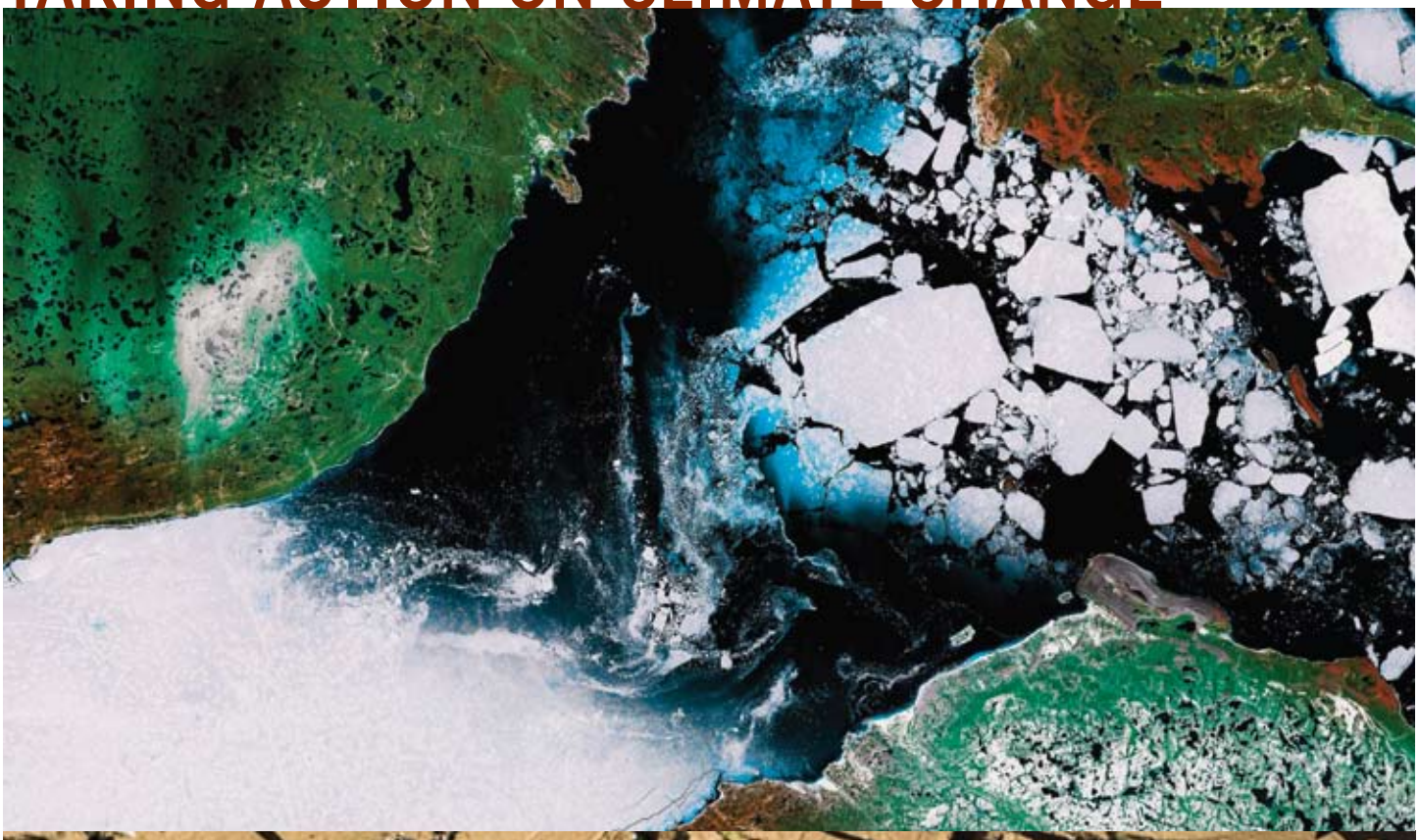
TAKING ACTION ON CLIMATE CHANGE



THE PROBLEM

ENVIRONMENT AND ENERGY SECURITY

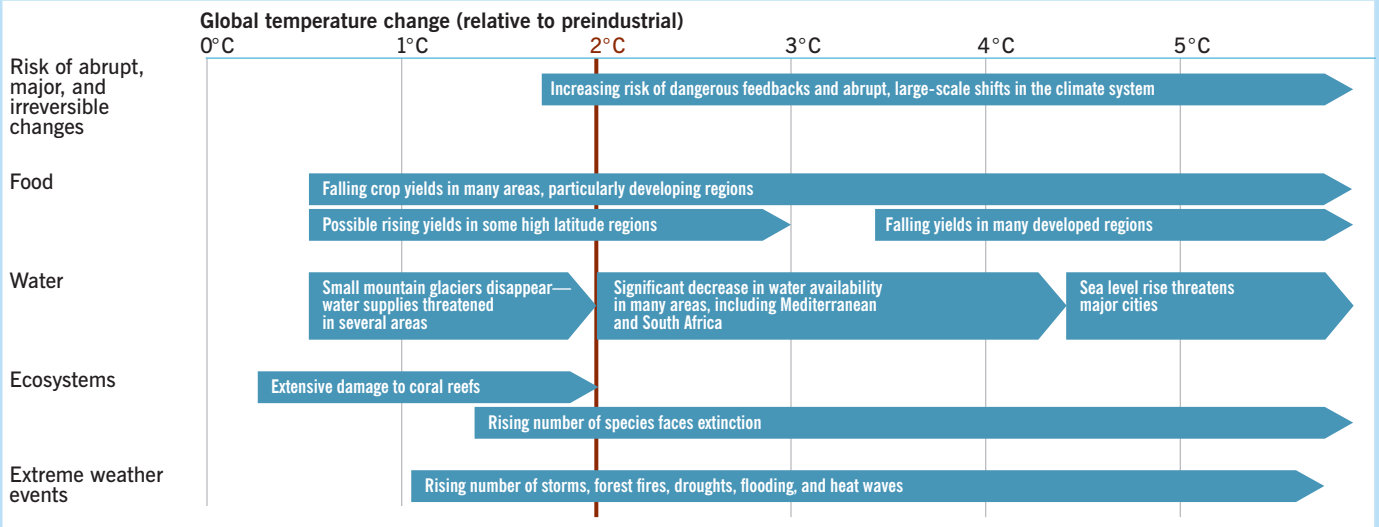
Fossil energy—coal and oil—has fueled tremendous economic growth over the last century, but at substantial, and growing, environmental cost. The U.S. Environmental Protection Agency and Department of Energy statistics show energy use is the leading cause of global warming pollution, smog, acid rain, nuclear waste, and air toxics.

The threat of climate change is the greatest environmental problem humanity has ever faced. The links between human-caused carbon dioxide (CO_2) emissions—a by-product of burning fossil fuels—and rising temperatures get stronger with each iteration of the science of climate change.* The consensus of the world's leading scientists is that to avoid the most disastrous impacts of global warming, we must not exceed a 2°C rise in average temperature. This requires stabilizing carbon concentrations of the world's atmosphere at 450–500 parts per million (ppm) CO_2.

This, in turn, requires a 50 percent reduction in global warming pollution by 2030 and an 80 percent reduction by 2050. In effect, the world has to reinvent its energy system or face catastrophic global consequences—from more extreme storms and droughts, to sea level rise, to changes in weather that impact crop production, to destruction of the world's coral reefs and acceleration of species extinction.

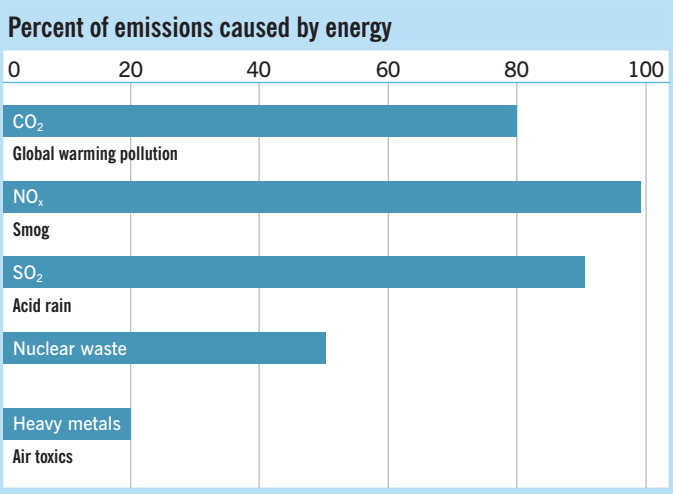
We must reinvent our energy system with new energy technologies. For example, in 2006 alone, China built over 100 new coal-fired power plants—90,000 megawatts of new power, almost double California's total peak electrical capacity. China is now expected to surpass U.S. carbon emissions before 2010, becoming the world's largest carbon emitter. India is on a similar high-fossil energy-growth trajectory.

Significant negative impacts of climate change arise at >2°C and catastrophic effects become more likely



Source: Adapted from Stern Review, *2006*

*For example, the most recent Intergovernmental Panel on Climate Change report released in early 2007 states, "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level."



Source: Energy Foundation

This challenge is made especially difficult because normal economic constraints will not solve it. There are vast reserves of coal, natural gas, and oil, especially when you include tar sands and oil shale. **The major crisis in energy turns out to be that the capacity of the environment—our atmosphere, forests, soils, rivers, and oceans—to absorb the wastes of our energy-intensive society is threatened long before energy supplies will be exhausted.** *Laissez-faire* economics, wherein prices rise due to supply scarcity and so drive investment in new energy options, will not solve this dilemma.

Sensible policy to save the environmental systems is needed to move developed and developing nations to a sustainable energy path. Foundations can help create and advance new policies, which in turn can drive billions of dollars into the cleanest technologies and reduce hundreds of millions of tons of global warming pollution.

TECHNICAL POTENTIAL

The largest, fastest, cheapest way to abate climate change is to reduce energy waste. Almost all processes in the economy—lighting, motors, transportation, etc.—can be done with half, or less, of the energy that is typically used today. Cutting energy waste pays for itself, can dramatically reduce CO_2 emissions, and by reducing energy demand, will help non-carbon energy sources meet a greater share of energy use.

With today's technologies and costs, 40 percent of U.S. natural gas and a third of U.S. electricity could be saved—while saving money. The savings would be more than twice the energy produced by the entire fleet of U.S. nuclear power plants.

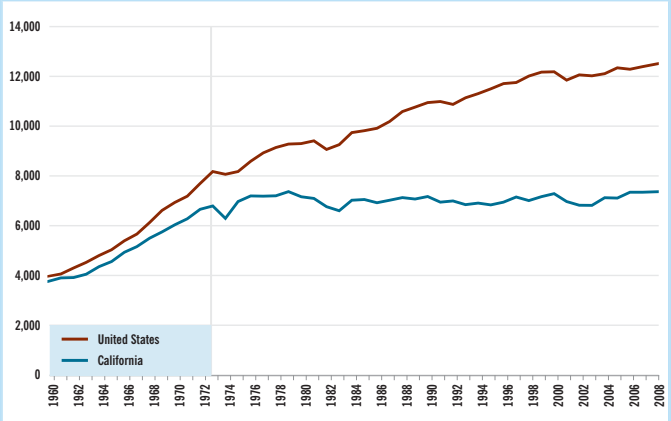
POLICY TO GET THERE

- Set clear performance standards for appliances and equipment
- Set strict building codes
- Change utility regulations so that utilities earn the most money when they find the most savings

WHERE HAS IT BEEN DONE?

California has the best building codes and the best utility regulations in the world. The United States has reasonable appliance and equipment standards. Europe and Japan have a mixed record. China is moving forward on appliance standards, but lags in the other realms.

Per capita electricity sales (kilowatt hours per person)



Since 1972, California per capita electricity use remained constant while U.S. use increased by more than 50 percent.

Source: California Energy Commission (2006 to 2008 are forecast data)

The roof of the Ford truck manufacturing plant in Dearborn, Michigan (opposite), is the largest so-called "living" roof in the world at 10.4 acres. It features sedum, a perennial ground cover that reduces energy costs, absorbs carbon dioxide, limits storm water runoff, and provides a habitat for birds and insects.

WHAT CAN PHILANTHROPY DO? HOW?

Help develop and spread the regulations that make energy efficiency profitable for utilities. This turns utilities into powerful allies on deploying new technologies. Foundation dollars can exert 1000 to 1 leverage here. Focus on moving the best codes and appliance standards from one jurisdiction to another.

TECHNICAL POTENTIAL

Wind power is now as cheap as any fossil alternative in areas with strong winds and access to transmission lines. Wind prices have dropped tenfold in twenty years. Global wind power resources are enormous, with much of the resource in North America and Europe. Central station solar power to generate electricity looks promising in the western United States. Solar cell power, shown on the facing page, is still about four times as expensive as fossil fuels, but prices are dropping fast with increased production. The worldwide solar market is growing at more than 30 percent per year.

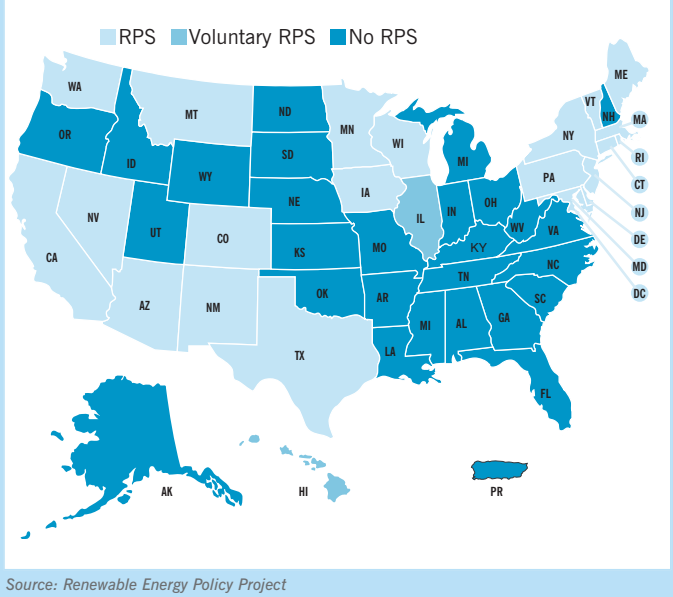
POLICY TO GET THERE

The most effective policy has been the renewable portfolio standard (RPS), which requires utilities to supply a growing portion of their electricity from renewable sources. Twenty-two states have now passed an RPS, creating some $45 billion in renewable energy investments.

WHERE HAS IT BEEN DONE?

The most ambitious renewable portfolio standard currently in existence is The California Renewable Portfolio Standard, which requires 20 percent renewable energy by 2010. Each state's RPS is shaped by a variety of regional factors including cost, political climate, resource availability, state electricity consumption, and so on. RPS laws are thus structured very differently across the states, and requirements for renewable energy production vary greatly.

REPP renewable portfolio standard (RPS) map



Source: Renewable Energy Policy Project

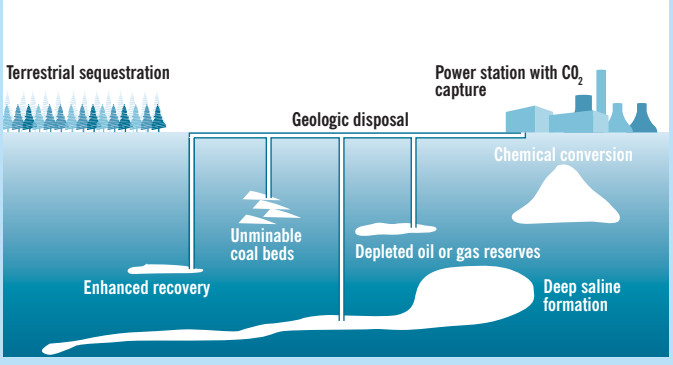
WHAT CAN PHILANTHROPY DO? HOW?

We need to secure a federal RPS. This would double investments in renewable energy to some $80 billion over the next decade. Focused efforts in Washington, D.C., and key states can win this policy. The nation also needs to quadruple renewable energy research and development, which would bring down the price of technologies such as photovoltaic cells and cellulosic ethanol. This will require the development of a new federal energy R&D lobby.

TECHNICAL POTENTIAL

Efficiency is the fastest, cheapest way to reduce the need for new coal power plants, and new renewable energy technologies, like wind, can displace many new plants. But coal power plants will continue to be built in fast-growing economies like China or fast-growing states like Texas. It is possible to build power plants with an Integrated Gasification Combined Cycle (IGCC) technology that can cut CO_2 emissions by increasing energy efficiency. But IGCC offers a further bonus: it creates a stream of pure CO_2, which can then be pumped into old natural gas wells or deep saline reservoirs, thereby "sequestering" it.

Carbon sequestration options



The full potential of IGCC plus carbon capture and sequestration (CCS) is not known, but new coal plants should, at the minimum, have IGCC technology, and CCS should be developed. In fact, a fair goal would be to build no more conventional pulverized coal power plants. As a motivator, consider that the conventional coal power plants currently planned for construction would, if built and operated their full design lives, emit as much CO_2 as all coal plants ever built to date.

POLICY TO GET THERE

Clean coal will not happen unless state public utility commissions require it—or if they receive subsidies. The extra cost of IGCC plus CCS is estimated to be about 3 cents per kilowatt-hour. This is a small amount when blended into total system costs, but it is a significant boost in per-plant costs. Getting state public utility commissioners to specify IGCC plus CCS requires focused, local advocacy.

WHERE HAS IT BEEN DONE?

No state has a full-blown transition program yet, but California now prohibits the purchase of any electricity from new, conventional coal plants, and Colorado has worked with the utility Excel to ensure its next plant has IGCC and possibly will include carbon sequestration.

WHAT CAN PHILANTHROPY DO? HOW?

Preventing the construction of a fleet of obsolete, pulverized coal plants is a top priority for climate change philanthropy. Focused regional campaigns that delay permitting of obsolete plants and encourage the deployment of IGCC plus CCS can win the day.

TECHNICAL POTENTIAL

The best cars use half the energy of the average—without reducing size or utility. This enhanced performance could be increased by 50 percent with advanced lightweighting. Incremental strategies to cut weight substitute, for example, aluminum for steel in key parts. Advanced strategies would entail a whole-car design based on advanced materials, like carbon fiber. Complementary technologies to make cars more efficient include hybridization, advanced diesels, advanced engine and transmission technologies, and better aerodynamics.

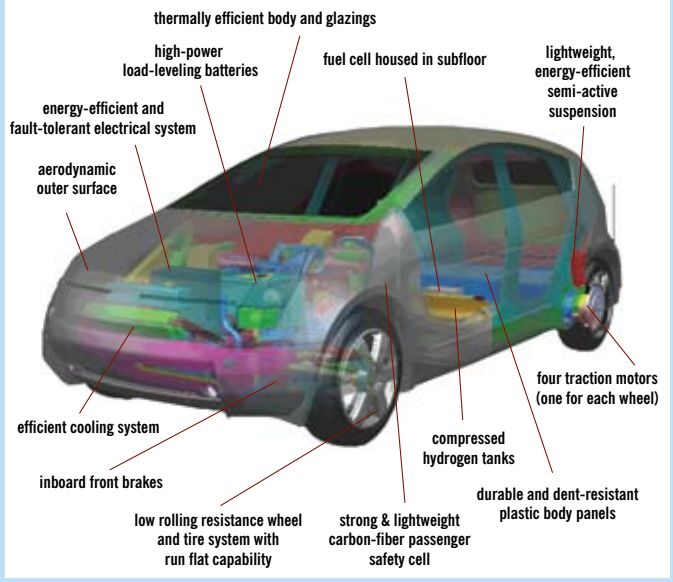
POLICY TO GET THERE

Fuel efficiency in autos requires policy. In the United States, we will ultimately need federal standards policy, but intransigence in Washington, D.C., has heretofore led states to establish greenhouse gas emissions (GHG) standards for autos. California's Pavley Bill, signed by Governor Schwarzenegger, will reduce GHG emissions by about 30 percent—if it survives a legal challenge by the auto companies.

WHERE HAS IT BEEN DONE?

California, China, Europe, and Japan have strong standards for reducing fuel consumption in autos. Another dozen U.S. states are poised to follow suit if California's program is upheld in the courts.

Anatomy of Hypercar, Inc.'s *Revolution* concept vehicle



Source: Hypercar, Inc. ©2002

WHAT CAN PHILANTHROPY DO? HOW?

- Spread the California program to other states, then use state momentum to seek federal fuel economy policy.
- Support work in other countries like China, Mexico, Brazil, and Canada to get them on a strong path.
- Help invent new approaches that reward the manufacturers and purchasers of the most efficient vehicles.

TECHNICAL POTENTIAL

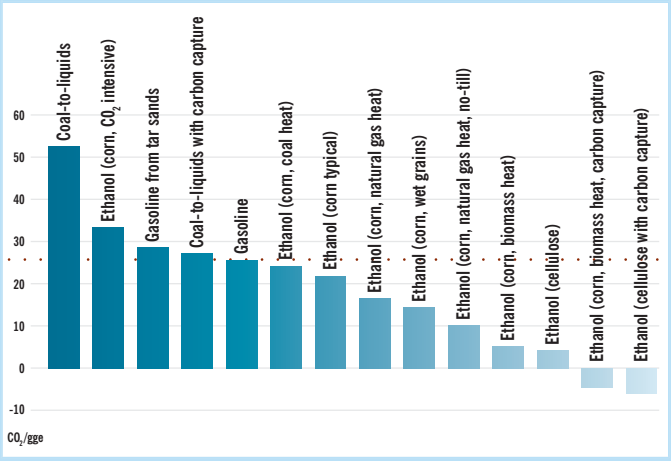
The right kind of biofuels, teamed with a more efficient vehicle fleet, could reduce gasoline use in light-duty vehicles by more than half by 2050. Eight million barrels of oil could be displaced daily—more than three times our current Persian Gulf imports. To reach this vision, we have to move beyond corn—which is only marginally beneficial—to advanced biofuels.

The answer lies in unlocking the energy potential in cellulose. Cellulose is the most common cell in the plant world and makes up much of the stem and leaves of many plants. By tapping the energy in cellulose we open a vastly expanded—and much more sustainable—supply of feedstocks such as wheat straw, rice husks, forestry waste, and perennial crops like native switchgrass. Plus, cellulosic ethanol is up to six times better than corn ethanol in terms of reducing global warming pollution.

POLICY TO GET THERE

Cellulosic ethanol is ready to go to commercial scale, bringing innovations to production and driving costs down. Policy can help launch a new industry. Two efforts are most promising: federal commercialization funds in the Energy Policy Act of 2005 and, potentially, in the next Farm Bill; and state low-carbon fuel standards that create a long-term market signal for this new industry.

Life cycle carbon emissions of various fuels



Source: Natural Resources Defense Council

WHERE HAS IT BEEN DONE?

Iogen, backed by Shell, has a cellulosic ethanol plant in Ottawa. The first commercial U.S. plant will likely open in 2009 in Idaho, running off wheat straw and supported by federal funds. Other cellulosic ethanol plants are proposed in Georgia, Kansas, and California.

California is the first state to propose a Low Carbon Fuel Standard, which creates a long-term market for clean, low-carbon fuels like cellulose. The European Union is proposing a similar fuels standard.

WHAT CAN PHILANTHROPY DO? HOW?

Steer the market investment toward low-impact biofuels through **low-carbon fuel standards** and other policies that set the bar for environmental performance. Spur public and private investment in technology capable of using diverse feedstocks. Support R&D and commercialization efforts at the state and federal levels. These policies will dramatically speed the development of large-scale, cost-effective, low-carbon biofuels.

ACCELERATE THE TECHNOLOGY DYNAMIC

BACKGROUND

Tomorrow's energy options depend on today's research investments. When energy research and development was at its peak during the Carter years, advanced technologies were developed—for lighting (compact fluorescent bulbs), windows (low-E windows), gas turbines, and dozens of other uses—that make it possible today, thirty years on, to slash energy use. Unfortunately, the feedstock of new technologies dropped precipitously as R&D budgets were slashed. Today, less than one-half of 1 percent of our annual energy bill—never mind capital stock investments—is spent on R&D, counting public and private sources combined!

The future of green design

	Old	Current	Future
LIGHTING lm/w = lumens per watt	Incandescent or halogen 10–20 lm/w	Compact fluorescent 35–70 lm/w	Light-emitting diode 70–100 lm/w The oscillation of electrons in bundled semiconductors produces light. Some LEDs already achieve the efficiency of compact fluorescents and are now well on their way to exceeding it. Time frame: 2 years
WINDOWS SHGC = solar heat gain coefficient	Single pane SHGC = 0.76	Double glaze, low-E SHGC = 0.25	Transition metal switchable SHGC = 0.04–0.50 A small electric current converts thin film from transparent to mirrored, squelching solar heat gain from the outside during the cooling season and retaining interior warmth during the heating season. Time frame: 3 years
HOME INSULATION R = resistance to heat flow	Fiberglass batt insulation R-3.3/inch	Expanded polyurethane insulation R-6.2/inch	Vacuum-insulated panel R-30/inch Airtight panels with evacuated cores take advantage of the principle behind a Thermos bottle, but drive a nail into one and all is lost. More research is required to move these panels into home construction. Time frame: 10 years

Source: Popular Mechanics

CAN R&D FUNDS BE SPENT EFFECTIVELY?

U.S. energy R&D has been analyzed by a number of groups, from the National Academy of Sciences to the President's Commission on Science and Technology. They have found that in its best examples, the Department of Energy and key national labs run first-rate energy R&D programs. There is a repeatedly identified gap in funds for preparing products for market through advanced engineering, and a further shortage in programs to stimulate early markets. But the basics of how to do these things effectively are known and proven.

THE NEED AND OPPORTUNITIES FOR PHILANTHROPY

There is essentially no lobby for energy R&D. Activists generally consider the prospects for improvement too remote and see R&D investment as a chance for politicians to dodge tougher issues, like actually capping carbon emissions. Scientists are notoriously bad at lobbying, except occasionally for their own projects. This is essentially an empty space.

A concerted effort to dramatically raise U.S. funds spent on R&D would have a good chance of success in Washington, D.C., since this is a nonpartisan issue, and it plays well upon the American know-how theme.

Keep in mind the basic issue of scale: U.S. R&D on low-carbon technologies is about $1.2 billion per year today. It would take a hundred years of effort at this level to equal a year's budget for our forces in Iraq.

PRINCIPLES FOR EFFECTIVE PHILANTHROPY IN ENERGY

FOCUS

Know the facts, know the strategies, and especially know the decision-making venue. The energy industry is large and is populated by enormous vested interests—and they are generally inclined to resist change. The scale of the energy business is also huge—some $4 trillion per year, worldwide. Philanthropy in the field therefore needs to have an intense focus, aimed at changing decisions in the pinch points in the system. Building codes, utility regulations, and auto fuel efficiency standards, for example, can affect hundreds of billions of dollars of capital investments, switching these capital flows from high-carbon to low-carbon alternatives.

DESIGN TO WIN

Build the strength to win in the venue. Use whatever tools are necessary to get the job done. When a venue is selected, learn it well, and then select the best strategies to win. The list below hints at the range of options available and gives examples of where they can be used. But these are not random choices and are not equally likely to succeed in any situation. Venue knowledge can tell you which to use, when, and with what intensity.

- Economics arguments (State Public Utility Comission (PUC), RPS)
- Technical (building codes)
- Science (California Global Warming Solutions Act of 2006 (AB 32))
- Legal (Pavley, PUC)
- Public opinion (RPS)
- Grasstops (AB 32)
- Grassroots (California Zero-Emission Vehicle Regulations)

STAY THE COURSE

Social change is never fast. Large-scale change requires funding the full cycle, from idea origination to selling to early adopters to mass rollout to serious implementation. Jumping in and out is unlikely to produce serious results.

JOIN WITH OTHERS

Very few foundations have the mass, patience, and expertise to transform decisions in any one venue. An organized strategy can use the strengths of colleagues to win.

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