

Decorah WE CAN: It all begins at home.



Energy Existing Conditions Report Stormwater Existing Conditions Report Policy Recommendations for Sustainability in Decorah, Iowa

Reports researched and written by the Decorah Water and Energy Community Action Network
Student Field Problems Team

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Finally, Decorah WE CAN would like to express its appreciation to City Administrator Jerry Freund, Mayor Don Arendt, and the Decorah City Council for enabling our initiative towards household stormwater and energy sustainability in Decorah. We are confident that your leadership will enable a more sustainable Decorah for future generations. We wish you the best of luck in realizing this vision.

The Authors

Melissa Atalig, M.S. University of Iowa, graduated from the Urban and Regional Planning program with an emphasis in Housing and Community Development. She is currently working for the City of Iowa City in Energy Efficiency and assists with implementing Energy and Conservation Block Grant initiatives and programs.

Molly Fleming, M.S. University of Iowa, graduated from the Urban and Regional Planning program with emphases in Housing, Community Development, and Economic Development. She will be working as a Policy and Development Organizer with Communities Creating Opportunity in Kansas City.

Patrick Knapp, M.S. University of Iowa, graduated from the University of Iowa Urban and Regional Planning program with an emphasis on Environmental Land Use & GIS. He is currently working for the Iowa Department of Natural Resources and is pursuing further educational or career opportunities.

Dean Meester, M.A. University of Iowa, Urban and Regional Planning. His concentration was Land Use and Environment. He will be continuing on at the University of Iowa College of Law in pursuit of his J.D.

Spencer Schoonover, M.S. University of Iowa, graduated from the University of Iowa Urban and Regional Planning program with an emphasis on Land Use Development, and from the College of Engineering with a focus on Civil/Environmental Engineering. He is also LEED certified, and is currently pursuing further educational or career opportunities.

Ben Visser, M.A. and J.D. University of Iowa, graduated from the joint degree program in Law and Urban and Regional Planning with an emphasis on Land Use and Transportation Policy. He is planning to take the Bar exam this summer.

Christopher Widmer, M.S. University of Iowa, graduated from the Urban and Regional Planning program with emphases in Transportation, GIS, and Land Use Planning. He is currently a transportation planning intern for Johnson County Council of Governments (JCCOG) in Iowa City and is pursuing further educational or career opportunities.

Decorah WE CAN

The Decorah Water and Energy Community Action Network (Decorah WE CAN) is a partnership between University of Iowa Urban and Regional Planning students and the City of Decorah. Our work relies on the fact that small towns throughout the state have the capacity to craft more sustainable futures for their current citizens and for future generations, and that this work can begin at home in Decorah. Learn more about our initiative at www.DecorahWECAN.ning.com.

About This Document

This document represents the culmination of our research and analysis to promote household energy and stormwater sustainability in Decorah, Iowa. Within this bound volume are three reports: “Report on Existing Household Energy usage and Carbon Emissions in Decorah, Iowa and Estimates of Carbon Reductions Possible with Efficiency Investments” initially released in January 2010, “Report on Stormwater Conditions for Decorah, Iowa and a Review of Opportunities for Impervious Surface Reduction” initially released in March 2010, and “Policy Recommendations for the Promotion of Household Energy and Stormwater Sustainability in Decorah” released in May 2010.

Our **“Report on Existing Household Energy Usage and Carbon Emissions in Decorah, Iowa and Estimates of Carbon Reductions Possible with Efficiency Investments”** estimates total energy usage in the residential sector in Decorah based on local data and trend reports. In this report, we estimate energy usage and costs per household annually, and we predict the energy and cost savings possible with specific home efficiency retrofits. Additionally, we estimate total carbon emissions per household due to residential energy usage, and we estimate how Decorah’s citywide carbon footprint can be reduced with efficiency investments.

Our **“Report on Stormwater Conditions for Decorah, Iowa and a Review of Opportunities for Impervious Surface Reduction”** details current soil, infrastructure, and precipitation conditions in Decorah that affect stormwater management. This report estimates the total gallons of precipitation that fall on impervious residential surfaces, like pavement and roofs. This precipitation that cannot infiltrate into the soil becomes stormwater runoff, which enters local water bodies and contributes to flooding and pollution risks. In this report, we also estimate the increase in infiltration possible if households reduce their properties’ impervious surfaces with improvements like porous pavement and rain gardens.

Our **“Policy Recommendations for the Promotion of Household Energy and Stormwater Sustainability in Decorah”** is structured as a guide for constructing and implementing local sustainable stormwater and energy policies in Decorah. We have focused our recommendations into six primary avenues of policy-making: land use regulations, building codes, municipal tax incentives, municipal financing, fee structuring, and local carbon policies. Within each section, we define our final recommendations for effective and long-term policy actions that will reduce energy usage and stormwater runoff at the household level. We also provide extensive resource support in our appendix with dozens of “best case practices” for each avenue of policy-making. The existing conditions research and analysis within our companion reports provide a foundation for our recommendations here.

Report on Existing Household Energy Usage and Carbon Emissions in Decorah, Iowa and Estimates of Carbon Reductions Possible with Efficiency Investments

Report researched and written by Molly Fleming, Patrick Knapp, and Ben Visser

Decorah Water and Energy Community Action Network
University of Iowa Student Field Problems Team

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EXECUTIVE SUMMARY

In Iowa, household energy consumption is a key contributor to climate change. According to the Center for Climate Strategies, Iowa's residential sector was responsible for 14 percent of the state's overall greenhouse gas emissions in 2005.¹ This figure is projected to increase dramatically over the next few decades if households continue to consume energy at present rates. One of the best ways to reduce Iowa's energy consumption, and thereby reduce statewide greenhouse gas emissions, is to make investments in home energy efficiency. Through a variety of extremely simple methods, such as changing light bulbs from incandescent to compact fluorescent bulbs, Decorah households can have a significant impact on citywide energy usage and carbon emissions.

HOUSEHOLD ENERGY USAGE IN DECORAH

Household energy consumption in Decorah is a factor of household size, household preferences, and home heating fuel type. We assume that all Decorah households use electricity for end-uses such as refrigeration, lighting, and appliances. Home heating fuels, however, constitute about 28 percent of energy consumed by Decorah households. Most Decorah households (78 percent) use natural gas furnaces to heat their homes, while 19 percent use electricity, according to the U.S. 2000 Decennial Census. The remaining 3 percent of households use other fuel sources like propane, kerosene, or fuel oil. Because home heating fuels provide different quantities of energy to households at different prices, the type of home heating fuel a Decorah household uses has significant impacts on its home energy consumption and monthly bills.

All told, each Decorah household consumes an average of 98 mmBTUs of energy each year, which costs each household about \$1,943 annually. For a household with a gas furnace, this equates to about 354 therms of gas and 18,365 kWh of electricity each year.² Households with less efficient home heating fuels, such as fuel oil or propane, consume even more energy and spend even more money annually to heat their homes. Aggregated at the city level, households in Decorah consume about 260,000 mmBTUs of energy each year across all fuel types.

CARBON IMPACTS AND HOUSEHOLD ENERGY USAGE IN DECORAH

When fossil fuels are burned through home heating or in the generation of electricity, greenhouse gases like carbon dioxide are released into the atmosphere. These greenhouse gases prevent the sun's heat from fully escaping the earth's surface, culminating in climate change. On average, with figures weighted based on proportion of fuel use citywide, households in Decorah emit about 40,934 pounds (over 20 tons) of carbon dioxide each year. Like energy usage, carbon emissions vary significantly by home heating fuel type. Households heated with natural gas emit about 41,734 pounds of carbon emissions annually, compared to about 36,123 pounds of carbon dioxide emitted each year by households heated with electricity. Homes heated with propane, a significantly less efficient home heating fuel, emit a whopping 59,119 pounds of carbon emissions annually. Citywide, we estimate that households in Decorah create an aggregate 56,939 tons of carbon dioxide emissions each year.³ It would take 51,245 acres of mature trees to absorb all of the carbon released by Decorah households.⁴

¹ Center for Climate Strategies. *Final Iowa GHG Inventory and Reference Case Projection*. October 2008. Table ES-1 and Table B3a.

² Analysis of U.S. Department of Health and Human Services, Division of Energy Assistance. *LIHEAP Home Energy Notebook for Fiscal Year 2007*. August 2009. Conversions from the Energy Information Administration.

³ Analysis of *LIHEAP Home Energy Notebook for Fiscal Year 2007*. See pages 11 and 12 for full sourcing of carbon emissions per energy unit estimates.

⁴ Carbon sequestration estimates from analysis of Environmental Protection Agency. *Sequestration in Agriculture and Forestry*, available at <http://www.epa.gov/sequestration>

ESTIMATED IMPACTS OF ENERGY EFFICIENCY MEASURES IN DECORAH

There are a variety of home energy efficiency measures that can be implemented to reduce annual energy use and energy costs at the individual household level. These measures include insulation improvements, infiltration reduction, high efficiency heating systems and water heaters, efficient showerheads and aerators, compact fluorescents, and high efficiency refrigerators and freezers. Table A lists the average implementation costs of each measure along with average energy savings, costs savings, and emission reductions in terms of both impacts per dollar spent and the time it takes each measure to pay for itself in costs savings.

Table A: Estimated Costs and Cost-Effectiveness of Individual Efficiency Measures for Decorah Households⁵

Measure	Average Measure Costs (\$)	Gas Savings per \$1 spent (BTUs)	Electricity Savings per \$1 Spent (kWh)	Carbon Emission Reductions per \$1 spent (lbs)	Time until measure pays for self (years)
Wall Insulation	\$1,228	7,573	0.20	1.30	7.6
Ceiling/Attic Insulation	\$974	8,111	0.32	1.59	6.6
Infiltration Reduction	\$395	4,557	0.09	0.71	13.3
Floor/Crawlspace Insulation	\$587	3,578	0.23	0.90	13.0
High Efficiency Heating System	\$2,498	6,005	0.00	0.70	11.6
Efficient Showerhead	\$10	80,000	24.20	58.87	0.3
Efficient Aerator	\$4	75,000	17.75	45.09	0.3
High Efficiency Water Heater	\$898	4,566	0.19	0.93	11.5
Compact Fluorescents	\$54	0	6.81	13.95	1.3
Exchange Refrigerator	\$712	0	0.99	2.02	9.2
Exchange Freezer	\$503	0	1.51	3.10	6.0

Even small individual efficiency measures can have substantial citywide impacts if they are implemented in a significant percentage of Decorah households. For example, if 10 percent of households in Decorah switched from incandescent light bulbs to compact fluorescent bulbs, the city would reduce electricity use by over 100,000 kWh per year and avoid almost 210,000 pounds (over 100 tons) of carbon emissions. Similarly, if 10 percent of homes installed efficient showerheads the city would save 67,000 kWh and avoid almost 164,000 pounds (over 75 tons) of carbon emissions annually. Table B shows the potential citywide impacts of these individual household efficiency measures for Decorah.

⁵ Analysis of Report on the Costs and Impacts of the Iowa Low-Income Weatherization Program, Table 2.12b

Table B: Estimated Citywide Impacts of Individual Efficiency Measures If Implemented in 10 Percent of Decorah Households⁶

Measure	Citywide Gas Savings (therms)	Citywide Electricity Savings (kWh)	Citywide Energy Costs Savings (\$)	Citywide Carbon Emission Reduction (lbs)
Wall Insulation	25,873	69,828	\$44,877	444,672
Ceiling/Attic Insulation	21,978	85,407	\$40,989	431,150
Infiltration Reduction	5,008	9,737	\$8,271	78,330
Floor/Crawlspace Insulation	5,842	38,113	\$12,589	146,159
High Efficiency Heating System	41,730	0	\$60,005	486,628
Efficient Showerhead	2,226	67,324	\$10,599	163,790
Efficient Aerator	835	19,752	\$3,371	50,172
High Efficiency Water Heater	11,406	48,685	\$21,752	232,687
Compact Fluorescents	-	102,378	\$11,251	209,603
Exchange Refrigerator	-	195,575	\$21,494	400,410
Exchange Freezer	-	211,988	\$23,298	434,015
Total	114,897	848,788	\$234,493	2,882,965

CONCLUSION

As these energy efficiency impact estimates show, sustainability measures taken at the household level can have potentially profound effects on collective outcomes. In order for the Decorah WE CAN initiative to be successful, however, it is imperative that we execute a strategic and all-encompassing community engagement campaign. With a coordinated public outreach based in the support of local leaders, Decorah WE CAN will reduce household energy consumption while empowering local residents toward dramatic global change.

⁶ Analysis of *Report on the Costs and Impacts of the Iowa Low-Income Weatherization Program*. See footnote 31 for full sourcing information.

INTRODUCTION

As crises of climate change, global economic uncertainty, and environmental degradation converge on Middle America, small towns are increasingly struggling to adapt to their changing worlds. Rather than neglect our rural roots, the Iowa Initiative for Sustainable Communities recognizes that small towns throughout the state have the capacity to craft more sustainable futures for their current citizens and future generations. Based on our conversations and exchanges with local residents, we are confident that Decorah is eager and able to rise to the occasion. The Decorah Water and Energy Community Action Network (Decorah WE CAN) recognizes the pervasive activism already on the pulse of community needs in the region. Therefore the Decorah WE CAN sustainability initiative relies on empowering the community base towards making household efficiency improvements in stormwater collection and energy usage. Small changes in daily habits, a new light bulb here or a rain barrel there, aggregate in dramatic ways for the city as a whole. As our motto goes, “It all begins at home.” We think that if we can encourage residents to make these small changes in their own homes, there will be potentially profound impacts on collective outcomes. By this margin, Decorah WE CAN has a twofold objective: ensuring a more sustainable Decorah and empowering the community to determine its own future.

The following report details the existing conditions of one component of our energy sustainability initiative: household energy usage. (A parallel document entitled “Report on Existing Stormwater Runoff in Decorah, Iowa and Estimates of Stormwater Diversion with Efficiency Investments” details the existing conditions of our second component: stormwater runoff.) In this report, we first estimate average annual household energy consumption in Decorah based our analysis of programmatic and demographic sources. Further, we differentiate between average annual energy consumption and expenditures for households by heating fuel source, as fuels such as propane require much more energy to heat a home than average. We then estimate average annual energy expenditures for low income households versus non-low income households to illustrate the “home energy burden.” From these data, we estimate average annual carbon emissions due to household energy usage, based on our analysis of Energy Information Administration tables. Our analysis additionally yields an estimate of the total tonnage of carbon emitted through household energy consumption in Decorah.

Through an analysis of home weatherization and LIHEAP data, we are also able to estimate the impacts of various energy efficiency measures on an average household’s energy consumption and expenditures. These impacts provide savings for individuals households on their monthly energy bills, and they greatly reduce individual household carbon emissions. More importantly, we estimate reductions in carbon emissions citywide if proportions of the Decorah population invest in energy efficiency.

HOUSEHOLD ENERGY USAGE IN DECORAH

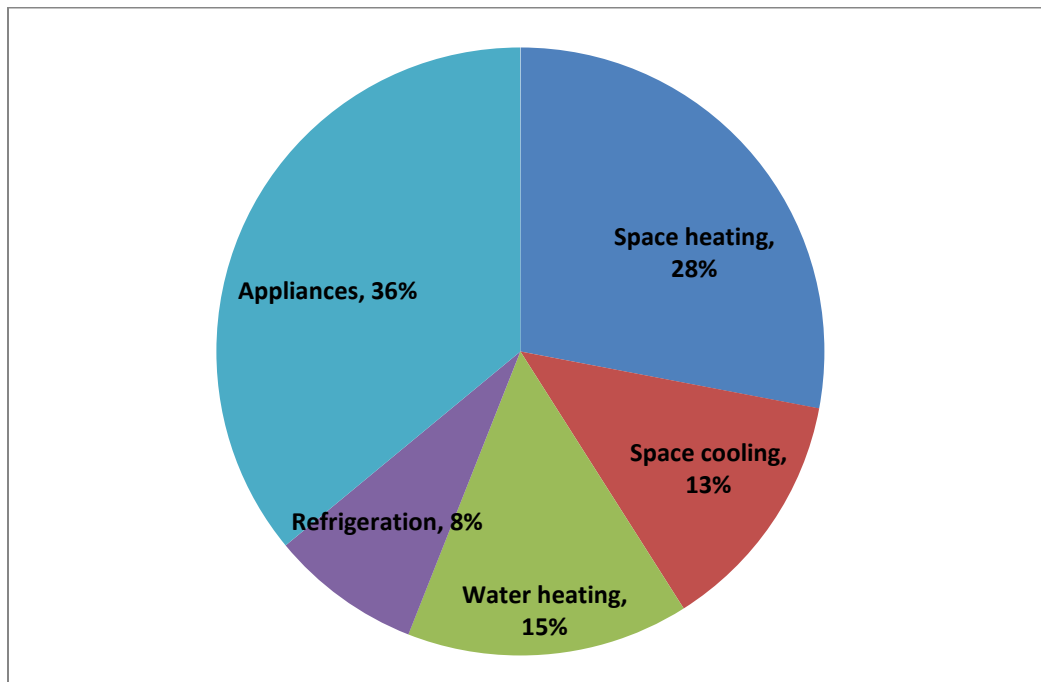
In order to estimate the total amount of energy consumed by households each year in Decorah, we analyzed the *LIHEAP Home Energy Notebook*⁷ for fiscal year 2007 as well as the *Report on the Costs and Impacts of the Iowa Low Income Weatherization Assistance Program*⁸ for calendar year 2008. These documents provide fairly local-level data on average household energy consumption, *LIHEAP Notebook* at the state level and the weatherization report at the regional level. While these sources do not enable data analysis at the local level, the detail of their information more than suffices for this shortcoming.

Except where otherwise noted, energy is measured in mmBTUs, or million British thermal units. British thermal units provide a standard measurement to denote both the amount of heat energy in fuels and the ability of appliances and air conditioning systems to produce heating or cooling. Therefore, analyzing energy usage in mmBTUs enables comparisons across fuel sources.

ENERGY END USES

Not all energy is created equal. Electricity comprises the bulk of home energy consumption for end-uses such as space cooling, appliances, refrigeration, and water heating. (See Figure 1, below.) However, space heating accounts for more than a quarter of home energy expenditures, meaning the fuel a household uses in space heating has significant impacts on its overall efficiency.

Figure 1: Average Household Energy Expenditures by End Use Nationwide, FY 2007⁹



⁷ U.S. Department of Health and Human Services, Division of Energy Assistance, *LIHEAP Home Energy Notebook for Fiscal Year 2007*, August 2009.

⁸ Dalhoff Associates, LLC. *Report on the Costs and Impacts of the Iowa Low-Income Weatherization Program—Calendar Year 2008*. June 1, 2009. Available from: http://www.dcaa.iowa.gov/bureau_weath/pdfs/CY08SLICE.pdf.

⁹ *LIHEAP Notebook 2008*, Table A-2

Most households in Decorah, 77 percent, use natural gas as their primary home heating fuel source. Another 19 percent use electricity, while most remaining households use fuel oil, kerosene, or LPG to heat their homes.¹⁰

ESTIMATED AVERAGE HOUSEHOLD ENERGY USAGE

On average, households in Decorah consume about 98 mmbTUs of energy each year, which costs each household about \$1,943 annually. As most households use natural gas to heat their homes, this often translates into 354 therms and 18,365 kWh of electricity each year. However, these estimates are in no way uniform for all Decorah households. Individual needs, practices, and capacities can dramatically alter the annual energy usage for different Decorah homes.¹¹

ENERGY BURDEN FOR LOW INCOME HOUSEHOLDS

On average, low income households in Decorah spend less on household energy than their non-low income counterparts. (See Figure 2.) However, low income households typically face a much greater home energy burden than non-low income households. The “home energy burden” for any household is the percent of the household income that is spent on energy expenditures. As Figure 2 shows, low income households in Iowa spend on average about 10 percent of their entire incomes on home energy costs, compared to less than three percent for non-low income households.¹² In other words, home energy costs as a share of income for an average low income household are more than three times the costs as a share of income for a non-low income household. An “affordable burden” for home energy bills is commonly defined as 6 percent of gross household income,¹³ meaning that the home energy burden for average low income households is nearly twice what is actually considered affordable. Therefore, energy efficiency efforts targeted towards low income households will have a greater impact on home energy burden than duplicate efforts targeted towards non-low income households.

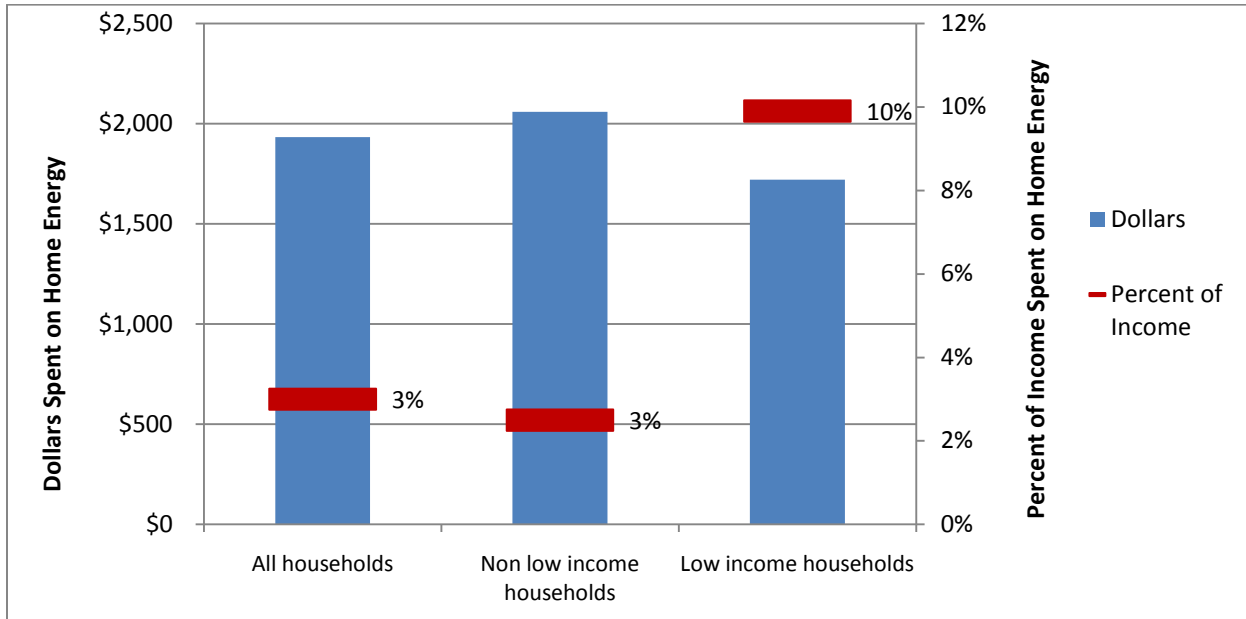
¹⁰ U.S. Decennial Census 2000, SF3 Tables

¹¹ *LIHEAP Notebook 2008*, Tables A-2 and A-3a; U.S. Decennial Census 2000, SF3 Tables

¹² *LIHEAP Notebook 2008*, Table A-2

¹³ Home energy affordability burden defined by Fisher, Sheehan, and Colton and widely utilized in energy analyses. Fisher, Sheehan, and Colton. *On the Brink: 2008--The Home Energy Affordability Gap*, Iowa factsheet, April 2009.

Figure 2: Estimated Average Household Energy Expenditures in Decorah by Income Group, FY 2007¹⁴

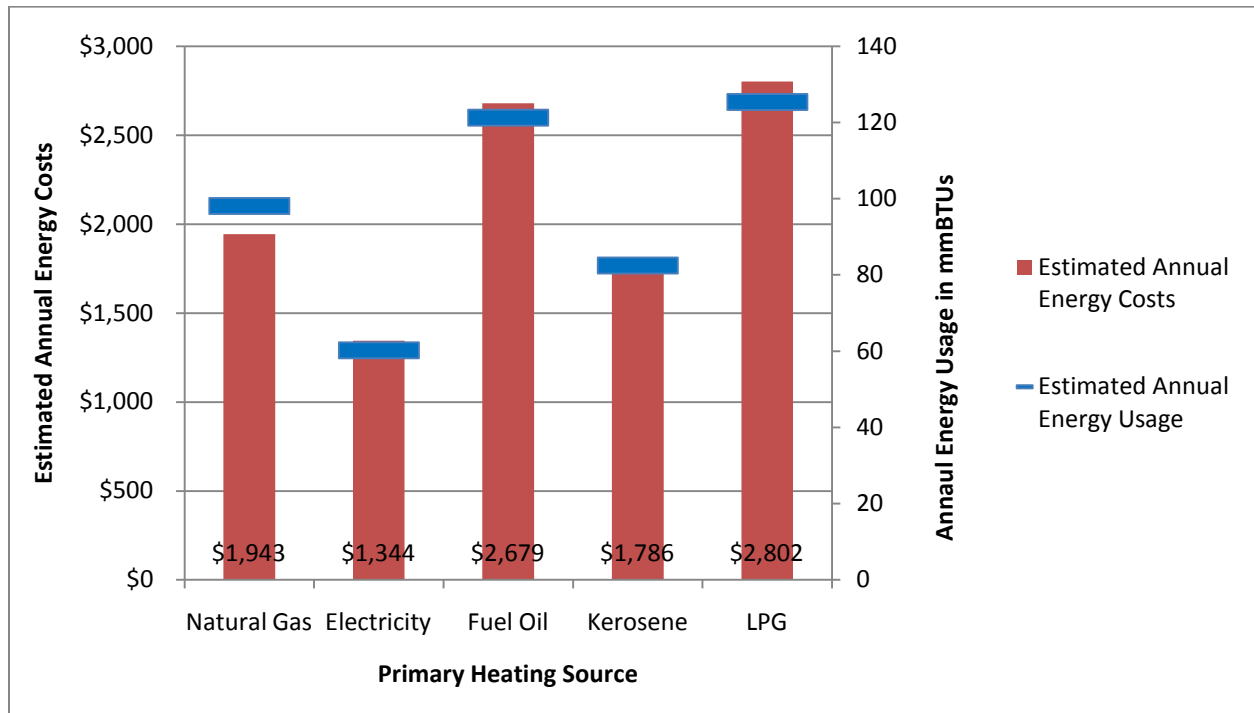


ENERGY BURDEN FOR HOUSEHOLDS WITH INEFFICIENT HOME HEATING

As all types of energy are not created equal, households with different home heating fuel types experience different energy impacts. Decorah households that use LPG (commonly in the form of propane) as a fuel for space heating spend twice as much on home energy as households heated through electricity. As Figure 3 shows, households that use less efficient home heating fuel sources, such as LPG and fuel oil, also spend more on their household energy bills. Luckily, the vast majority (96 percent) of Decorah households utilize relatively efficient home heating fuels. However, the three percent of Decorah households using LPG or fuel oil for home heating will particularly benefit from home energy efficiency investments.

¹⁴ LIHEAP Notebook 2008, Tables A-2 and A-3a

Figure 3: Estimated Household Energy Expenditures and Usage in Decorah, IA by Primary Heating Fuel Source¹⁵



CITYWIDE ENERGY USAGE

While significant at the household level, Decorah’s residential energy usage and expenditures substantially aggregate citywide, totaling nearly 260,000 mmBTUs each year across all fuel types. However, these net energy expenditures are particularly concentrated in natural gas therms (over 700,000 therms each year) and electricity kilowatt hours (over 51 million kWh each year). Table 1, below, shows estimated citywide residential energy usage in Decorah by fuel type, in both standardized mmBTUs and conventional units.

¹⁵ Analysis of LIHEAP Notebook 2008, Tables A-2 and Table A-3a

Table 1: Estimated Citywide Residential Energy Usage in Decorah by Fuel Type, in Standardized mmBTUs and Conventional Units, FY 2007¹⁶

Fuel Type	Energy Usage in mmBTUs	Energy Usage in Conventional Units	
Natural Gas	77,029	770,285	therms
Electricity	174,196	51,054,022	kWh
Fuel Oil	523	3,625	gallons
Kerosene	745	5,519	gallons
LPG	1,226	13,384	gallons

CARBON IMPACTS AND HOUSEHOLD ENERGY USAGE IN DECORAH

Carbon dioxide, as a greenhouse gas, is a major contributor to climate change and its devastating environmental consequences. Like all greenhouse gases, carbon dioxide emissions (often abbreviated to “carbon emissions”) allow sunlight to enter the atmosphere freely. When sunlight strikes the earth’s surface, some of it is reflected back towards space as infrared radiation, or heat. Carbon dioxide in the atmosphere absorbs this infrared radiation and traps the heat in the atmosphere. Over time, this heat builds up and increases global temperatures, a phenomenon known as “climate change” or “global warming.”

Some carbon emissions occur naturally through the life cycles of plants and oceanic life. However, deforestation and the burning of fossil fuels contribute significantly to global carbon emissions. Global carbon emissions are projected to continue to increase annually, speeding global warming, as more people drive cars with internal combustion engines, fossil-fueled power plants supply electricity to more households, and dwindling resources accelerate deforestation. In Iowa, household energy usage accounts for 14 percent of statewide carbon emissions.¹⁷

Therefore, significant reductions in Decorah’s household energy dependency may yield dramatic reductions in citywide carbon emissions. Every Decorah household burns fossil fuel for home heating or consumes electricity powered by a fossil-fuel burning plant, meaning that each household has a “carbon footprint.” Collectively, all household carbon footprints aggregate to create Decorah’s residential carbon footprint, or the total tonnage of carbon dioxide emitted annually in Decorah due to residential energy use. When households reduce their energy usage, they help to reduce Decorah’s overall carbon footprint, creating a city that is more sustainable and less dependent on nonrenewable fuels.

HOUSEHOLD ELECTRICITY USAGE AND CARBON EMISSIONS

In order to estimate the amount of carbon dioxide each Decorah household emits due to their energy usage, we first determined the local sources of electricity generation. Different types of electricity generation release different amounts of carbon dioxide into the atmosphere. In addition, we examined different heating fuel types and their corresponding carbon emissions.

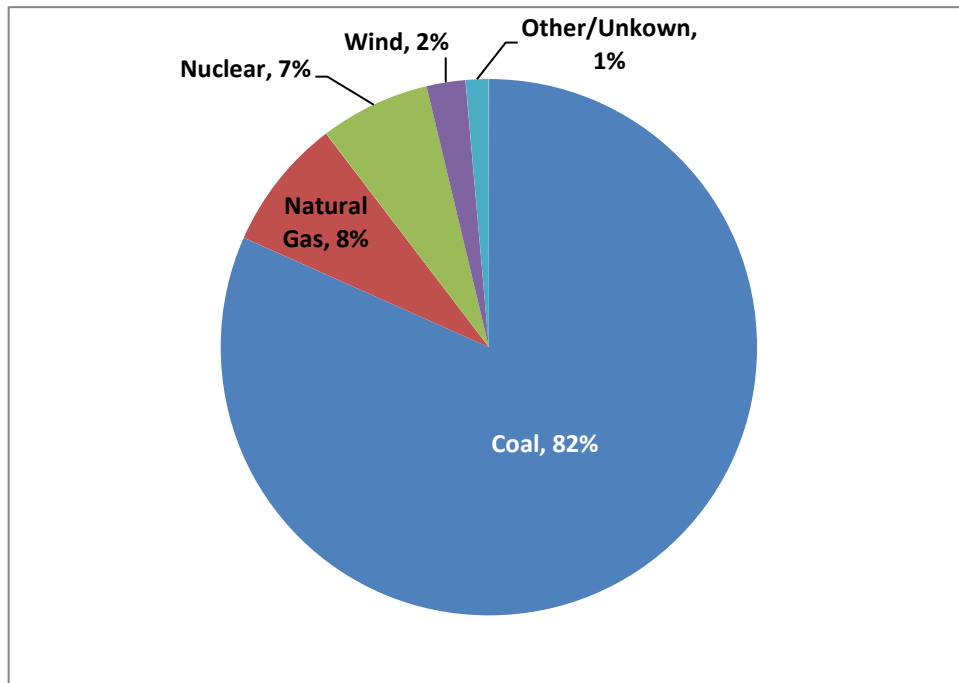
¹⁶ Analysis of *LIHEAP Notebook 2008*, Tables A-2 and Table A-3a; U.S. Decennial Census 2000, SF3 Tables; unit conversions calculated via the Energy Information Administration Conversion tables, available at <http://www.eia.doe.gov/oiaf/1605/coefficients.html>.

¹⁷ Center for Climate Strategies, *Final Iowa GHG Inventory and Reference Case Projection*, October 2008, Table ES-1 and Table B3a.

DECORAH ELECTRICITY SOURCE

Decorah’s chief provider of electricity is Alliant Energy, which provides electricity to 1.4 million customers in Iowa, Minnesota, and Wisconsin. Alliant Energy creates 61 percent of their own electricity and purchases the other 39 percent from other sources.¹⁸ We estimated the sources of Alliant’s purchased electricity based on Iowa’s greenhouse gas inventory. Since purchased electricity is difficult to trace back to the exact source, we estimated the sources based on Iowa’s electricity production statistics.¹⁹ Figure 4, below, is a breakdown of the most probable sources of Decorah’s electricity usage. A more extensive explanation of how we estimated these numbers is available in the technical appendix at the end of this report.

Figure 4: Estimated Source of Electricity Consumed in Decorah, by Proportion of Generation



CARBON RELEASED BY FUEL SOURCE

Each fuel source shown above releases a different amount of carbon dioxide in several different ways during the lifetime of the fuel. For example, carbon dioxide is released when fuel is burned, but also when fuel is transported. Natural gas and coal release carbon when they are extracted, transported, and burned. Nuclear energy does not expel carbon, but it does take energy to transport nuclear material to the plants and discard the material after it is spent. While wind power is considered the cleanest source of fuel and uses a renewable fuel, it still takes a lot of energy to assemble and transport the wind towers, though the carbon released is a minuscule amount compared to coal, natural gas, and nuclear. Table 2, below, shows the four primary fuel sources of electricity generation for Decorah and the estimated pounds of carbon produced by each. By using the approximate percentages of the source of the electricity from Alliant Energy and the Iowa Greenhouse Gas Inventory, we estimate a weighted average of 2.05 pounds of carbon per kWh for Decorah. Our “weight” is based upon the proportion of local electricity generation estimated to come from each fuel source.

¹⁸ Alliant Energy public information available at www.alliantenergy.com

¹⁹ Strait, Randy, Et al, *Final Iowa Greenhouse Gas Inventory and Reference Case Projections 1990-2025*, October 2008.

Table 2: Estimated Pounds of Carbon Produced in Electricity Generation by Fuel Source Type

Source	Pounds of Carbon Released per kWh
Coal ²⁰	2.095
Natural Gas ²¹	0.408
Nuclear ²²	0.198
Wind ²³	0.015
Weighted Average:	2.05

CARBON RELEASED FROM EACH HOUSEHOLD THROUGH ELECTRICITY USAGE

Using the weighted average calculated in the previous section, we estimated the average carbon emissions released per household due to electricity usage, as shown below in Table 3. In other words, Table 3 shows how much carbon dioxide a single Decorah home generates due to electricity usage, separated by home heating fuel type. Our analysis reveals that an average Decorah home emits between 34,000 and 55,000 pounds of carbon dioxide each year as a result of household electricity usage.

Table 3: Estimated Carbon Emitted by Decorah Household Due to Electricity Usage, By Primary Home Heating Fuel Type, FY2007²⁴

	Electricity Usage in kWh	Pounds of Carbon from Electricity
Natural Gas	18,365	37,600
Electricity	17,644	36,123
Fuel Oil	25,322	51,842
Kerosene	16,881	34,562
LPG	26,484	54,223

HOUSEHOLD HEATING FUEL USAGE AND CARBON EMISSIONS

As discussed in the last section, Decorah homes use various fuel sources to heat their homes, with natural gas being the most common fuel type. Each of these fuel sources, however, emits a specific amount of carbon dioxide as it is consumed. For example, natural gas emits nearly 12 pounds of carbon dioxide for every therm consumed versus over 22 pounds of carbon for every gallon of fuel oil consumed. Therefore, the carbon footprint of households due to home heating is influenced by two factors: fuel consumption and fuel type. As seen in Table 4, some fuels are much more efficient than others in the manner of how much carbon is released per unit of fuel consumed.

²⁰ Department of Energy, *Carbon Dioxide Emissions from the Generation of Electric Power in the United States*, July 2000, available from <http://tonto.eia.doe.gov/FTP/ROOT/environment/co2emiss00.pdf>.

²¹ Anke Herold, *Comparison of CO₂ Emission Factors for Fuels Used in Greenhouse Gas Inventories and Consequences for Monitoring and Reporting Under the EC Emissions Trading Scheme*, July 2003, available from http://air-climate.eionet.europa.eu/docs/ETCACC_TechnPaper_2003_10_CO2_EF_fuels.pdf.

²² Jan Willem Storm van Leeuwen, *CO₂ Emissions of Nuclear Energy Generation*, May 2007, available from <http://www.kreativrauschen.com/blog/2007/05/13/co2-emissions-of-nuclear-energy-generation/>.

²³ World Nuclear Association, *Comparative Carbon Dioxide Emissions from Power Generation*, available from <http://www.world-nuclear.org/education/comparativeco2.html>.

²⁴ Analysis of *LIHEAP Notebook 2008*, Table 2-2.

Table 4: Estimated Carbon Emitted by Decorah Household Due to Home Heating, By Primary Home Heating Fuel Type, FY 2007²⁵

Primary Heating Fuel	Heating Fuel Usage	Heating Fuel Unit	Pounds of Carbon per Unit	Pounds of Carbon for Home Heating
Natural Gas	354	therms	11.7	4,134
Electricity	<i>Included in previous section figures</i>			
Fuel Oil	242	gallons	22.4	5,409
Kerosene	184	gallons	21.5	3,962
LPG	382	gallons	12.8	4,897

HOUSEHOLD CARBON IMPACTS

To calculate the average household carbon footprint in Decorah, we simply sum the estimated carbon emissions per household due to electricity usage and the estimated carbon emissions per household due to home heating. In our average household carbon footprint, we weight each home heating fuel type’s carbon impact based on the proportion of the population using each fuel. A majority of Decorah’s population, 78 percent, uses natural gas for home heating while 19 percent uses electricity. The other three heating fuels combined are only used by 3 percent of the population.²⁶ These proportions are reflected in our weighted average of 40,934 pounds (over 20 tons) of carbon emissions per Decorah household per year due to home energy usage.

Table 5: Estimated Average Carbon Emissions per Household in Decorah in Pounds of CO2 per kWh, by Primary Heating Type, FY 2007²⁷

Primary Heating Fuel	Pounds of Carbon per Unit	Pounds of Carbon from Electricity*	Pounds of Carbon from Home Heating	Total Pounds of Carbon
Natural Gas	11.7	37,600	4,134	41,734
Electricity	2.0	24,925	11,198	36,123
Fuel Oil	22.4	51,842	5,409	57,252
Kerosene	21.5	34,562	3,962	38,524
LPG	12.8	54,223	4,897	59,119
Weighted average		35,443	5,492	40,934

CITYWIDE CARBON IMPACTS OF HOUSEHOLD ENERGY USAGE

With the data in the previous table, we were able to estimate a collective carbon footprint for the city of Decorah, as seen below in Tables 6 and 7.

²⁵ *Ibid.*

²⁶ U.S. Decennial Census 2000, SF3 Tables

²⁷ Analysis of LIHEAP Notebook 2008, Table 2-2.

Table 6: Estimated Total Residential Carbon Emissions in Decorah Due to Electricity Usage, FY 2007²⁸

Primary Heating Fuel	Number of Households	Total Pounds of Carbon from Electricity
Natural Gas	2,173	81,704,369
Electricity	529	19,108,878
Fuel Oil	15	777,637
Kerosene	30	1,036,849
LPG	35	1,897,793
Total pounds of carbon		104,525,526

Table 7: Estimated Total Residential Carbon Emissions in Decorah Due to Home Heating by Primary Heating Type, FY 2007²⁹

Primary Heating Fuel	Number of Households	Total Pounds of Carbon for Home Heating
Natural Gas	2,173	8,982,558
Electricity	<i>Included in previous section figures</i>	
Fuel Oil	15	81,136
Kerosene	30	118,865
LPG	35	171,382
Total pounds of carbon		9,353,942

Adding the carbon totals of household electricity usage and home heating together (104,525,526 + 9,353,942) yields a total of **113,879,468 pounds (56,939 tons)** of carbon emissions released by the city of Decorah per year through residential heating and electricity usage. It would take **51,245 acres** of mature trees, or roughly **569,390 acres** of conventionally tilled farmland to absorb all of the carbon released by Decorah households.³⁰

²⁸ *Ibid.*

²⁹ Analysis of *LIHEAP Notebook 2008*, Table 2-2.

³⁰ Carbon sequestration estimates from analysis of Environmental Protection Agency, *Sequestration in Agriculture and Forestry*, available at <http://www.epa.gov/sequestration>

ESTIMATED IMPACTS OF ENERGY EFFICIENCY MEASURES IN DECORAH

When it comes to energy sustainability, *it all begins at home*. No matter how big or broad the overarching goal, successful sustainability must be incorporated first at the residential level. Energy sustainability is ultimately about household decisions, and Decorah WE CAN recognizes the fundamental role that education and awareness play in influencing individual decisions to achieve collective impacts.

HOUSEHOLD IMPACTS WITH INDIVIDUAL EFFICIENCY MEASURES

There are a variety of home energy efficiency measures that can be implemented to reduce annual energy use and energy costs at the individual household level. These measures include insulation improvements, infiltration reduction, high efficiency heating systems and water heaters, efficient showerheads and aerators, compact fluorescents, and high efficiency refrigerators and freezers. Individual measures vary widely in terms of their nature, type of energy savings produced, carbon impacts, installation costs, and average costs savings. Table 8 shows the average per household impacts of individual efficiency measures with respect to energy savings, costs savings, and carbon emission reductions.

Table 8: Average Household-Level Impacts of Individual Efficiency Measures in Iowa³¹

Measure	Average Household Gas Savings (therms)	Average Household Electricity Savings (kWh)	Average Total Costs Savings (\$)	Average Carbon Emission Reductions (lbs)
Wall Insulation	93	251	\$161	1,598
Ceiling/Attic Insulation	79	307	\$147	1,550
Infiltration Reduction	18	35	\$30	282
Floor/Crawlspace Insulation	21	137	\$45	525
High Efficiency Heating System	150	0	\$216	1,749
Efficient Showerhead	8	242	\$38	589
Efficient Aerator	3	71	\$12	180
High Efficiency Water Heater	41	175	\$78	836
Compact Fluorescents	0	368	\$40	753
Exchange Refrigerator	0	703	\$77	1,439
Exchange Freezer	0	762	\$84	1,560
Total for listed measures	413	3,051	\$843	10,363

This information is useful for identifying which efficiency measures have the greatest potential impacts at the household level. For example, efficient insulation and high efficiency heating systems can drastically reduce energy use for heating, heating costs, and carbon emissions. As noted above, space heating accounts for an average of 28 percent of energy use at

³¹ All efficiency impacts estimates based on Decorah WE CAN analysis of Dalhoff Associates, LLC. *Report on the Costs and Impacts of the Iowa Low-Income Weatherization Program—Calendar Year 2008*. June 1, 2009. Figure 2.12b: Average Gas and Electricity Savings. Available from: http://www.dcaa.iowa.gov/bureau_weath/pdfs/CY08SLICE.pdf.

Carbon emission reductions estimates from Energy Information Administration Conversion Tables available at <http://www.eia.doe.gov/oiaf/1605/coefficients.html>.

Energy costs from Energy Information Administration tables available at http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html and http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_m.htm.

the household level, while space cooling accounts for an additional 13 percent. Households with poor insulation and inefficient heating systems require much more energy to heat and cool, leading to unnecessary energy use, increased carbon emissions, higher energy costs, and a greater energy burden for low-income households. The installation of a high efficiency heating system and measures that improve wall, ceiling/attic, and floor/crawlspace insulation have the combined potential to reduce annual household energy use by a total of 343 therms and 695 kWh, thereby reducing annual heating costs by \$569 and avoiding 5,422 lbs of carbon emissions per year.³²

However, these measures are also among the most expensive to implement, so it is useful to evaluate specific measures according to their cost effectiveness. This is as true for a community engagement initiative seeking to persuade households to implement efficiency measures as it is for a local government considering incentives or subsidies to reduce energy use or carbon emissions. Implementation costs of individual measures vary widely, and so do their returns on investment with respect to desired outcomes like energy savings, costs savings, or emission reductions. Table 9 lists the average implementation costs of each measure along with average energy savings, costs savings, and emission reductions in terms of both impacts per dollar spent and the time it takes each measure to pay for itself in costs savings.

Table 9: Costs and Cost-Effectiveness of Individual Efficiency Measures³³

Measure	Average Measure Costs (\$)	Gas Savings per \$1 spent (BTUs)	Electricity Savings per \$1 Spent (kWh)	Carbon Emission Reductions per \$1 spent (lbs)	Time until measure pays for self (years)
Wall Insulation	\$1,228	7,573	0.20	1.30	7.6
Ceiling/Attic Insulation	\$974	8,111	0.32	1.59	6.6
Infiltration Reduction	\$395	4,557	0.09	0.71	13.3
Floor/Crawlspace Insulation	\$587	3,578	0.23	0.90	13.0
High Efficiency Heating System	\$2,498	6,005	0.00	0.70	11.6
Efficient Showerhead	\$10	80,000	24.20	58.87	0.3
Efficient Aerator	\$4	75,000	17.75	45.09	0.3
High Efficiency Water Heater	\$898	4,566	0.19	0.93	11.5
Compact Fluorescents	\$54	0	6.81	13.95	1.3
Exchange Refrigerator	\$712	0	0.99	2.02	9.2
Exchange Freezer	\$503	0	1.51	3.10	6.0

Clearly, some inexpensive measures like efficient showerheads and aerators are extremely cost effective, offering the highest returns in both energy savings and carbon emission reductions and paying for themselves in a very short period of time. While these measures tend to have lower ceilings in terms of their total impact potential, they nonetheless can produce significant impacts for very little investment. Other more expensive measures have higher total impact potential but less impact per dollar spent. Both aspects are important in assessing the relative value of the various efficiency measures, and some measures, such as compact fluorescent light bulbs, are cost-effective and have relatively high impact potential. Total impact potential will ultimately enable more significant aggregate impacts, while impact per dollar spent is particularly useful for identifying the “low-hanging fruit” of household energy sustainability. Ultimately, implementation costs and cost-effectiveness of individual measures are important considerations for any initiative seeking to promote energy efficiency at the household level. This information is useful not only for identifying measures that are particularly

³² Analysis of Report on the Costs and Impacts of the Iowa Low-Income Weatherization Program. See footnote 31 for full sourcing information.

³³ Analysis of Report on the Costs and Impacts of the Iowa Low-Income Weatherization Program, Table 2.12b

cost effective, but also for identifying more expensive measures that are less affordable for low-income households. Many of these measures produce significant reductions in energy use or carbon emissions, and are therefore appropriate targets for incentives or subsidies for low-income households.

HOUSEHOLD IMPACTS WITH A BUNDLE OF EFFICIENCY MEASURES

A household with all of the measures identified above could potentially reduce average annual electricity usage by over 16 percent (when compared to the same household with no efficiency measures in place). However, the high cost of implementing all of these measures (almost \$8,000 per household) makes it unrealistic to expect a significant number of individual household to include all of them. To account for this, each efficiency measure was weighted based on how often it has been implemented in the Decorah area under the NEICAC Weatherization Assistance Program. The relative weight assigned to each measure was expressed as a percentage of total households (with any efficiency measures) that implemented that particular efficiency measure.³⁴ Since most households will not implement all of the measures, use of this “weighted bundle” provides a more realistic basis for estimating the potential for average energy savings, costs savings, and carbon emissions reductions at the household level. The weighted bundle is used to estimate the typical impacts of an individual household that implements some (but not all) of the efficiency measures. Table 10 shows the potential impacts of a weighted bundle of efficiency measures for an individual household.

Table 10: Estimated Impacts of Weighted Bundle of Energy Efficiency Measures for Decorah Households³⁵

	Energy Usage Before Measures ³⁶	Savings with Weighted Bundle ³⁷	Energy Usage Efficiency Measures	Percent Change
Gas Usage (therms)	354	187	167	52.8%
Electricity Usage (kWh)	18,365	1,177	17,188	6.4%
Energy Costs (\$)	\$1,933	\$398	\$1,535	20.6%
Carbon Emissions (lbs)	40,934	4,585	36,349	11.2%
As percent of income	3%	0.6%	2.4%	20.6%

Since weighting of measures is based on recent implementation rates, future changes in implementation trends can influence outcomes in significant ways. For example, efficient showerheads have the potential to save 242 kWh of electricity and 495 pounds of carbon per year at the household level, but were not installed in any of the households under the NEICAC Weatherization Assistance Program, so the weighted bundle does not account for their potential impacts. If this measure is introduced in the future, or if implementation rates of other measures increase, it has the potential to increase average household savings and reductions beyond what our current estimates predict.

³⁴ For example, of the 93 households that implemented one or more efficiency measures, 32 implemented the specific measure of wall insulation (34 percent). Meanwhile, 60 households (65 percent) installed ceiling or attic insulation. Average gas and energy savings for each measure were multiplied by these percentages to ensure that measures that are used more in Decorah are given more weight than those that are used less.

³⁵ Analysis of *Report on the Costs and Impacts of the Iowa Low-Income Weatherization Program*. See footnote 31 for full sourcing information.

³⁶ These estimates of energy usage are based upon analysis of *LIHEAP Notebook 2008*, Table 2-2 and reflect citywide averages.

³⁷ These estimates of energy usage are based upon analysis of *Report on the Costs and Impacts of the Iowa Low-Income Weatherization Program* and reflect averages for low-income households, whom the NEICAC serves through its Weatherization Assistance Program. As low income households are more likely than non-low income households to live in energy inefficient homes, they may experience greater energy and cost savings than Decorah households on average.

CITYWIDE IMPACTS

While energy sustainability begins at home, it does not end there. The broader goal of Decorah WE CAN is to promote energy sustainability at the citywide level. In order to bring about significant citywide impacts, efficiency measures need to be implemented in a sufficient number of Decorah households. With higher implementation rates, both individual measures and a typical bundle of measures can have dramatic impacts on citywide energy sustainability. Citywide impacts were calculated for both individual efficiency measures and the weighted bundle of efficiency measures based on the proportion of measures used in the NEICAC Weatherization Assistance Program.

CITYWIDE IMPACTS OF INDIVIDUAL MEASURES

Even individual efficiency measures can have substantial citywide impacts if they are implemented in a significant percentage of Decorah households. For example, if 10 percent of households in Decorah switched from incandescent light bulbs to compact fluorescent bulbs, the city would reduce electricity use by over 100,000 kWh per year and avoid almost 210,000 pounds (over 100 tons) of carbon emissions. If 25 percent of households made the switch, Decorah would save around 256,000 kWh and avoid 524,000 pounds (over 250 tons) of carbon emissions. Similarly, if 10 percent of homes installed efficient showerheads the city would save 67,000 kWh and avoid almost 164,000 pounds (over 75 tons) of carbon emissions annually, while 25 percent of households would save 168,000 kWh and avoid over 400,000 pounds (over 200 tons) of carbon emissions. Tables 11 and 12 show the potential citywide impacts of household efficiency measures implemented in 10 percent or 25 percent of homes.

Table 11: Estimated Citywide Impacts of Individual Efficiency Measures If Implemented in 10 Percent of Decorah Households³⁸

Measure	Citywide Gas Savings (therms)	Citywide Electricity Savings (kWh)	Citywide Energy Costs Savings (\$)	Citywide Carbon Emission Reduction (lbs)
Wall Insulation	25,873	69,828	\$44,877	444,672
Ceiling/Attic Insulation	21,978	85,407	\$40,989	431,150
Infiltration Reduction	5,008	9,737	\$8,271	78,330
Floor/Crawlspace Insulation	5,842	38,113	\$12,589	146,159
High Efficiency Heating System	41,730	0	\$60,005	486,628
Efficient Showerhead	2,226	67,324	\$10,599	163,790
Efficient Aerator	835	19,752	\$3,371	50,172
High Efficiency Water Heater	11,406	48,685	\$21,752	232,687
Compact Fluorescents	-	102,378	\$11,251	209,603
Exchange Refrigerator	-	195,575	\$21,494	400,410
Exchange Freezer	-	211,988	\$23,298	434,015
Total	114,897	848,788	\$234,493	2,882,965

³⁸ Analysis of Report on the Costs and Impacts of the Iowa Low-Income Weatherization Program. See footnote 31 for full sourcing information.

Table 12: Citywide Impacts of Individual Efficiency Measures If Implemented in 25 Percent of Decorah Households³⁹

Measure	Citywide Gas Savings (therms)	Citywide Electricity Savings (kWh)	Citywide Energy Costs Savings (\$)	Citywide Carbon Emission Reduction (lbs)
Wall Insulation	64,682	174,571	\$112,193	1,111,680
Ceiling/Attic Insulation	54,945	213,519	\$102,472	1,077,874
Infiltration Reduction	12,519	24,343	\$20,677	195,826
Floor/Crawlspace Insulation	14,606	95,284	\$31,473	365,399
High Efficiency Heating System	104,325	0	\$150,012	1,216,570
Efficient Showerhead	5,564	168,311	\$26,498	409,475
Efficient Aerator	2,087	49,381	\$8,427	125,431
High Efficiency Water Heater	28,516	121,713	\$54,379	581,717
Compact Fluorescents	-	255,944	\$28,128	524,007
Exchange Refrigerator	-	488,937	\$53,734	1,001,025
Exchange Freezer	-	529,971	\$58,244	1,085,037
Total	287,242	2,121,971	\$586,233	7,207,413

As the table indicates, relatively simple and inexpensive measures like efficient showerheads, efficient aerators, and compact fluorescents can generate substantial electricity savings at the citywide level. Additionally, more expensive electricity measures such as exchanging refrigerators and freezers can produce even more extensive citywide electricity savings. As electricity consumption decreases, carbon emissions are also moderately reduced due to lower demand for carbon-emitting electricity sources, like coal-fired power plants. More substantial carbon reductions occur with widespread implementation of gas-saving measures, like insulation improvements, infiltration reduction and high efficiency heating systems. For example, if all of these primary gas-saving measures were implemented in 25 percent of Decorah households, the city could avoid well over 1,500 tons of carbon emissions annually.

CITYWIDE IMPACTS WITH A BUNDLE OF MEASURES

As at the household level, it is also useful to focus on the citywide impacts of a weighted bundle of efficiency measures that reflects the different levels of implementation for each measure. Since different households will implement different combinations of energy efficiency measures, our weighted bundle reflects their average combination and provides more realistic estimates of citywide impacts at the aggregate level. Table 13 displays the energy savings, costs savings, and carbon impacts that would result from if the typical bundle was implemented in 5 percent, 10 percent, or 25 percent of Decorah households.

³⁹ Analysis of *Report on the Costs and Impacts of the Iowa Low-Income Weatherization Program*. See footnote 31 for full sourcing information.

Table 13: Citywide impacts of bundle of weighted measures if implemented in different percent levels of Decorah households⁴⁰

Percent of Homes	Citywide Gas Savings (therms)	Citywide Electricity Savings (kWh)	Citywide Energy Costs Savings (\$)	Citywide Carbon Emission Reduction (lbs)
Five Percent	26,012	163,712	\$55,362	637,774
Ten Percent	52,023	327,423	\$110,724	1,275,547
Twenty-Five Percent	130,059	818,559	\$276,809	3,188,868

⁴⁰ *Ibid.*

CONCLUSION

If Decorah residents have knowledge of energy efficiency investment benefits as well as access to residential energy efficiency opportunities, they will be able to reduce their home energy bills. In doing so, they will help lower Iowa's greenhouse gas emissions. As these data show, household investments in energy efficiency, even on a modest scale, can have potentially profound impacts on collective outcomes. In other words, **it all begins at home**. If Decorah WE CAN is successful in empowering the local community towards individual sustainability measures, these individual actions will aggregate towards dramatic citywide energy and carbon reductions. This is particularly true for underutilized but high-impact efficiency measures, such as low flow aerators, that have significant cost and carbon savings for relatively small investments.

Such concentrated and community-wide efforts have far-reaching ramifications for two reasons. First, targeted and intensive reductions in household energy consumption significantly decrease the total tonnage of carbon dioxide emissions entering the atmosphere. Worldwide, fewer carbon emissions beget a slower pace of climate. Second, such a sustainability effort focused at the household level provides a model of small town resiliency and ingenuity in the face of global climate change. Decorah can continue its longstanding leadership in environmental stewardship by expanding its efforts to promote energy efficiency through household endeavors. In doing so, Decorah will ensure a more sustainable future for all of its citizens while empowering the community towards affecting global change.

For Decorah WE CAN to be successful however, an integrated and expansive community engagement initiative is imperative. Our efforts over the next few months will therefore focus on expanding our base of local leaders while reaching out to the general community via public forums, sustainability workshops, and/or face-to-face canvassing.

TECHNICAL APPENDIX

The following text, tables, and figures further detail the methodologies and calculations used to derive estimates within the report.

RESIDENTIAL ENERGY USAGE

CALCULATING ENERGY USAGE PER HOUSEHOLD

To calculate energy usage per household in Decorah, we utilized the LIHEAP Home Energy Notebook for Fiscal Year 2007 released recently by the U.S. Department of Health and Human Services. This report includes estimates of home energy usage by fuel type for individual regions, with data standardized in mMBTUs. We combined total energy consumption data for Midwest households with national data regarding average energy end use to estimate the total household energy used by households for home heating versus other end uses. We completed these calculations for each of the home heating fuel types present in Decorah to estimate average energy consumption by fuel type. Additionally, we weighted these results by the proportion of homes heated with each fuel type to estimate energy consumption for the average Decorah household. To convert from mMBTUs to more conventional units, we used the following conversion table:

Table 14: Energy Conversion Table, from 1 mMBTU to Conventional Units

	Conventional Unit	
Natural Gas	10	therms
Electricity	293.1	kWh
Fuel Oil	6.9	gallons
Kerosene	7.4	gallons
LPG	10.9	gallons

CALCULATING CITYWIDE ENERGY USAGE

With the average energy usage by fuel type defined above, we utilized Census data to estimate total household energy usage citywide. For example, the 2000 Decennial Census states that 2,173 homes in Decorah use natural gas as their primary heating fuel. Therefore, the estimated combined emissions of all Decorah households heated with natural gas is 2,173 times the average energy usage per household, or over 770,000 therms and nearly 40 million kWh. Tables 15 and 16 show these calculations for all fuel types.

Table 15: Citywide Electricity Usage in Decorah, Calculations

Primary Heating Fuel Type	Number of Households		Average Electricity Usage in kWh	=	Estimated Citywide Electricity Usage in kWh
Natural Gas	2,173	x	18,365	=	39,907,349
Electricity	529	x	17,644	=	9,333,463
Fuel Oil	15	x	25,322	=	379,826
Kerosene	30	x	16,881	=	506,434
LPG	35	x	26,484	=	926,950

Table 16: Citywide Home Heating Fuel Usage in Decorah, Calculations

Primary Heating Fuel Type	Number of Households		Average Other Heating Fuel Usage	Unit of Other Heating Fuel	=	Estimated Citywide Heating Fuel Usage	Unit of Other Heating Fuel
Natural Gas	2,173	x	354	therms	=	770,285	therms
Fuel Oil	15	x	242	gallons	=	3,625	gallons
Kerosene	30	x	184	gallons	=	5,519	gallons
LPG	35	x	382	gallons	=	13,384	gallons

CARBON EMISSIONS

ESTIMATING APPROXIMATE SOURCES OF ALLIANT ENERGY POWER

Table 17: Alliant Energy Electricity Source⁴¹

Alliant Energy	
Coal	54%
Natural Gas	6%
Other	1%
Purchased	39%

Table 18: Purchased Electricity Source⁴²

Purchased	
Coal	71%
Nuclear	17%
Wind/Water	6%
Natural Gas	5%
Other	1%

⁴¹ Alliant Energy. www.alliantenergy.com

⁴² Strait, Randy, Et al. Final Iowa Greenhouse Gas Inventory and Reference Case Projections 1990-2025. Page 8. October 2008.

Table 19: Alliant Energy Sources

Approximate Decorah Usage	
Coal	82%
Natural Gas	8%
Nuclear	7%
Wind	2%
Other	1%

CALCULATING CARBON SEQUESTRATION

100 metric tons of carbon per acre is absorbed every 90 years by mature forests.

.1 metric tons of carbon per acre is absorbed per year by conventionally tilled farmland.⁴³

100 tons of carbon per acre / 90 years = 1.11 tons carbon acre / absorbed per year

$$\text{Total Acres Forest} = \frac{56,939 \text{ tons carbon released per year}}{1.11 \text{ tons carbon per acre absorbed per year}} = 51,245 \text{ acres of forest per year}$$

$$\text{Total Acres Farmland} = \frac{56,939 \text{ tons carbon released per year}}{.1 \text{ tons carbon per acre absorbed per year}} = 569,390 \text{ acres of farmland per year}$$

⁴³ Sequestration in Agriculture and Forestry. Environmental Protection Agency. Available at: <http://www.epa.gov/sequestration/faq.html>.

Report on Stormwater Conditions for Decorah, Iowa and A Review of Opportunities for Impervious Surface Reduction

Report researched and written by Christopher Widmer, Dean Meester, and Spencer Schoonover

Decorah Water and Energy Community Action Network
Student Field Problems Team

March 5, 2010

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EXECUTIVE SUMMARY

Despite its important in Iowa, stormwater management has yet to draw a considerable amount of attention in local sustainability practices. Yet with growth and development, the issue will continually become more prevalent as impermeable surfaces cover more land area in towns and cities statewide. Individuals may aware of the existing issues and potential solutions that come with energy management practices, but are often unaware of sustainability problems that exist in the area of water management. Water is the most valuable natural resource on earth, and it will become more important in years to come to promote sustainable practices at household and citywide levels.

Iowa is situated in a water-rich part of the United States, even more so in the northeast sector where Decorah is located. The City of Decorah receives an average annual precipitation of 32 inches, which equates to over 3.5 billion gallons of water falling on the city every year. Because of this abundant supply, water can often be taken for granted and undervalued. However, Decorah residents should be very conscious of their water management practices, because the water table rests at the very high level of just 12 feet across large portions of the city. At this depth, the groundwater that is Decorah's primary source of potable water is extremely vulnerable to contamination.

Luckily, a majority of the soil in Decorah is very efficient at draining water. In 2002, approximately 19 percent of the city was covered with impermeable surfaces. Assuming that other structures and infrastructure has been built within the last eight years this figure is expected to be slightly higher for 2010. Through natural growth and development, this percentage will continue to increase without the utilization and implantation of sustainable stormwater practices. If Decorah wishes to avoid future conflicts with flooding, erosion, and public health issues that are directly linked to poor stormwater practices, the city should initially push for little changes to be made at households across the city.

When it comes to stormwater, major impacts can be made to the entire cycle at the household level. By reducing the percent of impermeable surfaces at home by just 10 percent, over **14 million gallons** of stormwater could be diverted from runoff to infiltration. That would prevent a significant amount of oil, dirt, bacteria, heavy metals, nutrients, feces, and other harmful contaminants from being swept up by the flowing water and carried directly into nearby rivers and streams. With a reduction of impermeable surfaces stormwater would infiltrate the soil, recharging the groundwater and treating the contaminants in the soil by processes of phytoremediation and rhizoremediation.

So, how can households make the change and become more stormwater efficient? First, new developments should be made accountable for every drop of rainwater that falls on them. This means on-site management, and not runoff or conveyance to other treatment systems. For homes that have already been built, several simple retrofit strategies exist such as replacing existing impermeable pavements with permeable ones or removing the pavement altogether to restore vegetation. Also, diverting downspouts from conveying water towards the street and into a rain barrel or rain garden has a huge impact on decreasing runoff and can save the consumer money on their monthly water bill.

Ultimately, the city needs to take the lead in efficient stormwater management. A huge part of changing people's behavior is education. This is especially true when the negative impacts of stormwater runoff are difficult to observe directly. If there are stigmas for owning a rain barrel, green roof, or permeable driveway they will most likely disappear as more people become aware of the issues of stormwater runoff and how big of an impact good stormwater practices can have at homeowner level. Decorah has an opportunity to become an example and a model to neighboring small communities across the state. Incorporating new stormwater management practices and policies should ultimately be in mind when the City updates and adopts new comprehensive and sustainability plans to shift practice into policy.

INTRODUCTION

As crises of climate change, global economic uncertainty, and environmental degradation converge on Middle America, small towns are increasingly struggling to adapt to their changing worlds. Rather than neglect our rural roots, the Iowa Initiative for Sustainable Communities recognizes that small towns throughout the state have the capacity to craft more sustainable futures for their current citizens and future generations. Based on our conversations and exchanges with local residents, we are confident that Decorah is eager and able to rise to the occasion. The Decorah Water and Energy Community Action Network (Decorah WE CAN) recognizes the pervasive activism already on the pulse of community needs in the region. Therefore the Decorah WE CAN sustainability initiative relies on empowering the community base towards making household efficiency improvements in stormwater collection and energy usage. Small changes in daily habits, a new light bulb here or a rain barrel there, aggregate in dramatic ways for the city as a whole. As our motto goes, “It all begins at home.” We think that if we can encourage residents to make these small changes in their own homes, there will be potentially profound impacts on collective outcomes. By this margin, Decorah WE CAN has a twofold objective: ensuring a more sustainable Decorah and empowering the community to determine its own future.

The following report details the existing conditions of one component of Decorah WE CAN’s research and outreach: household stormwater runoff. (A parallel document entitled “Report on Existing Household Energy usage and Carbon Emissions in Decorah, Iowa and Estimates of Carbon Reductions Possible with Efficiency Investments” details the existing conditions of the other facet of our sustainability initiative.) Water management is a challenging endeavor for most Midwestern states that must find a balance between access and removal. Farmers, representing a crucial component of the Iowan economy, rely on water for crops and livestock. Water sustains the beauty of Iowa’s natural prairie grass and tree populations, while homes and businesses rely on water for consumption, sanitation, and commercial distribution. Despite this, water can be devastating to both the natural and built environment, as well as public health, when it comes in the form of stormwater runoff. For a town such as Decorah that resides along a river, the imminent threat of natural disasters caused by poor water retention and infiltration can be cause for alarm. When it rains, stormwater runoff from impervious surfaces travels into rivers and streams. Along the way, this stormwater often picks up pollutants and toxins that then infiltrate the water supply and natural bodies of water. Stormwater runoff can also cause erosion of valuable agricultural topsoil, destroy complex habitats, and contribute to combined sewer overflows.

Currently, Decorah’s Water Department is capable of producing one million gallons of water for distribution a day while the City’s Water Treatment Plant is capable of storing one million gallons of bio-solids. Therefore, Decorah has the ability to adequately provide ample quantity and sufficient quality of water throughout the city and the region.⁴⁴ However, it has been noted by City officials that Decorah is in need of a full-scale, citywide drainage study and upgrade. Decorah also lacks subdivision codes for infrastructure in light of storm events. Therefore, the area of water management that is in the most immediate need of attention is the city’s sewer system infrastructure and drainage capabilities. However, Decorah WE CAN believes that the solution for a sustainable storm sewer system goes beyond upgrading pipes and drainage ways and involves research on groundwater retention, surface permeation, and new technologies and techniques for reducing water runoff. We are confident that sustainable water practices can be achieved through community empowerment. In regards to any community sustainability initiative, it all begins at home. While a stormwater system is a citywide concern, teaching residents about stormwater management at home and at the community level can provide the City of Decorah with a unified front for ensuring a more sustainable town. This document begins the conversation about stormwater and is an attempt to examine the current conditions of the stormwater system infrastructure. Further, this report examines information regarding geographic characteristics and climatology of the city as well as research on surface coverage permeability evaluations, estimated effect of impermeability, and an evaluation of different techniques for increasing permeability throughout the city.

⁴⁴ City of Decorah. *Water Department History*. Accessed December 2009. <http://www.decorahia.org/decorah.asp>

PROFILE OF DECORAH

The traditional approach to stormwater management is the concern of moving water from the point of origin to its point of drop off. Cities that are built around streams or rivers like Decorah have a special advantage for moving water by bringing stormwater to a body of water for drop off. While this method is essentially easy and fiscally inexpensive there are two issues that arise that when considering effective sustainability practices for stormwater management.

The first is the volume and timing of water flow. Stormwater infrastructure is typically mindful about the capacity of water flowing from the time of infiltration to the point it is deposited. Large storm systems or build up of snow and ice melt could potentially cause issues for low capacity systems leading to problems with backflow and flooding.

The second issue is water pollution through what is often referred to as stormwater runoff. Solid particulates from vehicle output, pesticides and fertilizers from lawn chemicals, and other pollutants from human consumption have the potential to be washed away with stormwater runoff and dropped into stream and river habitats. Eventually this water has the potential to get into the ground water aquifers where drinking water originates. When considering both issues of water volume and pollution sustainable stormwater management practices need to factor in runoff mitigation at the point of origin.

One of the natural processes for capturing stormwater from going into a direct water source is stormwater infiltration. Infiltration is the basic process of water moving from the ground surface into the soil. The quality of infiltration is based on factors such as permeability of the ground surface and other factors in soil characteristics. Parking lots, roads, and any built infrastructure is typically designed for very little water penetration making it very impermeable moving water to the next lowest location. Water that is directed to more permeable surfaces infiltrate soils based on unique quality of soils that allow more capture and retention. Even the type of vegetation that resides in the area has the potential to affect the quality of infiltration. Soils that have the ability to hold more water than other types are considered to have high water retention rates.

To better understand how water gets from point A to point B we will analyze the general characteristics of Decorah’s water cycle and storm activities and how they affect on the city region. The following is a general review of Decorah’s average precipitation, soil composition, and ground water flow follow. These data and details reveal the quantity and degree of water cycling from precipitation to either soil retention or water runoff.

PRECIPITATION

Decorah is located in a United States region described as “humid continental” that averages rainfall between 16 to 32 inches per year.⁴⁵ Between 1931 and 1995, Decorah’s average precipitation was 31.5 inches, with a monthly average of 2.62 inches. As seen in Figure 1, the majority of precipitation occurs between the late spring months of April and May to the early fall months of September and October. Decorah sees the highest precipitation rates in the summer months of June and July, with averages of 4.4 and 4.5 inches per month, respectively.

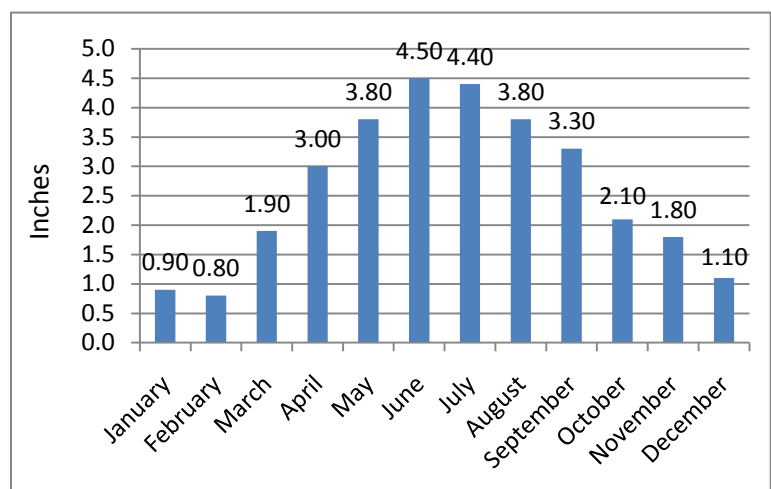


Figure 5: Average Monthly Precipitation, 1931-1995¹

⁴⁵ National Oceanic and Atmospheric Administration (2010)

The most recent rainfall averages recorded between 1996 and 2009 display a higher average of 35 inches per year compared to the previous 78 years between 1931 and 2009.⁴⁶ Three out of the top five years with the highest rates of precipitation were recorded within the last decade. While it's important not to generalize the precipitation characteristics of the last ten years with high degree of volatility of year to year precipitation rates remaining somewhere between a median of 30 inches, not falling below 20 inches or rising above 50 (Figure 2 and 2a), there has been a trend in increasing rainfall within the last 14 years compared to the last 78 years. These trends could have implications for Decorah's stormwater sustainability and flood mitigation strategies.

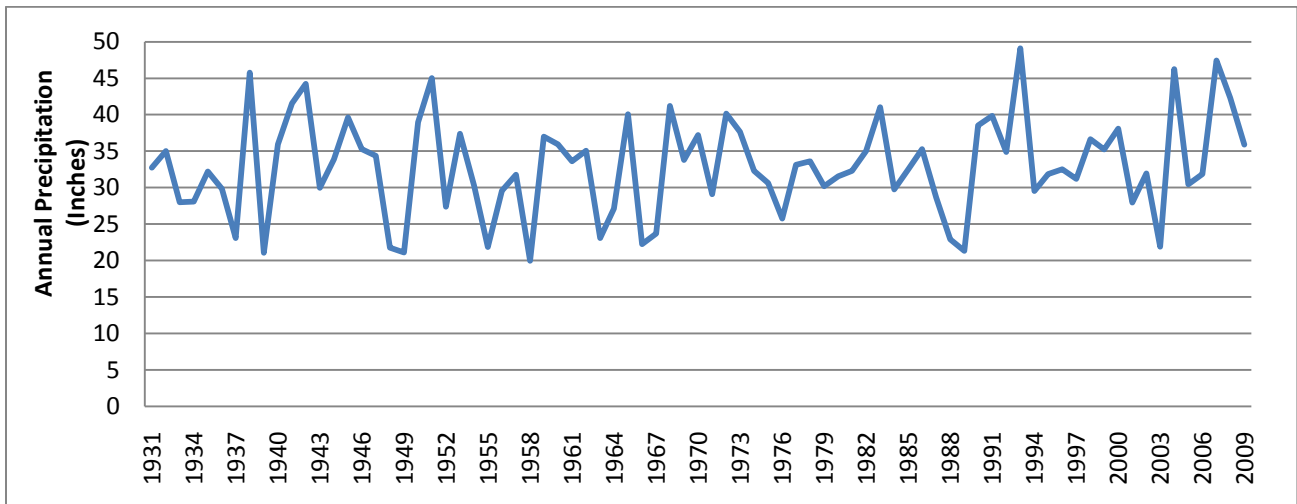


Figure 2: Average Yearly Precipitation between 1931 and 2009⁴⁷

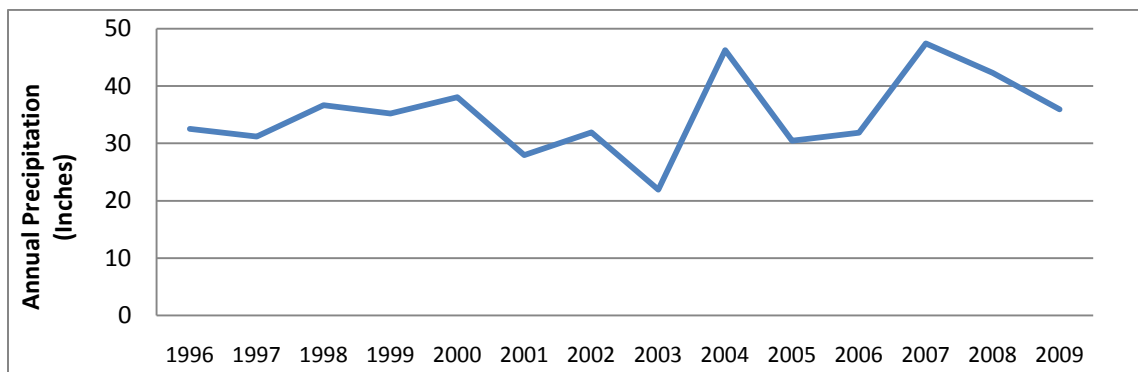


Figure 2a: Yearly Precipitation, 1996 to 2009⁴⁸

As Table 1 shows, the overall average rainfall is higher for years 1996 to 2009 (a 14 year period) compared to 1931 to 2009 data (a 78 year period). A comparative analysis on variance also showed a high degree of difference between the overall rates for average precipitation for the 78 year period than the 14 year period. This means that within the last 14 years it has become more common to see high annual precipitation than in the past.

By using all precipitation rate data from 1931 for a regression model to examine average precipitation trends, we found a variability of .04 (Appendix B). The positive trend associated with yearly precipitation rates suggests that each preceding

⁴⁶ Bernatz, Richard. (2004) *Decorah Weather Page*, January 23, 2010. <http://faculty.luther.edu/~bernatzr/DecWx/>

⁴⁷ Buttle and Tuttle Ltd. (1996-2008) *WorldClimate: Average Rainfall*, January, 23 2010. <http://www.worldclimate.com/cgi-bin/data.pl?ref=N43W091+2200+132110C>

⁴⁸ Buttle and Tuttle Ltd. (1996-2008)

year starting at 2009 has the potential for a .04 inch increase in average precipitation rates. If this trend is consistent, it may be possible to see a 0.5 inch increase in precipitation averages within the next decade. While there is obviously a great deal of volatility (ups and downs) between each year’s precipitation rates, it is still important to point out the trends of the last 14 years of storm system averages.

It is also important to understand that this analysis is just a snapshot of the overall factors that may contribute to the global phenomenon of climate change but is also vital information to be accustomed with when considering good stormwater management practices. As discussed before timing and volume play a significant role in the quality of this process. Creating a more efficient stormwater network that accounts for higher precipitation rates may be a factor to consider in updating an aging stormwater system.

Table 20: Variance Differences between Data Sets

1931 to 2009			1995 to 2009	
Variance	Average Precipitation	Year	Average Precipitation	Variance
-0.06316	32.51	1996	32.51	-0.35471
-0.25638	31.2	1997	31.2	-0.54306
0.545998	36.64	1998	36.64	0.239076
0.336553	35.22	1999	35.22	0.034917
0.756918	38.07	2000	38.07	0.444674
-0.7328	27.97	2001	27.97	-1.00745
-0.14871	31.93	2002	31.93	-0.4381
-1.62515	21.92	2003	21.92	-1.87728
1.966389	46.27	2004	46.27	1.623624
-0.36553	30.46	2005	30.46	-0.64945
-0.16051	31.85	2006	31.85	-0.4496
2.137485	47.43	2007	47.43	1.790402
1.380828	42.3	2008	42.3	1.05284
0.438326	35.91	2009	35.91	0.134121
Mean	32.93823		34.97714	
Standard Deviation	6.779824		6.95534	

STORMWATER INFRASTRUCTURE

In Decorah, storm sewer and sanitary sewers are separated. However, the overall condition of the sewer system is unknown. Understanding the storm sewer infrastructure plays an integral part to the overall effectiveness of stormwater management techniques. A drainage research study should be done, and would include a comprehensive review of the system’s quality and function such as flow rates, soil drainage characteristics, and storm sewer capacity. This would also involve mapping of the existing storm sewer infrastructure for Decorah, and determining the quality of the overall stormwater system.

GROUNDWATER

Decorah is located in a region of Iowa known for its access to high quality ground water. The majority of the water that comes out of our faucet to drink and use for everyday tasks comes from this source. The average statewide water table depth is over 20 feet. The water table (depth to the groundwater) is higher in Winneshiek County and Northeastern Iowa than the rest of the state, and can be close to only twelve feet below the surface in some locations, making it more susceptible to pollutants and impurities. Areas where the water table is very close to the surface in Decorah are shown in Figure 3 in dark blue. As one can see, a majority of the city, especially those areas near the river, hover just yards above the groundwater—their source of drinking water. Therefore, it is very important that Decorah practice sustainable groundwater management techniques.

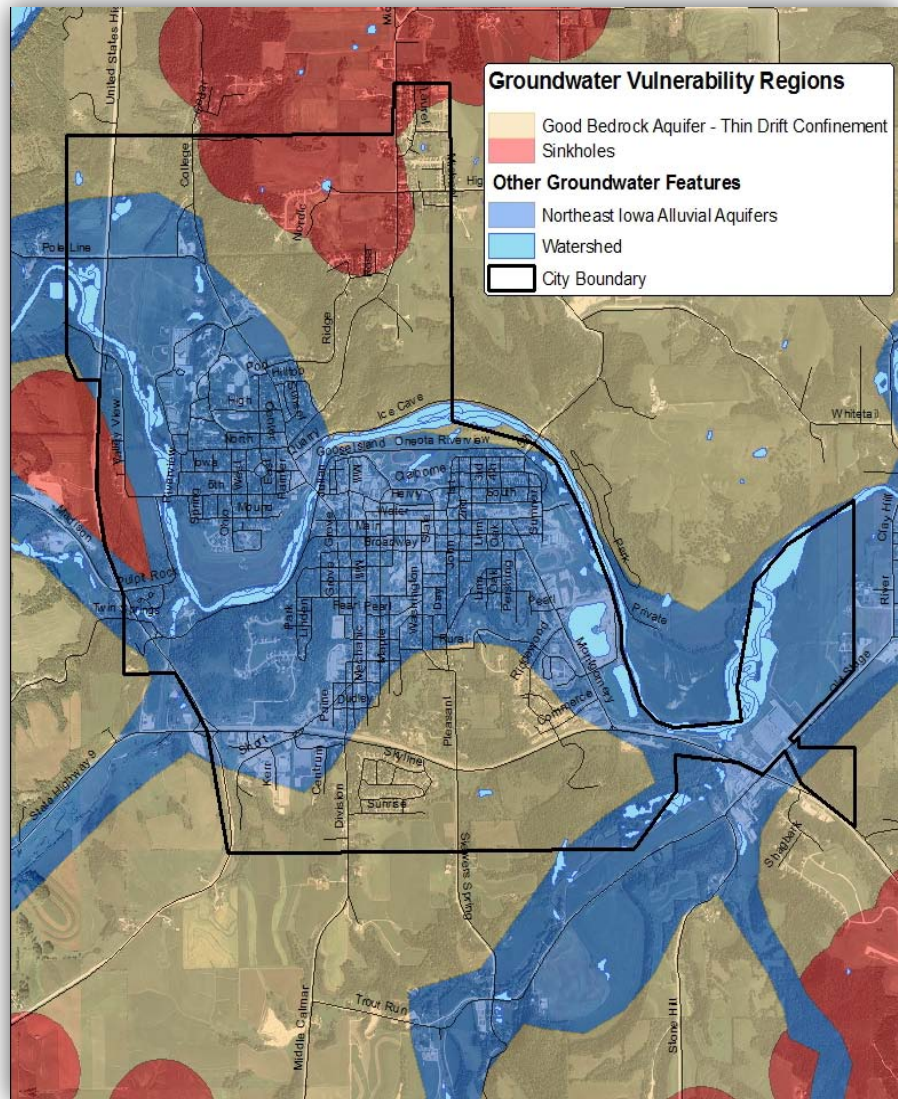


Figure 3: Water Table Vulnerability in Decorah and the Surrounding Area (Iowa DNR)

SOILS

Like other cities located on the Upper Iowa River, Decorah’s soils are characterized for their good drainage qualities. Topographically, Winneshiek County is made up of gently rolling, to strongly rolling areas between several locations where bedrock risers come to the surface. Several mixes of soils called associations are in different regions of the natural landscape, creating variant drainage qualities.

The drainage quality of soils throughout Decorah is shown in Figure 4. The type of soil found closest to the river is classified as Fayette-Lacrescent association,⁴⁹ which has excellent drainage quality. The rest of the soils in Decorah are of the Downs-Fayette-Lacrescent association, all of which are also well-drained. Each drainage type is on a 12 point scale from

⁴⁹ National Cooperative Soil Survey (2004) *Soil Survey of Winneshiek, Iowa: Part I and Part II*. National Resource Conservation Service. <http://soils.usda.gov/>

“excessively” as the highest degree of drainage to “very poor” as the lowest quality of drainage. Knowledge of this soil data should aid in the development process, because more or less stormwater management may be required in certain areas of the city. If not mandated by city code, incentives for developers to increase permeability across a development should be done in areas where soil drainage is classified as “poor” or worse.

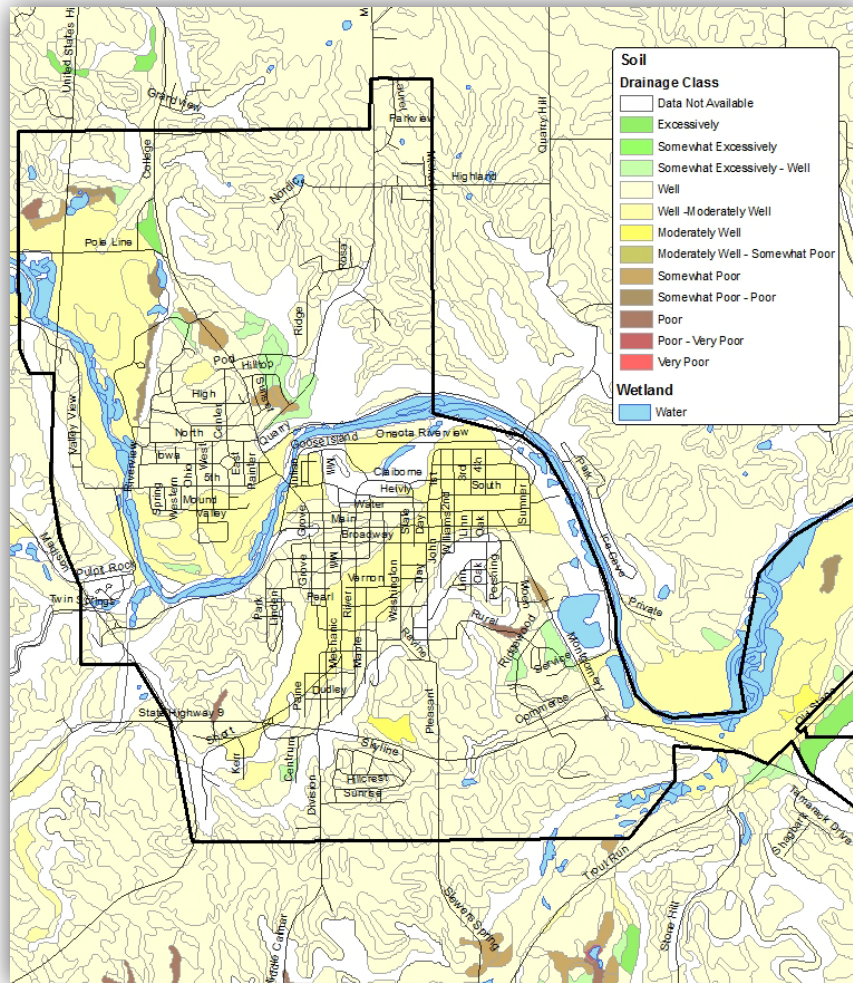


Figure 4: Soil Drainage Classifications⁵⁰

LAND USE

The efficiency of stormwater conveyance for Decorah and the surrounding region is dependent upon existing land use conditions, and the surface coverage. When more land use is associated with structural development and transportation infrastructure, the level of impermeability and stormwater runoff increases. Land use associated with natural or agricultural surface qualities, however, often increase the degree of permeability and decreases the level of runoff.⁵¹ In other words, natural landscapes make it easier for the soil to absorb stormwater, while aspects of the built environment, such as sidewalks, buildings, and streets, make it more difficult for soil to absorb stormwater.

⁵⁰ Iowa DNR NRGIS Library (1997)

⁵¹ Washington State Department of Ecology (1995) *Impervious Surface Reduction Study: Final Report*. Water Resources Program, City of Olympia, Washington.

Decorah's city limits comprise approximately 4,000 acres of land. Based on the most current land use map available (2002), 28 percent of the land is considered impermeable—roads, commercial/industrial buildings, and residential units. It is safe to assume that an even higher percentage is impermeable today, eight years later. Additionally, 10 percent of the city is either water or wetlands, 8 percent is agricultural fields, 38 percent is grasslands, and 16 percent is forests. A more detailed breakdown of the land use can be seen in Appendix A.

The unaltered landscapes, including grasslands, forests, and water areas (approximately two-thirds of Decorah's land area), do a sufficient job at conveying stormwater into the soil or retaining it until it is able to permeate or evaporate back into the atmosphere. However, the nearly 30 percent of the city that has impermeable surfaces causes Decorah to lose a significant amount of rainwater to overland runoff. Rather than being absorbed into the soil, this runoff enters local bodies of water, carrying with it pollutants and toxins it picks up along with way. Applying the typical site coverage percentages shown later in Table 2 to the land use types in 2002 in Decorah, it is estimated that 19 percent of the city was covered by impervious surfaces in 2002. This number is likely somewhere between 20 and 25 percent today. As seen in Figure 5, as Decorah approaches the 35 to 50 percent impervious surface threshold, it risks causing 35 percent of rainwater to run directly into the sewer system and flow untreated into local surface-water bodies.

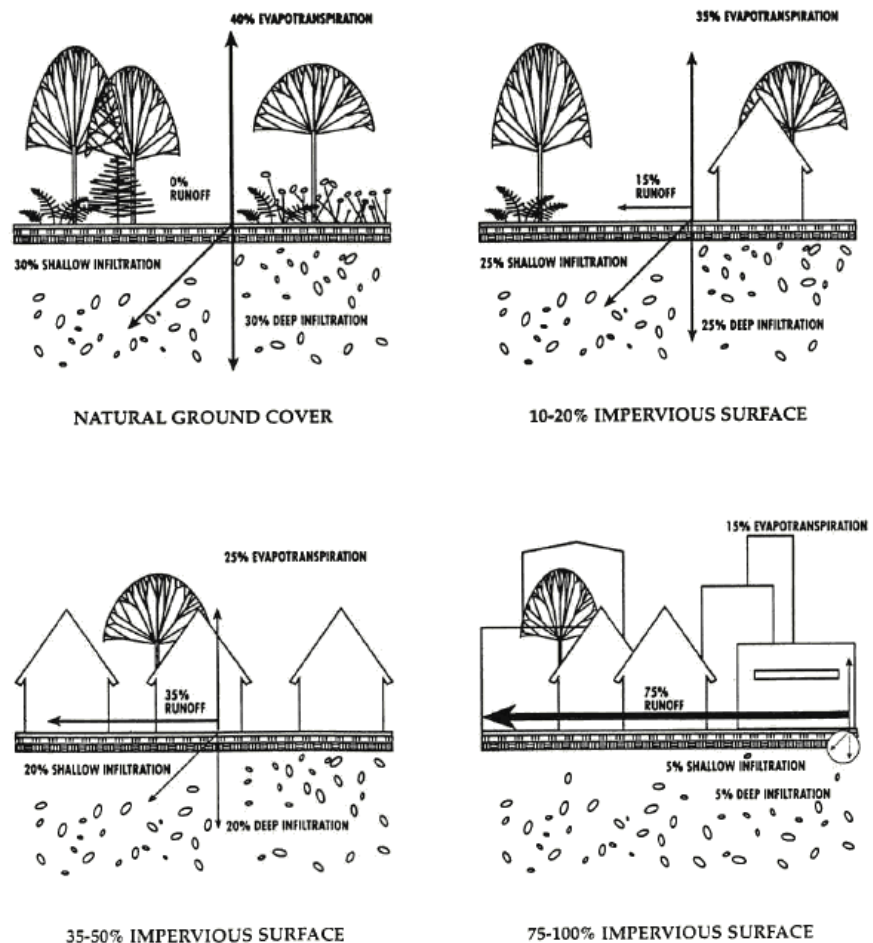


Figure 5: Stormwater Changes in Relation to Surface Coverage (EPA, 1993)

EFFECTS OF INCREASING RUNOFF

Traditional stormwater management techniques strive to convey water from the point of origin to a discharge point. Cities near streams or rivers, like Decorah, are able to move their stormwater quickly into that body of water. While this method of stormwater management is relatively easy with modern technologies, it raises several significant sustainability issues: spatial and temporal problems, and pollution problems.

As Decorah grows and becomes increasingly impermeable, rainwater and snowmelt are forced to runoff overland instead of percolating and recharging the groundwater supply. This lowers the water table, making farmers dig deeper wells for irrigation, and cities dig deeper wells for drinking water supply. It also causes stormwater conveyance systems that are at or near capacity to overflow and cause flooding. Additionally, surface water runoff acts as a non-point source pollutant as it carries pesticides, fertilizers, petroleum, and other harmful elements that are on the earth's surface with it into the sewer

system. Eventually, this contaminated water has the potential to permeate into groundwater aquifers, from which many cities draw their drinking water. Surface runoff also causes erosion and siltation issues if not properly managed, which results in the loss of topsoil and the need to dredge streams, lakes, and rivers. For these reasons, to increase stormwater sustainability, it needs to be managed at the source by increasing infiltration at home.

In lieu of recent major flooding events around the state of Iowa, a Water Resources Coordinating Council (WRCC) was formed to focus on recommendations for the Iowa legislature. Though Decorah did not suffer significant damages, many cities downstream in the Iowa River watershed did. Included on the WRCC are professors from each state university, members of the Iowa Department of Transportation, a homeland security representative, Iowa Department of Natural Resources employees, and Army Corps of Engineers personnel, among others. The council concluded that, “The state should require all cities and counties to implement stormwater management practices consistent with the Iowa Stormwater Management Manual (ISMM), and be given the opportunity to develop a phased-in approach to allow sufficient time to secure necessary technical and financial assistance for effective implementation.”⁵²

FLOODING

Increasing surface runoff results in stormwater reaching rivers more rapidly, creating a spike on the hydrograph curve. A hydrograph, such as that shown in Figure 6, charts the flow of water over time during a storm event. The more impermeable surfaces that exist, the more quickly the water will reach a stream, and the higher the flow in the discharging stream/river will be. As this water moves downstream through the watershed, more water from the storm joins this surge, and flooding results. Though flooding did not have a major impact on Decorah during the summer flooding of 2008 in Iowa, it did affect other major cities downstream of Decorah that are in the same watershed.

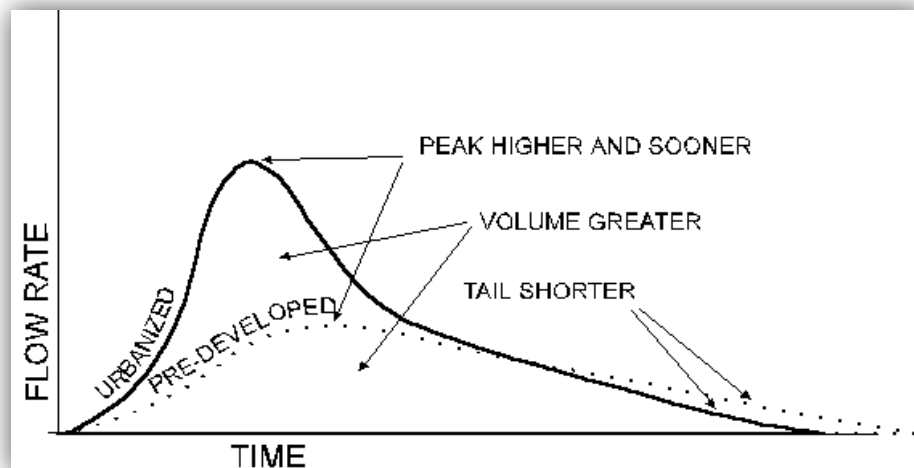


Figure 6: Hydrograph Showing Effects of Runoff after Urbanization (http://www.civil.ryerson.ca/Stormwater/menu_1/bin/pic_1.gif)

⁵² Water Resources Coordinating Council (WRCC). *Recommendation Summaries*. Issue brief. 2009. Print.

EROSION

Erosion is caused when soil particles are dislodged by water falling on or running across bare soil or vegetated areas that are unable to handle the force of the flowing water.⁵³ The more water that runs off, the worse erosion can get. Not only



Figure 7: Erosion Caused by Stormwater Runoff
(<http://www.state.me.us/dep/blwq/images2/erosion1a.jpg>)

does the eroded soil cause problems for property owners in the form of rills and topsoil loss, but it also increases the turbidity of the water body that it is carried into. Soils that have a high permeability and organic matter content are less susceptible to erosion, as well as those that are not on steep gradients and are covered with some sort of vegetation. Where soil is exposed to the atmosphere, such as in Figure 7, erosion is highly likely to occur because there is no vegetation to soften the impact or absorb the moisture.

WATER POLLUTION & PUBLIC HEALTH

With so many things in the world to worry about, many people neglect the effects that stormwater runoff can have on their physical well-being. However, drinking water outbreaks have been linked to stormwater runoff; more than half of the documented waterborne disease outbreaks in the United States since 1948 have followed extreme rainfalls.⁵⁴ Inflows of runoff to surface water bodies, indicated by increased turbidity from suspended soil particles eroded from the landscape, are associated with elevated concentrations of bacteria, *Giardia*, *Cryptosporidium*, and other harmful microorganisms.

Reducing stormwater runoff and associated nonpoint source pollution is a potentially valuable component of an integrated strategy to protect public health at the least cost. Traditional strategies to manage stormwater and treat drinking water require large infrastructure investments and face difficult technical challenges. However, simple at-home infiltration and runoff reduction improvements can go a long way in preventing a city from having to invest huge sums of money into water management technologies.

Although large lawns might seem capable of absorbing rainfall and runoff from adjacent surfaces, they are typically compacted by construction equipment and can generate up to 90 percent as much runoff as pavement. Simple changes, like diverting roof downspouts from sanitary sewers to yards in a Michigan community reduced storm flows in sewers by 62 percent, resulting in cost savings that matched the cost of the conversion in only two months. It makes sense to complement a city's water treatment infrastructure with improved permeability to reduce the runoff flow, because it is cheap, effective, and sustainable.

⁵³ <http://www.uwex.edu/ces/shoreland/images/Controlling%20Runoff%20and%20Erosion.pdf>

⁵⁴ Gaffield, Stephen J. *Public Health Effects of Inadequately Managed Stormwater Runoff*. Rep. 9th ed. Vol. 93. 2003. American Journal of Public Health.

NATURAL PURIFICATION OF PERCOLATING WATER

There are many chemicals, nutrients, oils, and bacteria on the surface of the earth that are swept away by stormwater into surface water bodies. A natural fear of any individual or city that uses groundwater as its primary drinking source, such as Decorah, would be that increasing infiltration of stormwater would also increase infiltration of these harmful contaminants, potentially degrading the water supply. Decorah has a very high water table—only 12 feet below the surface at certain times of the year in certain areas—which means the contaminants do not have to travel far before they reach the groundwater. However, increasing stormwater infiltration will not contaminate the groundwater, but rather, improve its quality.

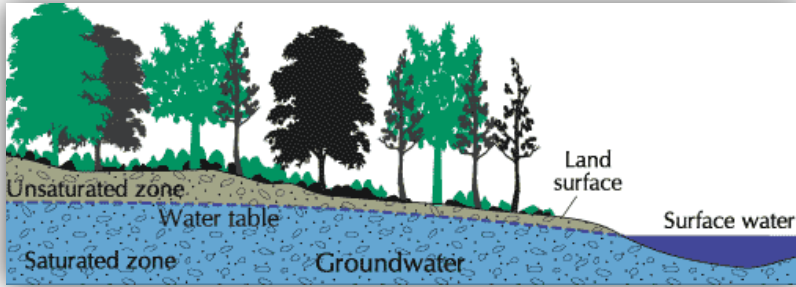


Figure 8: Groundwater Profile View
 (<http://www.who.edu/seagrant/images/groundwater.gif>)

Once contaminated stormwater reaches a nearby river/stream it harms the quality of this water source because it ran off impermeable surfaces. Flowing rivers have a more direct, unfiltered interaction with groundwater than percolating stormwater does, as can be seen in Figure 8. By short-circuiting the water cycle—that is, by not

allowing the water to percolate through the soil before it reaches a river—humans are putting their groundwater sources at a greater risk of contamination. When the stormwater is allowed to infiltrate through the soil, it is naturally purified by processes called *phytoremediation* and *rhizoremediation*.

Phytoremediation incorporates the use of plants to mitigate environmental pollutants without excavation of the contaminated material.⁵⁵ This is an economically advantageous process because it uses naturally occurring organisms to purify the water. Plants serve as solar-driven pumping and filtering systems as they take up water soluble contaminants through their roots and transport/translocate them through various plant tissues where they can be metabolized, sequestered, or volatilized⁵⁶, as can be seen in Figure 9. This process increases the amount of organic carbon in the soil, which then stimulates microbial activity in the rhizosphere (soil around plant roots), where rhizoremediation occurs.

Rhizoremediation is the degradation of contaminants by microbes in the soil around plant roots. Plants best suited for rhizoremediation include grass varieties and leguminous plants because of the high number of bacteria located on their branched root systems.⁵⁷ Because we are looking to improve stormwater infiltration at home in Decorah, and most homes have grass yards, rhizoremediation will be an effective mechanism for cleansing the stormwater.

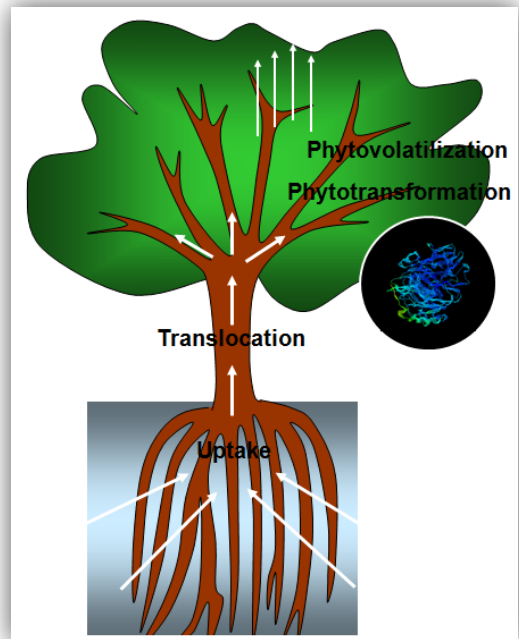


Figure 9: Phytoremediation Treatment Process¹³

⁵⁵ Beebe, Alexandra. *Phytoremediation of PCBs*. Rep. 2009. Print.

⁵⁶ McCutcheon, Steven C. *Phytoremediation Transformation and Control of Contaminants*. Hoboken, N.J. 2003. Print.

⁵⁷ Kuiper, Irene. "Rhizoremediation: A Beneficial Plant-Microbe Interaction." (2003): 6-15. Web. Feb. 2010.

OVERLAND FLOW REDUCTION TECHNIQUES

Cities, neighborhoods, homeowners, and farmers use many techniques to lessen the overland flow of stormwater and thus, limit its harmful side effects. While urbanized areas are motivated to lessen runoff to prevent flooding, among other things, rural areas desire to lessen erosion and the loss of top soil and nutrients. Though the motives vary for each stakeholder, society as a whole benefits from getting stormwater to percolate instead of running off and short-circuiting the natural water cycle.

The simplest and most common way of preventing excess runoff is to lessen the area of impermeable surfaces. Using porous concrete or asphalt of permeable pavers instead of the more common impermeable concrete or asphalt is an effective way of doing this. Additionally, breaking the continuity of impermeable surfaces so that overland flow has a greater opportunity to find places to permeate is an effective technique. Last, capturing the rainwater with a rain garden, green roof, or rain barrel is becoming more common and provides other positive externalities, as well.

PAVEMENT AREA REDUCTION

If fewer areas were paved and made impermeable, rainwater would more naturally be able to permeate. Driveways, roads, and parking lots are often unnecessarily oversized. When a new development is designed, it is often done so to accommodate estimated peak parking demand without requiring much off-site or on-street parking. However, peak demands are generally over estimated and rarely occur. Likewise, the size of a parking stall could be reduced, which would cause a significant reduction in pavement for large parking lots, and be a direct cost savings. Street widths, especially those in residential areas, such as that shown in Figure 10, are often excessive and allow for an abundance of unnecessary on-street parking. Each of these pavement area reduction strategies could be implemented by enacting an ordinance, and immediate overland flow reductions would be apparent.



Figure 10: Excessively Wide Residential Street

(http://activerain.com/image_store/uploads/9/7/5/8/8/ar11796929808857
 © IPC)

CONTIGUOUS SURFACE REDUCTION

A certain amount of overland stormwater flow is inevitable, especially during and after a large storm event. However, just because water becomes runoff does not mean it has to continue to run off. Rather than streamlining the overland flow process to quickly move water into sewers and surface water bodies, it should be given several opportunities to percolate and only reach the sewer system as a last resort.

Impervious surfaces, such as driveways and sidewalks, can be gently sloped to direct runoff towards rainwater catchment areas and infiltration beds, rather than allowing rainwater to sheet off onto other impervious surfaces, and ultimately into sewers. Instead of installing a driveway at a gradient that conveys water towards the street, it could be crowned (raised in the center) and thus force water to flow to the edge of the driveway where it can be better managed by the lawn. Also, a strip of permeable pavement could be installed at the foot of the driveway to allow runoff to permeate instead of reaching the street. For water that reaches the curb and gutter system, it is not too late to permeate. Curb cuts can be installed to allow the flowing rainwater to enter rain gardens or ponds, as shown in Figure 11, where the water is held and allowed to infiltrate the soil.



Figure 11: Curb Cut into a Rain Garden
 (http://www.ci.eagan.mn.us/upload/images/Lake%20Water%20Quality/Other%20images/Rain_Garden2.jpg)

For parking lots, infiltration or filter strips can be installed to break up of the contiguity of an impervious surface. They are often placed between rows of parked cars, much the way a grassy median might be constructed, but with a concave shape, below the level of the parking surface, and planted with water tolerant plant material. They are low-maintenance, cheap to implement, and aesthetically appealing. The cost of infiltration strips is offset by the reduced need for retention basins and/or other conventional stormwater infrastructure.

POROUS CONCRETES, ASPHALTS, & PAVERS

Porous pavements appear the same as their impermeable counterparts, but are made with built in void spaces (typically between 15 and 25 percent) to let water and air pass through⁵⁸. This extra void space is a result of limiting the number of small aggregates in the mixture to prevent them from filling in the spaces. The benefits to using permeable pavements are numerous, as professor Bruce Ferguson reports:

“Where porous pavements are properly selected, designed, and installed, they can naturally biodegrade the oils from cars and trucks, give long-lived urban trees viable rooting space, make streets quiet, make driving safer, preserve native ecosystems, and reduce development costs.”⁵⁹

Their significance to this report is the increase in water infiltration, as can be seen in Figure 12. However, there are several other positive externalities



Figure 12: Permeable Concrete
 (<http://www.raffinconstruction.com/images/perviousConcrete.jpg>)

that they provide, all while being equally as structurally sound as regular pavements. They do require annual or bi-annual cleaning, which can be done with a vacuum-fitted street sweeper, but regular pavements require cleaning, as well. They treat pollutants such as oils, feces, heavy metals, bacteria, and nutrients, and allow tree roots to grow beneath them because of the influx of water. Also, they make driving safer by preventing water from puddling on the road surface, which prevents glare and hydroplaning, and better absorb sound



Figure 13: Driveway made of Grass Pavers
 (<http://www.groundtradesexchange.com/forums/hardscaping/3783-eco-pavers.html>)

⁵⁸ <http://www.perviouspavement.org/>, retrieved January 10, 2010

⁵⁹ Ferguson, Bruce K. *Porous Pavements: The Overview*. Rep. 2005. Print.

waves to quiet driving noise.

Concrete or grass pavers are another option in the realm of pervious pavement. Concrete pavers, when installed with sand rather than mortar joints and laid over a sand base, can be pervious. Grass pavers are concrete pavers which are installed with voids between them, allowing grass to grow through them, as can be seen in Figure 13. These are particularly useful in non-vehicular pavement applications or driveways and overflow parking areas which are less frequently used.

RAIN GARDENS

While relevant to large-scale town planning because of their appeal to landscape architects and urban designers, rain gardens, like that shown in Figure 14, provide an opportunity for individual homeowners to make a real impact on the way water works in their town. While they are similar to the concept of **xeriscaping** because they do not require irrigation, rain gardens are even more beneficial because they lessen the impacts of heavy rainfall. They consist of absorbent soils which hold run-off until it can percolate into the soil. Unlike low monoculture vegetation (grass lawns) that require fertilizer, frequent upkeep, and irrigation, a rain garden thrives on soaking up excess water, and in doing so, limits the number of surface toxins that flow into nearby surface water bodies.

A rain garden is largely composed of flowering perennials, tall grasses, and shrubs—an ideal mix for supporting all types of wildlife and improving biodiversity. Not only are they beneficial to birds, butterflies, and insects, but humans, as well. “Until recently, water has been seen as a nuisance to be controlled and contained.”⁶⁰ Water is instinctively relaxing for humans, and the opportunities for contact with it are becoming more limited as populations urbanize. Though primarily used at commercial and institutional sites, it would be very easy to run ones home drain pipes into a rain garden as opposed to onto their lawn or driveway. And unlike ponds or rain barrels, a rain garden has a water retention time on the order of hours, so there is no potential for mosquito or other insect breeding.



Figure 14: Typical home Rain Garden
(www.bartholomewswcd.org/BC_SWCD/Land_Use.htm, accessed February, 13 2008)

RAIN BARRELS

Another at-home solution to slowing down rainwater is harvesting it for reuse, which can be easily accomplished with a rain barrel. These containers, like the one shown in Figure 15, are typically placed at the end of a downspout to capture rainwater, which is filtered through a screen to prevent mosquito breeding and capture debris, and store it for later release at a spigot placed low on the barrel. Often they are outfitted with a soaker hose which will slowly release the water into the lawn or a garden. A typical rain barrel is capable of holding between 50 and 60 gallons, which is roughly equivalent to the amount of rain which falls on a 1,000 SF house during a summer storm.

⁶⁰ Dunnett, Nigel, and Andy Clayden. *Rain Gardens Bringing Water to Life in the Designed Landscape*. New York: Timber, Incorporated, 2007. Print



Figure 15: Down Spout into a Rain Barrel

(<http://www.livelancaster.org/residential-projects/rain-barrels/>)

The effectiveness of this technique depends on the availability of destinations for the captured water to be discharged, such as in a garden or for outdoor cleaning. Unlike treated water that has additives which can be irritating to plants (fluoride, chlorine, etc.), water from a rain barrel is natural and great for use in gardens. In this way, the rain barrel saves the consumer money on their water bill by lessening their demand for treated water.

GREEN ROOFS

A green roof reduces the amount of water that would normally run-off of a roof, and also reduces the rate at which it runs off. In the simplest sense, they are a layer of vegetation added to the roof of a building/structure.

However, the benefits of placing this layer of vegetation atop a roof go much deeper than just the soil.

A green roof, like that shown in Figure 16, is an excellent layer of insulation for a home. It helps keep a home cool in the warm, muggy summer months, and aids in preventing heat from escaping a home during the frigid winter months, as well as reducing the heat island effect for the entire neighborhood. Additionally, a green roof reduces the monotony of structures, and become the focus point of any building. They sequester carbon from the atmosphere, are aesthetically appealing, and require little to no upkeep. Green roofs, or “eco-roofs”, are able to support a wide variety of plant life, and are becoming a staple in sustainably progressive communities around the country.⁶¹



Figure 16: Residential Green Roof

(<http://www.lotuslive.org/buildings/files/norwaygreenroof.png>)

ESTIMATED STORMWATER INFILTRATION IMPACTS

To estimate the impacts of improved infiltration in Decorah, we considered a significant amount of data. Using the table in Appendix A, we applied data regarding rainfall totals in Decorah to the figures for land-use types. We estimate that a total of 350 million gallons of rain lands on residential areas in Decorah each year, and approximately 10 percent of Decorah consists of residential land uses. We further break down this rainfall into the amount that lands on impermeable surfaces by using the percentages in Table 2.

⁶¹ Dunnett, Nigel, and Andy Clayden. *Rain Gardens Bringing Water to Life in the Designed Landscape*. New York: Timber, Incorporated, 2007. Print

Table 2: Typical Site Coverage Percentages for Residential Land Use (Aqua Terra, 1994)

Surface Coverage Type	Average Rate of Residential	Average Rate of Multifamily	Average Rate of Commercial
Streets	16	11	3
Sidewalks	3	5	4
Parking/Driveways	6	15	53
Roofs	15	17	26
Lawns/Landscaping	54	19	13
Open Space	6	34	1
Total Impervious Surface	40	48	86

By multiplying the volume of water that falls on residential lands by the percent that is impermeable, we were able to calculate the amount of stormwater runoff that could be reduced, which is shown in Table 3. By increasing infiltration by just 10 percent on residential lots throughout the city, Decorah would be able to permeate over 14 million gallons of water. That is enough water to fill a 5-story building with a footprint of an entire city block! However, Olympia, WA recently completed a stormwater management study and determined that residents could easily increase infiltration by 20 percent or more⁶², which would result in nearly 30 million gallons of increased infiltration.

Table 3: Volume of Water Captured through Run-off Conversion (Gallons)

Infiltration Increase	10%	20%	50%
Roof	5,362,660	10,725,319	26,813,298
Parking/Driveway	2,145,064	4,290,128	10,725,319
Sidewalk	1,072,532	2,145,064	5,362,660
All Impervious Surfaces	14,300,426	28,600,852	71,502,129

The key to increasing permeability is slowing the water down long enough to allow infiltration to occur. We have assumed that all rainfall falling on impermeable surfaces will become runoff. While not all rainfall landing on impermeable surfaces will necessarily end up in the storm sewer, likewise, not all rainfall onto permeable surfaces can infiltrate fast enough to avoid becoming runoff. Our assumptions give us only an estimate to what an active, real life test could produce within the City of Decorah.

⁶² Washington State Department of Ecology (1995) *Impervious Surface Reduction Study: Final Report*. Water Resources Program, City of Olympia, WA.

RECOMMENDATIONS

“It all begins at home.” This has been the focus of our efforts to promote sustainability within Decorah. Our belief is that individuals act independently; the collective impacts can be significant. We have discussed the reasons why stormwater is a significant issue and why we should make efforts to manage it in a more sustainable manner. The following recommendations are the ways we see the city taking its place of leadership within the community:

1. Sponsor a demonstration plot rain garden to show the aesthetic and functional qualities of a rain garden. Choose a residential property of typical quality and in a visible location. This garden could be integrated into a local garden tour/walk.
2. Sponsor/co-sponsor the installation of a pervious pavement parking lot, collaborating with a willing business and a paving company. The location should be prominent and the installation well promoted.
3. Promote these techniques through the sustainability plan and comprehensive plan, each of which are currently under development.
4. Mandate stormwater capture and infiltration in all new development and redevelopment through the implementation of a building code as well as within the subdivision regulations.
5. Offer rebates of stormwater surcharges for residents'/businesses implementation of stormwater capture through the installation of rain gardens, pervious pavement, rain barrels etc. via monthly utilities bills
6. Promote shared parking facilities to limit impervious surface creation.
7. Mandate use of pervious surfaces in new and resurfaced alleyways.
8. Mandate techniques that promote the discontinuity of impervious surfaces, i.e. sloping of sidewalks and driveways to direct run-off towards pervious coverages.
9. Institute a demonstration series on best management practices for stormwater management. Partner with a local landscaping company to lead the demonstrations.

APPENDIX – A: DECORAH LAND USE CHART (2002)

Land Use	# of Cells	Percent of Decorah	Consolidated Percentages	Land Area (square miles)	Land Area (acres)	Annual Rain Volume (ft ³)	Annual Rain Volume (MG)
Water	104	1.66%	10.24%	0.11	68.1	7,914,636	59.2
Wetland	536	8.57%		0.55	351.2	40,790,814	305.1
Bottomland Forest	139	2.22%	15.63%	0.14	91.1	10,578,215	79.1
Coniferous Forest	247	3.95%		0.25	161.8	18,797,259	140.6
Deciduous Forest	591	9.45%		0.60	387.2	44,976,439	336.4
Un-grazed Grassland	1138	18.20%	37.94%	1.16	745.6	86,604,377	647.8
Grazed Grassland	804	12.86%		0.82	526.7	61,186,221	457.7
Planted Grassland	430	6.88%		0.44	281.7	32,723,974	244.8
Alfalfa/Hay	240	3.84%	8.14%	0.25	157.2	18,264,544	136.6
Corn	117	1.87%		0.12	76.7	8,903,965	66.6
Soybeans	106	1.70%		0.11	69.4	8,066,840	60.3
Other Row crops	46	0.74%		0.05	30.1	3,500,704	26.2
Roads	746	11.93%	28.06%	0.76	488.7	56,772,290	424.7
Commercial/Industrial	358	5.73%		0.37	234.5	27,244,611	203.8
Residential	628	10.04%		0.64	411.4	47,792,222	357.5
Barren	22	0.35%		0.02	14.4	1,674,250	12.5
Totals:	6252	100.00%	100.00%	6.40	4,096.0	475,791,360	3,558.9

APPENDIX – B: ANNUAL PRECIPITATION & VARIANCES

Variance	Average Precipitation	Year ⁶³
-0.02776	32.75	1931
0.308529	35.03	1932
-0.73132	27.98	1933
-0.71805	28.07	1934
-0.10446	32.23	1935
-0.4555	29.85	1936
-1.45405	23.08	1937
1.889691	45.75	1938
-1.75052	21.07	1939
0.439801	35.92	1940
1.271681	41.56	1941
1.668446	44.25	1942
-0.4378	29.97	1943
0.137433	33.87	1944
0.988488	39.64	1945
0.345403	35.28	1946
0.206756	34.34	1947
-1.64432	21.79	1948
-1.74315	21.12	1949
0.89114	38.98	1950
1.784968	45.04	1951
-0.81982	27.38	1952
0.655146	37.38	1953
-0.39503	30.26	1954
-1.63695	21.84	1955
-0.49385	29.59	1956
-0.17231	31.77	1957
-1.91424	19.96	1958
0.600572	37.01	1959
0.441276	35.93	1960
0.097609	33.6	1961
0.311479	35.05	1962
-1.45258	23.09	1963
-0.85669	27.13	1964
1.050436	40.06	1965

Variance	Average Precipitation	Year
-1.57353	22.27	1966
-1.35966	23.72	1967
1.221532	41.22	1968
0.125633	33.79	1969
0.633021	37.23	1970
-0.56612	29.1	1971
1.062236	40.14	1972
0.69202	37.63	1973
-0.09561	32.29	1974
-0.34046	30.63	1975
-1.06171	25.74	1976
0.031236	33.15	1977
0.099084	33.61	1978
-0.40683	30.18	1979
-0.20623	31.54	1980
-0.09561	32.29	1981
0.307054	35.02	1982
1.194983	41.04	1983
-0.47173	29.74	1984
-0.06169	32.52	1985
0.348353	35.3	1986
-0.6325	28.65	1987
-1.47765	22.92	1988
-1.70922	21.35	1989
0.824767	38.53	1990
1.020937	39.86	1991
0.28493	34.87	1992
2.385279	49.11	1993
-0.50123	29.54	1994
-0.16198	31.84	1995

⁶³ 1931 through 1995 data is from Buttle and Tuttle Ltd. (1996-2008); 1996 through 2009 data is from Bernatz, Richard (2004)

APPENDIX – C: REGRESSION STATISTICS

Regression Statistics	
Multiple R	0.14
R Square	0.02
Adjusted R Square	0.01
Standard Error	6.76
Observations	79

ANOVA	df	SS	MS	F	Significance F
Regression	1	66.01	66.01	1.44	0.233
Residual	77	3519.34	45.71		
Total	78	3585.35			

	Coefficients	Standard Error	t Stat	P-value
Intercept	-46.03	65.72	-0.70	0.49
X Variable 1	0.04	0.03	1.20	0.23

	1931 to 2009	1995 to 2009
Mean	32.94	34.79
Standard Deviation	6.78	6.75
Correlation	0.14	0.33

Policy Recommendations for the Promotion of Household Energy and Stormwater Sustainability in Decorah

Report researched and written by Christopher Widmer, Dean Meester, Spencer Schoonover, Melissa Atalig, Patrick Knapp, Ben Visser, and Molly Fleming

Decorah Water and Energy Community Action Network
University of Iowa Student Field Problems Team

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INTRODUCTION

As crises of climate change, global economic uncertainty, and environmental degradation converge on Middle America, small towns are increasingly struggling to adapt to their changing worlds. Rather than neglect our rural roots, the Iowa Initiative for Sustainable Communities recognizes that small towns throughout the state have the capacity to craft more sustainable futures for their current citizens and future generations. Based on our conversations and exchanges with local residents, we are confident that Decorah is eager and able to rise to the occasion. The Decorah Water and Energy Community Action Network (Decorah WE CAN) recognizes the pervasive activism already on the pulse of community needs in the region. Therefore the Decorah WE CAN sustainability initiative relies on empowering the community base towards making household efficiency improvements in stormwater collection and energy usage. Small changes in daily habits, a new light bulb here or a rain barrel there, aggregate in dramatic ways for the city as a whole. As our motto goes, “It all begins at home.” We think that if we can encourage residents to make these small changes in their own homes, there will be potentially profound impacts on collective outcomes. By this margin, Decorah WE CAN has a twofold objective: ensuring a more sustainable Decorah and empowering the community to determine its own future.

To lay the foundation for long-term sustainability, changes at the household scale must be supported by smart policy at the citywide scale. Land development regulations, building codes, incentive programs, and numerous other city policies and regulations provide the framework in which sustainable practices flounder or flourish. As a result, ensuring that the right policies and regulations are in place is a vital element of any community effort to become sustainable. The implementation of sustainable development requires action on multiple and interlocking fronts. Municipal governments often struggle with carrying out long term actions, and many fail to build capacity to effectively implement sustainable processes. Many, however, have been successful in dramatically re-orienting their populaces towards more sustainable futures. Therefore, it is to the past and enduring practices of successfully sustainable local communities that we now focus our policy recommendations for Decorah.

The following document is structured as a guide for constructing and implementing local sustainable stormwater and energy policies in Decorah. This report is a companion piece to two previous documents: “Report on Existing Household Energy usage and Carbon Emissions in Decorah, Iowa and Estimates of Carbon Reductions Possible with Efficiency Investments” released in January 2010 and “Report on Stormwater Conditions for Decorah, Iowa and a Review of Opportunities for Impervious Surface Reduction” released in March 2010. The existing conditions research and analysis within these companion reports provide a foundation for our recommendations here. This report should not be interpreted as a minimum threshold for local regulations and policies, but rather as a range of options based on established practices. In some cases, individual recommendations are intended to supplement each other, while in other cases a range of alternatives is provided. Moreover, the recommendations vary significantly with respect to their potential impacts and the costs and resources required for implementation. Consequently, it is important to bear these factors in mind and consider each element of this report within Decorah’s specific administrative and political context of Decorah.

We have focused our recommendations into six primary avenues of policy-making: land use regulations, building codes, municipal tax incentives, municipal financing, fee structuring, and local carbon policies. Within each section, we define our final recommendations for effective and long-term policy actions that will reduce energy usage and stormwater runoff at the household level. Where policy tools are somewhat unfamiliar, we also provide some background context. For each avenue of policy-making, we also include an appendix of multiple “best case practices” in communities throughout the nation and world. These best case practices provide real-world examples of how similar municipalities have crafted more sustainable outcomes for their communities in stormwater management and energy usage. We suggest, therefore, that you consider each recommendation in the context of its best case practice examples, and that you use these examples as guides for future practices.

LAND DEVELOPMENT REGULATIONS

Land development regulations include a broad range of governmental controls affecting how land can be used or developed. This typically includes zoning ordinances, subdivision regulations, impact fees, sign ordinances, floodplain controls, stormwater controls, erosion and sedimentation regulations, and various other local laws.⁶⁴ Together, these laws influence the location, character, and pattern of development. By guiding what, where, and how communities build, land development regulations have a powerful impact on how residents interact with each other and their environment. Accordingly, evaluating these regulations and making needed reforms are critical steps in creating a long-term plan for a sustainable community.

Historically, land use zoning emerged as a means of addressing the health and safety issues associated with having homes near factories, stock yards, and other “noxious” uses brought about by a period of rapid industrialization. Most conventional zoning ordinances in use today continue to reflect this legacy, and are characterized by a strong emphasis on separating uses with little regard for whether particular uses are actually incompatible. Over time, this approach has produced the sprawling, low-density development patterns common today, where residents must drive to their jobs, schools, shops and services.

In the context of 21st century challenges like global climate change and fossil fuel depletion, it has become increasingly clear that these development patterns are inefficient, inconvenient, harmful to the environment, and ultimately unsustainable. Strict separation of land use and dependence on cars as the sole mode of transportation has resulted in increased traffic congestion, pollution, carbon emissions, and social isolation. While issues of truly incompatible uses are still important, many commercial uses and workplaces in today’s economy can be integrated with homes without any “noxious” effects. Consequently, the original health and safety justification for separating certain land uses must now be placed in context with a range of other problems that are created by not allowing uses where they would be most efficient.

Land development regulations that account for this balance are critical to any effort to address these problems and promote long-term sustainability. With this understanding in mind, many communities across the country are modernizing their land use and development policies to promote the following principles of the Smart Growth movement⁶⁵:

1. Mix land uses.
2. Take advantage of compact building design.
3. Create a range of housing opportunities and choices.
4. Create walkable neighborhoods.
5. Foster distinctive, attractive communities with a strong sense of place.
6. Preserve open space, farmland, natural beauty, and critical environmental areas.
7. Strengthen and direct development towards existing communities.
8. Provide a variety of transportation choices.
9. Make development decisions predictable, fair, and cost effective.
10. Encourage community and stakeholder collaboration in development decisions.

Neighborhoods that have a variety of amenities such as shops, offices, schools, churches, and parks located in proximity to residential uses can produce community scale gains in energy efficiency. In meeting their day-to-day needs, residents have options for walking, bicycling, and public transit where density permits. Additionally, a range of diverse housing types makes staying in the same neighborhood affordable through all stages of life—first time homebuyers, the elderly, and

⁶⁴ <https://myapa.planning.org/smartgrowthcodes/pdf/chapter2.pdf>

⁶⁵ <http://www.smartgrowth.org/about/default.asp>

families at all stages in between. Through smart growth approaches that involve residents in development decisions, cities can create neighborhoods that are vibrant places to live, work, and play—resulting in a high quality of life, better business opportunities, economic development, and a greater local tax base.

Zoning for mixed-use will vary from place to place. It should respond to the local context and reflect both the size of the city and the characteristics of individual neighborhoods—from downtowns to commercial corridors to the neighborhood corner store. In crafting land development regulations, it is important to bear these variations in mind rather than using a “one size fits all” approach to mixed-use zoning.⁶⁶ In order to be successful, mixed-use zones should also incorporate diverse housing types, promote higher residential densities, and be supplemented by design standards that require walkable, pedestrian-oriented, complete streets.

While Decorah is by no means a prototype for sprawling development patterns, there is still room for improvement in local land use policy and regulation. Even if the goal is not to transform existing land use patterns, the city’s land development regulations provide the framework governing development patterns for future growth. Accordingly, ensuring that local land development regulations promote—or at least enable—more efficient and responsible land use patterns is an important part of charting the course to a more sustainable future.

The following recommendations draw on some of the examples outlined in the appendix of Best Case Practices and Programs. They are a limited selection, and investigating many of the other examples and models referenced in the appendix is highly recommended. There are countless resources available that provide detailed information about the crucial relationship between land development regulations and sustainability, and how individual municipalities can respond.

RECOMMENDATIONS:

1. *Revise the zoning code to include a Traditional Neighborhood Development (TND) component that permits compact, mixed use, pedestrian-oriented and context-sensitive development according to established TND standards.* The state of Wisconsin has published a model ordinance for a TND zone that would serve as an appropriate starting point for Decorah.⁶⁷ The TND component could be implemented through a variety of mechanisms, including:
 - a. As a mapped, standalone zoning district that permits TND development in designated areas as a matter of right;
 - b. As an overlay zone that is designated for some portion of one or more underlying zones. The overlay zone would modify or eliminate any incompatible rules of the underlying zone, but would otherwise be subject to the requirements of both the underlying district and overlay zone;
 - c. As an unmapped floating zone that exists in the text of the zoning ordinance, but is only designated on the zoning map upon application by a property owner and approval by the zoning authority on the basis of specific criteria.

2. *Amend the Planned Unit Development (PUD) standards to allow for approved neighborhood commercial uses such as grocery stores and other small-scale retail.* This would give developers more flexibility to produce more walkable, less auto-dependent neighborhoods.

⁶⁶ http://www.epa.gov/smartgrowth/essential_fixes.htm

⁶⁷ <http://urpl.wisc.edu/people/ohm/tndord.pdf>. The model ordinance is meant to be customized to individual cities and towns. However, it is very comprehensive, and addresses: (1) TND description and purpose, (2) application procedure and approval process, (3) permitted uses, (4) density requirements, (5) open space requirements, (6) stormwater management requirements, (7) lot and block standards, (8) circulation standards, (9) architectural/design standards, and; (10) landscaping and screening standards.

3. *Expand various commercial zones to include options for residential uses other than dwelling units above stores and shops.* This would create opportunities to retrofit single-use commercial and retail areas into walkable, mixed-use communities.
4. *Introduce a community design standards to promote pedestrian circulation and a walkable pedestrian network.* This could be accomplished through a Pedestrian Overlay District (POD) based loosely on the APA model ordinance,⁶⁸ or universal Pedestrian Access and Circulation Standards based on Oregon's Model Unified Development Code.⁶⁹ The design standards could also be incorporated as a supplement to the Traditional Neighborhood Development (TND) district discussed above.
5. *Begin the process of gathering input from city officials and community stakeholders regarding interest in consolidating land development regulations into a comprehensive Unified Development Code (UDC) capable of organizing controls in a more seamless and systematic way.* Reliance on Oregon⁷⁰ and Colorado⁷¹ UDC models for small cities/towns as a starting point could substantially reduce the amount of resources needed for this process. A UDC based on these models could introduce a variety of sustainable elements into Decorah's land development regulations by introducing new zoning districts and comprehensive community design standards that incorporate Smart Growth principles.

⁶⁸ <https://myapa.planning.org/smartgrowthcodes/pdf/section48.pdf>

⁶⁹ <http://www.oregon.gov/LCD/TGM/modelCode05.shtml>

⁷⁰ <http://www.oregon.gov/LCD/TGM/modelCode05.shtml>

⁷¹ <http://www.dola.state.co.us/dlg/osg/modelcodes.htm#municode>

GREEN BUILDING CODES

More and more communities are embracing aspects of sustainability, incorporating long-term planning for future needs in a balanced manner that considers the environment, the economy, society, and culture.⁷² There is a spatial variability to city plans across the country as particular regions are more at risk than others to specific problems, and new eco-friendly concepts are formulated and tested.

One facet of a community's effort toward becoming more sustainable should be the adoption of a green building code. In 2006, buildings in the United States consumed 39 percent of the primary energy produced, with 74 percent of that energy being electricity.⁷³ Buildings also account for 14 percent of the nation's potable water use.⁷⁴ Decorah does not currently have a building code, but has begun the discussion process of implementing one. This presents the city with an excellent opportunity to be a progressive role model to which other Midwestern communities may look for sustainability guidance.

Building green has many environmental, economic, and public health benefits. Regarding the environment, natural resources are conserved, solid waste is reduced, and ecosystems are less impacted. Economically, operating costs are reduced, employees and people are more productive, and the building is more attractive to potential occupants. Last, people who live or work in green buildings breathe cleaner air, are more comfortable, use less energy and water, and have a higher overall quality of life.

The following recommendations for a green building code in Decorah draw from the best practice of other communities with similar characteristics. They are adapted to meet the specific needs and demands of Decorah's resources, landscape, and citizens. If enacted, these codes promise to bring greater sustainability and aesthetic appeal to prospective community structures, making them highly visible symbols of the city's efforts toward a sustainable future.

RECOMMENDATIONS

1. *Incorporate radon mitigation measures into the building code.* Iowa has one of the highest geologic potentials (>4 pCi/L) in the nation for radon.⁷⁵ However, the technology to prevent this deadly gas from entering buildings exists. It is not exceedingly expensive to prevent in-home radon gas poisoning, and it can be done through the use of building codes. It is much easier and less costly to install passive radon techniques at the time of construction than to retrofit a solution later. Some potential prevention mechanisms include:
 - o Appropriate sub-floor preparation and ground cover utilization
 - o Making sure all openings around pipes are sealed
 - o Routing condensate drains to daylight
 - o Damp proofing exterior surfaces
 Decorah should require that several of these (or other) radon mitigation methods be followed in order to improve the air quality of homes/buildings, and improve public health.
2. *Public outreach, education, and promotion for green building standards.* In order for green building to gain support and momentum in Decorah, it must be bolstered by regular and vociferous public promotion. To generate this awareness, Decorah can provide information on the city website about green building benefits, organizations, and case studies. The city should also organize a green building workshop for local developers, remodelers, and

⁷² Herman, Benjamin A. "Embracing Sustainability in Community Plans." *Planning* Apr. 2010: 8-11. Print.

⁷³ U.S. Department of Energy, Oct. 2009. Web. 31 Mar. 2010. <<http://buildingsdatabook.eren.doe.gov/Charts.aspx>>.

⁷⁴ U.S. Green Building Council, 2010. Web. 4 Apr. 2010. <<http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1718>>.

⁷⁵ <http://geology.about.com/library/bl/maps/usradonpotmap.gif>

the public to attend. At this workshop, energy and water reduction strategies should be promoted, and the procedure for conducting a home audit should be taught. The city should attempt to work with and be sponsored by local hardware businesses at the workshops, and offer free green building items such as insulation, thermostats, solar screens, caulk, and weather stripping.

3. *Require reductions in water and energy use in the building code.* California has taken the lead on green building, and Decorah should look closely at their codes and how they enforce them. At a minimum, a 15 percent reduction of indoor water use from the baseline case should be required, as well as a 15 percent reduction on energy use. If both of these policies are enacted, all new construction projects will receive enough points to come close to being LEED accredited with little extra effort.
4. *Include construction waste requirements in the building code.* During construction, 50 percent of waste should be diverted from landfills. This policy is also outlined in California's green building code, and has become commonplace across the country. Due to the large amount of waste that is generated during construction, this code has a heavy impact on extending the life of the local landfill. Additionally, locally purchased building materials should be encouraged to reduce travel miles required for construction.
5. *Require Low Impact Development (LID) in the building code.* LID emphasizes water conservation and the use of on-site, small-scale hydrologic controls to protect local water quality. An ideal LID discharges no stormwater to the sewer system, but rather infiltrates, evaporates, and detains the water until it can be managed on site. Examples of practicing LID include not allowing downspouts to discharge onto impermeable surfaces, such as a driveway, unless the water is conveyed onto a permeable surface shortly afterwards. Other strategies include the using a rain garden, a rain barrel, or permeable pavement to keep stormwater from running off, thus improving groundwater recharge, improving water quality, and reducing the risk of flooding.
6. *Require the use of Energy Star approved appliances.* Mandate that at least 50 percent of all appliances within a new structure are Energy Star certified. These are the most efficient appliances available, oftentimes using up to 30 percent less energy than a comparable product, and are cost competitive. Installing these highly efficient appliances will aid the homebuilder in achieving recommended code number 3, listed above—reduce energy use from the baseline by at least 15 percent.
7. *Require the use of low-emitting materials (LEM) in construction.* The builder should not use materials that are potentially harmful to either his workers or the future occupants of the structure. This includes adhesives and sealants, paints, flooring systems, and wood and agrifiber products. Many of these items emit odors that are harmful and degrade the air quality both during construction and after project completion.

MUNICIPAL TAX INCENTIVES

Given their inherent economic impacts, tax laws provide a ready avenue for encouraging environmentally-friendly behavior as well as for discouraging activities that harm the environment. Such mechanisms are frequently used, particularly at the federal and state level, as tools for changing behaviors. For example, federal tax credits exist for individuals who buy hybrid automobiles, enticing Americans to buy vehicles that consume less gasoline. In Iowa, the Local Option Special Assessment of Wind Energy Devices allows any city or county to assess wind energy conversion equipment at a special valuation for property tax purposes. In the first assessment year, the wind energy conversion equipment is assessed at zero percent of its cost. For the second through sixth assessment years, the valuation of the property is a percent of its cost, which increases by five percentage points each assessment year. For the seventh and succeeding assessment years, the valuation of the property is at 30 of its cost.

At this time, however, the state of Iowa does not have any statutes that similarly incentivize other sustainable household improvements. Further, municipal capacity to create property tax credits for sustainable residential investments is not expressly granted in the Iowa Code. However, the Iowa constitution grants home rule authority to cities and counties within the state.⁷⁶ Therefore, cities and counties have the authority to enact any law governing their local affairs unless such law contradicts a state law, with the exception of the creation of a tax or levy. This constitutional rejection of “Dillion’s Rule” and state acquiescence to local authority has been repeatedly reinforced by statutory local home rule acknowledgement.⁷⁷ Both the Iowa constitution and the Iowa Code demonstrate a broad notion of home rule authority. For example, in a recent case requiring a concise description of municipal home rule analysis, the court stated, “The question is not whether a statute gives a city authority. Instead, the question is whether a statute forbids it.”⁷⁸

By this margin, we believe that the City of Decorah likely has the authority to provide municipal property tax credits and abatements for specific sustainability measures, including those recommended below. We stress, however, that the Iowa Code is not our domain of expertise, and the City should ensure its authority to offer such credits before drafting legislation. That being said, we believe that municipal property tax provisions have the capacity to encourage more sustainable household consumption choices and practices. In particular, we focus our municipal tax recommendations on incentivizing green building practices, household energy reduction, and increased stormwater infiltration on residential lots.

RECOMMENDATIONS:

1. *Provide property tax credits for homeowners who install stormwater management devices on their properties.* Qualified stormwater management devices should include improvements that increase the infiltration of precipitation, thus reducing stormwater runoff. Rain gardens, rain barrels, impervious coverage reduction, permeable pavers, swales, dry well, bio-retention devices, landscape infiltration, and downspout redirection would therefore be eligible for these credits. Homeowners should receive property tax credits equal to 15 percent of the cost of materials and installation per year for two years. Over these two years, homeowners should be able to receive a maximum credit of \$3,500.
2. *Provide property tax credits for homeowners who install alternative energy generation devices on their properties for home energy usage.* Qualified alternative energy generators should include solar panels, wind generation devices, biomass energy generators, and micro-hydro generators. Homeowners should receive property tax

⁷⁶ Iowa Const. art. III, ss 38A, 39A.

⁷⁷ Syverson, Jay (2008). “The Inconsistent State of Municipal Home Rule in Iowa.” *Drake Law Review*. Fall 2008.

⁷⁸ *City of Asbury v. Iowa City Dev. Bd.*, 723 N.W.2d 188, 199 (Iowa 2006).

credits equal to 15 percent of the cost of materials and installation per year for two years. Over these two years, homeowners should be able to receive a maximum credit of \$3,500.

3. *Provide property tax abatements to homeowners who renovate their homes to LEED standards.* For renovated LEED residential dwellings meeting “certified” criteria, the city should provide a three year tax abatement on improvements up to a maximum \$300,000 market value. For renovated LEED residential dwellings meeting “silver” criteria, the property tax abatement should last for five years, and it should last for seven years for all renovated LEED residential dwellings meeting “gold” criteria. For renovated LEED residential dwellings meeting “platinum” criteria, the city should provide a ten year tax abatement on improvements up to a maximum \$400,000 market value. In all cases, owners should continue to pay taxes on the land.
4. *As a model for future residential development, ensure that new city buildings and major renovations of existing city buildings adhere to LEED “certified” standards, at minimum.*

STORMWATER FEES AND CREDITS

People have grown accustomed to paying for the fresh water they consume and the used water they discharge, but the concept of paying for stormwater is relatively new and surprising to a number of people. Many communities now charge a monthly stormwater fee as a part of the municipal utilities bill that goes unnoticed by a majority of the public. However, this fee is often a flat-rate fee that depends only upon the property type and not the size of the lot or how stormwater is managed upon it, leaving the property owner with little to no incentive to reduce their stormwater runoff. We believe that if stormwater costs incurred directly correspond to individual stormwater management practices, households will be more likely to invest in improvements that will increase the permeability of their properties. Therefore, households should be charged a fee based on impervious surfaces, and those fees should be offset with credits based on efforts to increase rainwater infiltration.

RECOMMENDATIONS:

1. *Perform a citywide drainage study.* In order to keep the stormwater network up to date and working efficiently, an assessment of Decorah's sewers should be performed within the next five years. Many older communities often have wood or clay sewers that date back over fifty years, and a large percentage of stormwater leaks directly into the ground. This is of particular concern for Decorah because of the high water table in the area.
2. *Charge a monthly stormwater fee to property owners, regardless of property type, that is directly related to the amount of impervious surface on the site.* Impervious surfaces include, but are not limited to:
 - Structural footprint, including sheds and detached garages
 - Driveways and parking lots
 - Sidewalks and other concrete/asphalt surfaces
 - Patios/Decks

To accurately determine the degree of impervious surfaces on a lot, a property owner can either measure and sum up his/her own impervious surfaces and address questions to the public works department, or have the city determine the amount of impervious surface for them. If a property owner makes his/her own calculations, submits them, and they are deemed acceptable by the public works department, the property owner will receive a \$40 utilities credit. This process should be redone every 10 years for each lot, and whenever a significant change to the amount of permeable surfaces on a lot is made. The fee structure is as follows:

$$\text{Monthly Rate (\$)} = \frac{\sum \text{Impervious Surfaces (ft}^2\text{)}}{1,000 \text{ ft}^2} * \$5.00$$

3. *Reduce monthly stormwater fees for households that put stormwater management tools in place.* Households should receive up to 50 percent credit (reduction) in their stormwater utility fee for management tools and practices that address stormwater quality. These tools include wet ponds, manufactured underground filters, rain gardens, dry ponds, vegetated swales, infiltration trenches, underground storage, sand filters, soak away pits, wet or dry swales, filter strips, pervious pavers, green roof, and dry wells. Households should also receive 50 percent or 100 percent credit (reduction) in their stormwater utility fee for management tools/practices that address stormwater quantity. To be eligible for a stormwater quantity credits, properties must demonstrate the capacity to handle a 10-year or 100-year rain event. The maximum credits are cumulative and cannot exceed 100 percent credit.

PROPERTY ASSESSED CLEAN ENERGY (PACE) FINANCING

Property Assessed Clean Energy (PACE) programs enable local municipalities to finance sustainable projects on private properties. In doing so, PACE programs eliminate the high up-front cost of environmentally sustainable installations. As it eliminates the chief barrier to such efficiencies, PACE financing has the capacity to wholly invigorate the rate at which homeowners make sustainable home improvements in Decorah.

Homeowner participation in PACE financing programs is one hundred percent voluntary. Decorah's city council would simply create an improvement district and issue a bond secured by real property within the district. The bond proceeds would be used to fund projects, and homeowners would repay the debt service on the bond in fixed payments as part of their property bills. Bond proceeds would solely be used to pay for prequalified sustainable improvements, like solar panels or permeable pavers. By this margin, PACE is a powerful tool for the city of Decorah to stimulate the local green economy while providing a competitive financing program for residents.

The capacity for municipal governments to utilize PACE bonds for home retrofits emerged in 2008 with the passage of enabling legislation in California. Since then, the following states have recently passed enabling legislation: Colorado, Illinois, Louisiana, Maryland, Nevada, New Mexico, Ohio, Oklahoma, Oregon, Texas, Vermont, Virginia, and Wisconsin. Florida and Hawaii have existing ability to launch PACE programs. The first PACE bond was issued by Berkeley, California in January 2009.

At this time, however, no PACE enabling legislation exists in the state of Iowa. Two study bills within the Iowa legislature, Senate Study Bill 3114⁷⁹ and House Study Bill 602⁸⁰, would enable this innovative form of financing statewide. Unfortunately, this legislation has not been prioritized by state lawmakers.

RECOMMENDATIONS:

1. *Advocate for the passage of statewide PACE enabling legislation to local legislators.* Stress the following benefits of this form of municipal financing:
 - a. Immediate job creation
 - b. No credit or general obligation risk
 - c. Obligation is the liability of the homeowner
 - d. Greenhouse gas reductions, stormwater runoff reductions, clean energy investments, and overall more sustainable residential practices and design
 - e. Only those homeowners who opt in will pay for home improvements
2. Upon passage of PACE enabling legislation in Iowa, select *a financial and/or administrative partner to provide assistance*. This partner should be based upon the recommendation of a PACE Team appointed by local government.
3. *Follow Iowa's requirements for creation of a PACE District.* When program launches, prioritize financing for households with particularly inefficient factors, such as fuel oil based heating.

⁷⁹ Track the Senate Study Bill at <http://coolice.legis.state.ia.us/Cool-ICE/default.asp?Category=BillInfo&Service=Billbook&ga=83&menu=text&hbill=SSB3114>

⁸⁰ Track the House Study Bill at <http://coolice.legis.state.ia.us/Cool-ICE/default.asp?Category=BillInfo&Service=Billbook&ga=83&menu=text&hbill=HSB602>

LOCAL CARBON POLICIES

Addressing climate change impacts will require a sustained commitment to integrating climate information into the daily governance and management of infrastructure, programs, and services that may be affected by climate change. An example of efforts in the United States to reduce impacts of global climate change is the strategic decision by local governments to develop emissions reduction targets and to develop an action plan for meeting the targets.

With the recent launching of Sustainability Planning in Decorah by the City Mayor, Council, and City Administrator, this is an extremely exciting time for the City of Decorah, as it relates to sustainable initiatives. The City and community are already taking action to support sustainability including adopting the U.S. Mayors Climate Protection Agreement, supporting smart business growth, and completing a comprehensive inventory of the City's greenhouse gas emissions. These recommendations provided below will facilitate the success of a local energy management program and will provide the foundation for further improving the City's efforts in reducing greenhouse gas emission throughout the region:

RECOMMENDATIONS:

1. *Execute a greenhouse gas emissions inventory for the City.* The purpose is twofold: The first is an inventory of the community greenhouse gas emissions that occur from the use of all fossil fuel energy within the Decorah city limits. The second part is an inventory of emissions resulting from the operation of the Decorah local government. The International Council for Local Environmental Initiatives (ICLEI) provides the Clean Air and Climate Protection Software (CACAP) and guidance in data management in an effort to make emissions calculations consistent internationally. More than 500 cities across the U.S. are members of ICLEI and have committed to taking action on reducing carbon emissions.
2. *Adopt an emissions reduction target for the forecast year.*
3. *Efficiently manage energy consumption of local government operations* by establishing a comprehensive system to track the City's operational energy and greenhouse gas emissions. This information can be used to evaluate progress and guide next steps and strategies to achieve target cuts in energy efficiency and greenhouse gas emissions.
4. *Develop a database of utility costs and energy usage* to establish baselines and quantify savings to manage energy consumption. This will also allow the City to streamline its energy and greenhouse gas emissions reporting.
5. *Require energy efficient construction* for buildings within the City.
6. *Require alternative energy and energy reduction* for new developments that go through the County's planning and building permit process.
7. *Provide outreach to the community* and engage them in efforts taken by the City and its partners to minimize fuel and energy use and reduce greenhouse gas emissions.

CONCLUSION

Given compelling public enthusiasm, grassroots leadership, and Council support for local sustainability, we have no doubt that Decorah has the capacity to enhance its energy and stormwater sustainability. We believe that Decorah can create a community in balance with the natural world, a community in which the needs of future generations are not compromised for the sake of the present. Further, we believe that Decorah has the capacity to be a model for similar towns throughout the state, empowering rural Iowa to embrace its own sustainable future. The policy and regulation recommendations within this report are not exhaustive, but we are certain that their adoption will enable a Decorah that is more aligned with the environmental, the economic, and the equity needs of its communities.

It is vital that Decorah's Council and other leaders recognize, however, that sustainable development cannot be enforced or incentivized solely through these policies. A comprehensive municipal sustainability initiative must include these institutional frameworks as well as the continuous participation of local stakeholders from all facets of the community. Participatory events (such as the public strategic planning forum held on April 15, 2010) are key to ensuring that local residents actively support the sustainable development process. Further, educational opportunities and training sessions are a vital component of Decorah's successfully sustainable future. For example, the city could invest in a series of "Greening Your Home" workshops to teach residents about rain garden maintenance, insulation installation, or building a rain barrel. While the following document makes recommendations towards incentivizing and enforcing sustainable outcomes at the broader policy level, Decorah leaders must also recognize the need for proper education and participatory schemes to empower residents towards these goals.

However, no matter the approach, Decorah must remember that sustainability is not an end-state, but an ongoing process. It is a balanced approach to community growth that considers people, planet, and prosperity. Just because a plan, code, or ordinance is adopted that is considered sustainable does not mean the fight is over, but that it has just begun. Though policymakers have the capacity to dramatically influence residential consumption and building patterns, we know that individual actions have a major impact of collective outcomes. As we say, it all begins at home.

APPENDIX: BEST CASE PRACTICES

The following appendix should be used as a reference of supplementary information. Each section details cases in which recommendations have been utilized. For most best-case practices, we provide additional resources that may assist in crafting city policies to promote energy and stormwater sustainability.

LAND DEVELOPMENT REGULATIONS

The term “land development regulation” is a shorthand reference to a broad range of governmental controls that affect one’s ability to use or develop land. Historically, such regulations came in the form of zoning ordinances, subdivision regulations, impact fees, floodplain controls, sign ordinances, stormwater controls, erosion and sedimentation regulations, and various other local laws.⁸¹

MODEL DEVELOPMENT REGULATIONS

UNIFIED DEVELOPMENT CODE (UDC)

Increasingly, municipalities are consolidating land development regulations into more comprehensive (and comprehensible) documents called Unified Development Codes (UDCs), in order to present controls in a more seamless and systematic manner. A variety of agencies and organizations have published model UDCs aimed at promoting more sustainable development patterns and streamlining the development process. These models can provide a great starting point for municipalities seeking to overhaul existing development regulations that are incomplete, obsolete, or unsustainable.

OREGON

MODEL DEVELOPMENT CODE & USER’S GUIDE FOR SMALL CITIES (2ND ED.)⁸²

Oregon’s model UDC has been an invaluable tool for small cities that lack the capacity to draft modern development regulations on their own due to limitations in staff, resources and expertise. By providing a flexible model framework, it enables small cities to overcome these obstacles and craft user-friendly, customized, unified development regulations that incorporate smarter policies, integrate land use and transportation, and remove regulatory obstacles to sustainable economic and community development. While tailored to the unique planning and legal context in Oregon, with a little customization the Model Development Code and accompanying User’s Guide are perfectly applicable to any city that desires to be a local leader in sustainable development.

The model contains individual articles for an introduction (definitions and land use category overview), land use districts, community design standards, administration of land use and development, and exceptions to code standards, as well as an empty article for the land use district map amendments and code interpretations. Each article contains regulations organized by chapters, which typically include a purpose statement and applicability statement along with the actual standards. Additionally, commentary intended to assist the user in drafting or amending local regulations is provided throughout the document in separate text boxes. The drafting process is further aided by the accompanying User’s Guide, which provides an overview of the model and step-by-step instructions for drafting and implementation.

⁸¹ <https://myapa.planning.org/smartgrowthcodes/pdf/chapter2.pdf>

⁸² <http://www.oregon.gov/LCD/TGM/modelCode05.shtml>

COLORADO

MODEL LAND USE CODE FOR SMALL COMMUNITIES⁸³

Colorado provides another model UDC that can serve as a template for land development regulation reform. While it also emphasizes smart growth principles such as mixed-use zones, compact development, and pedestrian-oriented design, it has a fairly conventional organization that will be familiar and accessible for most municipalities. It is very comprehensive in scope, with detailed regulations for community design principles and development standards, zoning, subdivision regulations, enforcement mechanisms, sign regulations, floodplain areas, and historic preservation. It also contains detailed sections on vesting of property rights and annexation, along with several other more specific subjects.

SMARTCODE⁸⁴

FORM-BASED UNIFIED DEVELOPMENT CODE⁸⁵

The SmartCode is described as an integrated land development ordinance that folds zoning, subdivision regulations, urban design, public works standards and basic architectural controls into one compact document. It is also a unified ordinance, spanning scales from the region to the community to the building. It is intended to support outcomes of walkable and mixed-use neighborhoods, transportation options, conservation of open lands, local character, housing diversity, and vibrant downtowns. It is intended to discourage outcomes of sprawl development, automobile dependency, loss of open lands, monotonous subdivisions, deserted downtowns, and unsafe streets and parks.

The SmartCode enables the implementation of a community's vision by coding the specific outcomes desired in particular places. It allows for distinctly different approaches in different areas within the community, unlike a one-size-fits-all conventional code. To this end, it is meant to be locally customized by professional planners, architects, and attorneys. This gives the SmartCode unusual political power, as it permits buy-in from stakeholders.

The SmartCode is one of the family of "form-based codes" addressing primarily the physical form of building and community. It is thus unlike conventional zoning codes based on use and density, which have caused systemic problems over the past sixty years by making mixed use and walkable neighborhoods inadvertently illegal.

The SmartCode is also a "transect-based code." A transect is usually encountered as a continuous cross-section of natural habitats for plants and animals, ranging from shorelines to wetlands to uplands. The transect of the SmartCode is extended to the human habitat, ranging from the most rural to the most urban environments. This allows environmental and urban concerns to be administered in an integrated way. The SmartCode's rural-to-urban Transect is divided into a range of "T-zones" each with its own complex character. The Transect ensures that a community offers a full diversity of building types, thoroughfare types, and civic space types, and that they have characteristics appropriate to their locations in the environment. The metrics for these T-zones should be locally calibrated.

What the SmartCode does:⁸⁶

- It utilizes a type of zoning category that ranges systematically from the wilderness to the urban core.
- It enables and qualifies Smart Growth community patterns that include Clustered Land Development (CLD), Traditional Neighborhood Development (TND™), Regional Center Development (RCD), and Transit-Oriented Development (TOD).

⁸³ <http://www.dola.state.co.us/dlg/osg/modelcodes.htm#municode>

⁸⁴ <http://www.smartcodecentral.org/>

⁸⁵ <http://www.smartcodecentral.org/about2.html>

⁸⁶ http://www.smartcodecentral.org/smartfilesv9_2.html

- It integrates the scale of planning concern from the regional through the community scale, on down to the individual lot and, if desired, its architectural elements.
- It integrates the design process across professional disciplines.
- It integrates methods of environmental protection, open space conservation and water quality control.
- It integrates subdivision, public works and Transfer of Development Rights (TDR) standards.
- It provides a set of zoning categories common to new communities and to the infill of existing urbanized areas.
- It is compatible with architectural, environmental, signage, lighting, hazard mitigation, and visitability standards.
- It establishes parity of process for existing and new urban areas.
- It integrates protocols for the preparation and processing of plans.
- It encourages the efficiency of administrative approvals when appropriate, rather than decision by public hearing.
- It encourages specific outcomes through incentives, rather than through prohibitions.
- It specifies standards parametrically (by range) in order to minimize the need for variances.
- It generally increases the range of the options over those allowed by conventional zoning codes.

Numerous jurisdictions around the country have adopted SmartCodes, mostly as an optional parallel code or for particular districts.⁸⁷

NON-COMPREHENSIVE DEVELOPMENT REGULATIONS

For communities interested in a more piecemeal approach to greening their development regulations, there are a variety of specific model ordinances available that can be more easily grafted into existing local regulatory frameworks.

AMERICAN PLANNING ASSOCIATION (APA)

MODEL SMART LAND DEVELOPMENT REGULATIONS⁸⁸

The APA has drafted a set of Model Smart Land Development Regulations (MSLDRs) for use by communities looking to reform the land use policies. Based on the principles of Smart Growth, these regulations are designed to encourage mixed uses, preserve open space and environmentally sensitive areas, provide a choice of housing types and transportation modes, and make the development review process more predictable. In addition, because smart growth ordinances involve providing more transportation options and more compact, mixed-use development, they also promote public health by encouraging walking, bicycling, and human interaction, with the potential to support more active, socially engaged lifestyles that result in better physical and mental health. While they are not designed as a Universal Development Code, the MSLDRs cover a wide range of land development regulations. They include model ordinances for the following zoning districts and development standards:

- Mixed-Use Zoning District
- Live/Work District
- Town Center Zoning District
- Affordable Housing Density Bonus
- Unified Development Permit Review Process
- Transfer of Development Rights (TDR)
- Cluster Development
- Pedestrian Overlay District
- On-Site Access, Parking, and Circulation
- Shared Parking

⁸⁷ <http://www.smartcodecomplete.com/learn/links.html>

⁸⁸ <https://myapa.planning.org/smartgrowthcodes/pdf/chapter4.pdf>

- Street Connectivity

The models are designed to be used as a starting point and adapted to local contexts, and include commentary to aid local policymakers in the process of reforming land development regulations. The MSLDR publication also provides insight on the content of land development regulations, alternative ways to update such regulations, methods to incorporate smart growth objectives, and particular types of smart growth ordinances. Communities are free to select only those models they deem appropriate to the local context.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

MODEL ORDINANCES TO PROTECT LOCAL RESOURCES⁸⁹

The EPA has published model ordinances to address a variety of specific environmental issues. These include aquatic buffers, erosion and sediment control, open space development, stormwater control operation and maintenance, illicit discharges, post construction controls, and source water protection. In addition to the model ordinance, each category also lists links to actual ordinances from cities around the United States, to provide a sample of best case practices.

COLORADO

WATER EFFICIENT LANDSCAPE DESIGN MODEL ORDINANCE⁹⁰

The Office of Smart Growth in the Colorado Department of Local Affairs (DOLA) has funded a new Water-Efficient Landscape Design model ordinance and best practices manual to assist local communities in their efforts to encourage the use of drought tolerant landscaping. The purpose of this ordinance is to protect and enhance the community's environmental, economic, recreational, and aesthetic resources by promoting efficient use of water in the community's public and private landscapes, reducing water waste, and establishing procedures for the design, installation and maintenance of water-efficient landscapes throughout the jurisdiction. The model ordinance is supplemented by the Waterwise Landscaping Best Practices Manual.⁹¹

MARYLAND

MODEL SMART NEIGHBORHOODS ORDINANCE⁹²

Maryland's Smart Neighborhoods Ordinance was drafted to facilitate compliance with the state's Smart Growth Act. It is designed to be implemented as either a standard zoning district or as an overlay zone. It emphasizes:

- Integrated mix of uses, including residential, commercial, employment/office, civic, and open space;
- Range of housing types and densities;
- Compact design;
- Interconnected streets designed to balance the needs of all users, with sidewalks and on-street parking;
- Open spaces integral to the community; and
- Location adjacent to and extended fabric of existing development.

The ordinance outlines goals and benefits such as efficient land and infrastructure use, socioeconomic diversity, transportation choices, environmental quality, sustained economic health, sense of community, planned open space, and logical extension and integration of communities. In addition to succinctly identifying the intent, characteristics, and benefits of smart neighborhoods, the document contains helpful information about existing barriers to smart

⁸⁹ <http://www.epa.gov/owow/nps/ordinance/index.htm>

⁹⁰ <http://www.dola.state.co.us/dlg/osg/docs/Water%20Efficient%20Landscaping%20Design.pdf>

⁹¹ <http://www.dola.state.co.us/dlg/osg/docs/WaterWise%20Landscaping%20Best%20Practices%20Manual.pdf>

⁹² <http://www.mdp.state.md.us/PDF/OurProducts/Publications/ModelsGuidelines/smartneighborhoods.pdf>

neighborhoods and incentives for developers. The ordinance is comprehensive, with regulatory language covering uses, development standards, density, open space, landscaping, access and circulation, parking, architectural standards, lot development standards, and application and processing fees.

WISCONSIN

MODEL TRADITIONAL NEIGHBORHOOD DEVELOPMENT (TND) ZONING DISTRICT⁹³

In connection to Wisconsin's 1999 Smart Growth Law, the University of Wisconsin Extension Service prepared a model ordinance for Traditional Neighborhood Development (TND). The model ordinance is written in a format similar to planned development district and planned unit development regulations to allow for relatively easy integration of TND principles into conventional land development regulations. It includes provisions intended to achieve compact development, mixed uses, multiple modes of transportation through an interconnected network, and enhancement of the cultural and environmental features of the site. The model ordinance calls for a three-step approval process:

1. An initial pre-application conference
2. Development of a general implementation plan and corresponding zoning map amendment
3. A specific implementation plan

The general implementation plan establishes the intent, density, and intensity of the proposed development. It includes a conceptual site plan, identification of architectural styles, a site inventory or analysis, and other features that are part of conventional planned developments. The local legislative body approves the general implementation plan, along with a zoning map amendment. The specific implementation plan is similar but more detailed, including elevations of all proposed commercial buildings and typical elevations of residential buildings. The legislative body approves this plan as well, but the planning department may, under certain conditions, approve minor changes.

The standards are fairly concrete and easy to follow. In addition to specifying neighborhood uses, the ordinance provides provisions for development units, open space, stormwater management, lot and block standards, circulation standards, architecture standards, and landscaping and screening standards. These standards support a series of density ranges, incorporate built-in incentives for affordable housing and mixed-use areas, propose perimeter blocks sizes, allow diverse lot sizes to encourage housing mix, mandate sidewalks, specify some features of entries and building facades, and include measures to slow down traffic at intersections.⁹⁴

As noted, Wisconsin's model TND ordinance is designed to be easily integrated into existing zoning codes, which makes it a useful tool for communities who favor a gradual approach to reform over a wholesale replacement of land development regulations.

⁹³ <http://urpl.wisc.edu/people/ohm/tndord.pdf>

⁹⁴ <https://myapa.planning.org/smartgrowthcodes/pdf/chapter3.pdf>, page 3-11.

BEST CASE PRACTICES

SUN PRAIRIE, WI

TRADITIONAL NEIGHBORHOOD DEVELOPMENT (TND)⁹⁵

In connection with the Wisconsin's Smart Growth Law, the city of Sun Prairie has zoned for TNDs that focus on creating aesthetically pleasing, mixed-use, pedestrian-oriented neighborhoods that accommodate a variety of housing types, public uses, and opportunities for neighborhood-scale commercial to help meet the day-to-day needs of residents. Currently, Sun Prairie is home to three large-scale TNDs currently in the early stages of development, as well as one smaller housing project strongly influenced by TND design concepts. The following principles guide TND development in Sun Prairie:

1. The neighborhood should have a discernable center. This is often a square or a green and sometimes a busy or memorable street corner
2. Most of the dwellings should be within a five-minute walk (averaging roughly 2,000 feet) of the center.
3. A variety of dwelling types should be available – houses, townhouses and apartments - so that younger and older people, singles and families, and people with a range of incomes may find a place to live.
4. Shops and offices should be found at the edge of the neighborhood, of sufficiently varied types to supply many of the weekly needs of a household.
5. An elementary school should be close enough so that most children can walk from their homes.
6. Small playgrounds should be convenient to every dwelling – not more than a block or two away.
7. Streets within the neighborhood should be a connected network, which disperses traffic by providing a variety of pedestrian and vehicular routes to any destination.
8. The streets should be relatively narrow and shaded by rows of trees. This slows traffic, creating an environment suitable for pedestrians and bicycles. Tree lined streets provide added benefits by shading paved areas, helping to control the temperature of storm water runoff entering our streams and drainage systems.
9. Buildings in the neighborhood center should be placed close to the street, creating a well-defined outdoor room.
10. Parking lots and garage doors should rarely front the street. Parking should be relegated to the rear of buildings, usually accessed by alleys.
11. Certain prominent sites at the termination of street vistas or in the neighborhood center should be reserved for significant buildings.
12. The neighborhood should be organized to be self-governing. A formal association should be involved in decisions regarding maintenance, security, and physical change.

MASHPEE, MA

TRADITIONAL NEIGHBORHOOD DEVELOPMENT (TND)⁹⁶

Mashpee Commons set the standard for TND in New England and is the most recognized example of New Urbanism in Massachusetts. Formerly a disinvested strip mall, Mashpee Commons is now a mixed-use, mixed-income, pedestrian-friendly town center. It boasts a diverse retail mix, diverse housing mix, and a range of community spaces. Planning for Mashpee Commons has since been expanded to include six interrelated mixed-use neighborhoods with housing, offices, stores, civic buildings and open space, which are all controlled by strict design codes. The development is permitted for

⁹⁵ http://www.cityofsunprairie.com/docs/category.php?department_id=13&category_id=1419

⁹⁶ http://www.mass.gov/envir/smart_growth_toolkit/pages/CS-tn-d-mashpee.html

thirty-six mixed-use buildings whose collective footprints comprise 255,000 square feet (many will be 2-story buildings) and up to 100 dwelling units. The development is currently under construction and, thus far, 97,923 square feet of retail, 24,505 square feet of restaurant, 36,415 square feet of office and 13,250 square feet of theatre space has been built.

GREENSBORO, NC

LAND DEVELOPMENT ORDINANCE REWRITE⁹⁷

In connection with a new comprehensive plan, Greensboro is in the process of rewriting their original Unified Development Ordinance into a new Land Development Ordinance that emphasizes mixed-use, pedestrian-oriented development. The current draft provides a good example of a comprehensive, flexible and modern UDC.

SUFFOLK, VA

UNIFIED DEVELOPMENT CODE⁹⁸

Suffolk adopted a Unified Development Code intended to implement Smart Growth principles and enable the city to respond uniformly and consistently to development proposals.

KANNAPOLIS, NC

UNIFIED DEVELOPMENT CODE⁹⁹

Kannapolis provides another example of a UDC with strong links to the city's comprehensive plan.

SEATTLE, WASHINGTON

SEATTLE GREEN FACTOR¹⁰⁰

The Seattle Green Factor requires new development in neighborhood business districts to meet a landscaping target. The Green Factor is designed to improve the extent and quality of landscapes, while allowing greater flexibility for developers and designers to meet open space requirements. A worksheet helps applicants calculate their project's score, allowing them to try different combinations of features to reach the requirement.

According to the website, permit applicants in affected zones must demonstrate that their projects meet the Green Factor by using the Green Factor Score Sheet. They are encouraged to use larger plants, permeable paving, green roofs, vegetated walls, preservation of existing trees, and layering of vegetation along streets and other areas visible to the public. Bonuses are provided for food cultivation, native and drought-tolerant plants, and rainwater harvesting. As designers add landscape features, the score sheet automatically calculates a project's Green Factor score, allowing the applicant to easily experiment with different combinations.

Green Factor makes growing neighborhoods more livable. In addition to being attractive, green elements in the landscape improve air quality, create habitat for birds and beneficial insects, and mitigate urban heat island effects. They also reduce stormwater runoff, protecting receiving waters and decreasing public infrastructure costs.

⁹⁷ <http://www.greensboro-nc.gov/departments/Planning/ordinance/>

⁹⁸ http://library1.municode.com/default-now/home.htm?infobase=14461&doc_action=whatsnew

⁹⁹ http://www.ci.kannapolis.nc.us/dept_pz_udo.asp

¹⁰⁰ <http://www.seattle.gov/dpd/Permits/GreenFactor/Overview/default.asp>

PUBLIC EDUCATION AND CODE ACCESSIBILITY¹⁰¹

Seattle publishes Client Assistance Memos to provide user-friendly information on the range of city permitting, land use and code compliance policies and procedures that may be encountered while conducting business with the city. A variety of city departments issue CAMs in topics such as land use codes, building codes, energy and mechanical codes, grading, side sewer and drainage, housing and zoning, green building, drainage and wastewater, building materials salvage and recycling, urban forestry, and more. In addition to compliance and permitting issues, CAMs provide general information about best practices and the benefits they yield.

CALVERT COUNTY, MD

OPEN SPACE DEVELOPMENT ORDINANCE¹⁰²

Calvert County, MD, provides an example of a mandatory open space development ordinance. Open space development, also called "cluster development," is an alternative site planning technique that concentrates dwelling units in a compact area to reserve undeveloped space elsewhere on the site. In this technique, lot sizes, setbacks, and frontage distances are minimized to allow for open space. The typical open space development creates less impervious cover and reduces the need to clear and grade 35 percent to 60 percent of the site. Open space areas are often used for neighborhood recreation, stormwater management facilities, or conservation purposes. Open space preserved in a natural condition needs little maintenance and helps to reduce and sometimes to treat stormwater runoff from development.

ST. CROIX, MN

CLUSTER DEVELOPMENT AND OPEN SPACE SPECIFICATIONS¹⁰³

Open space development places limitations on building lot size so that less land is consumed through the development process and open space lands are retained and protected. Clustering development into different spaces subsequently increases the amount of green space that can be opened up for locations like parks, recreational fields, and natural habitats or wetlands, as well as decrease utility costs for stormwater, road, and power infrastructure.

Jackson Meadow is a great example of cluster development accomplished through community action. Town leaders and residents of the residential development in the City of Marine on St. Croix, Minnesota decided how to deal with requests from numerous developers wanting to build large-lot communities they believed would diminish the community's nature areas. The concept of an open-space cluster development provided a people-friendly model that was intricately linked to the existing town center. It also solved the rural sprawl of large lot development forced by the individual onsite wastewater technology. The result was the approval of a cluster 64-lot development covering 250 acres. Seventy-five percent of the development remains open space.

The next challenge for this new community was to incorporate and manage an effective wastewater treatment program for this new neighborhood. The capacity of the city's existing sewer system was limited and sewer service was not available for Jackson Meadow. The smaller lot sizes (resulting from the open space preservation) were not suitable for individual on-site sewage treatment systems. A number of alternatives were explored and the decision was made to construct two engineered wetland systems designed by North American Wetland Engineering of Forest Lake, Minn. The first system was constructed in 1998 to serve the north half of the development. The second wetland was constructed in 2002 to serve the south half of the development. Each wetland system was integrated into the community open space.

¹⁰¹ <http://www.seattle.gov/DPD/Publications/CAM/CAM520.pdf>

¹⁰² <http://www.epa.gov/owow/nps/ordinance/documents/calvertcty.pdf>

¹⁰³ http://www.edcmag.com/Articles/Feature_Article/BNP_GUID_9-5-2006_A_1000000000000342998

The Jackson Meadow development has won numerous awards for its architecture, planning, and environmental protection. Since 1998, Jackson Meadow and other open-space developments have created a new paradigm in land use, resulting in more than 40 similar developments throughout the Twin Cities area alone. It has also become a model for similar “livable” communities nationwide.

HAMBURG TOWNSHIP, MI

OPEN SPACE COMMUNITY ORDINANCE¹⁰⁴

Hamburg Township provides a good example of a small rural community using open space development and clustering to preserve open space, promote efficient use of infrastructure, and encourage a less sprawling form of development while allowing for greater design flexibility. Additionally, this ordinance incorporates commercial land uses (e.g., mixed use) for projects of a certain size, and provides an example of the application procedure for one community.

INFILL DEVELOPMENT

Zoning for infill development emphasizes the utilization of empty, abandoned lots that are either leftover in the development process or are left unused by landowners. This type of zoning either targets a specific area within the zoning code for infill development or develops language within the code to define an area that that would qualify for infill development. In both cases the main goal is to conserve land, create and maintain community centers, and provide an alternative to sprawl.¹⁰⁵

Concentrating power, wastewater, and road infrastructure rather than spreading it out across larger distances promotes energy and wastewater sustainability and lowers costs. Having development in closer proximity also decreases transportation costs and the associated externalities of pollution and greenhouse gas emissions. Infill development also promotes more walkable communities, better access to attractions and commercial retail resources, and a sense of community in areas once considered empty and unattractive. Overall, encouraging higher densities encourages sustainable development.

SOUTH LAKE TAHOE, CA

INFILL REDEVELOPMENT PROJECT

The Park Avenue Redevelopment Plan¹⁰⁶ brought a new attitude toward sustainable development for the South Lake Tahoe community. Resting at the edge of Lake Tahoe, the city began to see its tourism-based economy slip away with the neglect to but put forth any effort in updating amenities and infrastructure within the area. The proposed plan implemented strategies that would improve accommodations, concentrate on improving commercial space and public facilities as well as architectural improvements to existing buildings, and targeted pedestrian environment design. The plan involved acquiring 27 properties through the City’s redevelopment agency and implemented development agreements with existing property owners for a guide for redevelopment. In some cases, the City used eminent domain to acquire 19-acres of the land used in the plan. While the City of South Tahoe spent \$60 million for the initial implementation of the plan, almost \$300 million in private investment was leveraged from public/private partnerships generated through the plan.

¹⁰⁴ <http://www.epa.gov/owow/nps/ordinance/documents/C2c-Hamburg.pdf>

¹⁰⁵ New Hampshire Department of Environmental Services. (October 2008) *Innovative Land Use Planning Technique: handbook for sustainable development*. http://des.nh.gov/organization/divisions/water/wmb/repp/documents/ilupt_complete_handbook.pdf

¹⁰⁶ Southern Nevada Regional Planning Coalition. (February 2001) *Infill Development Plan*. P. 66 – 68, Appendix E. <http://www.snrpc.org/Reports/InfillDevelopmentPlan.pdf>

NEW HAMPSHIRE

INFILL DEVELOPMENT USES

Several locations within the state of New Hampshire have successfully implemented infill development techniques to redevelop a parcel or building. One such example is the City of Portsmouth that has introduced a Downtown Overlay District¹⁰⁷ to ensure pedestrian oriented business uses remain along downtown streets. This zoning tool is effective use of planning policy to ensure that a land use will remain consistent with the desired community identity.

MINIMUM DENSITY ZONING

Infill development can also be linked to a zoning technique of minimum zoning density. Conventional practice of Euclidian zoning typically uses maximum density zoning that distinguishes zones by the maximum number of dwelling units per lot. In this case, a residential site that is zoned RS-5 indicates no more than 5 dwelling units are allowed per lot which means it is possible to build 1 dwelling unit to a lot within a zone designated for RS-8. While this measure is typically used to maintain the character of the surrounding environment it can leave the contiguous land underutilized and essentially, push development to the outer limits of town.

Minimum zoning density is designed to look at zoning with less restriction to development and promote higher densities for designated areas. Now, a minimum zoning of RS-5 would indicate that no less than 5 dwelling units are allowed per lot allowing developers the freedom to build more units per lot than if it were a maximum zoning density regulation. Encouraging density through different zoning designations is a reward to developers for utilizing land resources to its fullest potential. Minimum zoning densities can also be utilized for commercial and industrial zoning in the same manner. While there are numerous benefits to minimum zoning density it may be inappropriate apply this type of zoning to special cases where land uses do not conform to higher densities.

OREGON LAND CONSERVATION AND DEVELOPMENT COMMISSION (LCDC)

METROPOLITAN HOUSING RULE

The LCDC created the Metropolitan Housing Rule to require local governments in the metropolitan Portland area with projected populations of less than 8,000 to have overall housing densities at least six units per net developed per acre by the year 2000. This restriction was designed under the intention of promoting minimum density standards either formally by the regulation or informally in the review process.

DISTRICTING AND OVERLAYS

Generating identifiable City Districts can be a helpful technique for a city to bring a particular sense of identification to certain areas and guide specific development to each district. Districting can also be the basis of planning documents like a comprehensive plan or long range plan as well as a tool for uniting neighborhood initiatives directing communities to common values and goals. Zoning policy can also be designed around districts to allow or regulate specific land use measures pertaining to the character of the district. An example could be the creation of a downtown district that promotes higher densities, commercial and residential land use, and smaller lot sizes with restrictive setbacks. Another District outside that is more residential oriented could be designed to have light to medium density, residential land use, and small to medium lot sizes with less restrictive setbacks. Districting can promote cohesive land use and land use design as well as bring a greater sense of identity and community recognition to the identity of each designated district.

¹⁰⁷ City of Portsmouth, New Hampshire (January 2010). *Zoning Ordinance: Adopted December 21, 2009*. P. 82, Article 6, http://www.cityofportsmouth.com/planning/application/ZoningOrd_20100101.pdf

PITTSBURG, PA

GREEN DISTRICTS¹⁰⁸

The City of Pittsburg has a number of Green Districts that act as overlay zones designed to protect and preserve the natural environment. If infrastructure like roads and buildings are built within the overlay zones, they must work to enhance the view of the protected area as well as add to the stability of the area instead of destroying it. The City of Pittsburg currently targets protective areas for districts with steep slopes, open spaces, and the riverfronts. Overlay zones do not limit the area to the public, but to encourage sustainable design of streets, bike paths, and look out points within the districts.

COLUMBIA, CT

GREEN OVERLAYS

The City of Columbia uses green overlay zones to protect the Columbia Lake by requiring new developments within the watershed to comply with regulations set by the Columbia Lake Watershed Management Plan. The plan has established regulations for immediate, intermediate, and remote levels within the overlay that determines how much contamination can be released by based on the proximity of the river front to the site. For example, a landowner must show that the phosphorus levels released by the future site are negligible or they will have to implement permeable pavements, bio swales, or any other BMP's to obtain a building permit in a green overlay.¹⁰⁹ The management plan also outlines a detailed Best Management Practices (BMP's) for building regulations within the overlay.

MASSACHUSETTS

PIONEER PLANNING COMMISSION

Overlay districts can be used several different ways to encourage household renewable energy. A wind energy overlay district can be placed over areas that receive high enough wind speeds to allow for wind capture. This overlay district would work to limit the height of surrounding buildings in order to allow for better access to the wind for individual and community wind generators. The same concept works for household solar panels by limiting the height of buildings or pitch of surrounding roofs panels would have better access to light to generate more electricity. A green overlay zone that targets building height-restrictions is an underutilized zoning technique, but is currently being considered in many communities that have well established alternative energy policies already established.¹¹⁰

OTHER DEVELOPMENT REGULATION GUIDELINES AND RESOURCES

ENVIRONMENTAL PROTECTION AGENCY (EPA) SMART GROWTH ZONING RESOURCES

GETTING TO SMART GROWTH: POLICIES FOR IMPLEMENTATION: VOLUMES 1 AND 2¹¹¹

ESSENTIAL SMART GROWTH FIXES FOR URBAN AND SUBURBAN ZONING CODES¹¹²

SMART GROWTH GUIDELINES FOR SUSTAINABLE DESIGN AND DEVELOPMENT¹¹³

¹⁰⁸ <http://www.city.pittsburgh.pa.us/rfp/assets/river6.pdf>

¹⁰⁹ http://www.greenvalleyinstitute.org/brochures/fact_sheet_6_overlay_zones.pdf

¹¹⁰ <http://www.islandplan.org/doc.php/PVPC%20renewables%20guide.pdf?id=878>

¹¹¹ http://www.epa.gov/smartgrowth/getting_to_sg2.htm

¹¹² http://www.epa.gov/smartgrowth/essential_fixes.htm

¹¹³ http://www.epa.gov/smartgrowth/sg_guidelines.htm

SMART GROWTH SCORECARDS FOR EVALUATING POLICIES AND PROJECTS¹¹⁴

COLORADO

COMMUNITY SUSTAINABILITY GUIDE: SELF-ASSESSMENT TOOL¹¹⁵

MARYLAND

FLEXIBLE AND INNOVATIVE ZONING SERIES: OVERLAYS¹¹⁶

¹¹⁴ <http://www.epa.gov/smartgrowth/scorecards/index.htm>

¹¹⁵ <http://www.dola.state.co.us/dlg/osg/docs/SustainabilitySelfAssessmentGuide.pdf>

¹¹⁶ <http://www.mdp.state.md.us/PDF/OurProducts/Publications/ModelsGuidelines/mg10.pdf>

GREEN BUILDING CODES

BEST CASE PRACTICES

BRENTWOOD, TN

RADON RESISTANT CONSTRUCTION CODES (RRC)¹¹⁷

In 1999, Brentwood, TN became the first city in Tennessee to adopt radon resistant construction codes (RRC). This city is located in a high radon risk potential county, and has made the codes a mandatory part of their building process. Brentwood requires inexpensive but effective techniques to mitigate the presence of radon gas, and offers a brief training course for contractors to inform them how to abide by the codes. It is estimated that the construction cost of a standard single-family residential unit will increase between \$300 and \$500, and the codes are expected to increase overall indoor air quality.

ALBUQUERQUE, NM

MANDATORY GREEN BUILDING STANDARDS¹¹⁸

In 2005, Albuquerque, NM made adhering to at least the minimum building standards established by the U.S. Green Building Council mandatory. Each adhering building then receives an Albuquerque Green Certificate, which signifies that the structure is contributing towards the city's effort to meet the 2030 Challenge (see link below). The city has allowed teamed with Energy Star for extra incentive on going green. To become more water efficient, an innovative contract was formulated with the Citizen's Conservation Services, which plans to reduce water consumption across the city by 24 percent after their audits are complete. They plan to do this by recycling wastewater, capturing stormwater, and offering incentives on water efficient items such as low-flow toilets and faucets, washing machines, and multi-setting timed sprinklers.

CALIFORNIA

STATEWIDE GREEN BUILDING STANDARDS CODE (CALGREEN)¹¹⁹

In 2008, the California Building Standards Commission passed the first-ever statewide green building standards code. However, it was not until January of 2010 that the code was revised and given some teeth, and will become effective on January 1, 2011. This comprehensive code is designed to achieve major reductions in greenhouse gas emissions, energy consumption, and water use. CalGreen requires that every new building reduce water consumption by 20 percent from the baseline structure, divert 50 percent of construction waste from the landfill, and use low pollutant-emitting materials. Additionally, separate water meters for indoor and outdoor water use are required to monitor irrigation, and mandatory inspections are to be done on buildings over 10,000 square feet to ensure all systems are working as designed.

SEATTLE, WA

CITYWIDE GREEN BUILDING PROGRAM¹²⁰

Since the late 1990's, Seattle has been striving to promote all three pillars of sustainability through the use of green building. As part of their Environmental Management Plan, the city added a green building sector to its Department of

¹¹⁷ <http://www.tn.gov/environment/apc/radon/pdf/buildingcodes.pdf>

¹¹⁸ http://www.architecture2030.org/2030_challenge/index.html, <http://www.cabq.gov/albuquerquegreen>

¹¹⁹ <http://www.bsc.ca.gov/CALGreen/default.htm>

¹²⁰ <http://www.cityofseattle.net/environment/building.htm>

Planning and Development, which provides design guidance, education, incentives, and technical education to those looking to “build green”. Then, in 2008, the city established a Green Building Task Force to establish new policies aimed to “make Seattle the nation’s green building capital”. The city now has a comprehensive green building policy, a sustainable building library, a real-time green projects list, and incentives for single-family, multifamily, and commercial green building.

AUSTIN, TX

CITYWIDE GREEN BUILDING PROGRAM¹²¹

In 2009, the Austin Energy Green Building program was established. This program has its own rating guides and forms, materials maps, workshops, rebates and loans, and case studies. Austin not only established a green building code, but also heavily emphasized the public education component. Upcoming events include a Renewable Energy Stampede and Green Living Fair, ACI Home Performance Conference, a Greening Existing Buildings Seminar, and a Green by Design forum. They also offer several free home energy improvements, including thermostats, attic insulation, solar screens, caulk, and weather-stripping.

FORT COLLINS, CO

CITYWIDE GREEN BUILDING PROGRAM¹²²

In 2007, Fort Collins developed a dynamic, integrated approach to green building. They are not only focusing on “greening” their own city, but the entire Northern Colorado region. They put green policies into their municipal code, city plan, structure plan, land use code, and building code, and made all of them available online. Their green building code has specific standards for residential, multifamily, and commercial development, and they offer rebates, tips, and resources for building or improving each type of structure. The city also offers free energy and water audits.

GREEN BUILDING ORGANIZATIONS AND STANDARDS

INTERNATIONAL ENERGY CONSERVATION CODE (IECC)¹²³

The United States Department of Energy supports this code, which is little more than a building code template. There is not much to this code in terms of being green, but it is a very straightforward, simple code that is easily understood and abided by. Most cities today are choosing to go beyond the measures outlined in this code, but it is an adequate starting point for cities without a building code who desire quick implementation.

NATIONAL ASSOCIATION OF HOME BUILDERS (NAHB) GREEN BUILDING¹²⁴

NAHBGreen offers builders, remodelers, developers, and other home building professionals a variety of services to learn, incorporate, and market green building. They offer how-to videos, certifications, scoring tools, a toll free hotline, and have nationally recognized conferences supporting green building. This program certifies both single- and multi-family homes, as well as land developments.

¹²¹ <http://www.austinenergy.com/Energy%20Efficiency/Programs/Green%20Building/index.htm>

¹²² <http://www.fcgov.com/greenbuilding/>

¹²³ <http://www.energycodes.gov/>

¹²⁴ <http://www.nahbgreen.org/index.aspx>

NORTHEAST ENERGY EFFICIENCY PARTNERSHIP (NEEP) & BUILD IT GREEN¹²⁵

These membership organizations have a mission of promoting healthy, energy- and resource-efficient building practices. NEEP has a focus region in the Northeastern United States, while Build it Green focuses on California. They focus on energy and water efficiency, resources conservation, and air quality, with the goal of making communities more livable and healthy. To achieve these goals, they offer training events, many tools and resources, and market the many benefits of green building.

LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN (LEED)¹²⁶

The US Green Building Council (USGBC) is a highly recognized non-profit green building organization that has set the bar for the United States in terms of green building standards. Many cities, universities, and companies now require that all new construction projects achieve a minimum level of LEED certification. They have expanded their focus areas from commercial to residential, neighborhoods, and renovations, and have progressed through several versions of standards.

ENERGY STAR¹²⁷

This government-backed program was created by the Clinton administration in 1992 and has since moved worldwide. Energy star certified consumer products generally use 20-30 percent less energy than is required by federal standards. The program also offers rebates and tax incentives on new purchases, as well as buy-back programs for old appliances. They also provide audits, and are a widely recognized name brand.

¹²⁵ <http://www.builditgreen.org/>

¹²⁶ <http://www.usgbc.org/>

¹²⁷ <http://www.energystar.gov/>

MUNICIPAL TAX INCENTIVES

BEST CASE PRACTICES

ANNE ARUNDEL COUNTY, MARYLAND

STORMWATER MANAGEMENT¹²⁸

Homeowners in Anne Arundel County who install stormwater management qualified devices on their properties are eligible for a property tax credit. These qualified improvements include rain barrels, rain gardens, impervious coverage removal, swales, dry well, landscape infiltration, micro bioretention devices, and permeable pavers. The value of the credit is 10 percent of the cost materials and installation per year for five years. Over those five years, homeowners may receive a maximum credit of \$10,000.

ARIZONA

ARIZONA GREYWATER-HARVESTING & RAINWATER-HARVESTING TAX CREDITS¹²⁹

Since the beginning of 2007, Arizona taxpayers who install a “water conservation system” are eligible for a one-time tax credit of 25 percent of the cost of the system, up to a maximum of \$1,000. Water conservation systems should harvest residential greywater and/or rainwater. Builders who install water conservation systems are eligible for a tax credit of up to \$200 per residential unit. Each year \$250,000 is allocated for these water conservation tax credits, so they are limited and typically are exhausted before the end of year.

CHATHAM COUNTY, GEORGIA

PROPERTY TAX ABATEMENT¹³⁰

Commercial buildings achieving LEED Gold certification receive full property state and county tax abatement for the first five years. This tapers off by 20 percent year until the tenth year. Qualified projects are new or expanding businesses in an enterprise zone that increases employment opportunities.

CINCINNATI

PROPERTY TAX ABATEMENT¹³¹

Any homeowner in Cincinnati may be eligible for property tax abatement if they have renovated their home or purchased a newly constructed home that was built to LEED standards. New LEED construction of one, two, and three unit residential structures, including condominiums, are eligible for a 15-year 100 percent tax abatement valued up to \$530,450. For renovated LEED residential dwellings (condominiums, one, two, and three unit structures), there is a 10-year tax abatement on improvements up to a maximum \$530,450 market value. Owners pay taxes on the land. The market value limit increases by 3 percent compounded each year. There is no maximum value limit for new and rehabilitated residential structures certified with the LEED Platinum.

¹²⁸ <http://www.aacounty.org/DPW/Highways/RainGarden.cfm>

¹²⁹ <http://www.azdor.gov>

¹³⁰ <http://www.leg.state.or.us/ors/469.html>

¹³¹ <http://www.cincinnati-oh.gov/cdap/pages/-3521-/>

HARRIS COUNTY, TEXAS

PROPERTY TAX ABATEMENT¹³²

Since May, developers who certify buildings with the U.S. Green Building Council can receive tax abatements for costs incurred to meet the Green Building Council's criteria. Buildings that meet the certified level are eligible for tax abatements of 1 percent of the construction costs. Buildings with higher ratings are eligible for higher discounts. For example, buildings that meet LEED Platinum certification level are eligible for tax abatements of 10 percent of the construction costs. Among other requirements, the minimum value of increase attributable to LEED certification must be at least \$100,000 for a proposed new commercial building to qualify for tax abatement, and total investment must be at least \$10 million for basic certification, \$4 million for silver, \$2 million for gold and \$1 million for platinum.

HAYS COUNTY, TEXAS

PROPERTY TAX EXEMPTIONS¹³³

For rainwater harvesting systems serving as the sole source of water for a residence, Hays County grants a property tax exemption from county taxes for the value of the rainwater harvesting system. Additionally Hays County encourages rainwater harvesting with a \$100 rebate on the development application fee.

HONOLULU, HAWAII

PROPERTY TAX EXEMPTION¹³⁴

A 2004 ordinance in Honolulu provides an exemption from real property taxes on the building improvements for a period of one year on all new commercial, resort, hotel and industrial construction that achieves LEED certification.

MONROE COUNTY, NEW YORK

PROPERTY TAX ABATEMENT¹³⁵

Monroe County has extended tax abatements from 10 to 14 years for LEED buildings. Additionally, new county buildings and major renovations of county buildings are required to adhere to LEED standards.

NEW YORK

NEW YORK STATE MULTIPURPOSE GREEN BUILDING TAX CREDIT¹³⁶

Owners and tenants of building that meet green standards are eligible for a multipurpose tax credit that can be applied against corporate taxes, personal income taxes, insurance corporation taxes, and banking taxes. New buildings receiving the credit must not exceed 65 percent of the permitted energy usage, and rehabilitated buildings must not exceed 75 percent of the permitted energy usage.

¹³² http://www.csd.hctx.net/edah_taxabatment.aspx

¹³³ <http://www.co.hays.tx.us/LinkClick.aspx?fileticket=V6743iYiOzM%3d&tabid=71&mid=438>

¹³⁴ <http://www.honolulu.gov/refs/bill/text/2004/b069.htm>

¹³⁵ http://74.208.110.60/comida/incentives#Leed_Certification

¹³⁶ <http://www.dec.ny.gov/regs/4475.html>

TEXAS

TEXAS PROPERTY TAX EXEMPTION FOR COMMERCIAL INSTALLATIONS¹³⁷

Since 1993, pollution control equipment is exempt from Texas state property taxes. This includes water conserving equipment and rainwater harvesting systems. This exemption seeks to ensure that capital expenditures undertaken to comply with environmental rules and regulations did not raise a facility's property taxes. Since 2001, taxing units of government can exempt from taxation the assessed value of the property on which water conservation modifications have been made. The taxing entity designates by ordinance or law the list of eligible water conservation initiatives, which may include rainwater-harvesting systems.

¹³⁷ Page 53, http://www.twdb.state.tx.us/publications/reports/RainwaterHarvestingManual_3rdedition.pdf

STORMWATER FEES AND CREDITS

BEST CASE PRACTICES

PORTLAND, OREGON

CLEAN RIVER REWARDS: CONTAIN THE RAIN

In 1977, Portland created a new utility fee to pay for stormwater runoff costs in their city. However, the City Council decided to reward ratepayers who worked to keep stormwater from leaving their property, and they founded the Clean River Rewards program. This program was successfully implemented in 2006.

With Clean River Rewards, residents are able to receive up to a 100 percent discount on their on-site stormwater management charges. For residential properties, the discount is based on managing stormwater runoff from roof areas only, while commercial properties include paved areas. The maximum discount available is 100 percent of the on-site charge; partial credit may also be available to those who can only manage a portion of their stormwater.

DOWNSPOUT DISCONNECT PROGRAM

According to their website, this program disconnects household roof-gutter downspouts from the combined sewer/stormwater system, and then redirects the roof runoff to irrigate the landscape with the rainwater. The work is done for free by the city of Portland, or you can get a \$53 reimbursement if you do it yourself. More than 42,000 homeowners have participated, removing over 942 million gallons of roof water per year from the combined sewer/stormwater system.

CINCINNATI, OHIO

RAIN GARDEN AND RAIN BARREL INCENTIVES

The Cincinnati EPA office has instituted a program to give incentives to homeowners for rain gardens or rain barrels to improve quality/timing of stormwater runoff, rather than promoting a central engineering solution.

According to the abstract, the project has two goals: "(1) to test the use of an auction to cost-effectively allocate stormwater management practices among landowners, and (2) to determine the effectiveness of the resulting implementation in terms of hydrological, water quality, and ecological measures."

They created an auction for community members to bid on. The goal was to pay those landowners who adopted the most effective best management practices at the lowest price. The auction was run in the spring 2007 and repeated in spring 2008, and resulting in actual payouts and installations of rain gardens and rain barrels. In 2007, 50 rain gardens and 100 rain barrels were installed at 67 of the 350 residential properties in the experimental watershed. In 2008, the auction was repeated and they accepted bids for an additional 35 rain gardens and 74 rain barrels.

SEATTLE, WASHINGTON

WATER RIGHT PERMIT

Seattle's Public Utilities received a water right permit from the Washington State Department of Ecology to capture and reuse rainwater that falls on rooftops in the combined and partially combined sewer system. This enables homeowners to become involved in stormwater management because it removes "legal uncertainty". It is projected that this permit, if implemented, will benefit Seattle's Public Utilities public water supply by getting rid of the demand for potable water that is

currently used for non-portable purposes. Additionally, it may lower storm flows into the sewer system, thus benefiting the sewage collection system.

RAINWISE INCENTIVES FOR CISTERNS AND RAIN GARDENS¹³⁸

When it rains hard, combined storm and sanitary sewers in some areas can't handle all the volume, causing "combined sewer overflows" (CSOs) into the nearest water body. Seattle is working on this problem with a combination of traditional (big pipes and tanks) and "green" infrastructure. As part of that investment, the City plans to help residents reduce stormwater runoff from their property in target CSO basins. Starting in the Spring of 2010, residents in the pilot basin in Ballard (see map at right) will be eligible for incentives. The City will pay most of the cost of installing rain gardens and cisterns, depending on how many square feet of roof runoff is controlled.

AUSTRALIA

WATERFUTURE STRATEGY¹³⁹

Adopted by Council in December 2005, The Gold Coast Waterfuture (GCWF) Strategy provides a blueprint for managing the city's water supply in a sustainable way over the next 50 years.

The strategy has been able to remove reliance on surface water storages, and provided water solutions that fit their city.

According to the website, the strategy now includes a diverse range of water supply initiatives such as the use of rainwater tanks, recycling of water back to the home for garden use and toilet flushing, reducing the pressure of the water supply network to reduce water usage, augmenting existing surface water storages and desalination.

Many initiatives are available and include a pressure and leakage management program, water conservation programs and desalination, and increasing the use of recycled water around the city.

MINNEAPOLIS, MN

STORMWATER CREDIT PROGRAM

The Minneapolis Stormwater Credit Program offers customers a way to reduce their monthly stormwater utility fee by putting in place stormwater practices or tools that manage their property's stormwater quality or quantity. Water quality refers to the fact that urban activities increase the potential for surface and groundwater pollution, while water quantity means that the less land there is to absorb stormwater, the more of an increase in the volume of stormwater and the rate at which it flows into the storm drain system.

Through the Stormwater credit system, residents can receive up to 50 percent credit (reduction) in their stormwater utility fee for management tools/practices that address stormwater quality.

Property owners can apply for a credit of up to 50 percent of their stormwater utility fee if they are using stormwater quality management tools/practices (often referred to as "best management practices" or "BMPs"), including: wet ponds, manufactured underground filters, rain gardens, dry ponds, vegetated swales, infiltration trenches, underground storage, sand filters, soak away pits, wet or dry swales, filter strips, pervious pavers, green roof, dry wells.

¹³⁸

http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/ResidentialRainwiseProgram/Incentives/index.htm

¹³⁹ http://www.goldcoastwater.com.au/t_gcw.aspx?PID=3840

They can also receive 50 percent or 100 percent credit (reduction) in their stormwater utility fee for management tools/practices that address stormwater quantity. However the maximum credits are cumulative and cannot exceed 100 percent credit.

Only those properties that can demonstrate the capacity to handle a 10-year or 100-year rain event can receive a stormwater quantity credit. To apply for a stormwater quantity credit, property owners must have their applications certified by a state licensed engineer or landscape architect.

Property owners can apply for either the "Standard Quantity Reduction Credit", which is a 50 percent credit on a property's stormwater fee or the "Additional Quantity Reduction Credit," which is 100 percent credit on a property's stormwater fee.

GREENSBORO, NC

The stormwater program in Greensboro, North Carolina got underway in 1994 during Phase 1 of the amended CWA. According to the website the "Storm Water Infrastructure Inventory project includes three primary components: (1) determination of the location of each structure; (2) collection of structure attributes; and (3) development of a Geographical Information System (GIS) database that includes all of the information on the storm water conveyance system."

Under this new Storm water utility all residential customers are charged for an average of 2,543 square feet of impervious surfaces. The residential charge is \$2.44 per month. Why are all houses charged the same, regardless of size? According to officials, "The city does not have the data that would allow it to charge each of the 55,000 single family homes on the basis of its impervious surface area measurement. In addition, the majority of services benefit citizens equally, regardless of how large their lot or built area is."

How does one become exempt from the Greensboro rain tax? According to the city if you have a properties that has "no disturbed area or less than 600 square feet of total impervious surface" you can get an exemption. Otherwise, "All other property owners cannot be exempted unless they remove all structures and other impervious materials from the property, and re-seed and re-plant it, returning a parcel to its natural state. The city further states, "All property owners can return property to its natural state" in order to get an exemption.

According to Annambhotla, the rain tax produces between \$6 and \$7 million in revenue, which is controlled by the Storm water Management Department and used for managing storm water, capital improvements and water quality monitoring. He said all funds stay with in the city and that the funds are not used for anything else.

GRESHAM, OREGON

BUSINESS STORMWATER INCENTIVES¹⁴⁰

In Gresham, fee reductions are possible for storm water reduction projects in businesses that lessen the stormwater impact on the city. They may be eligible for a 27 percent fee reduction if they have on-site mitigation facilities.

¹⁴⁰ <http://greshamoregon.gov/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=6256>

SANDY, OREGON

STORMWATER MANAGEMENT INCENTIVE PROGRAM¹⁴¹

The City of Sandy initiated a stormwater management incentive program to encourage multi-family, commercial, and industrial property owners to reduce runoff by treating and disposing of stormwater on-site.

According to the website, Sandy's incentive program is intended to "encourage property owners to utilize source control facilities on new development or redevelopment, or to make improvements to existing properties to mitigate stormwater discharges." The simplest way to reduce stormwater runoff is to reduce or eliminate impervious surfaces.

Credits may be given up to 1/3 of the total number of ERUs; therefore, a property owner must have at least 3 ERUs (8250 square feet of impervious surface) to qualify for a credit. Additional credit may be given to property owners who completely eliminate impervious surfaces on their property.

LEXINGTON, KENTUCKY

GRANTS TO OFFSET STORMWATER FEES¹⁴²

Businesses in Lexington are able to apply for grants that total over \$1.5 million to help build permeable pavements, rain gardens, and other structures that would offset the cost of the stormwater utility fee.

There are three types of grants available, according to the website:

Water Quality Education/Public Involvement Projects: Projects designed to provide and promote public or private education and involvement related to the importance of stormwater quality in Fayette County.

Structural Water Quality Best Management Practices (BMP) Projects: Design or construction of structural BMPs that reduce pollutant discharge to the city's stormwater conveyance system and the waters of the Commonwealth.

Structural Water Quantity BMP Projects: Design or construction of structural BMPs that reduce peak offsite stormwater discharge rates in excess of minimum requirements specified in city Engineering Manuals.

¹⁴¹ http://www.ci.sandy.or.us/index.asp?Type=B_BASIC&SEC={A9D3CDDE-3BA0-42DE-BE30-4E321A155AA8}&DE={826E8D6A-A177-4CB6-8431-6CA8E061970F}

¹⁴² <http://www.bizlex.com/Articles-c-2010-02-19-91535.113117-City-announces-incentive-program-for-businesses-to-offset-stormwater-fee.html>

PROPERTY ASSESSED CLEAN ENERGY (PACE)

BEST CASE PRACTICES

BABYLON, NEW YORK

LONG ISLAND GREEN HOMES¹⁴³

Long Island Green Homes Program is a self-financing residential retrofit program for upgrading the energy efficiency of existing homes in the Town of Babylon. The program will enable residents to make their homes greener and healthier at little or no out-of-pocket cost. All participants will first have a Home Performance Evaluation by a licensed energy auditor. Homeowners then receive a detailed explanation of how their home uses energy, where the most energy is being wasted or lost, and specific improvements that could increase energy efficiency. The Long Island Green Homes Program pays the contractor the entire cost of the energy-efficiency improvements. Under a separate contract with the homeowner, the Town sets up a monthly payment plan that has the homeowner pay for the improvements over time only from a projected utility bill cost savings.

BERKELEY, CALIFORNIA

BERKELEY FIRST FINANCING INITIATIVE FOR RENEWABLE AND SOLAR TECHNOLOGY¹⁴⁴

Berkeley FIRST is the City of Berkeley's solar financing program. The recently concluded pilot program provided property owners an opportunity to borrow money from the City's Sustainable Energy Financing District for the installation of solar photovoltaic electric systems. The pilot was the first in the nation to finance the cost of solar installations through an annual special tax on the homeowner's property tax bill that is repaid over 20 years. To follow up on the pilot, the City has joined with a state-wide consortium developing a California FIRST program. Berkeley FIRST was designed to solve many of the financial hurdles facing property owners who wanted to install solar systems. The advantages of the Berkeley FIRST program are:

- There is relatively little up-front cost to the property owner.
- The cost for the solar system is paid for through a special tax on the property, and is spread over 20 years.
- The financing costs are comparable to a traditional equity line or mortgage.
- Since the solar system stays with the property, so does the tax obligation—if the property is transferred or sold, the new owners will pay the remaining tax obligation.

BOULDER COUNTY, COLORADO

CLIMATESMART LOAN PROGRAM¹⁴⁵

The ClimateSmart Loan Program provides a voluntary mechanism for commercial and residential property owners to obtain financing for renewable energy and/or energy efficiency improvements to properties in Boulder County. Loans obtained through the ClimateSmart Loan Program are not funded through a countywide tax increase. The individual property owners who obtain financing through the ClimateSmart Loan Program will repay their debt via a special assessment on their individual properties that will be included with their annual property tax bills and will cover the administrative costs of the program as well.

¹⁴³ <http://ligreenhomes.com/page.php?Page=home>

¹⁴⁴ <http://www.cityofberkeley.info/ContentDisplay.aspx?id=26580>

¹⁴⁵ <http://www.bouldercounty.org/bocc/cslp/>

PALM DESERT, CALIFORNIA

PALM DESERT ENERGY INDEPENDENCE PROGRAM¹⁴⁶

Part of the City's five-year goal to cut energy usage by 30 percent, the Palm Desert Energy Independence Program offers residents affordable financing for major energy-saving home improvements, such as high-efficiency air conditioners, dual-pane windows and solar panels. Long term payback of the improvements is linked to the owner's property taxes. Since its launch in August 2008, the Energy Independence Program has made \$5 million in loans, funded with \$2.5 million each from the city's general fund and Redevelopment Agency.

SAN FRANCISCO, CA

GREENFINANCESF¹⁴⁷

GreenFinanceSF is a low-cost loan program established by the citywide Mello-Roos special tax district to fund energy efficiency, renewable energy, water conservation, and other improvements on privately held property. Owners repay the funds through a special line-item property tax over the life of the loan. The loan is attached to the property so property tax is assumed by new owners if the building is sold. Participants only pay a tax on a fixed payment schedule for the improvement plus charges for interest and administration. Interest will be fixed. The life of the loan will match the expected useful life of the improvements. The time limit is up to 20 years. Project qualification criteria being developed will focus primarily on the scope of improvements proposed, the property's tax and mortgage payment history, and the value of property relative to its outstanding debt, according to GreenFinanceSF. Some of the projects that could receive loans include energy efficiency upgrades such as adding insulation, replacing windows, and newer heating systems, and water efficiency upgrades such as installing low-flow toilets.

SONOMA COUNTY, CALIFORNIA

SONOMA COUNTY'S ENERGY INDEPENDENCE PROGRAM¹⁴⁸

Sonoma County's Energy Independence Program allows property owners to finance energy efficiency, water efficiency and renewable energy improvements through a voluntary assessment. These assessments are attached to the property, not the owner. The improvements will be paid back through the property tax system over time, making the program not only energy efficient but also affordable.

¹⁴⁶ <http://www.cityofpalmdesert.org/Index.aspx?page=484>

¹⁴⁷ <https://greenfinancesf.org/systems/energy>

¹⁴⁸ <http://www.sonomacountyenergy.org/energy-improvements.php>

LOCAL CARBON POLICIES

Currently, various businesses, industries and governmental entities acknowledge that carbon dioxide and other greenhouse gases (GHGs) have a profound effect on Earth's climate. The Iowa Climate Change Advisory Council has summarized the impact of climate change within the state of Iowa as well as our own communities (Iowa Greenhouse Gas Inventory & Reference Case Projections, 1990-2025, October 2008). The possible effects of climate change include impacts on the number of extreme storms, flooding, soil erosion, and ecosystem and human health. As one of the largest emitters of green house gasses per capita in the world, averaging 22 metric tons per capita per year, the United States legislation aims to reduce the country's emission to a more manageable annual limit of 2 metric tons per person.

Decorah faces challenges of increased energy consumption and environmental and resource constraints. These fluctuating dynamics then become magnified when viewed under the lens of developing an energy management and emissions reduction program. Therefore, the challenge before us is how Decorah should conduct strategic and tactical decision-making under the pressure of low carbon ideals. Decorah must strive to make insightful, intelligent and practical decisions so as to ensure that the community's growth is achieved effectively and sustainably.

Today Decorah would most benefit from an energy management system in order to accelerate its shift in moving the community towards a more sustainable future. Beginning with improving energy efficiency in municipal buildings and facilities, Decorah will decrease overall energy usage and resource consumption. The fundamental shift will determine the quality of the community's social development and economic growth, its future competitiveness, as well as the welfare of its residents.

To achieve such a fundamental transformation, Decorah's leadership as well as its academic and think tank community must continually question and challenge themselves. The following case studies illustrate local government's efforts to reduce local carbon emissions.

BEST CASE PRACTICES

SACRAMENTO COUNTY, CALIFORNIA

SACRAMENTO COUNTY¹⁴⁹

Currently, 28-percent of Sacramento County's GHG emissions are attributed to residential, commercial, and industrial electricity and natural gas use for the region. For Sacramento County operations, approximately 17-percent of GHG emissions are attributed to energy used in buildings. The county continually tracks current and historical energy and fuel purchase data of County-owned facilities and vehicles.

The County influences energy use to comply with state climate change regulations by influencing energy use in the following ways:

- Collaborating with local utilities [such as Sacramento Municipal Utilities District (SMUD) and Pacific Gas and Electric (PG&E) to encourage energy use reduction through rate structures and energy efficiency rebate programs
- Requiring energy efficient construction for buildings within its jurisdiction

¹⁴⁹ http://www.dera.saccounty.net/portals/0/docs/EnvDocs_Notices/200201051220090417151455.pdf

- Requiring alternative energy and energy reduction for new developments that go through the County's planning and building permit process
- Efficiently managing energy consumption of County government operations

Sacramento County and the entire community are committed to reducing energy-related GHG emissions through various existing initiatives that decrease the use of fossil fuels. In February 2007, the County adopted an ordinance that exempts building permits and plan review fees for SMUD-approved residential photovoltaic solar system projects on existing residential buildings. By 2006, the County's landfill gas-to-energy facility was expanded. The landfill gas-to-energy plant produces 14 megawatts of electricity and powers 8,900 homes. This conversion of methane to clean energy has reduced GHG emissions by over 4 million metric tons of CO₂e.

KING COUNTY, WASHINGTON

KING COUNTY¹⁵⁰

Over the past 15 years, King County has actively fostered the growth of a clean fuel economy and climate-friendly development. In 2002, the county joined the Cities for Climate Protection and the Executive created an action plan to reduce emissions of greenhouse gases and targeted air pollutants from its operations. This action plan coincided with:

- Establishment of the Green Building program and Renewable Energy policy;
- Development of a hydrogen fuel cell at one of the county's wastewater plants;
- Purchase of 89,000 acres of development rights at Snoqualmie Forest;
- Operation of regional transit with alternative fuels such as ultra-low sulfur diesel and biodiesel; and
- Operation of the Cedar Hills landfill with maximum capture of methane.

These measures have worked in tandem with establishment and protection of the Urban Growth Area Boundary, as well as high-density development based around easy transit access, which preliminary data suggests could reduce global warming pollution from transportation emissions on a regional level.

By 2009, King County had created a comprehensive system to track the county's operational energy and greenhouse gas emissions. All direct sources of emissions were recorded including gasoline, diesel, natural gas, heating oil, steam, propane and jet fuel used in all parts of county government. The data are used to assess progress and guide next steps and strategies to achieve target cuts in energy efficiency and greenhouse gas emissions.

Further, King County implemented a consolidated countywide database of utility costs and energy usage. The database software is used to establish baselines and quantify savings. By this measure, the county tracks energy and resource consumption data for its facilities. Such detailed energy tracking is essential for King County to actively and strategically manage energy consumption. This tool also allows the county to streamline its energy and greenhouse gas emissions reporting.

MIAMI-DADE COUNTY, FLORIDA

THE CHICAGO CLIMATE EXCHANGE IN MIAMI-DADE COUNTY¹⁵¹

Recognizing the importance of meeting their emission reduction goals, Miami-Dade County adopted a comprehensive plan to reduce the local contribution to global climate change through their "Urban CO₂ Reduction Plan." This plan identified 35 unique opportunities to improve the county's operations, reduce energy demand, and improve the quality of life for its residents. The plan focused on energy use, transportation, land use and solid waste as primary contributors to climate

¹⁵⁰ http://your.kingcounty.gov/dnrp/climate/documents/2009_King_County_Climate_Report.pdf

¹⁵¹ http://www.miamidade.gov/derm/library/air_quality/CO2_Reduction_Final_Report.pdf

change at the local level. Several measures were created to reduce CO2 reductions including mass transit and road improvements, reducing vehicle miles traveled through technology improvements, increasing efficiencies of Miami-Dade facilities/operations, and promoting and expanding participation in energy conservation. Progress on these measures is reported annually to the Miami-Dade Board of County Commissioners.