Consumer Guide to Green Energy Choices

Summary Report

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Copies of the Consumer Guide to Green Energy Choices and other reports from the Green Energy Project can be downloaded from the Cleaner and Greener[sm] Web Site or requested directly from Leonardo Academy.

Foreword

This report is dedicated to the proposition that we can each lead the way to a cleaner environment and a better quality of life for us, our children, our grandchildren, and future generations.

Our energy use causes pollution. Fortunately, the following low cost options are available that allow each of us to act directly to reduce this pollution today. We can:

- Increase the efficiency of our energy use by conserving energy and buying more efficient products. Energy efficient products are available at competitive prices in the marketplace, those with the Energy Star label for example.
- Buy electricity from renewable sources. Renewable electricity is available in areas where utility restructuring has created a competitive retail energy market, or areas where a monopoly utility chooses to provide renewable electricity.
- Buy and retire emission reduction credits to offset the emissions caused by our energy use. Emission reduction credits are available at competitive prices in the marketplace.

This report discusses how to select a combination of these direct emission reduction actions that works for you. By doing just a little of each of these actions, you can show that consumers want reduced environmental emissions, that consumers are willing to pay to reduce emissions, and finally, that emission reductions are available at a lower cost than most people think. In addition to providing direct environmental benefits, taking these actions will help the marketplace, regulators, and legislators do more to reduce pollution. Take these actions and you will be leading the way to a cleaner environment.

If you want see how easy this can be, just visit our web site at *www.cleanerandgreener.org*. Buy as much green energy as you want by making a tax-deductible donation so we can buy and retire emission reduction credits in your name that offset the emissions caused by your energy use.

Pogo had it right, “We have found the enemy and they are us.” As consumers, we have been using our purchasing power to pay others to do most of our polluting for us. It has been easy and effective. Just as easily and just as effectively, we as consumers can create market demand for pollution reduction by using our purchasing power to pay others to do our pollution *reduction* for us.

Michael Arny
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Executive Summary

Green energy is gaining recognition as we become increasingly aware of the health problems, environmental destruction, and other impacts that result from the pollution caused by our energy use. This growing interest in green energy raises many questions for consumers: *What really **is** green energy? **What kind** of green energy should I buy? **How much** green energy should I buy?* This report was prepared to answer these questions and to help organizations decide what green energy options to recommend to their members. The energy choices consumers make can have a substantial impact on reducing pollution. The use of regulation and legislation to clean up the environment should not be neglected, but expanding the impact of direct actions by consumers will give the environmental improvement stool a third leg to stand on.

The "right" kind of green energy for individual consumers will depend on their values, their willingness to pay for reduced environmental impacts, and their access to reduced-emission options. Given the diversity among both individuals and organizations, it is likely that different individuals and organizations will come to different conclusions about the type of green energy that is right for them. This report accommodates this diversity by examining the issues that underlie green energy choices, developing a framework for making conclusions, and then providing the information needed to make decisions. Organizations can use this information to make green energy recommendations to their members based on the objectives of their organization.

Consumers cause air pollution both by the energy they use in their homes and vehicles, and by the energy used to produce and deliver the goods and services they buy. The United States uses 2 to 3 times more energy per capita than highly developed countries like France, Germany, England, and Japan. And although the United States contains less than 5% of the world's population, it generates almost 25% of its air pollution.

In the United States, the conventional production of electricity from power plants causes more air pollution than any other source, and contributes to global warming. In 1997, the burning of fossil fuels accounted for 82% of greenhouse gas emissions[1]. Traditional fossil fuel-based energy generation also emits lead, mercury, sulfur dioxide, particulate matter, carbon monoxide, nitrogen oxides, and volatile organic compounds.

Pollution from fossil-fuel based energy generation is hazardous to public health. Toxic compounds, like mercury and lead, poison organ systems and can lead to brain damage and death. Fish consumption advisories have been imposed in parts of the country where lakes and waterways have been contaminated with mercury from electric power plants. Other pollutants cause respiratory and other health problems, particularly in children and the elderly.

[1] Emissions of Greenhouse Gases in the United States 1997, Energy Information Administration Publication, U.S. Department of Energy, DOE/EIA-0573(97).

Conventional methods of energy generation are also detrimental to the environment. Climate change on a global scale has been attributed to increased emissions of carbon dioxide (CO_2), a greenhouse gas. A global average temperature rise of 1° to 3.5°C could have serious implications. Possible consequences include melting of polar ice caps; an increase in sea level; and increases in precipitation and severe weather events like hurricanes, tornadoes, heat waves, floods, and droughts. Indirect effects include increases in infectious disease, weather-related deaths, and food and water shortages. All these effects put a stress on ecosystems and agriculture, and threaten our planet as a whole.

Other atmospheric effects of air pollution include urban smog and reduced visibility, which are associated with ozone-forming nitrogen oxides and volatile organic compound emissions. Visibility is also affected by emissions of sulfur dioxide and fine particulates. In addition, sulfur dioxide and nitrogen oxides combine with water in the atmosphere to cause acid rain, which is detrimental to forests and other vegetation, soil, lakes, and aquatic life. Acid rain also causes monuments and buildings to deteriorate.

Energy use and the production and delivery of goods and services also degrade the quality of our land and water resources. Although this report focuses on actions that reduce the environmental and human health effects of air pollution caused by our energy use, green energy actions that reduce air pollution will also reduce solid waste and water pollution. Using our energy resources wisely and efficiently can reduce the air, water, and land pollution that typically results from traditional fossil fuel-based energy generation. This pollution, and its associated health and environmental effects, can be reduced by investing in green energy and electricity options.

Unfortunately, a consensus has not been reached on how to define green energy. Some consider all reduced-emission electricity to be green energy, while others include only renewable energy. Some define green energy as all renewable energy except for hydropower and certain forms of biomass power, while others include small existing hydropower as green energy. For the purposes of this report, we used a broad definition of green energy to include all options that reduce the pollution and other environmental impacts caused by a consumer's energy use, as compared to the current generation mix.

Green energy *is defined as energy that is produced and used in ways that reduce the pollution and other environmental impacts caused by consumer energy use. Green energy includes more efficient energy production and end use, and energy generated from renewables and cleaner fuels.*

As consumers, we have many green energy options available to us that reduce the pollution caused by our energy use. Conserving energy is one way we can reduce our emissions–many of us already turn off lights when not in use and adjust the thermostat a couple degrees up or down depending on the season. But beyond energy conservation, what can we do to reduce our emissions?

Green Energy Strategy #1: Make Our Energy Use More Efficient

Increasing energy efficiency around the house and office is one option that scores high in both availability to consumers and environmental benefits. Buying energy-efficient appliances and light bulbs, switching to natural gas, and installing insulation and programmable thermostats are just a few of the ways consumers can be energy-efficient. When buying new appliances compare Energy Guide labels and look for the Energy Star–a label given by the U.S. EPA and U.S. DOE to products whose energy efficiency rating is best in its category and also exceed the minimum federal standards. To find out how you can further improve the energy efficiency of your home, consider having a home energy audit done.

Energy efficiency reduces the environmental impacts that result from the entire process of producing and delivering energy to consumers, including fuel extraction, combustion, transmission, and distribution (Table 1). Energy efficiency is also a low cost way to reduce emissions. Most efficiency measures more than pay for themselves with the energy savings they provide. Implementing energy efficiency measures has the potential to reduce emissions from household electrical consumption by 30% (Figure 2) and save the average consumer up to $23 per month ($278 per year) on their electricity bills (Figure 1).

Energy efficiency measures have the potential to reduce emissions that result from household electricity use by 30%, with a cost savings of up to $23 per month.

As consumers, we should do as much to increase the efficiency of our energy use as we are comfortable with, but since efficient energy use can only affect a portion of total energy use, we should not stop there.

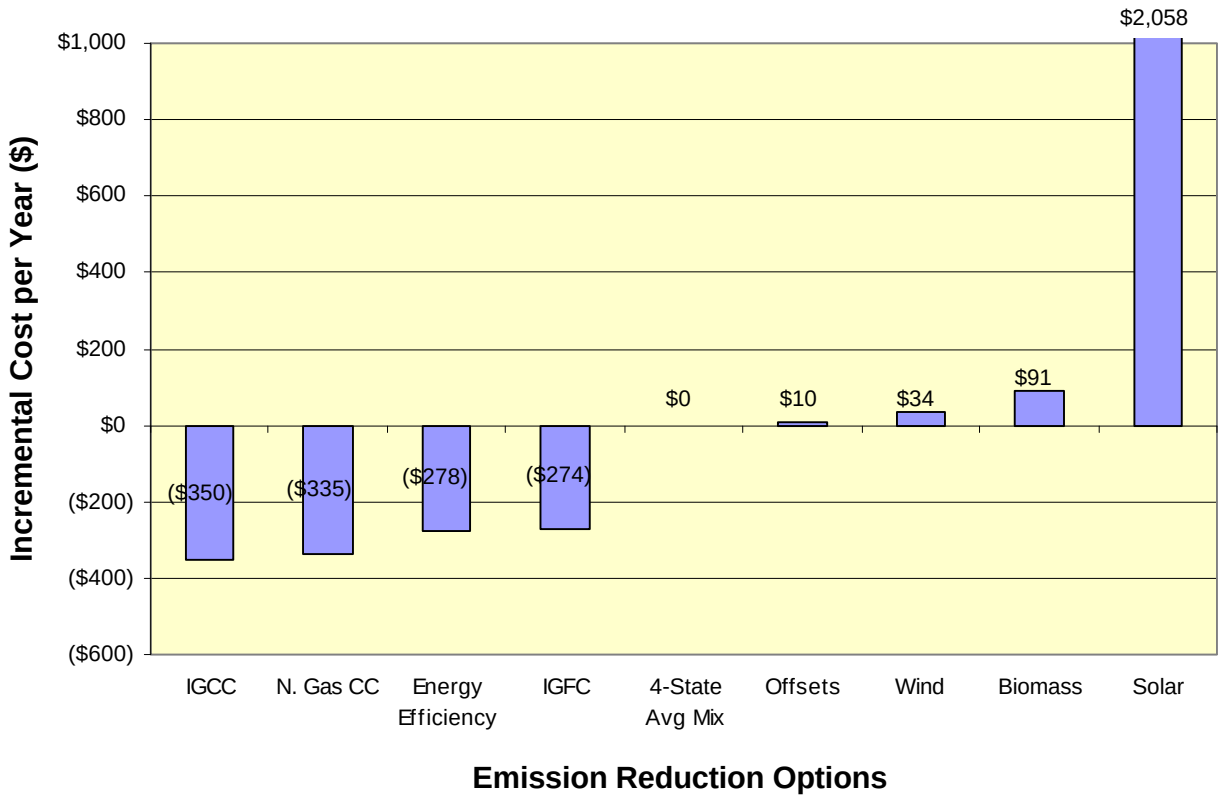
Green Energy Strategy #2: Buy Cleaner or Renewable Electricity

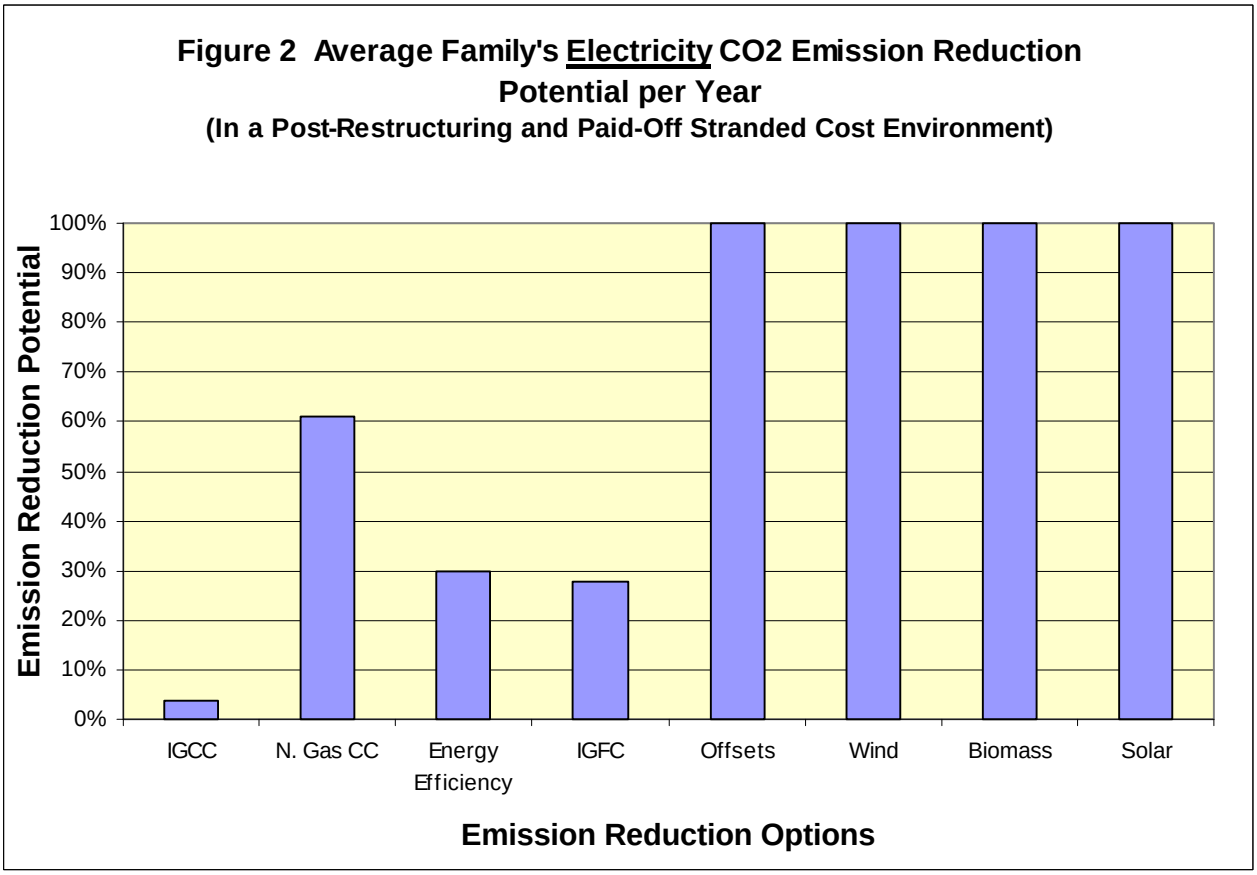
Buying cleaner or renewable electricity has positive emission reduction benefits, but availability can be restricted by the status of electric industry deregulation. In areas where utilities still have a retail monopoly, green electricity is only available to consumers if the utility chooses to make it available, or if regulations require that it be made available. Furthermore, where utilities still have retail monopolies, any green electricity services are only available at non-competitive prices set through the regulatory process. Where utility deregulation has created fully competitive retail energy services markets, green electricity can be purchased at prices set by the competitive market. So where the electricity market is competitive, the green electricity is likely to be available at lower prices than where the utility still has a retail monopoly.

Key to emission reduction technologies in Figures 1 and 2:

IGCC = Integrated Gasification Combined Cycle
N. Gas CC = 215 MW Natural Gas Combined Cycle (stand alone)
Energy Efficiency = Potential for household efficiency measures
IGFC = Integrated Gasification Fuel Cell
Offsets = CO_2 Emission Offsets (voluntary market)
Wind = Average wind turbine
Biomass = Atmospheric Fluidized Bed Wood-fired Biomass
Solar = Fixed Flat Plate Photovoltaic (5 MW) - dispersed connection
4-State Average Mix = Average electricity generation mix for the states of Illinois, Iowa, Minnesota, and Wisconsin

Figure 1 Average Family's Incremental Electricity Cost per Year
(In a Post-Restructuring and Paid-Off Stranded Cost Environment)





The analysis of electricity generation options shows that renewable technologies can economically turn wind, sunlight, and organic matter (biomass) into electricity and other useful forms of energy. 100% reductions of CO_2 emissions (Figure 2) from our electricity consumption are possible using a number of different "renewable" technologies. Of these, proven renewable energy alternatives such as wind and solar-fueled generation continue to gain market penetration and enjoy cost decreases over time. Wind power in particular has emerged as an attractive and viable electric generation option for consumers. Buying 100 percent proven available renewable electricity has an incremental cost (as compared to the current generation mix) of about 0.4 to 3 cents per kWh for wind and biomass (fluidized bed combustion) electricity. This means that the average U.S. family could eliminate all their CO_2 emissions caused by household electricity use for less than $3 more per month or around $34 more per year (Figure 1) in a *competitive* market.

In a competitive market, the average U.S. household could eliminate all of their CO_2 emissions from household electricity use for an additional $3 per month.

Several emerging renewable technologies such as biomass feed integrated gasification combined cycle (Biomass-IGCC) can produce electricity at incremental cost savings to consumers. As expected for Illinois,

Iowa, Minnesota, and Wisconsin, large scale photovoltaic generation is a more expensive way to produce cleaner electricity at approximately $2000 more per year. But this technology offers an alternative for isolated consumers located large distances from the power grid.

Figure 1 shows that on a cost basis, newer emerging generation technologies such as integrated coal gasification combined cycle (IGCC) and integrated gas fuel cells (IGFC) are very cost-effective. However, these two technologies are not widely utilized and offer low emission reduction potentials of 4% and 28%, respectively (Figure 2). Fuel switching to natural gas-fired generation and energy efficiency options provide cost-effective consumer approaches for reducing emissions with emission reduction potentials of 60% and 30%, respectively.

Green Energy Strategy #3: Buy and Retire Emission Reduction Credits

Sources of air pollution that reduce their emissions below their required limit (cap) may receive saleable credits for their reductions. Emission reduction credits reward those who take action to reduce their pollutant emissions and therefore encourage pollution reduction actions. Credits for emission reductions provide an incentive to find the most cost-effective way to reduce emissions, since once an emission reduction credit is earned, it can be sold on the open market. Markets for emission reduction credits or emission allowances can be created by regulation (the sulfur dioxide market for example) or voluntarily (the current market for greenhouse gases).

Emission reduction credits can be used to reduce pollution. Instead of reselling emission reduction credits to sources of air pollution that will use them to compensate for their pollutant emissions, allowances can be retired, *without* emitting any pollution. Once an emission reduction credit is retired, it can no longer be bought, sold, or used to offset pollution. Purchasing and retiring emission reduction allowances reduces the amount of pollution that is discharged to the atmosphere for regulated markets, and creates future pollution reduction potential for voluntary markets.

*Traditionally, in areas of tight environmental controls, new sources of air pollution are required to **offset** their new emissions with a reduction in emissions from an existing source. Similarly, consumers can "**offset**" the pollution caused by their energy use by buying and retiring the emission reduction credits created by someone else.*

The third green energy strategy allows consumers to take advantage of emission reduction credit markets. Buying and retiring emission reduction credits produced by energy efficiency or renewable energy projects allows consumers the chance to:

- Influence public policy decisions to implement market-based pollution reduction strategies
- Give value and financial incentive to the pollution reduction actions made through energy efficiency and renewable energy projects
- Strengthen emission reduction markets
- Reduce the negative environmental impacts produced by whole chain of energy production and distribution, including the production and delivery of goods and services purchased by consumers

Buying and retiring emission reductions provides many environmental benefits (Table 1). Energy efficiency and renewable energy projects reduce the negative environmental impacts caused by the production and delivery of energy to consumers, as well as provide emission reductions which can be purchased by consumers. Increasing consumer energy efficiency provides many environmental benefits as well, but it is difficult for consumers to reduce the emissions caused by the production and delivery of goods and services they buy. Buying emission reduction credits has an added advantage, it allows consumers to offset their net emissions, including those produced by goods and services purchased, by 100 percent (to zero).

Green energy in the form of emission reduction credits can be purchased in the competitive marketplace, so competition will eventually drive the price of emission reductions down to the point where supply and demand are balanced. Buying emission reduction credits lets consumers conveniently offset the emissions, caused by both their direct and indirect energy use, as much as they want at a low competitive market cost. For example, an average U.S. family's CO_2 emissions from their household electricity consumption could be offset for less than $1 per month, or $10 per year (Figure 1). An average U.S. family's total CO_2 emissions, including emissions from transportation and the goods and services purchased, can be offset for less than $5 per month ($56 per year).

To demonstrate the impact that consumers can have on reducing pollution, Leonardo Academy has instituted a program that lets consumers buy green energy in the form of making a donation (all U.S. donations are tax-deductible) to buy and retire emission reduction credits.

For pollutants that have established national emission trading systems in place, the Cleaner and Greener[sm] Program buys emission reductions from within that trading system. For example, sulfur dioxide allowance auctions are conducted by the Chicago Board of Trade. For pollutants like carbon dioxide, that do not have established emission trading systems, the Cleaner and Greener[sm] Program buys emission reduction credits that are reported[2] according to the Multiple Pollutant Emission Reduction Reporting System developed by Leonardo Academy with funding from the U.S. EPA. Any emission reduction credits that are purchased are retired. Once retired, they cannot be sold, traded, given away, or otherwise used to offset pollution.

The Cleaner and Greener[sm] Green Energy Program shows that there are low cost pollution reduction options available, encourages increased energy efficiency and renewable energy, and shows that there is public support for taking action to reduce pollution.

The bottom line for consumers is that they can easily take direct action to reduce emissions at a modest cost. Our survey results show that environmentally-oriented consumers are willing to spend $33 more per month to reduce environmental pollution, although consumers also need to feel like they are getting a value for their premium and that the dollars they spend will make a difference.

[2] Emission reductions are reported under the Voluntary Reporting Program of the U.S. Department of Energy - Energy Information Administration (1605(b) of the Energy Policy Act).

The demand for cleaner energy sources is already present. What is needed now is more education and access to these cleaner sources. Electricity providers should be able to offer cleaner electricity to consumers for little or no additional cost. The resources are currently available for a supplier to respond to an educated consumer market.

Buying emission offsets helps people and organizations that implement energy efficiency, renewable energy, sequestration, and cleaner generation projects to pursue more and bigger projects. You also help put people to work installing, designing, manufacturing, and developing the equipment needed to carry out these cleaner energy projects.

When we incorporate energy conservation and efficiency measures in our own homes we decrease energy consumption. These energy savings increase our disposable income, which leads to growth in employment since most of the income is spent locally on consumption of goods and services instead of flowing out of state to pay for fuel imports. Renewable generation built in-state also has positive economic impacts by eliminating the cost of paying for out of state fuel products.

Consumers can also help the environment by supporting environmentally beneficial regulation and legislation. They can do this by giving their time and money to organizations that are supporting smart, effective policies for promoting cleaner energy sources. These policies include measures such as renewable portfolio standards, rewarding all pollution reduction actions with allocations, net metering, public benefits funding, and fair rules between all energy sources (even playing field). Our survey results showed high support for many of these policies by environmentally-minded consumers as desirable ways to clean up the pollution our energy use causes. This report provides information which can be used to add support for these policies but was geared towards helping individual consumers take direct actions towards reducing their own air pollution.

Regardless of the combination of emission reduction actions you choose, by incorporating just a little of each of the Green Energy Strategies, you can show that consumers want reduced environmental emissions, that consumers are willing to pay to reduce emissions and finally, that emission reductions are available at a lower cost than most people think. Your actions can produce direct environmental benefits–by reducing the demand for emission-producing fossil-fueled electricity generation, you reduce the environmental impacts from energy production and delivery. Your actions also help the marketplace, regulators, and legislators do more to reduce pollution.

So read this report, and choose a mix of increased energy efficiency, renewable electricity, and emission offsets that works for you. If you represent an organization, recommend that each of your members implement a mix that fits your organization’s objectives. Start leading the way today to a cleaner environment for you, your children, your grandchildren, and future generations.

Table 1 The Green-O-Meter: Summary of Environmental Impacts of Options for Reducing the Emissions that Result from an Average Household's Energy Use

Types of Green Energy		Environmental Impacts Reduced						
		Air pollution[1]	Solid Waste Disposal	Fuel extraction	Electric transmission and distribution	Fuel transmission and distribution or transportation	Electric generating plants	Goods and services[2]
Emission Offsets[3]		Yes (100%)	Yes	Yes	Yes	Yes	Yes	Yes
Increased Energy Efficiency		Yes (20-30%)	Yes	Yes	Yes	Yes	Yes	No
Renewable Generation (wind, solar, etc.)	On-Site	Yes (100%)	Yes	Yes	Yes	Yes	Yes	No
	Off-Site	Yes (100%)	Yes	Yes	No	Yes	Yes	No
Fuel Switching: Coal to Biomass Fuel Generation		Yes[4] (100%)	Yes	Yes	No	Maybe[5]	No	No
Generation Efficiency Improvements		Yes (Varies)	Yes	Yes[6]	No	No	No	No
New Generation Technologies (IGCC & IGFC)		Yes (4-28%)	Yes	Yes	No	No	No	No
Fuel Switching to Natural Gas Generation		Yes (30-60%)	Yes	No	No	No	No	No
Generation End-of-Pipe Actions		Yes (Varies)	No	No	No	No	No	No

[1] Percentages reflect the average U.S. household's CO_2 emission reduction potential from electricity

[2] Impacts of energy used to produce and deliver the goods and services we buy

[3] Buying and retiring emission reduction credits offsets the emissions caused by household energy use.

[4] Impact varies by type of emission and combustion process

[5] Dependent on distance from fuel source – no, if distant source; yes, if nearby source

[6] Impacts vary by type of emission and combustion process

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Section 1 Introduction

The Purpose and Structure of this Report

Green energy is gaining recognition as we become increasingly aware of the health problems, environmental destruction, and other impacts that result from the pollution caused by our energy use. This growing interest in green energy raises many questions for consumers: *What really **is** green energy? **What kind** of green energy should I buy? **How much** green energy should I buy?* This report was prepared to answer these questions and to help organizations decide what green energy options to recommend to their members. The energy choices consumers make can have a substantial impact on reducing pollution. The use of regulation and legislation to clean up the environment should not be neglected, but expanding the impact of direct actions by consumers will give the environmental improvement stool a third leg to stand on.

The "right" kind of green energy for individual consumers will depend on their values, their willingness to pay for reduced environmental impacts, and their access to reduced-emission options. Given the diversity among both individuals and organizations, it is likely that different individuals and organizations will come to different conclusions about the type of green energy that is right for them.

This report accommodates this diversity by examining the issues that underlie green energy choices, developing a framework for making conclusions, and then providing the information needed to make decisions. Organizations can use this information to make green energy recommendations to their members based on the objectives of their organization. The *Consumer Guide to Green Energy Choices* presents this information in a step-by-step manner. The report:

(1) Examines how consumer energy use causes air pollution and other environmental impacts.
(2) Provides some context for evaluating the emissions caused by our energy use, the health effects of air pollution, and how much energy the United States uses per capita relative to other countries.
(3) Identifies green energy types and actions for consumers.
(4) Evaluates the environmental benefits of various types of green energy.
(5) Presents survey results on consumers' willingness to pay for reduced emissions.
(6) Presents the costs of various types of green energy.
(7) Concludes by reviewing the highlights of what issues individuals should consider when deciding what kind of green energy to buy, and what issues organizations should consider when deciding what options to recommend to their members.

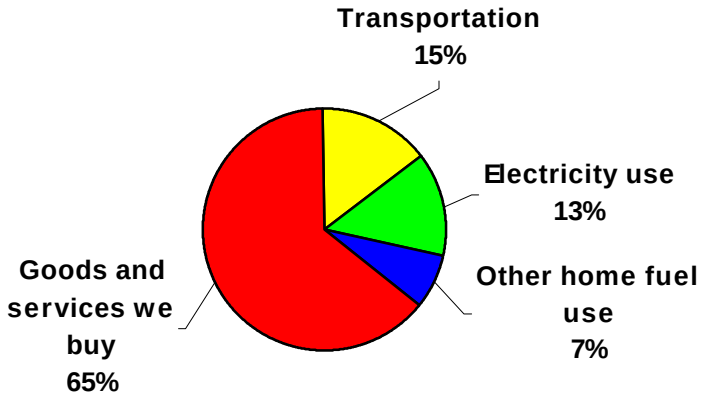
Pollution and Other Environmental Impacts of Consumer Energy Use

How Do We Cause Air Pollution?

We cause air pollution directly through our use of electricity, fuels, and transportation. We also cause air pollution *indirectly,* when we buy goods and services that use energy in their production and delivery. Electricity and home fuel use could be categorized as just another good or service we buy that uses energy in its production and delivery. Either way, we are still responsible for the air pollution caused by both our direct and indirect energy consumption.

In the United States, the conventional production of electricity from power plants causes more air pollution than any other source, and contributes to global warming. In 1997, the burning of fossil fuels– such as coal, oil, and natural gas– accounted for 82% of greenhouse gas emissions[1]. Traditional fossil fuel-based energy generation also emits lead, mercury, sulfur dioxide, particulate matter, carbon monoxide, nitrogen oxides, and volatile organic compounds.

Figure 1.1: How Do We Cause Air Pollution? [1,2]



Carbon dioxide is a good indicator of how much fossil fuel is burned and how much of other pollutants we cause to be emitted. Using carbon dioxide as an example, Figure 1.1 presents the distribution of causes of air pollution by an average family in the United States. Since individual electricity use and other home fuel use account for only 13% and 7% of our total emissions, to really clean up the environment, we need solutions that clean up all of the emissions we cause.

How Much Air Pollution Do We Cause?

Table 1.1 shows how much air pollution the average family and individual person (per capita) in the United States causes each year. The per capita emissions are calculated by dividing the total national emissions of each pollutant by the total population. The average family's share of the national emissions is calculated by multiplying the per capita share by the average family size of 2.6 people per household.

These per capita and per family pollution numbers indicate how much each of us would need to reduce the emissions caused by our energy use to cause a major reduction in national emissions. Since our direct energy use causes only 35 percent of our emissions, while our indirect energy use causes 65 percent of our emissions, to have the greatest effect on reducing the emissions caused by our energy use, we need green energy options that address both direct and indirect energy use.

Table 1.1 Air Pollution Produced by the Average U.S. Family and U.S. Per Capita Levels of Direct and Indirect Energy Consumption

Pollutant	Environmental Impacts	Family Yearly Pollution Production		Per Capita Yearly Pollution Production	
Carbon Dioxide (CO_2)	Climate Change	56 Tons	112,000 lbs.	22 Tons	44,000 lbs.
Sulfur Dioxide (SO_2)	Acid Rain and Haze	0.187 Tons	374 lbs.	0.072 Tons	144 lbs.
Nitrogen Oxides (NOx)	Acid Rain, Ozone, and Haze	0.229 Tons	458 lbs.	0.088 Tons	176 lbs.
Particulate Matter (PM)	Haze	0.032 Tons	63 lbs.	0.012 Tons	24 lbs.
Lead (Pb)	Toxics	-	0.075 lbs.	-	0.031 lbs.
Mercury (Hg)	Toxics and Bio-accumulation	-	0.050 lbs.	-	0.019 lbs.

Emission Levels Around the World

Although the United States contains less than 5% of the world's population, it generates almost 25% of its air pollution. Most countries that maintain a similar standard of living as the United States use much less energy per capita, and therefore are likely to produce fewer emissions per capita. Tables 1.2 and 1.3 compare the per capita emissions of carbon dioxide for selected developed countries and regions of the world.

There is a lot of room for emission reductions in the United States, without incurring a significant drop in standard of living. Greater investments in energy efficiency provide an avenue for moving in this direction. Increasing energy efficiency often offers the lowest cost option for decreasing our energy needs, and meeting future needs. With energy efficiency, reduction in electricity production does not necessarily mean a reduction in the effective services received. For example, efficient lighting and heating technologies deliver a similar, and often improved level of light and comfort, in addition to cost savings over time.

Table 1.2 Per Capita Emissions of Carbon Dioxide for Selected Developed Countries [3]

Country	Population (millions)	Carbon Dioxide Emissions		Carbon Dioxide Emissions Per Capita	
		(millions of metric tons)	(millions of short tons)	(metric tons per person)	(short tons per person)
Switzerland	7	44	49	**6.1**	**6.7**
France	58	374	412	**6.4**	**7.1**
Sweden	9	59	65	**6.7**	**7.4**
Japan	126	1063	1172	**8.4**	**9.3**
United Kingdom	59	568	626	**9.6**	**10.6**
Germany	82	873	962	**10.6**	**11.7**
Australia	19	290	320	**15.6**	**17.2**
USA	270	5375	5925	**19.9**	**21.9**

Table 1.3 Per Capita Emissions of Carbon Dioxide for Selected Regions of the World [3]

Region	Population (millions)	Carbon Dioxide Emissions		Carbon Dioxide Emissions Per Capita	
		(millions of metric tons)	(millions of short tons)	(metric tons per person)	(short tons per person)
North America	400	6211	6846	**15.5**	**17.1**
South America	408	440	485	**1.1**	**1.2**
Western Europe	474	3557	3921	**7.5**	**8.3**
Eastern Europe and Counties of Former Soviet Union	390	3007	3315	**7.7**	**8.5**
Middle East	152	928	1023	**6.1**	**6.7**
Africa	760	807	890	**1.1**	**1.2**
India	984	851	938	**0.9**	**1.0**
China	1237	2948	3250	**2.4**	**2.6**
World	5940	22132	24396	**3.7**	**4.1**

Effects of the Air Pollution We Cause

The energy choices you make have a direct impact on public health and the environment. Traditional fossil fuel-based sources of electricity deliver detrimental health and environmental consequences. Table 1.4 summarizes some sources and effects of common air pollutants.

Health Effects

Exposure to emissions of lead, mercury, sulfur dioxide, particulate matter, carbon monoxide, and ozone-forming nitrogen oxides and volatile organic compounds are hazardous to public health. Toxic compounds, like mercury and lead, poison organ systems and can lead to brain damage and death. Fish consumption advisories have been imposed in parts of the country where lakes and waterways have been contaminated with mercury from electric power plants. Other pollutants cause respiratory and other health problems, particularly in children and the elderly. One study estimated that each year in the United States, more people die prematurely from heart and lung disease due to particulate air pollution than die in car accidents[5].

Environmental Effects

Climate change on a global scale has been attributed to increased emissions of carbon dioxide (CO_2), a greenhouse gas. A global average temperature rise of 1° to 3.5°C could have serious implications. Possible consequences include melting of polar ice caps; an increase in sea level; and increases in precipitation and severe weather events like hurricanes, tornadoes, heat waves, floods, and droughts. Indirect effects include increases in infectious disease, weather-related deaths, and food and water shortages. All these effects put a stress on ecosystems and agriculture, and threaten our planet as a whole.

Other atmospheric effects of air pollution include urban smog and reduced visibility, associated with ozone-forming nitrogen oxides and volatile organic compound emissions. Visibility is also affected by emissions of sulfur dioxide and fine particulates. Sulfur dioxide and nitrogen oxides combine with water in the atmosphere to cause acid rain, which is detrimental to forests and other vegetation, soil, lakes, and aquatic life. Acid rain also causes monuments and buildings to deteriorate.

Economic Effects

The effects of air pollution on human health and the environment have economic impacts. According to the Healthy People 2000 report[6], each year in the United States:

- The health costs of human exposure to outdoor air pollutants range from $40 to $50 billion.
- An estimated 50,000 to 120,000 premature deaths are associated with exposure to air pollutants.
- People with asthma experience more than 100 million days of restricted activity, costs for asthma exceed $4 billion, and about 4,000 people die of asthma.

The Environmental Defense Fund (EDF) article[7], "Why is it Better to Buy Green Electricity?" states that acid rain causes $6 billion a year in damage to crops, forests, lakes, and buildings. The potential economic impact of global warming is estimated to be in the billions of dollars. While green sources of electricity may cost more, they do not incur the external costs of traditional fossil fuel-based generation. The EDF article states that:

> "Increasing reliance on green sources reduces financial risks such as future regulations, taxes on greenhouse gases, and price fluctuations associated with fossil fuels. Green resources increase U.S. energy self sufficiency, and thus economic security, by reducing reliance on fossil fuel imports. They also help reduce current rapid depletion of natural resources.
>
> Green resources are a good source of jobs and income because they rely on local labor, land, and resources. Rural communities would probably benefit the most from renewable energy development, as wind and biomass energy production is likely to take place in rural areas."

Air Pollution Regulation

In the United States, National Ambient Air Quality Standards (NAAQS) regulate six pollutants (criteria pollutants): ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter (PM-10), and lead. These standards are put in place by the U.S. Environmental Protection Agency (US EPA) as a result of the Clean Air Act, and define an acceptable level of pollutant concentration, at or above which, public health is protected. A stricter primary standard aims to protect public health, while a more lax secondary standard is intended to protect public welfare (vegetation, wildlife, etc.).

A geographic area that meets or does better than the primary standard is called an attainment area; areas that do not meet the primary standard are called nonattainment areas. It has been estimated that 90-100 million people in the United States live in nonattainment areas [4, 8], and therefore remain at risk for adverse health consequences. Children, the elderly, and people with asthma are among those who are most susceptible to the health effects of air pollution.

These health and environmental effects demand that action be taken to reduce air pollution. An Environmental Defense Fund article[7] notes that in 1994, electricity generation was responsible for 70% of sulfur dioxide emissions, 33% of nitrogen oxide emissions, 23% of mercury emissions, and 23% of direct emissions of fine airborne particles. Fossil fuel combustion is at least part responsible for the emissions of all of the pollutants listed in Table 2.3. These pollutants, and their associated health and environmental effects, can be reduced by investing in green energy and electricity.

Table 1.4 Sources and Effects of Common Pollutants [4]

Pollutant	Anthropogenic Sources	Human Health Effects	Environmental Effects
Ozone (O_3)	Secondary pollutant formed by chemical reaction of VOCs and NOx in the presence of sunlight.	Breathing problems, reduced lung function, asthma, irritates eyes, stuffy nose, reduces resistance to colds and infections, premature aging of lung tissue.	Damages crops, forests, and other vegetation; damages rubber, fabric, and other materials; smog reduces visibility.
Nitrogen Oxides (NOx)	Burning of gasoline, natural gas, coal, oil. (Cars are a major source of NOx.)	Lung damage, respiratory illnesses, ozone (smog) effects.	Ozone (smog) effects; precursor of acid rain which damages trees, lakes, and soil; aerosols can reduce visibility. Acid rain also causes buildings, statues, and monuments to deteriorate.
Carbon Monoxide (CO)	Burning of gasoline, natural gas, coal, oil.	Reduces ability of blood to bring oxygen to body cells and tissues.	
Volatile Organic Compounds (VOCs)	Fuel combustion, solvents, paint. (Cars are a major source of VOCs.)	Ozone (smog) effects, cancer, and other serious health problems.	Ozone (smog) effects, vegetation damage.
Particulate Matter	Emitted as particles or formed through chemical reactions; burning of wood, diesel, and other fuels; industrial processes; agriculture (plowing, field burning); unpaved roads.	Eye, nose, and throat irritation; lung damage; bronchitis; cancer; early death.	Source of haze which reduces visibility. Ashes, smoke, soot, and dust can dirty and discolor structures and property, including clothes and furniture.
Sulfur Dioxide (SO_2)	Burning of coal and oil, especially high-sulfur coal; industrial processes (paper manufacturing, metal smelting).	Respiratory illness, breathing problems, may cause permanent damage to lungs.	Precursor of acid rain, which can damage trees, lakes, and soil; aerosols can reduce visibility. Acid rain also causes buildings, statues, and monuments to deteriorate.
Lead	Combustion of fossil fuels and leaded gasoline; paint; smelters (metal refineries); battery manufacturing.	Brain and nervous system damage (esp. children), digestive and other problems. Some lead-containing chemicals cause cancer in animals.	Harm to wildlife and livestock.
Mercury	Fossil fuel combustion, waste disposal, industrial processes (incineration, smelting, chlor-alkali plants), mining.	Liver, kidney, and brain damage; neurological and developmental damage.	Accumulates in food chain. Harm to wildlife (e.g. fish, loons, and eagles)

Section 1 Sources

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Section 2 What is Green Energy?

Unfortunately, a consensus has not been reached on how to define green energy. Some consider all reduced-emission electricity to be green energy, while others include only renewable energy. Some define green energy as all renewable energy except for hydropower and certain forms of biomass power, while others include small existing hydropower as green energy. For the purposes of this report, we used a broad definition of green energy to include all options that reduce the pollution and other environmental impacts caused by a consumer's energy use, as compared to the current generation mix. This definition would include fuel switching from coal to natural gas generation, but not nuclear power because of the added negative environmental impacts.

The objective of green energy is to reduce the pollution and other environmental impacts caused by a consumer's energy use. Green energy options include all the ways that reduce the pollution and other environmental impacts caused by a consumer's energy use. It includes energy produced with increased energy efficiency, renewable energy, and cleaner fuels. The greater the reduction in pollution and other environmental impacts that result from consumer's energy use that a green energy option provides, the greener the energy.

Traditional Sources of Energy and Electricity

Fossil Fuels

Most of a typical U.S. consumer's energy comes from the burning of fossil fuels. Fossil fuels include coal, oil, and natural gas. Fossil fuels cause air pollution when they are burned and also cause indirect environmental effects. These indirect environmental effects include the extraction of fuel from the earth, the construction and maintenance of transportation facilities and pipelines to deliver the fuel to where it is used, and the construction of electric generating plants and electric transmission and distribution lines. Fossil fuels are not renewable – we are currently using them faster than they can be replenished.

Nuclear Power

Nuclear energy currently provides about 20% of the electricity generated in the United States. Nuclear power is created by the splitting (fission) of atomic nuclei, namely uranium or plutonium. This process generates the necessary heat to convert water to steam to drive turbines that generate electricity. Although nuclear power emits little air pollution, the storage of radioactive nuclear waste and chances of nuclear reactor accidents are environmentally dangerous and controversial.

Renewable Sources of Energy and Electricity

In contrast to fossil fuels, renewable energy is often in infinite supply and less polluting. Renewable energy includes solar (photovoltaics), wind, biomass, hydropower, and geothermal. Renewable energy can be used as a form of supplying energy in homes and businesses, and can also be converted directly to electricity.

Currently, most electricity production in the United States currently comes from coal-fired power plants. In some areas, consumers can impact the amount of air pollution emitted from power plants by choosing to buy electricity generated by renewables or cleaner fossil fuels. Green electric power is being offered in parts of the country where electric utility deregulation has occurred, such as California, Pennsylvania, and Massachusetts. Where electric industry competition does not exist, some utilities offer special “green rates” to their customers for electricity generated from renewables. In this case, these rates are set by regulations rather than competition. Consumers also need to make sure any premiums they pay for green electricity are going towards new, not mandated, renewable generation.

Solar

Energy from the sun can be used in several ways. For example, solar energy can be used to heat homes by taking advantage of south-facing windows (solar heating), and can be used to heat water (solar water heating) with flat plate solar collectors. Energy from the sun can also be used to generate electricity. Sunlight can be used to heat water to create steam, which powers a turbine and generates electricity (solar thermal electric power). Photovoltaic (PV) cells, or solar cells (much like those on a solar calculator), convert sunlight directly into electricity. Thousands and thousands of these cells can be joined together to form a photovoltaic system that can be incorporated into an electric utility’s supply network.

Photovoltaic systems are ideal for remote or rural villages, and stand alone sites or residences. In early July 1998, photovoltaics became the fastest-growing energy source, as world-wide production increased 40% in the past year. Converting solar energy into electricity suffers from the constraint that electricity cannot be produced when the sun isn’t shining, like on cloudy days or at night. Photovoltaic energy systems can also be relatively expensive, however, it is expected that prices will continue to drop until photovoltaic is an economical energy source.

Wind

Wind can also be used to generate electricity and is the second-fastest growing energy source. Blades on a wind turbine turn when the wind blows, and drive a generator which produces electricity. Large groups of wind turbines are called wind farms. Wind energy can be used for individual residences and businesses, or can be connected to a utility power grid and transmitted over power lines. In order to generate electricity, wind speeds must be sustained above about 10 mph, although average wind speeds of at least 14 mph are desirable. Since wind speeds are less at ground level than at higher elevations, more wind power can be achieved with taller towers. Wind turbines are usually constructed in the windiest areas, although there are many locations throughout the United States and the rest of the world that are suitable for wind power production. Wind energy is an intermittent source since wind does not blow at consistent speeds and times. For this reason, small wind systems may need to use batteries for backup.

Biomass, Geothermal, and Hydropower

Biomass serves as another renewable energy source. Wood is the most common biomass fuel, but biomass includes many types of organic matter that can be converted into energy, such as plants, agricultural products and by-products (such as corn and sugarcane residue), animal waste, and even garbage. Biomass fuels can be burned to generate heat and electricity directly, converted to gaseous fuel like methane, or converted to liquid fuel such as ethanol and methanol. Agreement has not yet been reached regarding which types of biomass energy should be regarded as renewable or green energy.

Geothermal energy comes directly from the interior of the earth. The heat from hot, molten rock far below the earth's surface can be used heat large reservoirs of water, or to create steam that can be used to power turbines that generate electricity.

Hydropower accounts for over 90% of all electricity that comes from renewable resources. Electricity can be generated by collecting water in a reservoir, such as behind a dam, and then allowing it to flow past a turbine that is connected to a generator. By comparison, water is cleaner than fossil fuels for electricity generation, however, large dams stop the natural flow of water which can destroy vegetation, aquatic life, and cause other serious ecological damage.

Much more detailed information on renewable energy resources is widely available on the Web. The Energy Efficiency and Renewable Energy Network of the U.S. Department of Energy is one such source (http://www.eren.doe.gov).

Environmental Benefits of Green Energy

Green energy has the potential of significantly reducing the health problems, environmental destruction, greenhouse gas emissions, and other impacts associated with traditional forms of energy. Not only is the fuel itself cleaner and oftentimes renewable, but green energy can reduce the negative environmental impacts that result from the entire process of producing and delivering fuel to customers. These indirect environmental effects include the extraction of fuel from the earth, the construction and maintenance of transportation facilities and pipelines to deliver the fuel to where it is used, the construction of electric generating plants, and the construction of electric transmission and distribution lines. All of these facilities have a negative impact on the environment. How the various types of green energy affect these indirect environmental impacts needs to be considered when evaluating the relative merits of green energy options.

For example, our use of natural gas causes environmental emissions when we burn it for cooking or heating. Our demand for natural gas requires the construction of pipelines and other infrastructure needed to deliver natural gas to consumers, and the extraction of natural gas from the earth. If we use less natural gas, we will decrease these impacts.

When we use electricity, we cause air pollution to be emitted from power plants. As our demand for electricity increases, we also increase: the number of electric distribution and transmission lines;

construction of new power plants; the amount of train systems, pipelines, and other infrastructure needed to deliver fuel to power plants; and the need to mine or extract fuels from the earth. When we reduce how much electricity we use, we reduce all of these environmental impacts.

When we buy electricity produced by renewable energy, like wind for example, we reduce the need for fuel extraction from the earth, train systems, pipelines, and other infrastructure. However, power plants in the form of wind generators and electric transmission and distribution lines must still be built to deliver power to customers. Wind generators that are located directly on the consumer's site reduces the amount of transmission and distribution lines needed.

Green Energy Actions for Consumers

As consumers, we have many green energy options available to us that reduce the pollution caused by our energy use. The green energy choices we make can have a big impact on reducing air pollutant emissions. Conserving energy is one way we can reduce our emissions–many of us already turn off lights when not in use and adjust the thermostat a couple degrees up or down depending on the season. But beyond energy conservation, what can we do to reduce our emissions? Consumers can reduce the environmental impacts of their energy use by increasing the efficiency of their energy use, purchasing cleaner or renewable energy and electricity, and buying and retiring emission reduction credits.

Green Household Energy Use

Electricity and other home fuel use is responsible for approximately 20% of the average U.S. household's pollutant emissions. Consumers can reduce the emissions, and therefore the environmental impacts, caused by their home energy use by using energy efficiently, and using renewable energy and cleaner fuels.

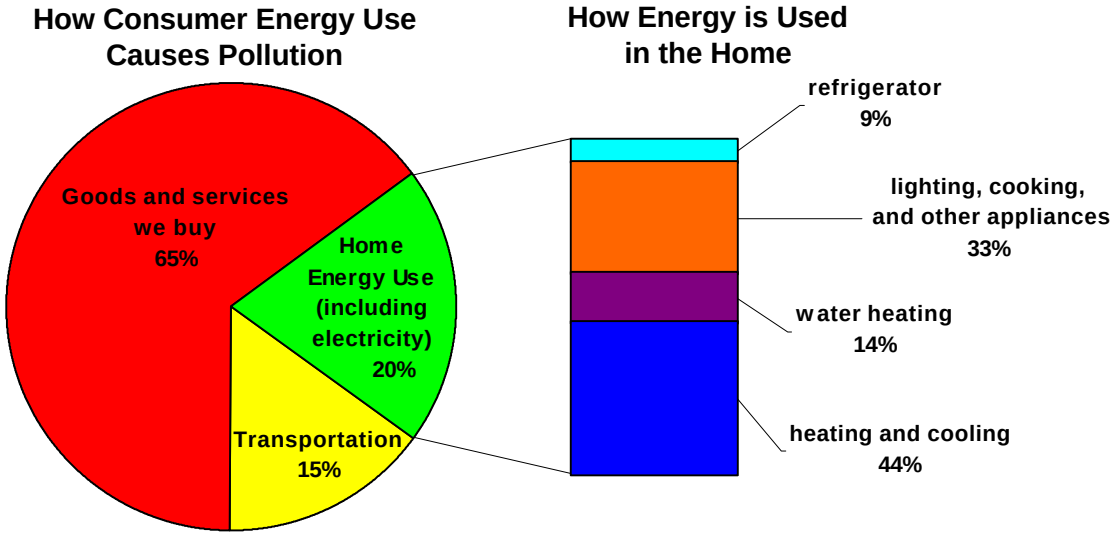
Energy Efficiency

Many low cost energy efficiency measures are available to consumers for decreasing their home energy and electricity use. And while most energy efficiency options may cost a little more at the time of purchase, they save the consumer money over the life of the equipment. Consumers can expect to save between 10% and 50% on utility bills by making their homes energy efficient. In addition, utility companies often offer rebates and other incentives for making homes more energy-efficient.

Buying energy-efficient appliances and light bulbs, switching to natural gas, and installing insulation and programmable thermostats are just a few of the ways consumers can be energy-efficient. When buying new appliances (furnaces, air conditioners, refrigerators, washers, water heaters, clothes driers, etc.) compare Energy Guide labels and look for the Energy Star – a label given by the U.S. EPA and U.S. DOE to products whose energy efficiency rating is best in its category and also exceed the minimum federal standards.

Figure 2.1 shows how energy is used in a typical household.

Figure 2.1



Heating and cooling consumes the most energy (44%) in an average household. Consumers can reduce the energy used for heating and cooling by conserving energy and implementing the following energy efficiency measures:

- ✓ Lower the thermostat in winter; raise it in the summer
- ✓ Use shades and drapes to block sunlight out during hot weather and let it in during cold weather
- ✓ Use ceiling fans in the summer and winter to keep air circulating and mixed
- ✓ Caulk, weatherstrip, and insulate walls, attics, basements, windows, doors, and pipes
- ✓ Clean and service furnace and air conditioner, replace filters as recommended
- ✓ Install a programmable thermostat
- ✓ When replacing windows, buy double- or triple-pane storm windows with solar control or low emissivity (low-E) glass

The water heater and refrigerator account for 14% and 9% of household energy use, respectively. The following practices can help to reduce the energy used by these appliances:

- ✓ Keep hot water heater set between 120 and 140°F
- ✓ Wrap your water heater with an insulating blanket to reduce heat loss
- ✓ Keep the refrigerator set between 36 and 38°F, keep freezer set between 0 and 5°F
- ✓ Check for leaks around refrigerator doors, keep coils clean, defrost freezer to eliminate ice buildup
- ✓ Consider replacing an older inefficient refrigerator with a new one–new refrigerators use up to half the energy of older models
- ✓ Remove old second refrigerator if possible, old appliances are usually inefficient and consume a lot of energy

The remaining portion of home energy (33%) is used for lighting, cooking, and other appliances. Consumers can reduce the energy used for these purposes by implementing the following energy conservation and energy efficiency measures:

- ✓ Turn off lights and appliances when not in use
- ✓ Replace incandescent light bulbs with compact fluorescent
- ✓ Install dimmers and timers on lights
- ✓ Washer: Use cold or warm water for the wash cycle; use hot only for very dirty loads; always use cold water for the rinse cycle; use appropriate water level and amount of detergent
- ✓ Dryer: Clean lint screen after every use, keep vents and ducts clean, hang clothes to dry
- ✓ Use the microwave instead of the stove whenever possible
- ✓ When replacing appliances (furnaces, air conditioners, water heaters, clothes dryers, etc.), buy those that are energy-efficient. When buying new appliances, compare Energy Guide labels, and look for the Energy Star. Energy Star products also save money on utility bills. The energy savings from newer, more efficient appliances can make up for the purchase price of the appliance in just a few years.
- ✓ Appliances that run on natural gas are often more efficient and cause less pollution than those that run on electricity

These are only a few of the low cost ways consumers can make their energy use efficient and decrease pollution from home energy use. To find out how you can further improve the energy efficiency of your home, consider having a home energy audit done. Many tips for making homes energy efficient are also available on the Web. The following web sites offer helpful information on energy efficiency and renewable energy:

- **P** Energy Efficiency and Renewable Energy Network (EREN) of the U.S. Department of Energy, (http://www.eren.doe.gov)

- **P** Renewable Energy: A Guide to the New World of Energy Choices, available from EREN at http://www.eren.doe.gov/consumerinfo/

- **P** Energy Savers, available from EREN at http://www.eren.doe.gov/consumerinfo/energy_savers

- **P** The Energy Advisor feature of the Home Energy Saver Web Site (http://hes.lbl.gov/hes/vh.html)
  The Energy Advisor is a helpful tool for comparing the utility bills for an average home to an energy-efficient home in your area. The estimate also offers a breakdown of how the energy is used within a home (heating, cooling, appliances, etc.). The site also offers specific recommendations for updating to a more energy-efficient home.

- **P** Energy Star® (http://www.energystar.gov)
  The Energy Star Web Site lists products that have earned the Energy Star Label and features a store locator. The site also offers appliance-buying tips.

Implementing energy efficiency measures in the home has the advantage of saving money on utility bills and can typically reduce air pollutant emissions by 20%. However, since electricity and other home fuel use only account for 20% of a household's total emissions, increased energy efficiency will only counteract a small portion (≈4%) of a consumer's total household air pollution emissions.

Purchasing Cleaner or Renewable Energy and Electricity

Consumers can reduce the emissions that result from their energy use by investing in cleaner or renewable energy and electricity, either on or off their site. On-site renewable energy alternatives for consumers include solar hot water heaters, photovoltaic arrays, and small wind generators.

Energy produced from renewable sources offers many environmental benefits over fossil fuels. When we buy electricity produced by renewable energy, like wind for example, we reduce the emission of air pollutants associated with the burning of fossil fuels. We also reduce the need for fuel extraction from the earth, fuel transportation systems, pipelines, and other infrastructure. However, power plants in the form of wind generators and electric transmission and distribution lines must still be built to deliver power to customers.

Electricity generated by renewables also has positive emission reduction benefits, but availability can be restricted by the status of electric industry deregulation. In areas where utilities still have a retail monopoly, green electricity is only available to consumers if the utility chooses to make it available, or if regulations require that it be made available. Furthermore, where utilities still have retail monopolies, any green electricity services are only available at non-competitive prices set through the regulatory process. Where utility deregulation has created fully competitive retail energy services markets, green electricity can be purchased at prices set by the competitive market, i.e. at lower prices than where the utility still has a retail monopoly. However, in many emerging competitive markets, transition costs will delay this effect for several years.

Wind-generated electricity is the most common renewable resource available. This option is available in many areas at a price a bit above the cost of fossil fuel-generated electricity. Biomass energy is available at moderate costs, and emerging biomass technology can produce electricity at cost savings. Electricity generated by photovoltaics is relatively more expensive, however the use of photovoltaics is increasing as costs continue to decrease.

Another option is buying electricity generated with lower environmental emissions. For example, since natural gas burns much more cleanly than coal, changing the fuel burned to generate electricity from coal to natural gas will decrease emissions by about two thirds. However, fuel costs would increase because natural gas is more expensive than coal.

Combining a cleaner fuel with a more efficient generation design, like natural gas combined cycle[1], can also reduce emissions. This very clean and efficient type of generation reduces carbon dioxide (CO_2) emissions approximately 60% over the average emission rate for electric generation, and provides a cost savings to the consumer. This significant reduction in emissions from electric generation is achieved utilizing a mature and widely used generation technology. In fact, the majority of the new generation capacity currently being planned or built in the United States is natural gas combined cycle because it is a reliable technology that has relative low capital investment and environmental emissions compared to coal-fired generation. However, the cost of natural gas-fired combined cycle generation is more sensitive to fuel costs than typical coal-fired generation. Broad implementation of natural gas combined cycle generation could have an uncertain effect on natural gas prices and the consequent competitiveness of this generation option. Planners question natural gas suppliers who assert that natural gas reserves are not a problem.

Green Transportation

To use energy efficiently and reduce air pollutant emissions in the transportation sector, consumers should use mass transit, car pool, telecommute, and bike and walk as much as possible. When consumers do drive, they can make sure that tires are properly inflated, and air and oil filters are clean. Cars that are properly tuned up use less gasoline. When the time comes to buy a new vehicle, look for smaller, more fuel-efficient vehicles that get good gas mileage.

In the future, electricity, fuel cells, and liquid fuels derived from biomass may power more of our cars. Vehicles that use renewable fuels are already available. According to "Fuel-Cycle Fossil Energy Use and Greenhouse Gas Emissions of Fuel Ethanol Produced from U.S. Midwest Corn" by Argonne National Laboratory in 1997, using E85 fuel reduces CO_2 emissions by 41.1% over conventional gasoline. Flexible fuel vehicles that can operate on E85 are readily available to consumers in the form of Ford's Taurus sedan and Ranger pickup, Mazda's B3000 pickup, and a variety of Chrysler and Plymouth minivans all priced identically to their standard gasoline counterparts.

Green Goods and Services

To reduce emissions that result from the production and delivery of goods and services we buy, we can purchase goods and services that are produced and delivered in cleaner ways. For example, commodities that are grown or produced locally can reduce emissions that result from shipping. Consumers can also look for reusable and recyclable products, avoid excess packaging, and buy from companies that have good environmental track records.

[1] Combined Cycle is an efficient electric generating technology which makes use of the otherwise lost waste heat exiting from gas (combustion) turbines. The hot exhaust gas from the turbine is converted to steam and used to power a steam turbine to produce additional electricity.

Emission Offsets

Sources of air pollution that reduce their emissions below their required limit (cap) may receive saleable credits for their reductions. These reductions are measured and recorded in an appropriate way so that the resulting credits can be bought, sold, and traded. Emission reduction credits reward those who take action to reduce their pollutant emissions and therefore encourage pollution reduction actions. Credits for emission reductions provide an incentive to find the most cost-effective way to reduce emissions, since once an emission reduction credit is earned, it can be sold on the open market.

Emission reduction credits can also be used to reduce pollution even further. Instead of reselling emission reduction credits to sources of air pollution that will use them to compensate for their pollutant emissions, credits and allowances can be retired, *without* emitting any pollution. Once an emission reduction credit is retired, it can no longer be bought, sold, or used to offset pollution. Purchasing and retiring emission reduction allowances reduces the amount of pollution that is discharged to the atmosphere for regulated markets, and creates future pollution reduction potential for voluntary markets.

Consumers can purchase emission reduction credits and emission allowances in the marketplace, and retire them to cancel out (offset) part or all of the emissions caused by their energy use. This is a low cost and convenient approach, and allows consumers to offset their net emissions, including those produced by goods and services purchased, by 100 percent (to zero).

This gives people the option of reducing the environmental impacts of their energy use directly, or they can buy and retire emission reductions in the form of emission reduction credits created from someone else implementing efficiency or renewable energy projects. The same overall environmental benefits are achieved either way.

What is a Good Way to Evaluate Green Energy Options?

Based on Figure 1.1, using green electricity will only reduce the total amount of air pollution caused by our energy use by 13%. To reduce all of the emissions caused by our energy use, we must also account for the emissions that result from transportation, home fuels, and the production and delivery of goods and services we buy.

We can take action to reduce emissions that result from our energy use in all of the sectors. For example, increasing our reliance on mass transit and buying cleaner, more efficient vehicles can reduce air pollution emissions in the transportation sector. Making our energy use and homes more energy-efficient, for example, replacing less efficient appliances (water heaters, furnaces, stoves, clothes dryers, etc.) with those that are more efficient and run on natural gas can reduce overall emissions from home energy use. To reduce emissions from the goods and services sector, we can purchase goods and services that are produced and delivered in cleaner ways. We can also buy emission reduction credits from energy efficiency and renewable energy projects to offset part or all of the emissions caused by our

energy use. This amounts to paying someone else to reduce *their* emissions to compensate for the emissions that result from our energy use.

We all use energy in many direct and indirect ways. The direct ways we use energy include heating and cooling, appliances and lights, and transportation. We use energy indirectly by purchasing goods and services that use energy in their production and delivery. We must consider the entire picture when we make energy choices. A good way to evaluate green energy is to look at how each green energy option reduces the total environmental impact caused by both our direct and indirect energy use.

Section 3 Green Energy Survey

A Green Energy Survey was conducted as part of the Green Energy Project's work on helping individuals decide what kind of green energy to buy and organizations decide what green energy options to recommend to their members. The survey was conducted to capture, and better understand, the views of consumers on green energy and other selected environmental issues.

The Green Energy Survey addressed consumer views on:

- ❏ Level of concern regarding different types of pollution
- ❏ Pollution impacts
- ❏ Willingness to pay for reduced pollution
- ❏ Assorted emission reduction approaches

The survey was posted on Leonardo Academy's Cleaner and Greener[sm] web site. Leonardo Academy notified environmental, health, energy, consumer, and sporting organizations in Iowa, Illinois, Minnesota, and Wisconsin through email messages to the organizational contacts. The survey was therefore biased towards these groups. We asked our contacts to encourage their members to visit our web site and fill out the Green Energy Survey.

Survey Results

Respondent Information

We received responses from 239 individuals, including 60 responses from Renew Wisconsin members and 46 responses from Iowa Renew members. We received a total of 126 responses from within the four-state study region of Wisconsin, Iowa, Minnesota, and Illinois and 113 responses from outside this region including 34 responses from outside the United States.

Below are the results on the "Willingness to Pay for Reduced Pollution" question. Detailed results on all sections of the survey can be found in the complete *Consumer Guide to Green Energy Choices* with Appendices.

How much are you willing to pay to clean up the environmental pollution caused by our energy use?

The survey asked respondents how much more they would be willing to spend per month to clean up (reduce, offset, or eliminate) the pollution caused by their direct and indirect energy use.

Willingness to Pay for Reduced-Emission Energy

	Mean	Std. Dev.	Mode	Median
What is your bottom line?	$33	$33	$10	$20

We added a willingness-to-pay question to our survey to try and reflect the views of specific organization's members. Our survey results showed a high level of willingness to pay premiums for reduced-emission electricity. The mean response was $33 more per month. This is somewhat higher than most other surveys done on both national and local levels and could reflect the bias of our sampling group. Over the last twenty years, there have been numerous surveys done on willingness to pay for cleaner electricity. The majority of respondents in a number of recent surveys are willing to pay $6 to $25 more per month (Holt, 1997). A 1996 local-area survey of Central Power and Light customers in Corpus Christi, Texas discovered that residential customers were willing to pay an additional $5.60 per month on average for renewable electricity (Farhar, 1996).

Research has shown that willingness to pay usually does not transcend into being the most important factor when actual green electricity programs are offered. Although between 56% and 86% of respondents to recent national surveys said they would pay a premium for environmental protection or renewable electricity, less than 10% of customers have signed up to participate (usually only 1 - 2%) when green-pricing programs have actually been initiated (Farhar, 1996). This could be due to existing barriers to renewables for competing fairly in the marketplace. Other factors involved with the program offerings were important for customers, such as flexibility for participation, and whether premiums were going towards new, not mandated cleaner electricity and not for existing green electricity. Several respondents to our survey indicated that their answer would depend on if the premium was applied to all customers and not just voluntary. Customers are willing to pay more for cleaner electricity but given other factors in place, utility green electricity programs are likely to develop slowly.

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Section 4 The Cost of Green Energy: Consumer Cost of Reduced-Emission Options

Green energy is energy produced and used with fewer total emissions to the environment. Green energy options include using energy efficiently, renewable energy and cleaner fuels, and buying emission reduction credits or offsets. These options provide a way for consumers to reduce emissions caused by their energy use at a modest cost. This section provides a summary of consumer costs of green energy options, and a summary of the cost of green electricity programs in the four-state study area (Iowa, Illinois, Minnesota, and Wisconsin).

Cost to Consumers of Becoming More Energy-Efficient

Increased efficiency of energy use is a low cost way to reduce emissions from electric generation from both an end user (consumer) perspective and a generation (the avoided cost of producing and delivering power) perspective. There are many low cost emission reduction measures available to end use consumers that provide a net cost savings over the life of the equipment and appliances. Implementing energy efficiency measures has the potential to save the average consumer up to $23 per month or $278 per year on their electricity bills (Figure 4.1). Using energy efficiency to reduce emissions can also increase employment and economic activity at a state and regional level.

The costs and emission reduction results for energy efficiency measures are equally applicable in both regulated and competitive utility structures. Only the environment for promoting and implementing the cost-effective efficiency measures changes between the different utility structures.

Cost to Consumers of Reduced-Emission Generation Technologies

The production of electricity can be accomplished with a wide range of technologies in conjunction with various energy sources, including fossil fuels – such as coal, oil, and natural gas, and renewables– such as wind, solar, and biomass. Cleaner electricity generation alternatives are becoming more important as conventional sources of electricity like fossil fuels, are both limited and bring about negative environmental consequences.

To determine the potential consumer price of “green” or less-polluting electricity, the cost and emissions for various types of generation technologies were determined. This information was then compared to the average electricity mix for each of the four states (Iowa, Illinois, Minnesota, and Wisconsin) to provide a relative measure of the cost effectiveness of these generation technologies to reduce air emissions.

Table 4.1 shows an average family's CO_2 emission reduction options and costs for household electricity consumption in a post-restructuring and paid-off stranded cost[2] environment. The incremental costs in Table 4.1 are in comparison to the four-state study area average generation mix. These costs therefore do not reflect transition to competitive market costs such as required consumer responsibility for stranded costs. This also assumes consumer access to one emission reduction source option only for any of the options instead of the usual mix of options. Generation technologies are rated in terms of the cost of reducing carbon dioxide (CO_2) emissions, since CO_2 emissions provide a relatively strong measure for the reduction of other pollutants of consideration.

The Green Energy Project analysis of reduced emission electric generation technologies leads to several interesting insights. The use of natural gas combined cycle units[3] reduce CO_2 emissions approximately 60% over the average emission rate for a net cost savings to the consumer. This is significant as it is achieved by utilizing a fully mature and widely implemented generation technology. In fact, the majority of the new generation capacity currently being planned or built in the United States is natural gas combined cycle because it is a reliable technology that has relatively low capital investment and environmental liabilities compared to coal-fired generation. However, the cost of combined cycle generation is more sensitive to fuel costs than typical coal-fired generation, and may therefore have limited capability to meet a wide market demand for low cost cleaner electricity.

The analysis of generation technologies also showed that 100% reduction of CO_2 emissions from electricity use was possible using a number of different renewable technologies, including two common proven renewable energy alternatives, wind and solar-fueled generation. As expected for Illinois, Iowa, Minnesota, and Wisconsin, large scale photovoltaic generation is an expensive way to produce cleaner electricity. Alternatively, for an approximate added cost of $2.58 per month, wind power is an attractive and viable electric generation option for consumers.

The estimated cost of providing 100% CO_2 reduction electricity could potentially be achieved with a *cost savings to the consumer* by utilizing biomass feed integrated gasification combined cycle (Biomass-IGCC) technology. This is an emerging technology which is typically considered in technical evaluations of new generation alternatives, but is as yet unproven in the field. Therefore, electric suppliers are less apt to utilize this technology without special considerations. This represents a case where educated consumers who request cleaner electricity at lower costs could potentially force the electric supplier to implement newer and cleaner technologies.

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[2]Stranded costs are the financial obligations of regulated utilities (investments made in generation technology and resources to be able to generate and distribute power to customers) that would not be recoverable under deregulation. Utilities expect to recover their investments through customer rates, however, if a competitive market allows customers to leave the utility for a market-based supplier, the costs become unrecoverable.

[3]Combined Cycle is an efficient electric generating technology which makes use of the otherwise lost waste heat exiting from gas (combustion) turbines. The hot exhaust gas from the turbine is converted to steam and used to power a steam turbine to produce additional electricity.

Table 4.1 The Cost of Cleaner Electricity for the Residential Sector (4-State Average)					
Technology	% CO_2 Reduction	Incremental consumer cost of cleaner electricity ($/kWh)	($/ton)	($/month)	($/year)
215 MW Combined Cycle (CC) - unit n	61%	($0.0422)	($61.50)	($30.26)	($363)
Integrated Coal Gasification CC	4%	($0.0411)	($999.72)	($29.46)	($354)
215 MW CC - stand alone	61%	($0.0392)	($57.15)	($28.14)	($338)
215 MW CC - unit 1	61%	($0.0382)	($55.59)	($27.38)	($329)
154 MW CC - stand alone	59%	($0.0342)	($51.64)	($24.51)	($294)
154 MW Combustion Turbine - unit n	41%	($0.0328)	($70.58)	($23.56)	($283)
Integrated Coal Gasification Fuel Cell	28%	($0.0321)	($103.63)	($23.05)	($277)
154 MW CT - stand alone	41%	($0.0310)	($66.50)	($22.21)	($267)
154 MW CT - unit 1	41%	($0.0305)	($65.53)	($21.89)	($263)
75 MW CT - stand alone	42%	($0.0295)	($62.35)	($21.18)	($254)
Whole Tree Biomass	100%	($0.0293)	($25.99)	($21.03)	($252)
83 MW CT - stand alone	20%	($0.0241)	($109.11)	($17.30)	($208)
Integrated Biomass Gasification CC	100%	($0.0098)	($8.46)	($7.01)	($84)
Spreader Stoker Biomass (57 MW)	100%	($0.0096)	($8.28)	($6.86)	($82)
Molten Carbonate Fuel Cell	54%	($0.0086)	($13.64)	($6.17)	($74)
Wind Turbine	100%	$0.0036	$3.53	$2.58	$31
Atmospheric Fluidized Bed Biomass	100%	$0.0103	$9.50	$7.35	$88
Spreader Stoker Biomass (7.2 MW)	100%	$0.0250	$22.73	$17.93	$215
Fixed Flat Plate Photovoltaic (5 MW), dispersed connection	100%	$0.2386	$214.34	$171.17	$2,054
Fixed Flat Plate Photovoltaic (5 MW)	100%	$0.2612	$234.56	$187.34	$2,248
Fixed Flat Plate Photovoltaic (0.5 MW), dispersed connection	100%	$0.3640	$326.78	$261.09	$3,133
Fixed Flat Plate Photovoltaic (0.5 MW)	100%	$0.3899	$349.95	$279.63	$3,356
Atmospheric Fluidized Bed Combustion	-14%	---------- No CO_2 Reduction ----------			
Coal Fluidized Bed Combustion	-25%	---------- No CO_2 Reduction ----------			

Notes on Table 4.1:

[1] Based on a weighted average of 8607 kWh usage per year per household

[2] Parentheses indicate cost savings; negative percentages indicate CO_2 increase

Cost of Emission Reduction Credits or Offsets

Emission reductions are decreases in pollutant emissions that result from actions such as increasing renewable energy use and improving energy efficiency. Emission reduction credits and offsets are measured and recorded in an appropriate way so that they can be bought, sold, and traded. This gives people the option of reducing emissions from their energy use directly, or they can buy emission reductions from someone else in the form of emission reduction credits. The same overall emission reductions are achieved either way.

Table 4.2 shows the estimated cost of offsetting all the emissions caused by the average household's energy use at projected future costs of efficiency-based reductions. (The average household's energy use includes electricity and other home fuel use, transportation, and the production and delivery of goods and services purchased.) Emission reduction credits could be purchased on a trading market at relatively low costs. One person could offset their own emissions for approximately $190 per year ($16 per month). The cost of offsetting NOx emissions accounts for 83% ($150/year) of this amount.

Table 4.2 Estimated Cost of Offsetting Emissions at Projected Future Costs of Efficiency-Based Reductions

Pollution Type	Estimated Market Cost of Emission Reductions ($/ton)	Estimated Annual Per Family Cost ($)	Estimated Annual Per Capita Cost ($)	Estimated Monthly Per Capita Cost ($)
Climate Change (CO_2)	$1	$56.00	$22.00	$1.83
Acid Rain (SO_2)	$200	$37.40	$14.40	$1.20
Ozone-Causing (NOx)	$1,700	$389.30	$149.60	$12.47
Particulate (PM10)	$200	$6.30	$2.40	$0.20
Toxic Lead (Pb)	$30,000	$1.13	$0.47	$0.04
Toxic Mercury (Hg)	$30,000	$0.75	$0.28	$0.02
Total Cost	N/A	$490.88	$189.15	$15.76

Notes on Table 4.2:

The estimated cost of offsetting emissions are based on the U.S. average per capita and family emissions per year. The estimated value of emission reductions from energy efficiency and renewable energy assumes emission reductions from these sources are given credit in future emission reduction regulatory programs. These estimates are based on emission reduction prices in situations where there is not a fully competitive market for emission reductions that includes full participation of energy efficiency-based reductions. If a fully competitive market for energy efficiency-based reductions *is* created, this additional supply of low cost emission reductions will clearly affect the market price.

SO_2: When SO_2 emission reductions regulations were proposed, estimates of reduction were in the range of $1000 to $1500 per ton. In the last 3 years, SO_2 allowances have been in the $50 to $210 per ton range. As phase two of the SO_2 reduction regulations take effect in early 2000's, the prices for SO_2 allowances may rise.

NOx: Current regulatory proceeding estimates of reduction costs for generation-based reduction measures.

Hg, Pb: Current regulatory proceeding estimates of reduction costs for generation-based reduction measures.

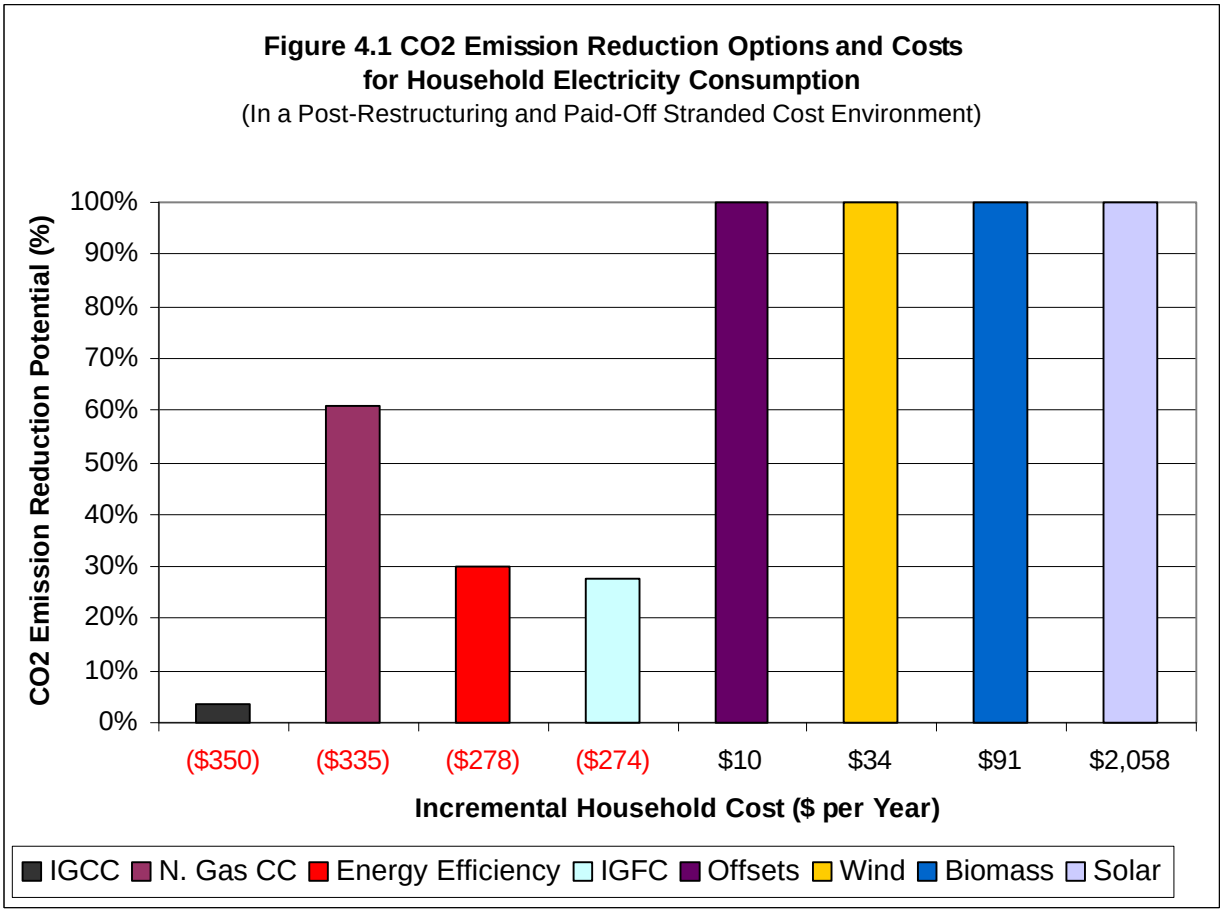
PM10: The market price of particulates was estimated to be the same as SO_2

CO_2: Based on some early transactions in Oregon and estimates of future market prices

These offset cost figures assume a separate trading market for each emission type, so therefore overestimate the total cost. If an integrated trading market which includes energy efficiency is created, the total costs would decrease, because many of the allocations rewarded for energy efficiency and renewable projects reduce emissions of multiple pollutants from the list.

Cost Summary of Emission Reduction Options

Figure 4.1 summarizes the CO_2 emission reduction options and costs for household electricity consumption in a post-restructuring and paid-off stranded cost environment. Costs are compared to the four-state average generation mix. Costs do not reflect transition to competitive market costs such as required consumer responsibility for stranded costs. The figure also assumes consumer access to one emission reduction source option only for any of the options, instead of a mix of the options.



*Parentheses indicate cost savings

Figure 4.1 shows that energy efficiency is a low cost way to reduce emissions. In addition, most low cost efficiency measures rapidly more than pay for themselves through the energy savings they provide. Implementing energy efficiency measures has the potential to save the average household up to $23 per month ($278 per year) on electricity bills.

Another green energy option available to all consumers is buying emission reductions produced by someone else's energy efficiency or renewable energy projects. Emission reductions can be purchased in the competitive marketplace, so competition will drive the price down to the point where supply and

demand are balanced. Buying emissions reduction credits lets consumers conveniently offset the emissions caused by their direct and indirect energy use at a low competitive market cost. For example, an average US family's CO_2 emissions from their household electricity consumption could be offset for less than $1 per month or only $10 per year (Figure 4.1). 100 percent of an average US family's CO_2 emissions, including the emissions caused by the production and delivery of goods and services purchased, can be offset for less than $5 per month, or $56 per year (Table 4.2).

Figure 4.1 shows that 100 percent reductions of CO_2 emissions from our electricity consumption are possible using renewable generation technologies. Wind power in particular has emerged as an attractive and viable electric generation option for consumers. Buying 100 percent proven available renewable electricity has an incremental cost of cost of about 0.4 to 3 cents per kWh for wind and biomass (fluidized bed combustion) electricity. This means that the average U.S. family could reduce all of their household electricity emissions for less than $3 more per month (around $34 per year) in a competitive market.

Several emerging renewable technologies such as biomass feed integrated gasification combined cycle (Biomass-IGCC) can produce electricity at incremental cost savings to consumers. As expected for Illinois, Iowa, Minnesota, and Wisconsin, large scale photovoltaic generation is a more expensive way to produce cleaner electricity at approximately $2000 more per year. But this technology offers an alternative for isolated consumers located large distances from the power grid. Purchasing electricity produced from fuel switching generation technologies provides another opportunity for emission reductions. Fuel switching to the use of cleaner-fueled generation, such as natural gas combined cycle, by generation sources reduce CO_2 emissions approximately 60% over the average emission rate for a net cost savings to the consumer.

On a cost basis alone, Figure 4.1 shows that new emerging generation technologies such as integrated coal gasification combined cycle (IGCC) and integrated gas fuel cells (IGFC) are very cost-effective. However, these technologies are not widely practiced and offer low emission reduction potentials of 4% and 28%. Fuel switching to natural gas-fired generation and energy efficiency options are cost effective approaches for reducing emissions that provide greater emission reduction potential (60% and 30%). Emission reduction offsets offer a very low cost option with 100% emission reduction potential. Renewable options such as wind, biomass, and solar provide more costly emission reduction options, although on a monthly basis, wind and biomass are quite inexpensive and also provide 100% reductions of the emission resulting from our electricity use.

Under a regulated environment, there are still many cleaner generation packages available through utility green energy programs. Several utilities in the four-state study area offer, or are planning to offer, green energy to their consumers for a premium of $5 to $50 more a month for 100 percent renewable electricity. Consumers need to make sure that premiums charged for green electricity from these programs are the result of new, not mandated renewable projects which would occur regardless of consumer participation.

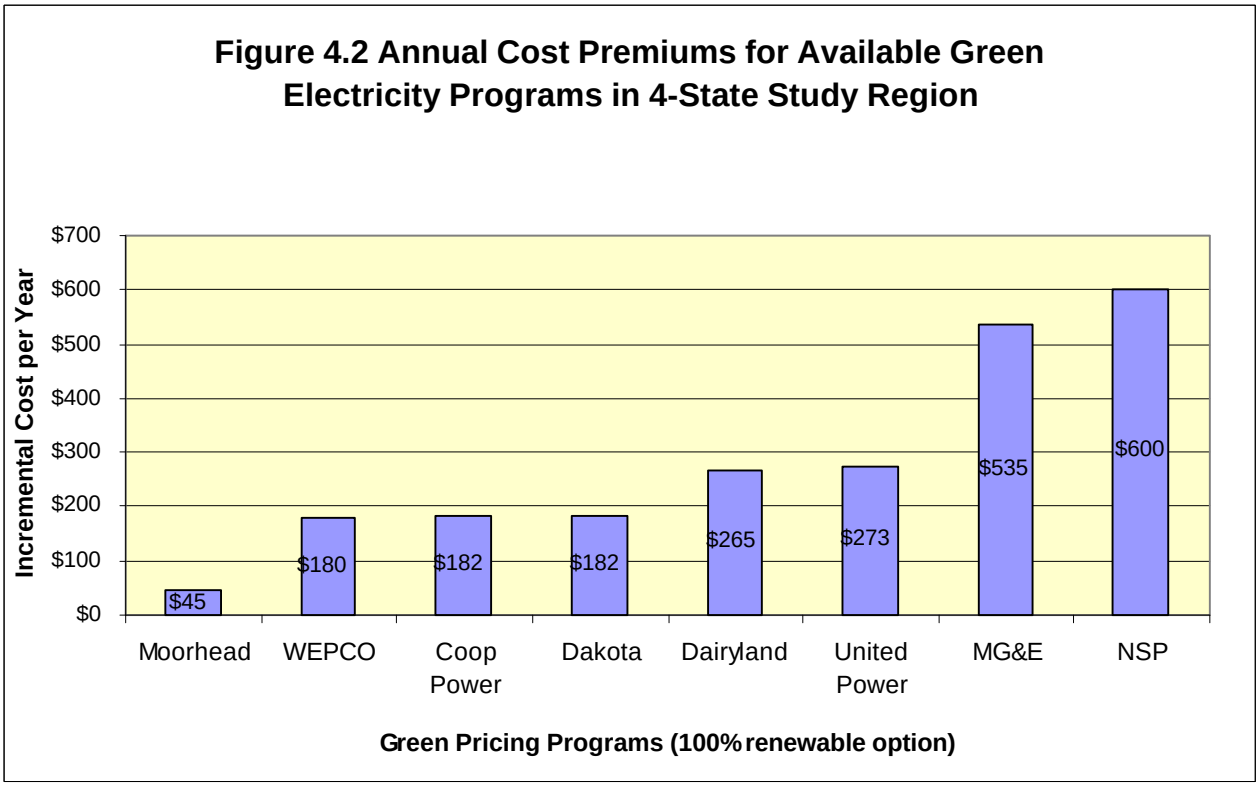
Consumers can reduce the emissions that result from their energy use *while* saving money, since the cost savings from energy conservation and energy efficiency measures more than make up for the price of premiums for valid green energy programs and emission reduction offsets.

Current Green Electricity Pricing Programs in Four-State Study Area (March 1999)

Minnesota and Wisconsin have many green electricity offerings in their states as summarized in Table 4.3 and Figure 4.2. Iowa and Illinois currently have no green pricing programs available to residential customers. Iowa has significant mandated wind resources available or in development. Iowa's MidAmerican has no plans for offering a green pricing program. Their position is that the Alternate Energy Production law of 1990 encourages renewable energy at a rate that should be shared by all customers. Alliant Energy is exploring the development of a green pricing program in 1999 using mandated wind energy. There are several other Iowa Municipal utilities and electric co-ops offering their own wind energy generation to all customers as a part of their mix. Illinois currently has very little in-state renewable generation available to offer residential customers.

Table 4.3 Costs of Current Green Electricity Pricing Programs in 4-State Study Area

Utility Name	Program Name	Type	Size	Program Offer	Premium
Moorhead Public Service	Capture the Wind Project	Wind & hydro	0.8 MW	$5 / 1000 kWh	0.5 cents / kWh
Dakota Electric Association	Wellspring Renewable Energy	Wind	0.7 MW	$2 / 100 kWh	1.4 cents / kWh
Cooperative Power Assoc.	Wellspring Renewable Energy	Wind	0.7 MW	$2 / 100 kWh	2.0 cents / kWh
Wisconsin Electric Power	Energy for Tomorrow	Hydro, wind, & biomass	7.5 MW	30% Premium	2.0 cents / kWh
United Power Association	Wellspring	Wind	1.0 MW	$3 / 100 kWh	3.0 cents / kWh
Dairyland Power	Evergreen Program	Wind	1.8 MW	$3 / 100 kWh	3.0 cents / kWh
Madison Gas and Electric	Wind Power Program	Wind	11.2 MW	$5 / 80 to 120 kWh	4.2 - 6.3 cents / kWh
Northern States Power Company	EnergyWise Solar Advantage	Rooftop PV	0.034 MW	$50 / month	6 - 7 cents / kWh



Note: Costs in Figure 4.2 based on different mixes of renewable products and costs within each green pricing program combined with the residential electric consumption characteristics for the 4-state area. Moorhead (66% hydro & 33% wind) and WEPCO (hydro, wind, & biomass mix) programs are mainly hydro power, Dakota, Coop Power, Dairyland, United Power and MG&E programs are 100% wind, and NSP's program is 100% solar. Coop Power and United Power are now a part of Green River Energy.

Section 5 Green Energy Project Summary

Green energy is gaining recognition as we become increasingly aware of the health problems, environmental destruction, and other impacts that result from the pollution caused by our energy use. This growing interest in green energy raises many questions for consumers: *What really **is** green energy? **What kind** of green energy should I buy? **How much** green energy should I buy?* The Green Energy Project was designed to answer these questions, as well as to help organizations decide what green energy options to recommend to their members. The use of regulation and legislation to clean up the environment should not be neglected, but expanding the impact of direct actions by consumers will give the environmental improvement stool a third leg to stand on.

The "right" kind of green energy for individual consumers will depend on their values, their willingness to pay for reduced environmental impacts, and their access to reduced-emission options. It is likely that organizations and individuals will come to different conclusions about the type of green energy that is right for them. The Green Energy Project accommodates this diversity by examining the issues that underlie green energy choices, developing a framework for making conclusions, and then providing the information needed to make decisions. Organizations can use this information to make green energy recommendations to their members based on their objectives.

The Green Energy Project:

- Provides information on consumer energy use
- Identifies environmental impacts caused by household energy use
- Introduces various types of green energy and their associated environmental benefits
- Provides information on the cost of green energy, including energy efficiency, generation options, and emission offsets
- Surveyed consumers' willingness to pay for reduced emissions and views on assorted emission reduction options
- Highlights three basic strategies for consumers and organizations for reducing the overall pollution that results from household energy use

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Consumers cause air pollution both by the energy they use in their homes and vehicles, and by the energy used to produce and deliver the goods and services they buy. The United States uses 2 to 3 times more energy per capita than highly developed countries like France, Germany, England, and Japan. The United States contains less than 5% of the world's population, but generates almost 25% of its air pollution.

In the United States, the conventional production of electricity from power plants causes more air pollution than any other source, and contributes to global warming. In 1997, the burning of fossil fuels

accounted for 82% of greenhouse gas emissions[4]. Traditional fossil fuel-based energy generation also emits lead, mercury, sulfur dioxide, particulate matter, carbon monoxide, nitrogen oxides, and volatile organic compounds, all of which are detrimental to public health and the environment.

Using our energy resources wisely and efficiently can reduce all the pollutants that are typically emitted from traditional fossil fuel-based energy. These pollutants, and their associated health and environmental effects, can be reduced by investing in green energy and electricity options.

As consumers, we have many green energy options available to us that reduce the pollution caused by our energy use. Conserving energy is one way we can reduce our emissions. Many of us already turn off lights when not in use and adjust the thermostat a couple degrees up or down depending on the season. But beyond energy conservation, what can we do to reduce our emissions?

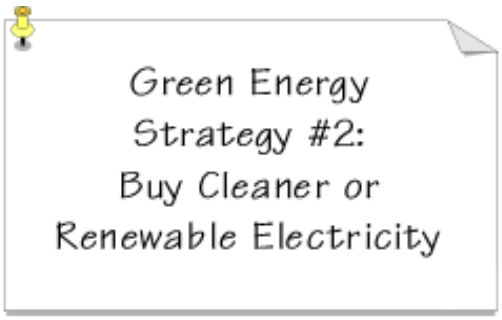
Green Energy Strategies for Consumers

Increasing energy efficiency is one strategy that scores high in both availability to consumers and environmental benefits. Buying energy-efficient light bulbs and installing insulation and programmable thermostats are just a few of the ways consumers can be energy-efficient. When buying appliances, compare Energy Guide labels and look for the Energy Star, a label given to products whose energy efficiency rating is best in its category and also exceed the minimum federal standards. To find out how you can further improve the energy efficiency of your home, consider having a home energy audit done.

Energy efficiency reduces the whole chain of negative environmental impacts caused by the production and delivery of energy to consumers (Table 5.1), as well the pollution from the use of the fuel itself. Energy efficiency is also a low cost way to reduce emissions. Most efficiency measures more than pay for themselves with the energy savings they provide. Implementing energy efficiency measures has the potential to reduce emissions from household electricity consumption by 30% and save the average consumer up to $23 per month ($278 per year) on their electricity bills.

As consumers, we should make our energy use as efficient as we are comfortable with, but since efficient energy use can only affect a portion of total energy use, we should not stop there.

[4]Emissions of Greenhouse Gases in the United States 1997, Energy Information Administration Publication, U.S. Department of Energy, DOE/EIA-0573(97), October 1998.



Buying cleaner or renewable electricity has positive emission reduction benefits, but availability can be restricted by the status of electric industry deregulation. In areas where utilities still have a retail monopoly, green electricity is only available to consumers if the utility chooses to make it available, or if regulations require that it be made available. Furthermore, where utilities still have retail monopolies, any green electricity services are only available at non-competitive prices set through the regulatory process. Where utility deregulation has created fully competitive retail energy services markets, green electricity can be purchased at prices set by the competitive market. So where the electricity market is competitive, the green electricity is likely to be available at lower prices than where the utility still has a retail monopoly.

The Green Energy Project analysis of electricity generation options shows that renewable technologies can economically turn wind, sunlight, and organic matter (biomass) into electricity and other useful forms of energy. 100% reductions of CO_2 emissions from our electricity consumption are possible using a number of renewable technologies. Of these, proven renewable energy alternatives such as wind- and solar-fueled generation continue to gain market penetration and enjoy cost decreases over time. Wind power in particular has emerged as an attractive and viable electric generation option for consumers. Buying 100 percent proven available renewable electricity has an incremental cost (over the current generation mix) of about 0.4 to 3 cents per kWh for wind and biomass (fluidized bed combustion) electricity. In a competitive market, the average U.S. family could reduce all of their household electricity emissions for as little as $3 more per month.

Sources of air pollution that reduce their emissions below their required limits may receive credit for their reductions. Emission reduction credits reward those who take action to reduce their pollutant emissions and therefore encourage pollution reduction actions. Credits for emission reductions provide an incentive to find the most cost-effective way to reduce emissions, since once an emission reduction credit is earned, it can be sold on the open market. Markets for emission reduction credits or emission allowances can be created by regulation (the sulfur dioxide market for example) or voluntarily (the current market for greenhouse gases).

Emission reduction credits can be used to reduce pollution. Instead of reselling emission reduction credits to sources of air pollution that will use them to compensate for their pollutant emissions, allowances can be retired, *without* emitting any pollution. Once an emission reduction credit is retired, it can no longer be bought, sold, or used to offset pollution. Purchasing and retiring emission reduction allowances reduces the amount of pollution that is discharged to the atmosphere for regulated markets, and creates future pollution reduction potential for voluntary markets.

The third green energy strategy allows consumers to take advantage of emission reduction credit markets. Energy efficiency and renewable energy projects reduce the negative environmental impacts caused by the production and delivery of energy to consumers, as well as provide emission reductions which can be purchased by consumers. Buying and retiring emission reduction credits produced by energy efficiency or renewable energy projects provides many environmental benefits (Table 5.1) and allows consumers the chance to:

- Influence public policy decisions to implement market-based pollution reduction strategies
- Give value and financial incentive to the pollution reduction actions made through energy efficiency and renewable energy projects
- Strengthen emission reduction markets
- Reduce the whole chain of negative environmental impacts produced by energy production and distribution, including the production and delivery of goods and services purchased by consumers

Increasing consumer energy efficiency provides many environmental benefits as well, but it is difficult for consumers to reduce the emissions caused by the production and delivery of goods and services they buy. Buying emission reductions has an added advantage, it allows consumers to offset their net emissions, including indirect emissions from goods and services purchased, by 100 percent (to zero).

Green energy in the form of emission reductions can be purchased in the competitive marketplace, so competition will eventually drive the price of emission reductions down to the point where supply and demand are balanced. Buying emission reduction credits lets consumers conveniently offset the emissions, caused by both their direct and indirect energy use, as much as they want at a low competitive market cost. For example, an average U.S. family's CO_2 emissions from their household electricity consumption could be offset for less than $1 per month (about $10 per year). An average U.S. family's *total* CO_2 emissions, including emissions that result from the production and delivery of goods and services purchased, can be offset for less than $5 per month (about $56 per year).

To demonstrate the impact that consumers can have on reducing pollution, Leonardo Academy has instituted a program that lets consumers buy green energy in the form of making a donation (all U.S. donations are tax-deductible) to buy and retire emission reduction credits.

The Cleaner and Greener[sm] Green Energy Program shows that there are low cost pollution reduction options available, encourages increased energy efficiency and renewable energy, and shows that there is public support for taking action to reduce pollution.

Benefits of Implementing Green Energy Strategies

The bottom line for consumers is that they can easily take direct action to reduce emissions at a modest cost. Our Green Energy Survey results show that environmentally-oriented consumers are willing to spend $33 more per month to reduce environmental pollution, though consumers also need to feel like they are getting a value for their premium and that the dollars they spend will make a difference.

By implementing a little of each these green energy strategies, you can show that consumers want reduced environmental emissions, that consumers are willing to pay to reduce emissions and finally, that emission reductions are available at a lower cost than most people think. Your actions can produce direct environmental benefits–you reduce the environmental impacts of the energy production and delivery chain, from fuel extraction to delivery to you, as well as the environmental impacts of conversion processes like fossil-fueled electricity generation. You also reduce the demand for emission-producing fossil fueled generation. And you help the marketplace, regulators, and legislators do more to reduce pollution.

Buying emission offsets help people and organizations that implement energy efficiency, renewable energy, sequestration, and cleaner generation projects to implement more and bigger projects by buying the emission reductions they produce. You also help put people to work installing, designing, manufacturing, and developing the equipment needed to carry out these cleaner energy projects.

When we incorporate energy conservation and efficiency measures in our own homes we decrease energy consumption. These energy savings increase our disposable income, which leads to growth in employment since most of the income is spent locally on consumption of goods and services instead of flowing out of state to pay for fuel imports. Renewable generation built in-state also has positive economic impacts by eliminating the cost of paying for out-of-state fuel products.

Consumers can also help the environment by supporting environmentally beneficial regulation and legislation. They can do this by giving their time and money to organizations that are supporting smart, effective policies for promoting cleaner energy sources. These policies include measures such as renewable portfolio standards, rewarding all pollution reduction actions with allocations, net metering, public benefits funding, and fair rules between all energy sources (even playing field). Our survey results showed high support for many of these policies as desirable ways to clean up the pollution caused by our energy use.

The demand for cleaner energy sources is already present, what is needed is more education and access to these cleaner sources. Electric providers should be able to provide cleaner electricity to the consumer for little or no additional cost. The resources are currently available for a supplier to respond to an educated consumer market.

Select a combination of direct emission reduction actions, such as increased energy efficiency, renewable electricity, and emission offsets. If you represent an organization, recommend that each of your members implement a mix that fits your organization’s objectives. Start leading the way to a cleaner environment for you, your children, your grandchildren, and future generations.

Table 5.1 Summary of Environmental Impacts of Options for Reducing the Emissions that Result from an Average Household's Energy Use

Types of Green Energy		Environmental Impacts Reduced						
		Air pollution[1]	Solid Waste Disposal	Fuel extraction	Electric transmission and distribution	Fuel transmission and distribution or transportation	Electric generating plants	Goods and services[2]
Emission Offsets[3]		Yes (100%)	Yes	Yes	Yes	Yes	Yes	Yes
Increased Energy Efficiency		Yes (20-30%)	Yes	Yes	Yes	Yes	Yes	No
Renewable Generation (wind, solar, etc.)	On-Site	Yes (100%)	Yes	Yes	Yes	Yes	Yes	No
	Off-Site	Yes (100%)	Yes	Yes	No	Yes	Yes	No
Fuel Switching: Coal to Biomass Fuel Generation		Yes[4] (100%)	Yes	Yes	No	Maybe[5]	No	No
Generation Efficiency Improvements		Yes (Varies)	Yes	Yes[6]	No	No	No	No
New Generation Technologies (IGCC & IGFC)		Yes (4-28%)	Yes	Yes	No	No	No	No
Fuel Switching to Natural Gas Generation		Yes (30-60%)	Yes	No	No	No	No	No
Generation End-of-Pipe Actions		Yes (Varies)	No	No	No	No	No	No

[1] Percentages reflect the average U.S. household's CO_2 emission reduction potential from electricity

[2] Impacts of energy used to produce and deliver the goods and services we buy

[3] Buying and retiring emission reduction credits offsets the emissions caused by household energy use.

[4] Impact varies by type of emission and combustion process

[5] Dependent on distance from fuel source – no, if distant source; yes, if nearby source

[6] Impacts vary by type of emission and combustion process