A booklet about

Greening Your Sanctuary

by

Earth Care

Booklet Table of Contents:

I. Why we are greening our sanctuaries

Introduction: Faith communities share commitments to both justice and stewardship of the earth. Recognizing that the climate catastrophe will fall most heavily on the vulnerable poor, we accept our urgent moral responsibility to curb climate change. In honor of Dr. King, Earth Care is sponsoring an intergenerational hands-on event in which we will learn specific skills and actions for reducing energy use in our faith communities as well as our homes – actions which both benefit the earth and cut our costs, leaving more of the earth and its resources to future generations.

IA. Environmental Stewardship, Environmental Justice, & Economics:

- ***Environmental Stewardship***: The earth is a gift from God. "We can't sit on the sidelines and watch creation be destroyed" – Sally Bingham, Grace Cathedral, San Francisco
- ***Environmental Justice***: The poor and disenfranchised people are the first to suffer from unmitigated climate change.
- ***Economics***: Good environmental care goes hand in hand with good economy.

IB. A useful reference on Sustainability and Environmental Justice
"What Is Sustainability, Anyway?" Thomas Prugh & Erik Assadourian
(World Watch Magazine – Sept/Oct 2003)

- ***Four lessons from Easter Island:***

1.) Human beings respond strongly to incentives to overuse resources.
2. We have great difficulty noticing when things are going wrong, unless it happens over relatively short periods.
3.) Declining resources availability can undermine the very organizational structures and capacities needed to fashion a response.
4.) The failure of the Easter Island culture to grasp what was happening to it led, not to its extinction, but to its radical impoverishment.

- ***What to do?***

1.) Returning to a cyclical system- harvesting renewable resources sustainability, reusing and recycling materials in preference to mining virgin ones, rebuilding and nurturing agricultural soils, weaning ourselves off of fossil fuels, and son on – along with respectful husbanding of biodiversity, will start us down the path of material sustainability.
2.) Giving due and purposeful attention to the inequities that lock billions into wretched poverty and undermine the security of all will start us toward social sustainability.

II. The economics of greening our sanctuaries:

Among the ways of making your sanctuary more sustainable, many are more effective than others. This idea is captured in the concept of "return on investment or ROI." For every dollar invested in your sanctuary you will earn back (save) a certain number of pennies each year, a certain percentage of your investment. A related concept it the economic pay-back time, the number of years it takes to recover your investment. Not surprisingly, certain kinds of investments have a greater return on investment than others. That is to say, their pay-back time is shorter.

A useful tool for your sanctuary greening team is a list of potential greening investments in order of their ROI. It often makes sense to start with projects that provide a high ROI, those that give maximum savings for the money (and effort) you spend. These investments are often called the, "low hanging fruit." Energy savings projects provide instructive examples. Knowing the cost of a few forms of energy in Indiana, say electricity (from coal), gasoline (from oil), and natural gas, allows us to estimate the ROI for various energy saving projects.

Not surprisingly, each of these three forms of energy when burned produces carbon dioxide (CO_2), the most important of the greenhouse gasses. Since the consequences of climate change raise social justice issues of direct concern to us in Earth Care, a related and equally important measure of success is the number of pounds of carbon dioxide avoided per dollar invested. For a particular fuel the ROI (dollars saved per dollar invested) is proportional to this new measure (pounds of CO_2 saved per dollar invested).
Both provide an excellent measure against which to measure success.

The ROI list below may be viewed as steps in a process that your sanctuary might like to consider. Clearly, the list might also be considered for use at home. Please add your own contributions to this list from your own experience.

IIA: An Ordered Check List of Return on Investment:

LEVEL I: Highest ROI: (immediate savings)

- GOVERNANCE: an institutional commitment to energy conservation with energy steward, governing board and in-house publicity
- SIGNS: signage on lights, thermostats, doors, windows
- THERMOSTATS: adjusting heating and air conditioning thermostats for lower energy use
- HEATING: holding small meetings in small heated rooms
- WATER TEMP: reducing water temperatures to 95F for faucets and 110F for showers and use lowest appropriate laundry water temperature
- PILOT LIGHT: turning off gas pilot lights in summer
- ELECTRONICS: turning off all sleep-mode electronics
-

LEVEL II: High ROI: Payback times less than 3 years (ROI > 33%)

- AIR LEAKS: air infiltration, weather stripping, caulking [payback ~ 1 year assuming 125W leakage and $1.20/therm natural gas = $45/yr]
- LIGHTING: installing motion sensors on lights [payback ~ 1 year assuming sensor saves 100 W, 5 hours/day]
- BULBS: replacing incandescent bulbs with compact fluorescents (CFLs) [payback 9 months]
- BULBS: replacing tubular fluorescent T-12 lights with T-8 lights [payback 3 years or less if lights used 15 hours/week or more.]
- THERMOSTATS: install and properly site programmable thermostats [payback 6 months or less]
- MAINTENANCE: conduct regular Boiler/Furnace maintenance [payback ~ 1 year]
- WATER: install faucet flow restrictors [payback ~ 1 year]
- LIGHTING: replace Exit signs with LED's. [payback ~ 1 year]
-

LEVEL III: Medium ROI: Payback times of 3-10 years (10%<ROI< 33%)

- INSULATION: increasing ceiling insulation from R-11 to R-19 [payback ~ 5 years in California]
- INSULATION: increasing wall insulation from R-0 to R-11 [payback ~ 9 years in California]
- INSULATION: insulating ducts in unheated areas
- WATER: installing solar water heating [payback ~3-4 years]
- HVAC: replacing a gas furnace with an air-to-air heat pump system in Bloomington
- WATER: installing low-flush toilets
- APPLIANCES: replacing old (1993) appliances with high efficiency Energy Star models (dishwashers, refrigerators) [payback ~ 5 years]
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LEVEL IV: Low ROI: Payback times longer than 10 years (ROI < 10%)

- WATER: installing on-demand water heating on sinks
- HVAC: replacing an air-to-air heat pump by a geothermal heat pump system in Bloomington
- ELECTRICITY: installing a photovoltaic array on the roof (taking advantage of Indiana net metering)
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IIB: An Example House in California

Figure 9.6, plot of energy saved (on vertical axis) vs. investment (on the horizontal axis) gives a lovely sense of the priority one might assign to greening a home in California. Steeper lines show greater energy saving for fewer investment dollars.

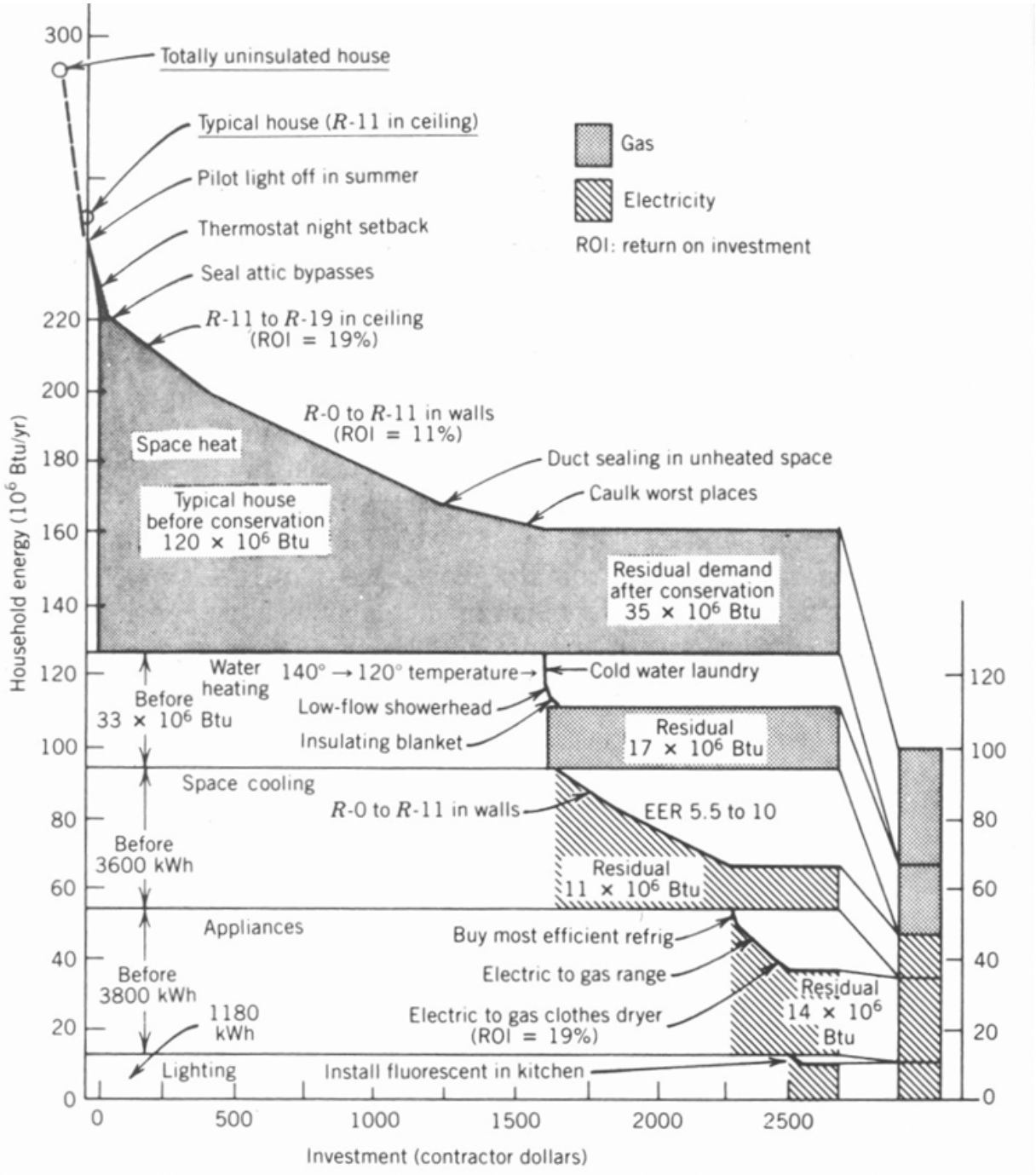

Figure 9.6 Potential energy savings in 10^6 Btu/yr for various energy conservation measures for a northern California house (1200 ft^2, 3000 heating degree days) in terms of the investment required. The shaded areas correspond to energy demand in the form of natural gas and the lined areas electrical energy demand. If all the indicated measures were adopted, the total energy demand per year would be reduced (compared to a totally uninsulated house) by a factor of 3 for an investment of $2700. (Source: Lawrence Berkeley Laboratory Report LBL-11650.)

III. What others are doing to green their sanctuaries

IIIA. GreenFaith's Twelve Priority Measures to Save Energy

Through energy audits at 24 houses of worship, GreenFaith identified the twelve priority items below that tend to yield the greatest energy savings.

People--Develop an institutional commitment to energy conservation.

Governing board commitment. In-house publicity. Appoint and support an Energy Steward.

Temperature --Install and/or Correctly Site Programmable Thermostats. Use 7-day programmable thermostats. Good models available for $70 and under. Payback: 6 months or less.

Temperature --Increase Temperature Setbacks. Lower in winter, higher in summer. Schedule small meetings in small rooms. Cost: $0. Payback: large (= or < 3% of total energy costs)

Temperature --Conduct Regular Boiler/Furnace Maintenance. Keep interior heat exchange surfaces scale-free; net stack temp. 300-400 degrees, CO2 content 10-13%, chimney suction: -0.02" to -0.03". Cost: Depends. Payback: 8 months or less.

Temperature --Insulate and Weather-strip. Cost: Depends on amount of weather-stripping Payback: 5 years, on average

Lighting --Replace Incandescent bulbs with CFL's. Cost: @ $3/bulb. Payback: 9 months.

Lighting --Retrofit Tubular Fluorescent Lights from T-12's to T-8's. Payback: Rooms lit 15 hours/week or more, usually 3 years or less.

Lighting --Retrofit/Replace Emergency Exit Signs with LED inserts. Cost: @ $21 per one. New LED Exit Signs (insert plus case and mount) cost approximately $60. Payback: 1 year. Appliances--Turn off unused computers/equipment. Cost: $0. Payback: Can be substantial. Consider motion sensor switches if efforts to change habits are unsuccessful.

Appliances --Replace inefficient refrigerators/appliances. Replace refrigerators bought before 1993 with new, energy-efficient models. Cost: approx. $450 Payback: 5 years, on average

Water --Install faucet flow restrictors. Faucet flow restrictors, reduce water use (and hot water use) and save energy. Cost: $10-$15/showerhead. Payback: 1 year, on average

Water --Reduce water heater temperature to 110 degrees (for showers, 95 degrees for handwashing Cost: $0

GreenFaith recommends these first steps:

- Install programmable thermostats. Increase temperature setbacks.
- Disconnect unnecessary equipment. Turn off computer equipment on power strips.
- Check seals/weather stripping on windows, doors, refrigerators.
- Replace incandescent bulbs with CFL's.
- Retrofit Emergency Exit signs with LED's.
- For new appliances, buy Energy Star models.
- Schedule meetings to ensure energy-efficient use of space. Small meetings, small rooms.

IIIB. Additional references outside Bloomington

- U.S. Green Building Council (USGBC): Working to advance buildings that are environmentally responsible, profitable and healthy places to live and work. There is a branch in Bloomington

- Companies_Go_Green_Indiana: A list of regional and local green companies [http://articles.directorym.net/Companies_Go_Green_Indiana-r934377-Indiana.html]

- HeraldTimesOnline.com: See for example: Down to Earth, Earth Link, Bloomington Green Events, and Sustainable Living Ideas [http://www.heraldtimesonline.com/earth/]

- Green Sanctuary Task Force Unitarian Universalist Church of Indianapolis: Their activities include: Tree Planting Project, Sharing Nature & Ecology w/ children. They also provide an excellent bibliography on Earning Earth Points (nice list) and on Transportation Action Tips [http://www.uui.org/prog/green/]
- UU Church of Reading Massachusetts Action Plan [http://www.uureading.org/gs/gshome.htm]

  Religious Education including Adult Enrichment , Child RE Curriculum, RE Pledge, and Child's Garden

  Sustainability including Farmer's Markets Support, Landscaping & Grounds, UUCR Solid Waste Reduction & Recycling, Congregational Solid Waste Reduction & Recycling, Automobiles Miles Driven Reduction Campaign, Town Recycling Center, UUCR Resource Reduction Campaign

Worship & Celebration including Greening Sunday Morning Worship Service, Annual Earth Centered Celebrations, Annual Green Brunch

Environmental Justice including Local Charity Energy Efficiency Support, Green Sanctuary Task Force

- Ceders UU Church, Bainbridge Island, WA [http://www.cedarsuuchurch.org] with a program that includes Just and Sustainable Food Systems, World Hunger, Fair Trade, Organic Food, etc.

IV. What others are doing in Bloomington

IVA. Green Sanctuary Task Force on Global Climate Change
Unitarian Universalist Church of Bloomington

The goal of this task force is to explore ways of reducing the ecological footprint of the UU Church of Bloomington and to assist in becoming certified as a Green Sanctuary from the UU Ministry for Earth.

1. To build awareness of societal environmental issues among UU's.
2. To generate commitment for personal lifestyle changes.
3. To motivate UU's to community action on environmental issues.
4. To build a connection between spiritual practice and environmental consciousness.
5. To build awareness of and rectify environmental injustices.

Ongoing Projects/Activities

1. Fair Trade Coffee Sales
2. COB Participation in Mayors' Climate Protection Agreement: To support the City of Bloomington in its adherence to the agreement of 284 U.S. mayors to cut global warming
3. Environmental justice and governmental relations
4. Children's Plant a Row for the Hungry Garden
5. Earth Pledge Points whereby congregants are asked to accumulate at least 365 points over the course of the year, with each point representing a greener alternative to life's various activities

IVB. Other Bloomington references:

- Building Green in Bloomington Indiana – Green initiatives including monthly seminars on basic building science by Bob Geswein [http://www.in.gov/oed/files/John_Hewett_Building_Green_in_Bloomington_Indiana.pdf]

- GreenBuildIndiana – Carol Gulyas' website on green building [http://carolgulyas.typepad.com/green_build_indiana/2008/08/bloomington-ind.html]

- Green Building Incentives Web Site Green building incentives are offered through the following:
    1. State of Indiana
    2. Duke Energy
    3. South Central Indiana Rural Electrical Membership Corp (REMC)
    4. City of Bloomington

http://bloomington.in.gov/documents/viewDocument.php?document_id=2163;

- Bloomington Evergreen Village: EverGreen Village is a 12 unit subdivision being developed by the City of Bloomington Housing and Neighborhood

Development Department as a green-built, Leadership in Energy and Environmental Design (LEED) Pilot project. (add reference)

- Indiana Natural Builders
  Design, consulting, and construction company in Bloomington
  Passive solar, straw bale, cob-earth, cordwood, and timber framing, radiant floor design and installation
  [http://www.buildwithnature.com/]

- Herndon Design
  Green design with radiant heat, on-demand hot water heaters, dual flush toilets, heat pumps, solar heating
  [http://www.russherndondesign.com/green.html]

- Indiana University Field Laboratory
  Research and teaching preserve field laboratory and LEED building
  Advancing environmental science (add reference)

- Excellent sources of weatherization materials:

  1.) Black Lumber - 1710 S. Henderson, Bloomington, Tel: 332-7208

  2.) Bloomington Hardware - S. College Mall Road, Tel: 339-7575

- Sherlock Homes – Dan Killeon (812)339-5828, c.inspector@comcast.net
- Bloomington Commission on Sustainability – Adam Watson in the Mayor's Office, Christine Glaser, Dave Rollo, Jim Sherman, Paul Schneller, Toby Stroub, Michael Leahey, Laura kamp, John Hamilton, Ken Berglund, Geroge Huntington, Stev Ashkin
- INCAA - Indiana Community Action Association – Dan Hartman, (317)638-4232, dhartman@incap.org, good on weatherization for low-income homes
- SIREN – Southern Indiana renewable Energy Network, Terry Usrey, SPEA (812)855-7980, especially on Photovoltaics.
- Caldwell Center for Sustainable Living – Vicky Provine, (812)349-3401, insulation and furnaces
- SCCAP - South Central Community Action Program (812)335-3610 x225 Brian Berkeley, (812)339-3447, Matt Wysocki (8120335-3611 Housing Director, Rick Snow – weatherization for low income homes.
- HEC – Hoosier Environmental Council – Brady Hansel – (317)686-4790, bhansel@hecweb.org, Common Ground Christian Church, Broad Ripple, Kerwin Olson – kolson@citact.org
- HAND – Housing and Neighborhood Development , hand@bloomington.in.gov, (812)349-3420
- Cynthia Schultz – cschultz@alumni.iu.edu
- Bob Geswein (Energy Services at Harrison County REMC (812)738-4115 or (8120923-9819

V. Greening Bloomington's Sanctuaries:
Spring 2009 Campaign

A GREEN TEAM: To assist congregations considering aspects of "greening" their sanctuary, Earth Care is assembling a knowledgeable group from its membership, a "Green Team" willing to consult with congregations and to provide information from the local community.

POTENTIAL AREAS OF EXPERTISE:

- ***Your Carbon Footprint*** – home energy conservation
- ***Heating & AC***, fans, air leaks, heat pumps, geothermal
- ***Lighting*** – light shelves, windows, curtains
- ***Passive Solar*** – windows, insulation, heat sinks
- ***Active Solar*** – PV, solar thermal, thermal storage
- ***Appliances*** – high efficiency, low maintenance
- ***Local Materials*** – carpet, recycled materials, stone, tile
- ***Landscaping*** – native species, trellises
- ***Instrumentation*** – sensors, computer control
- ***Food –*** Energy costs

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A. Appendix of useful information:

Table L.6 gives a sense of the fraction of energy used for space heating (~55%) compared to the next most important energy uses such as hot water (~13%), and lighting (~8%).

TABLE L.6 Energy consumption in the residential sector, 1973.

Use	Direct uses of fuels* (mQ)	Electricity (including waste heat from generation)* (mQ)	Total energy consumption* (mQ)	Percentage of residential sector	Percentage of national total
Space heating	6.4 (+0.7%)	1.26 (+24.7%)	7.7 (+3.5%)	55.4%	10.6%
Hot water	1.2 (+1.3%)	0.62 (+2.5%)	1.82 (+1.6%)	13.1%	2.5%
Lights	0	1.09 (+0.3%)	1.09 (+0.3%)	7.8%	1.5%
Refrigeration	0	0.76 (+4.8%)	0.76 (+4.8%)	5.5%	1.0%
Cooking	0.36 (0%)	0.28 (+3.6%)	0.64 (+1.6%)	4.6%	0.9%
Air conditioning	0	0.56 (+8.3%)	0.56 (+8.3%)	4.0%	0.8%
Television	0	0.42 (+5.9%)	0.42 (+5.9%)	3.0%	0.6%
Clothes drying	0.08 (+2.6%)	0.19 (+8.8%)	0.27 (+6.8%)	1.9%	0.4%
Freezers	0	0.29 (+8.3%)	0.29 (+8.3%)	2.1%	0.4%
Misc. appliances	0	0.22 (+2.5%)	0.22 (+2.5%)	1.6%	0.3%
Dish washers	0	0.06 (+10.6%)	0.06 (+10.6%)	0.4%	0.08%
Washing machines	0	0.04 (0%)	0.04 (0%)	0.3%	0.05%
Total	8.1 (+0.8%)	5.8 (+7.5%)	13.9 (+3.3%)	100%	19.1%

*Figures in parentheses are average annual percentage rates of change during the period 1970–1973.

Table M.1 is useful for comparing typical energy uses of appliances. For example, a microwave oven at 1450 Watts uses less energy than an electric stove at 12,200 Watts.

TABLE M.1 Average wattage and estimated energy consumption of various appliances.

Appliance	Average power required (W)	Estimated electrical energy used per year (kWh)
Air conditioner (window, 5000 BTU/hr)	1565	1390
Blanket	177	147
Broiler	1436	100
Carving knife	92	8
Clock	2	17
Clothes dryer	4855	990
Coffee maker	895	105
Deep-fat fryer	1450	83
Dishwasher	1200	363
Egg cooker	516	14
Fan (attic)	370	290
Fan (circulating)	88	43
Fan (window)	200	170
Floor polisher	305	15
Food blender	385	15
Food freezer (15 ft^3)	340	1200
Food freezer (15 ft^3, frostless)	440	1760
Food mixer	127	13
Food waste disposer	445	30
Frying pan	1200	185
Grill (sandwich)	1160	33
Hair dryer	380	14
Heat lamp	250	13
Heater (portable)	1320	175
Heating pad	65	10
Hot plate	1260	90
Humidifier	175	163
Iron	1000	144
Microwave oven	1450	190
Radio	71	86
Radio-phonograph	110	110
Razor	14	2
Refrigerator (12 ft^3)	240	730
Refrigerator (12 ft^3, frostless)	320	1215
Refrigerator-freezer (14 ft^3)	325	1135
Refrigerator-freezer (14 ft^3, frostless)	615	1830
Roaster	1333	205
Sewing machine	75	11
Stove	12,200	1175
Sun lamp	280	16
Television		
Black & white, vacuum tubes	160	350
Black & white, solid state	55	120
Color, vacuum tubes	300	660
Color, solid state	200	440
Toaster	1145	40
Tooth brush	7	0.5
Trash compactor	400	50
Vacuum cleaner	630	46
Vibrator	40	2
Waffle iron	1115	22
Washing machine (automatic)	512	103

A1: Large Ideas in Green Architecture

- **MIT's Kresge Auditorium (1953)**
  - Eero Saarinen's 1200 tons of concrete shell resting on 3 points with no internal support, 1/8th of a sphere
  - And a new ice skating rink next door!
  - What happened next, do you suppose?

- **University of Alabama: Student Recreational Center (1994)**
  - Spanning Summer/Winter cycle!
  - Geothermal storage of summer heat under the campus for use the following winter.
  - Average ground temperature ~ 65 ^{o}F

Related ideas:
* Winter Ice for summer
* "Flywheel" (geothermal storage)
* Heat Pumps & AC

A Model Green Building Design Mass Audubon's Boston Nature Center

- Photovoltaic Shingles on the cupola illuminate parking lot and entrance
- Solar Thermal Panels heat water
- Trellises shade south side in summer
- Light shelves increase internal light
- Max use of natural light + sensors
- Local materials need min. transport
- Renewable building materials (wood..
- Geothermal heat pumps
- Recycled materials: carpet, tiles
- Low emission paint & carpet
- Landscaping with native species

A2: Excellent References:

- Gershon, David, Low Carbon Diet, A 30-day Program to Lose 5000 Pounds, Empowerment Institute, ISBN 10: 0-9630327-2-0.
- Krigger, John & Chris Dorsi, The Homeowner's Handbook to Energy Efficiency, Saturn Resource Management, ISBN-13: 978-1-880120-18-7.
- Brown, Lester, Plan B 3.0, Mobilizing to Save Civilization, W.W. Norton & Co., ISBN 978-0-393-33087-8, (2008)
- Kraushaar, J.J., & R.A. Ristinen, Energy and Problems of a Technical Society, John Wiley & Sons, Inc., ISBN 0471-51323-7 (1992).
- Romer, Rl.H., Energy An Introduction to Physics, W.H. Freeman & Company, (1976).

A3: Converting from pounds of CO_2 saved to dollars saved:

Many sources in the literature have already calculated the number of pounds of CO_2 you will save by reducing your energy use. For example, David Gershon, Low Carbon Diet tells us that you save 250 pounds of CO_2 per year for each low-flow showerhead you install. It would be useful to know approximately how much this savings in CO_2 is worth to you in *dollars saved*.

The CO_2 you generate comes from one of three sources, electricity mainly from coal (C) in Indiana, natural gas (CH_4), and gasoline (C_8H_{18}). Here in Indiana we know the present price of each of these commodities and from these prices per kilowatt hour (or per cubic foot or per gallon), we can calculate the dollar amount that goes with each pound of CO_2 generated. These three numbers are also the number of dollars saved for each pound of CO_2 not produced.

Electricity: At the moment here in Indiana electricity costs us about 8¢ a kilowatt hour ($0.08/kWh). Knowing that Indiana coal produces about 12,000 Btu of energy per pound, and that a typical coal plant is about 40% efficient, we easily calculate the number of pounds of CO_2 needed to generate one kWh of electric energy. If we save one kWh, we have saved 8 cents and have also saved this many pounds of CO_2.

$$1\text{kWh elec} \times \frac{1\text{kWh heat}}{0.4\text{kWh elec}} \times \frac{1\text{ pound Coal}}{12{,}000\text{ Btu}} \times \frac{1\text{ Btu}}{1055\text{ J}} \times \frac{3.6\times10^{6}\text{J}}{1\text{kWh}} = 0.71\text{ pound of Coal}$$

Indiana coal is about 70% carbon giving:

$$0.71\text{ pound Coal} \times \frac{0.70\text{ pound C}}{1.00\text{ pound Coal}} = 0.50\text{ pounds C}$$

and, because CO_2 contains one carbon atom (16) and two oxygen atoms(16 each), for a total molecular weight of 44, the weight of the CO_2 produced is:

$$0.50\text{ pounds C} \times \frac{44\ CO_2^{*}}{12\text{ C}} = 1.83\text{ pounds } CO_2$$

In summary, you save 8¢ for every 1.83 pounds of CO_2 saved by reducing your electricity. This amounts to:

$$\frac{8\text{ cents}}{1.83\text{ pounds}} = \boxed{\textbf{4.4¢ per pound of } CO_2 \textbf{ saved.}}$$

In table form:

Pounds CO_2 Avoided	Profit to you	Energy Saved
1 pound	4.4¢	0.55 kWh
1.83 pounds	8¢	**1 kWh**
22.7 pounds	**$1.00**	12.5 kWh

For example, David Gershon points out that each incandescent bulb replaced by a CFL saves 100 pounds of CO_2 per year. The table above tells us that you also save $4.40

per year for every bulb replaced! Replacing 10 bulbs saves $44/year or $220 over the five year lifetime of the bulbs.

Natural Gas (CH_4): At present in Indiana the price of natural gas is about $1.00 per hundred cubic feet (or therm). Since a therm weighs 5.55 pounds, we can easily calculate the number of pounds of CO_2 produced when a therm is burned.

$$1\text{therm} \times \frac{5.55 \text{ pounds } CH_4}{1 \text{ therm}} \times \frac{12 \text{ C}}{16 \text{ } CH_4} \times \frac{44 \text{ } CO_2}{12 \text{ C}}^{*} = 15.3 \text{ pounds } CO_2$$

So, for every therm saved, you save both 15.3 pound of CO_2 and you save $1.00. That is, you save.

$$\frac{\$1.00}{15.3 \text{ pounds } CO_2} = \boxed{\textbf{6.5¢ per pound of } CO_2 \textbf{ saved}.}$$

In table form…

Pounds CO_2 Avoided	Profit to you	Energy Saved
1 pound	6.5¢	0.065 therms
15.3 pounds	$1.00	**1 therm**

For example, if you lower your thermostat saving 1000 pound of CO_2 per year, you save $65.00 a year.

Gasoline (C_8H_{18}): At the moment the price of gasoline in Indiana is about $2.00/gallon and a gallon of gasoline weighs about 6.6 pounds. From this information we can easily calculate the number of pounds of CO_2 saved for every gallon saved.

$$1 \text{ gallon} \times \frac{6.6 \text{ pounds}}{1 \text{ gallon}} \times \frac{96 \text{ C}}{114 \text{ } C_8H_{18}} \times \frac{44 \text{ } CO_2}{12 \text{ C}}^{*} = 20.4 \text{ pounds } CO_2 \text{ per gal}$$

So, for every gallon saved, you save both 20.4 pounds of CO_2 and $2.00. That is, you save

$$\frac{\$2.00}{20.4 \text{ pounds } CO_2} = \boxed{\textbf{9.8¢ per pound of } CO_2 \textbf{ saved}.}$$

In table form:

Pounds CO_2 Avoided	Profit to you	Energy Saved
1 pound	9.8¢	0.05 gallons
20.4 pounds	$2.00	**1 gallon**

So, if you drive less, saving 1000 pounds of CO_2 per year, you are saving $98.00/year.

In Indiana for a given amount of energy, electricity generation from coal produces more carbon dioxide than either natural gas or gasoline. The reason for this is simply that a major part of the energy from natural gas (CH_4) or from gasoline (C_8H_{18}) comes from the

burning of the hydrogen whereas coal contains very little hydrogen. This argues for strong reduction in our use of electricity. However, in Indiana electricity is cheaper than almost anywhere in the country, so cheap that you only save 4.4¢ for every pound of CO_2 produced. In Indiana the relative cost of energy favors reducing gasoline use first (saving 9.8¢ per pound of CO_2 produced) and reducing electricity last (at only 4.4¢ per pound of CO_2).

In summary, we may now make a table of savings in dollars for each of the items in David Gershon's Low Carbon Diet (ISBN 13:978-0-9630327-2-0). We begin such a list here:

Gershon's Ch.	**Action**	**CO_2 (#)**	**$/yr Saved**	**Engy**
1 Garbage	35 gal → 20 gal each week	1,560	**$52.00****	
2 Showers	3 members reduce to time to < 5min	900	**$58.50**	NG
3 Dishes	Reduce by 1 washer/week	100	**$6.50**	Elec
4. Clothes	Reduce by 1 dryer load/week	260	**$11.44**	Elec
5. Thermostat	65-68 Day, 55-58 Night	1400	**$91.00**	NG
6. Elec. Leaks	Turn equipment all the way off	600	**$26.40**	Elec
7. Air Condition	Replace filter	350	**$15.40**	Elec
8. Car 15,000m	Reduce driving by 10%	1000	**$98.00**	Gaso
9. Driving smar	55mph, steady, plan your route	1100	**$107.80**	Gaso
10. Eating	Meat-based → Veg one day a week	700	**$68.60*****	Gaso
11. Water Heat	Set thermostat at 120oF	120	**$7.80**	NG
12. Lighting	Replace 5 bulbs with CFLs	500	**$22.00**	Elec
13. Air Leaks	Thorough sealing air leaks	800	**$52.00**	NG
14. Furnace	Seal/insulate warm air ducts	800	**$52.00**	NG
15. Insulation	Add insulation to ceiling/walls	1200	**$78.00**	NG
16 Green Powe	Purchase 100kWh of green power	200	**$8.80**	Elec

*[Sometimes people give the number of pounds of carbon saved rather than the number of pounds of CO_2. In that case you get to multiply the above numbers by 44/12.]

** Reducing garbage saves gasoline (9.8 cents/pound CO2) and reduces greenhouse gas generated by anaerobic decomposition. At $2.00 per 35 gal container, reducing trash to one container every two weeks saves $52.00 a year.

*** We assume that the majority of the saving is in the form of gasoline (6.5¢/pound CO_2) for transport and tilling.