City of Boise 2012).

Action - Federal Bicycle Commuter Program

Bicycle commute programs, such as that currently offered by the federal Biker Commuter Benefit Program (BCBP), can increase employee bicycle commuting habits. The BCBP is a program that offers funding of up to $20 per month tax-free to individuals who primarily bicycle to work (San Francisco Bicycle Coalition 2012).

Action - Amenities to Support Alternative Transport

Some additional possibilities for encouraging bike commuting include providing additional supportive amenities and resources such as loaner bicycles; loaner, free, or low-cost helmets; showers and changing facilities; and secure bike parking. (Network of Employers for Traffic Safety 2012).

Guaranteed Secure Bicycle Parking: The City of Springfield can increase employee comfort levels with bicycle commuting by reducing risk of bike theft and damage. The City could guarantee a secure parking space for any bicycle commuter by installing bike lockers or allotting an indoor room for bike storage. Lockers cost approximately $700 each. Up to 8 bike lockers can fit in one parking space.

Precedent: Boise City employees can participate in the BEAT Program, which provides free bike locks for employees who ride a bike at least 60% of the time between April and October (City of Boise 2012).

Showers at multiple city locations: Adding showers to City of Springfield's main buildings will help encourage employees to walk or bike to work and between meeting locations.

Precedent: City Hall in Meridian, Idaho offers showers and lockers for employees who use alternative forms of transportation (City of Meridian 2012).

Employee Commuter Resource Center Website: A simple way to increase commuting is to provide City employees with information regarding commute alternatives. According to the recent City of Springfield Commute Survey, 30% of City employees were not aware of the LTD Commuter Club Program.

A City of Springfield employee commuter resource website could publicize all available resources to make alternative commuting as convenient for City employees as possible. Such a site could include:

- city policies and procedures regarding vehicle use, carpooling, and bicycle parking;
- online employee services such as enrollment in available commuter subsidy programs, requests for carpooling, or requests for secure bicycle parking;
- community resources such as links to LTD's Point2point carpooling program and Emergency Ride Home Program, bicycle commute maps and resources, commuter bus maps, and commuter parking information.

Community

Objective: Implement an Electric Vehicle (EV) Public Charging Program

Related Council Strategic Plan Goals

Goal 2: Encourage Economic Development and Revitalization through Community Partnerships

Goal 5: Promote Livability and Environmental Quality

Goal 6: Improve Infrastructure and Facilities

Action - Partner with local businesses

One concern regarding electric vehicles (EV) has been named "range anxiety", the fear that a vehicle will have insufficient range to complete a trip and thus strand the driver somewhere before the destination. The availability of EV charging stations can reduce range anxiety. If the City

Figure 9: Example of EV charging station in Vacaville, CA. Source: http://www.hybridcars.com/news/vacaville-calif-gets-first-public-electric-car-rapid-charger-us-27977.html.

of Springfield can help bring about the construction of charging stations, this may make the choice for City residents to use EVs more attractive and may incentivize local EV purchases. Charging stations may also attract EV owners from other regions to Springfield, and these drivers could patronize local businesses while their cars charged at EV charging stations.

Precedent: St. Paul Minnesota plans to use stimulus funds in conjunction with funds and cooperation from the local electricity provider, Xcel Energy, to install 30 new charging stations throughout the metro area (MinnPost 2011).

Action – Acquire Grant Funding

The Oregon Department of Transportation (ODOT) is implementing a program to create an electric vehicle corridor for major transportation routes. They are seeking Electric Fast Car charging stations using the Tiger II Grant for EV infrastructure as part of the EV Corridor Connectivity Project (ODOT 2012). Additionally, the federal 'EV Project' offers grants that can cover nearly the entire cost of EV charging facilities and associated installation costs (The EV Project 2012).

Objective: Adopt Innovative Policies and Regulations

Related Council Strategic Plan Goals

Goal 1: Provide Financially Responsible and Innovative Government Services

Goal 3: Strengthen Public Safety by Leveraging Partnerships and Resources

Goal 5: Promote Livability and Environmental Quality

Goal 6: Improve Infrastructure and Facilities

Action - Promote Walkability

The 20-minute neighborhood concept allows for citizens to walk to essential amenities and services within 20 minutes. In 20-minute neighborhoods, citizens have an increased opportunity to walk or bike instead of utilizing personal vehicles, thus reducing vehicle miles traveled (VMT). This concept offers City planners a lens for analysis and decision making when working on issues of land zoning, density targets, livability, and property values (Walkscore 2012).

Implementing a 20-minute neighborhood assessment will help determine which areas of town are the most and least walk-able and why. An entry-level walkability assessment is available at walkscore.com with more in-depth resources, such as maps linked to public transport access and density information, available upon request.

Precedent: Portland has adopted the goal of all citizens living in 20-minute neighborhoods into its comprehensive plan. The city provides maps and information emphasizing walking. A network of safe crosswalks helps facilitate pedestrian traffic (City of Portland Bureau of Planning and Sustainability 2009).

Action – Implement Feebates

"Feebate" programs are simultaneous fee and rebate programs that can be used to shift consumption patterns in transportation and energy sectors. Under such a system, the initial net cost of a vehicle is partly based on the vehicle's fuel efficiency. The transaction (fee or rebate) occurs at the point of purchase so there is a direct financial incentive to choose a vehicle based on fuel efficiency. The purchaser of a relatively inefficient vehicle pays an up-front fee on top of the purchase price, and the purchaser of a relatively efficient vehicle receives a rebate. Prices can also be set within classes of automobiles for choosing more efficient models within a size class. While this is not common, government agencies can institute such programs.

Precedent: France started using feebates in 2008, charging up to 2,600 euro (about $3,450 US) and giving up to 1,000 euro (about $1,325 US) within seven distinct classes of vehicles. The outcome was that demand for vehicles with high fuel efficiency rose while demand for low efficiency vehicles fell by nearly three times (Lovins 2011). California is currently considering implementing a statewide feebate plan and the city of San Francisco is proposing a citywide version (SPUR 2012).

Conclusion

Students of PPPM 607 have identified numerous opportunities for the City of Springfield to reduce energy use and greenhouse gas emissions. These include opportunities within the municipal sphere—the operations of the City government itself as an entity—and the community sphere—the activities of Springfield as a city over which the local government has some influence. In virtually all of the opportunities, students have attempted to show a connection between improved environmental performance (like reducing GHG emissions) and improved delivery of City services (through long term financial resiliency and direct improvements to community well-being.)

Students hope that the ideas they present can increase the knowledge of these issues among City staff, and that the recommendations here will inspire future actions. Despite the fact that many of the recommendations do not fall within the scope of reasonable action for the City within the near future, due to required cultural shifts or capital expenditures, there is the intention that these recommendations plant seeds for longer-term decision making. Hopefully these recommendations, along with the included list of references, will also provide an information resource for City staff members as they consider long-term objectives and strategies, and look for precedents and tools to address the many environmental and financial challenges that Springfield faces.

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