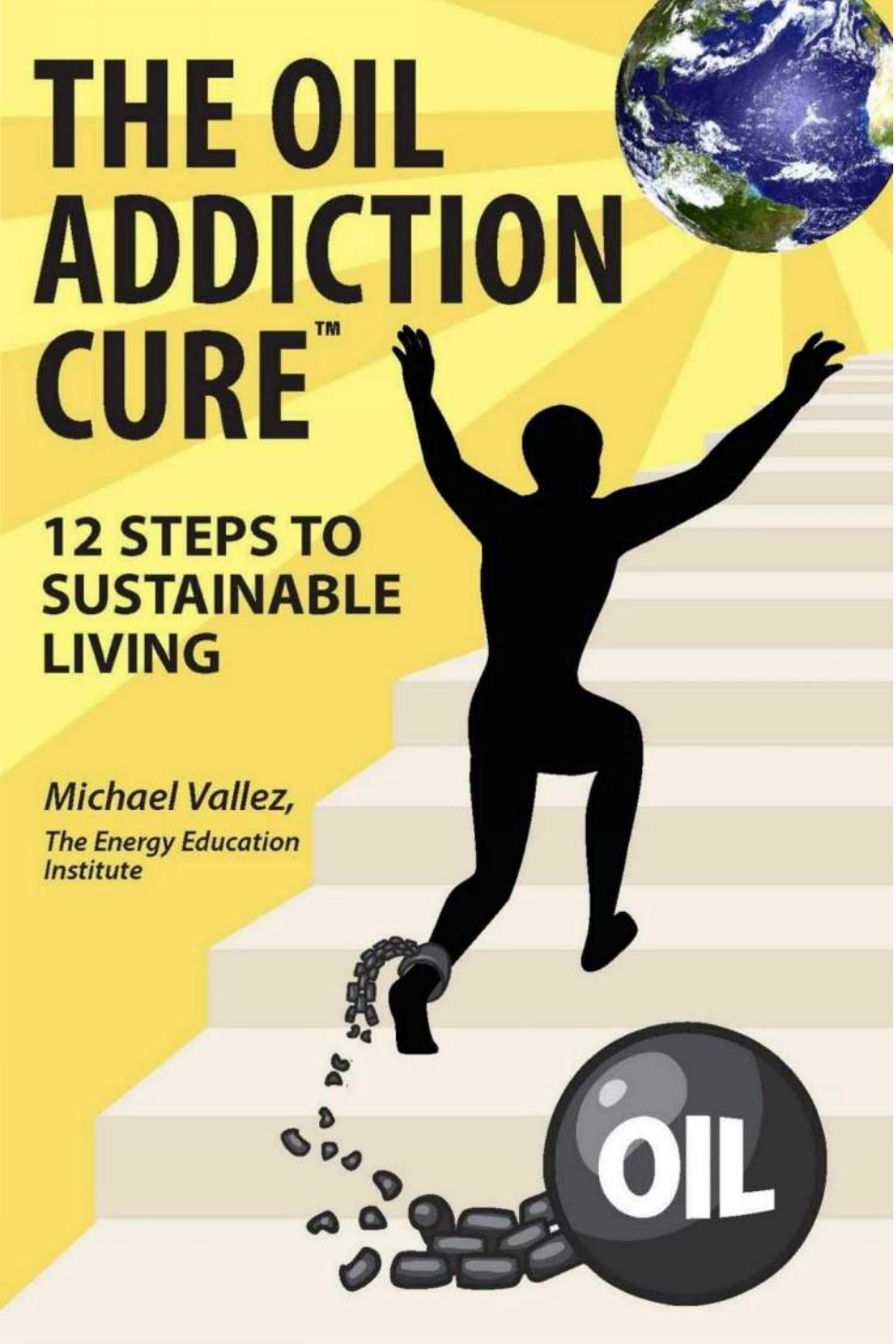
THE OIL ADDICTION CURE™

12 STEPS TO SUSTAINABLE LIVING

Michael Vallez,
The Energy Education Institute



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12 Steps to Sustainable Living

Michael Vallez, PE

The Energy Education Institute

FOR

Rebecca

Michael

David

Anna

"And our small planet at this moment, here we face a critical branch point in history, what we do with our world, right now, will propagate down through the centuries and powerfully affect the destiny of our descendants, it is well within our power to destroy our civilization and perhaps our species as well. If we capitulate to superstition or greed or stupidity we could plunge our world into a time of darkness deeper than the time between the collapse of classical civilization and the Italian Renaissance. But we are also capable of using our compassion and our intelligence, our technology and our wealth to make an abundant and meaningful life for every inhabitant of this planet." —Carl Sagan

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FOREWORD

When I first started writing this foreword, the oil spill in the Gulf of Mexico was on day 53. The scale of the oil leak had just been revised upward to 40,000 barrels per day; the original estimate was 1,000 barrels per day. Day after day, for 53 days, people all over the world followed this front-page story as the oil spewed out into the waters of the Gulf of Mexico and onto the shores of our Southern states. The collective public feelings of helplessness turned into anger focused at BP. But if we let our anger stop there, what have we gained? It's time to take our anger about the oil spill, fear of peak oil, anxiety about climate change, and frustration with Congress and turn them into personal and intelligent action.

Now, as we're sending the book to the printer, another potential disaster looms. A tragic earthquake and tsunami hit Northern Japan and damaged a nuclear power plant in Fukushumu. We still don't just how catastrophic this event will be. We're looking at nuclear power plants in this country—some of them built very near fault lines—and again wondering what we should do to protect ourselves from the horror that is facing Japan.

What actions would be most intelligent, most effective? Do we really need to endanger our environment and our very existence to produce enough energy to live? Are oil, gas, coal, and nuclear power the only alternatives? Politicians, corporations, marketers, and bureaucrats have obscured the facts with propaganda and false information to the point where it would take an enormous amount of research to figure out what to do.

I've done that research. And I've written four books that form an encyclopedic compendium on sustainable energy and conservation that will sweep away confusion and provide a comprehensive and clear vision of the dramatic changes that are coming upon us as well as what each of us should do to help the transition. This is the first book in the series, and focuses on you, the consumer. Books II, III, and IV show strategies for government, industry, and the global community. (See page 183 for more information about the books.)

Publication of this book series is part of the overall mission of The Oil Addiction Cure Project and The Energy Education Institute to help

facilitate the transformation to a sustainable civilization. Our multi-channel, multimedia effort will support readers who wish to implement the ideas we present. Our website (www.TheOilAddictionCure.com) provides links to the necessary products, services, and informational films. "Oil-Anon" support groups, where teams can gather together to make positive changes in their lives and communities, are being formed around the country. I am setting up lectures and seminars nationwide to spread the word.

People ask me all the time how I've had the nerve to take on a project of this magnitude. I'm one man. I'm not backed by a government, by a massive fortune, by an industry. My first answer is to show them my credentials. I'm an engineer, and I've worked on dozens of energy-related projects with budgets that add up to over a billion dollars. As an energy auditor, I crawled through hundreds of basements and attics and talked to hundreds of homeowners about energy. I've traveled all over the world and seen the new technologies that are being developed. My second answer is that I've had a personal and spiritual response to everything that I've encountered on my travels and in my life. Everything I've experienced and been inspired by has led me to a position where I see both the big picture and the nitty-gritty details. I know that the way we are using energy today can lead to destruction of our civilization and is already leading to desperate poverty in developing countries. I see both the problem and solution clearly and my question to my doubters is, "How could I not do whatever I can?"

I sometimes think that every step in my life, even before I knew what I'd be doing, has led me to this point. I don't feel that I chose this mission; I feel that it chose me. I merely responded taking the next step in the path that appeared before me. Someone said, "God only puts enough oil in your lamp to illuminate the path right in front of you." My path continues with the publication of The Oil Addiction Cure series.

MIKE VALLEZ,
MARCH 2011

PART I

Part I covers the current energy situation, how we got here, and what we can do to make it better. In Chapter 2, I relate how I became involved in this journey. Chapter 3 describes new energy sources.

CHAPTER 1

A CALL TO ACTION

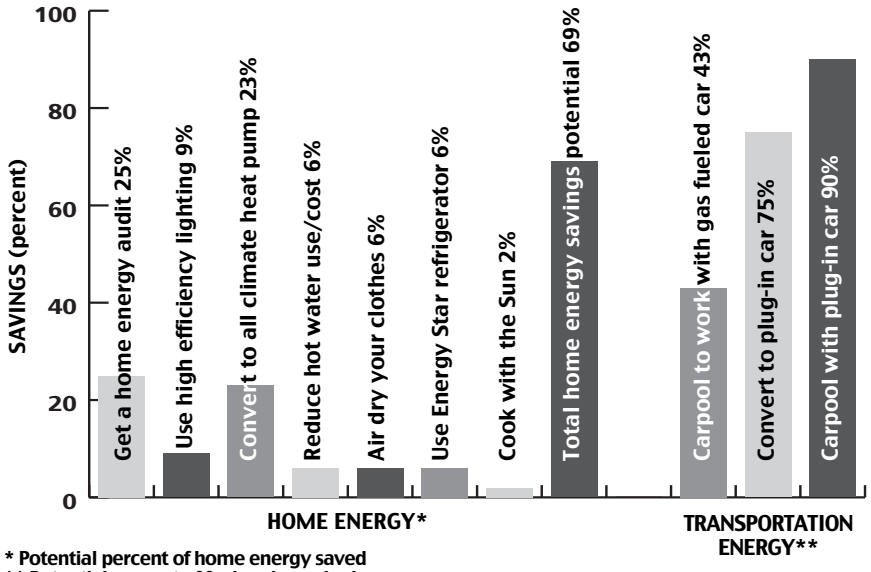
Our addiction to oil, and why we have to cure it

As you open this book, the first in a series by The Energy Education Institute, you are embarking upon a sweeping investigation into the way energy is produced and used in America and around the world. You're about to discover how and why we have come to rely on energy sources that are rapidly depleting and how and why we can replace them with better, cleaner forms of energy that will last forever. You are about to join in a dramatic effort to save us all from an energy crisis that could plunge us back into the dark ages.

Yes, we will get to all that. But first, I'm going to focus on simple, basic issues. We don't have to think globally or philosophically or even scientifically to appreciate what this book has to offer. We are starting with the first benefit you will enjoy from the first book in this series. This book will save you money—lots of money. If you follow the advice in these pages, you will save up to $3,000 a year at current energy costs—a 200-percent return on your $15 purchase price.

The Oil Addiction Cure project is based on ten years of research that would have cost millions of dollars if performed by an energy consultantcy. It focuses on how we produce and use energy and how we can do it better without reducing our quality of life significantly. We will not worry about saving the world right now—curing our oil addiction will certainly make a better world, but that's just a bonus. Let's just concentrate on you.

What I am going to do is help you make important choices about your home, your car, your work, your appliances, and the food you eat—decisions that will save you money for decades. After all, the average road life



*** Potential percent of home energy saved**
**** Potential percent of fuel savings, single car**
NOTE: These figures provide an average of savings. Energy costs vary widely depending on your climate and lifestyle. See page 190 for additional explanation.

of a car purchased today is about seventeen years; the average life of a home heating unit is about fifteen years; a house can last for hundreds of years. So if we want to avoid costly mistakes—mistakes that we will regret in the near future—we need to understand how the world is going to operate in the next few years.

FACING AN UNAVOIDABLE TRUTH

We need to understand a truth that the world has been hiding from since the Industrial Revolution, the fact that we have built our lives around the use of finite resources, such as oil, coal, and natural gas. And geologists have shown us, indisputably, that we are going to find fewer of these resources as time goes by. The time is coming when these nonrenewable resources won't be available to us in the way we have become accustomed to acquiring them at a price anywhere near what we can afford.

You can change the effect that this fact will have on your life. There are concrete, practical steps that every consumer can take to make this crisis less painful. The steps that I will outline in this volume are aimed at individuals. They will change your life and the lives of your children and grandchildren. Some of these steps require investment and research; some

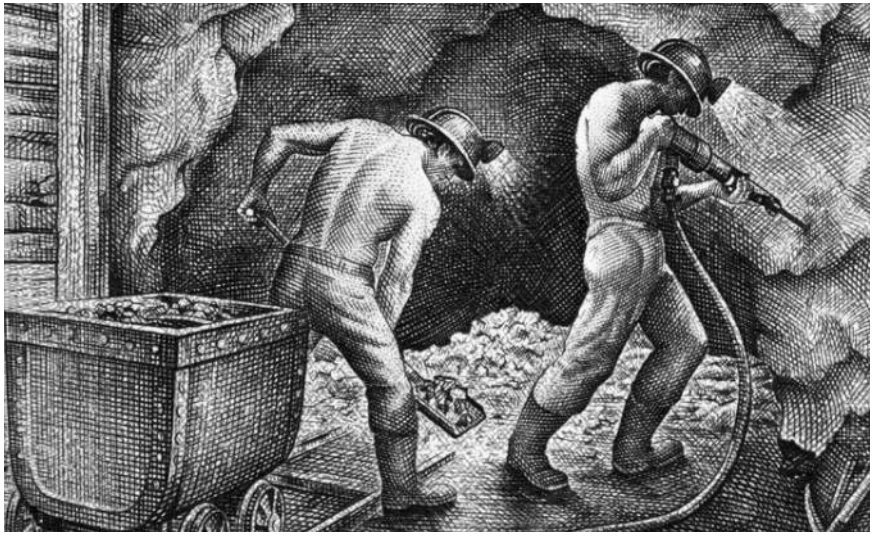
require labor and effort; some require reducing luxuries in which you indulge. And participating in this program requires you to pull your head out of wherever it has been hiding and think long and hard about where you want to stand in this crisis.

So what are you going to do? You can go with the flow—but what if the flow is wrong? You can bury your head in the sand and believe that science will find a way (possibly a destructive way) to allow us to keep indulging in our addiction to oil. You can keep using energy in the same way it has been used for a century, without regard to its scarcity, and you can pay ever-escalating prices until you can afford nothing else.

Or, you can break your addiction. You can embrace breakthrough technologies—some of which you've already heard about, some still obscure—that will join world-changing inventions, like the cotton gin and the sewing machine. At the same time, you can turn back the clock and return to simple energy-free practices that were used before we depended on machines. You can make minor changes in your life that will allow us to live happily and addiction-free. It's up to you.

CHANGE IS EASY: WE CAN CURE OUR ADDICTION WITHOUT CHANGING OUR LIVES AT ALL

Did you believe that? If you did, you have a lot of work to do. Because change is hard, especially when it involves an addiction. We are not going



to have to go back to toiling twelve hours a day or living in the dark. We are, however, going to have to do some things differently. The twelve steps in The Oil Addiction Cure will break old habits and force us to open our minds to technology.

Our use of oil and other fossil fuels is an addiction, if we define an addiction as a dependence on something that can do us harm. Using fossil fuels as we do now might bring us temporary pleasure; so does cocaine. Neither gives us benefit in the long run; both can do us great harm. I am not suggesting that you break your addiction out of altruism or concern for mankind. I am telling you that if you understand the situation, you will know that it is in your own best interest to kick your fossil fuel habit. And you can't do it without a bit of temporary discomfort. Just remember two words, temporary—because we will soon find better ways to live, and discomfort—because we are not talking about pain and deprivation, only minor adjustments.

I'm reminded of an energy audit I did some years back. I was at a farmhouse whose owners were sure that their house was "leaking energy" because their bills were so high. The man of the house was showing me around, and I noticed several significant energy-guzzlers—a fridge in the basement used to store beer for poker night, an outdoor hot water tank for car-washing, a large freezer for storing meat, a baseboard heater in an upstairs bedroom that the owner said his wife liked because it kept her feet

Why are we still using rapidly diminishing sources of energy such as oil, gas, and coal (opposite page) when cleaner, renewable sources like wind power (left) can be developed?

warm. I suggested eliminating some of these. No, he said as I ticked off each one. He couldn't get along without the beer fridge, the freezer, and the outdoor hot water tank. Just then, as I was getting to the baseboard heater, his wife came home. "Sorry, honey," he said, "the heater is going to have to go." I hope I haven't busted him—but this story reminds me that we have to understand that each of us will have to decide what we can do without—we can't just expect everyone else to make the sacrifices.

Our homes and vehicles are currently fitted with devices that use nonrenewable fuels; we need to retrofit them with machinery that uses renewable energy sources that are cleaner and that are becoming more affordable and more accessible every year. We should not think of money used for this technology as an expenditure—we should think of it as an investment. It's like buying stocks—except that you rarely see so great a return on money invested in the stock market. Your energy costs will be reduced substantially every year after we make the change. And if we take advantage of national and state programs to offset costs, we might find that there are no up-front costs at all.

In other cases, we are going to use a source of renewable fuel that has been undervalued in recent years— human energy. We're going to get off our backsides and avoid using fuel when a bit of labor will serve us better. We're going to use our thought processes to find the best technological solutions and our elbow grease to implement them. And we're going to take advantage of one more renewable energy source that has been staring us in the face since we were born— the sun.

Some of the change is out of our hands. In order for the transition to a sustainable society to take place, the corporate sector, the government, and the global community will have to do their part. I will deal with those in future volumes of this series. But the individual—you—must start the transition. You must do so first, because it is in your own best interest. You want to enjoy the benefits of the transition before the crisis sucks up your wealth, not wait until you're circling the drain. Also, we have to remember that corporations, politicians, and the international community follow the needs and desires of individuals. It takes a while, sometimes a destructively long time. However, without the input of individual consumers and voters, the larger structures have no reason to change. Therefore, change is, on every level, up to us.

HOW DID WE GET INTO THIS MESS?

Over the last ten years, the average family's energy bill has risen by about 65 percent, from about $3,000 per year to over $5,000 per year. In the year 2000, the wholesale cost of natural gas was about $2 per therm. It rose to about $14 per therm in 2005 and again in 2008. Oil has seen similar increases. It cost about $30 a barrel until 2003, doubled in 2005, and peaked at around $146 in 2008. Today, it bounces around from $70 to $100 a barrel. Usually, the laws of supply and demand would now come into play—since prices are high, supplies should increase. However, in this case, we simply cannot increase supply. We once had an abundance, but we have used much of it up. Since we didn't create it in the first place—we only found it—we are almost done. We're trying desperately to find more, to pull it out of places where it is hiding, and we can see where that has brought us. We have watched oil gush into our precious waters because we drill down five miles into the Gulf with precarious equipment. We wage wars in foreign lands to protect the oil fields there. Yet none of this is solving the problem. So we have to ask—how did we get here? To answer, we have to go back to when there was no problem.

When Columbus came to America, there were no fences, no highways, and no power plants. Over 60 million buffalo roamed the Great Plains, and Native Americans used them, along with other fauna and flora, and sun, wind, fire, water, and earth, to fill all their needs. Native

One of the most inefficient uses of energy: single-passenger driving.

Americans balanced their own consumption with the needs of the environment; their ways would never allow an energy crisis to occur.

For the next several centuries, things progressed slowly. Then, in the middle of the nineteenth century, the Industrial Revolution and the completion of the trans-continental railway created a whole new scenario. Change came quickly, transforming the landscape and the way we live.

Today, huge buildings scrape the sky in every city from coast to coast; farmers use diesel-powered tractors and petroleum-based fertilizers to grow our food; highways, crowded with trucks and cars, traverse the country. The land is punctured with oil wells and dotted with abandoned mine shafts. We need energy to fuel every aspect of our lives, from eating food grown with fertilizers and transported by trucks, to keeping our homes warm, to getting to work and play. And we're finding less and less of the fuel that we use to run our lives.

The problem has many causes. The first is population. In the nineteenth century, we had only reached a mass of 50 million people. Today, there are more than 300 million of us. So providing basic necessities is not as easy. We have needed to build upward, creating high-rise apartments that require elevators and big furnaces. We have needed to grow more food. The cheapest, easiest way to do so was to pump the soil with petroleum-based chemicals, even if the long-term effects were destructive. We have wanted to make all our lives easier and more convenient, so we use our labor-saving, luxury devices—hot-water heaters, single-occupancy vehicles—without regard for their effects.

This has led to the second cause of the energy crisis: Each person is using more energy than individuals did half a century ago. At the last analysis in 2005, the United States used 100 quadrillion BTUs (British

thermal units, the amount of heat needed to raise one pound of water one degree Fahrenheit at one atmosphere pressure) of energy—three times what we consumed in 1950. Each of us uses about 350 million BTUs every year (five times the average in the rest of the world). We have held that number since around 1970, partially because we now import many of the products we use. Now the rest of the world is catching up and things are only going to get worse.

But the crux of the issue is not how much we use, but what we use. Way back in 1712, Thomas Newcomen invented a crude engine that allowed coal to produce mechanical work. That development, which meant that coal could be used for more than just heating, sparked the use of a nonrenewable energy source to power manufacturing. There was plenty of coal—so much so that no one thought about it running out—and within decades, it was being mined prodigiously to fuel the budding Industrial Revolution. By the mid nineteenth century, oil had joined coal as a mechanical fuel. The first oil well was drilled in western Pennsylvania. Until the beginning of the twentieth century, petroleum was a minor energy source. Then we began using automobiles. We fell in love with oil. By the middle of the twentieth century, coal had fallen in popularity and oil and natural gas had taken over. Petroleum was used to fuel our cars, to make plastics and fertilizers, as well as for heat and electric power production.

Our energy needs multiplied as we altered our landscape to accommodate an ever-growing population that spread across the country. *Above left:* A century ago. *Above:* Now.

For another century, no one sounded the alarm. These fuels were cheap, plentiful, and easy to find, yet they had one drawback: There was a limit to how much existed. Still, it seemed as if there was so much of them that the pits were bottomless. They are not. There are many sources of renewable energy around—wind, sun, and geothermal activity. But no one bothered to develop them because oil and coal were just there. We had many sources of energy, but we kept using oil and natural gas.

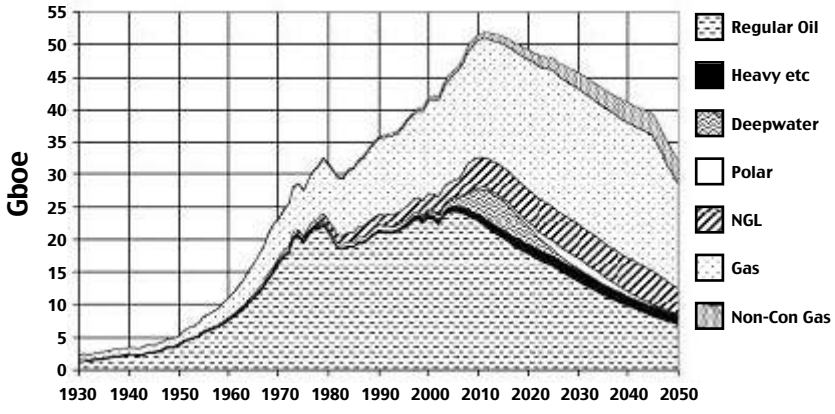
PEAK OIL

In 1956, M. King Hubbert developed a model that showed U.S. oil production peaking in about 1970, then diminishing, and finally running out entirely. People in the industry laughed at him. Then, in 1971, they looked back and, sure enough, oil production in the U.S. had peaked. So the industry went on a worldwide shopping spree. We found more oil to develop in the Middle East and other places around the world. Now, more than 50 years after Hubbert's first model, we are seeing his predictions come true again, this time on a global scale. But at this point, there is little easy oil to be found. And suddenly, after ignoring the warnings for decades, we are racing to develop other resources and to conserve what we have; all while we consider the effects that running out of oil will have on our lives. Richard Simmons, author of *Twilight in the Desert: The Coming Saudi Oil Shock and the World Economy,* writes that, "Without energy our system shuts down. Water, food, healthcare all wind down in a few days." Through a cold and rational analysis of the oil situation, reserves, production, and consumption, he and others have marked the years 2012 to 2013 as the time of an unavoidable 8 to 10 percent per annum sharp decline in global oil production.

Another theory about the impact of peak oil was developed by Dr. Richard Duncan, who founded the Institute on Energy and Man in 1992. He developed his Olduvai theory in 1999, which predicted that per capita energy would peak in 2007, and industrial civilization would begin to collapse back to conditions found in the Olduvai Gorge of Africa, considered the cradle of civilization. His prediction of a 2007 energy peak was essentially correct. Since 2008, we are on the portion of his graphic called the "slide," leading up to the "cliff," predicted to begin in 2012.

The General Depletion Picture

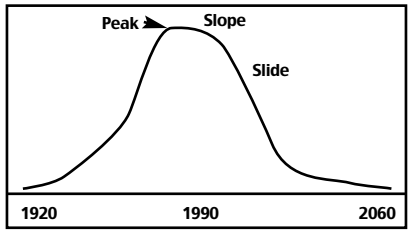
OIL & GAS PRODUCTION PROFILES
2006 Base Case



The goal of this book is not to dwell on the coming crisis and its effects. Instead, we're going to focus on solutions and opportunities. We can fix this; we just haven't tried hard enough yet.

THE GOOD NEWS

THE OLDUVAL CURVE



I'm an optimist by nature. Things may look grim right now. Some people say that our best days are over. But America will rise again. We have the best combination of renewable energy resources on the planet, the best agricultural resources of any place on Earth, the best-developed infrastructure, the best educational and defense systems, and the largest economy in the world. Our democracy will hold us together. Can we feed ourselves, power ourselves, educate ourselves, and defend ourselves? Absolutely. In the coming age of sustainability, the U.S. will regain its lost luster. We just need to do the right things, the right way, right now.

Sometimes, problems become insurmountable because we stop trying to surmount them. We see how deep the ditch is that we've dug for our-

selves, and we think we can't get out. So I want to assure you: Work is being done, all over this country and all over the world. There is a goal and there is a plan for us to reach it. Governments, both in the U.S. and around the world, as well as the industrial community have not given up. But every one of us has a part to play in the transition to a sustainable world. This book, and the ones that follow it, will present the complete picture. For now, what you have to do is act in your own best interest. You have to educate yourself about what is truly the best for you in the long term, not just for today but forever.

DRASTIC THINKING

There are drastic changes coming in the world, and they are coming very soon. It is not the focus of this book to use the current system more effectively. We cannot make the differences that are necessary by just turning a dial here and there, tweaking something, inflating tires, cleaning filters. We are not going to spend much time or space telling you to keep your furnace filter clean, when what you really need to do is throw away your furnace and change the way you heat your home. The changes that are coming are going to be drastic, and we need drastic measures to respond to them.

The Oil Addiction Cure has identified twelve ways in which we can significantly reduce our use of energy. Twelve "step" chapters in this book each outline a practice that can make a clear, quantifiable difference in our energy usage. If you follow them all, you will find that you've cut your energy bills by about 60 percent or more. What's more, you'll find yourself thinking differently about how you use nonrenewable resources, and making sure that you use only what you need. You'll find that energy doesn't run your life.

There are dozens of ways to cut back on energy use; we've chosen, through exhaustive research, the twelve ways that are most effective. That doesn't mean that you should ignore other energy-saving tips. It does, however, give you a way to focus on the practices that make drastic differences.

For example, many people tout low-flow showerheads as a way to cut heating bills. And it's true—you can reduce your hot water use by 10%. But you can save triple that much in most areas by installing an on-demand water heater. North America is one of the few places in the world

where homes typically have an 80-gallon tank of water kept hot 24 hours per day, ready for dispensing to any number of end points in a home at a moment's notice. This system represents 18 percent of the energy used in the average home, and it may have made sense when there was cheap and abundant energy but no longer. If you are like most people, you do not want to give up your central hot-water system and long, hot showers. Few of us do. You may choose to continue to spend a growing portion of your income keeping this kind of system going, until you cannot afford to buy food to eat or to pay your mortgage. Then you will have to make a decision between food, mortgage, and a long hot shower with central hot water. Or, perhaps you will be congratulating yourself for adopting one of the more efficient methods of making and using hot water that I recommend—and you will not be dependent on a resource you cannot afford.

Another example: You can save a few drops of gas by turning the nozzle upside down after gassing up—there are a few drops of "free" gas still in the nozzle—and you can get slightly better gas mileage if you clean your air filter. But these savings are minuscule compared to what you can save by carpooling or, even better, investing in one of the plug-in electric vehicles that are hitting showrooms. Our research identifies the practices that make the most extreme differences—and allows you to prioritize in the most cost-effective way.

This list of the top twelve steps can and will change over time, as circumstances change. The twelve steps will not get us to the ultimate goal of sustainability for all of the earth's inhabitants. They will allow us to start down that road and move away from the path that is leading us to calamity.

WHEN THE CRUNCH COMES

In the coming years, changing the way we use energy is not going to be a choice; we will all need to do it. Some of the change will take the form of conservation and alterations in lifestyle. We'll cut back on how much energy we use, which will be better for all of us. Some of it will come by substituting other forms of energy, forms that are renewable and cleaner than oil and natural gas. We will begin using new energy technologies in place of old ones. What we are trying to avoid is deprivation—significant loss of food and quality of life, even starvation.

ELECTRICITY

There is no magic bullet, no simple solution that will take us to sustainability quickly and easily. However, I am going to give you one word that encapsulates the future. That word is electricity. When we come out on the other side of this crisis, much more of the energy that we use for transportation, space heating, and other needs will be electric.

The first question you probably want to ask is, "Where will all this electricity come from? Because we're using electricity now, and it sure isn't cheap." You have also probably heard that generating electricity causes environmental problems—we are all trying to conserve electricity, just as we're doing with fossil fuels. And those who have researched electricity, and the equipment that will be needed to harness it, know that it takes about 300 tons of steel to make a wind turbine or tower. They know that the manufacture of an electric car uses about three times as much copper as a standard gas-fueled one. So where is all this material going to come from, and why am I so enthusiastic about electricity?

The answer is in long-term sustainability. Recent studies by government and industry tell us that there is enough wind energy potential in North Dakota, Kansas, and Texas to provide power for the entire United States. And if solar thermal power were developed over a 94- by 94-mile square in the desert Southwest, that too could give us all the power that the whole country needs. Geothermal power—which is produced under the earth's crust—is another huge resource: A recent MIT study shows we can economically develop 100,000 megawatts of capacity—about 10 percent of our total current installed capacity—or more, through geothermal sources. The key to establishing energy independence is to generate electricity through wind, solar, geothermal, and biomass resources. Those resources are clean, green, and sustainable. And the cost for development is relatively reasonable—less than 1.6 percent of global gdp over several decades. In fact, if managed properly the conversion to renewable energy could increase economic growth throughout the world.

And we are already doing it. The U.S. Department of Energy has endorsed a plan to build an "interstate highway system" for renewable electricity, connecting power sources with power users. Volume II of this series will fully discuss this energy system, and the ways in which we will

find the resources—steel, copper, and other materials—to develop and sustain it. For now, what you need to know is that there is an answer, and people are working on it.

As we end this chapter, we refer to its beginning. We have focused here on individual needs, because these needs are important and valid. Every one of us must take care of ourselves and our families first. But we've also seen that there is a bigger picture. Clearly, Earth and our civilization are entering another period of dramatic change. With the end of oil appearing on the horizon, we must ask ourselves how we will continue to exist with the means and elements that are available in the future. Which resources, technologies, and companies will be the leaders in this transformation? What must we do, as individuals and collectively, to navigate this transition successfully? Will civilization make it?

In a hundred years, historians will look back on this era and discuss how humans acted in these critical times. So we want the answer to be clear and resonant. We did what we had to do, from tiny tasks in our own backyards to huge endeavors that spanned continents. We kept our minds open and our hearts attentive, not only to our own needs, but also to those of our neighbors all over the world. We returned to prosperity and we allowed a new and grand civilization to rise, a civilization that can be sustained forever.

This is where we start, with ourselves, with what each of us can do, right now.

CHAPTER 2

EXPERIENCE AND INSPIRATION

The personal journey of Mike Vallez

The simplest purpose of this book is saving you money on fuel and energy. On a deeper level, this book—and the Energy Education Institute—aim to change the way we all think about energy, to spur us to shake off our dependence on a quickly diminishing resource and move to a new and better era of prosperity and sustainability. That's not a simple or an easily accomplished goal, but over the past decade I have come to realize that the most important thing I can do with my life is to join thousands of others working tirelessly to complete this mission—and that I am in a position to do it.

This book is not autobiographical and the transition to a sustainable future is certainly larger than any one person. But, through a varied and complex collection of experiences, practical education, research, and inspirations, I came to the conclusion that I have a place in this transition. I feel lucky to have had this charge placed in my lap by the universe. And I think it's useful to take a few pages to show how I arrived at this critical point.

EARLY DAYS

I have been studying energy ever since I was seven years old and watched a gas station attendant in a blue jumpsuit at Standard Oil fill up my father's Buick. I knew that there was a connection between that smelly liquid and the fact that we could pile into the car and get where we wanted to go. As the gas dripped into the tank, I wondered where it came from and just how it worked.

I asked questions throughout my childhood, and my parents tried to answer. (I have to admit they sometimes just sent me to the other parent when my questions became vexing.) They recognized and encouraged my curious mind; for birthdays and Christmas I got science

kits—a Jensen Steam Engine that turned a flywheel and blew a whistle; an electronics set with transistors, diodes, solar cells; a molten lead model kit, and other gifts that helped me learn how things worked. As a youngster, I tore apart and fixed motor scooters and lawn mowers, and as a teenager I rebuilt car engines.

Mike, age 8

MUD HUTS AND TRANSCENDENTAL MOMENTS

When I was sixteen years old, I had the opportunity to work in the Venezuelan rain forest for a summer. My uncle Mike Vallez, who worked for U.S. Steel, visited us in Minneapolis when I was fifteen, and I casually asked if he could get me a summer job in Venezuela where he worked. I was surprised when an offer came in the mail a few months later, but I jumped at the chance.

At the time, there was a show on television called High Chaparral that took place on a vaguely Spanish-style Southwest ranch (it was actually in the Arizona territory). The family in the show lived in a mansion; they dressed for dinner. They had hot and cold running water and hot and cold running servants. Their hardest job seemed to be choosing a horse for their daily ride. I thought I was going someplace like that.

My actual destination was La Paragua, at the end of the road that stretches south from eastern Venezuela toward the Amazon jungle. After driving through muddy ruts and potholes, with the branches of jungle growth swooshing across the windshield of the car, we finally came to a stop at a washout in the road. The owner of the ranch, Roger (who was one of the most unusual people I've ever known), casually announced: "We're here. I call it 'Calcetin Del Diablo' [the devil's sock]." I saw a one-

In Venezuela, clockwise from top left: my bed, transportation, working, my hut

room mud hut—no water, no electricity, pretty much nothing but a dirt floor, mud-packed walls, and thatched roof. I put down my suitcase. I had brought an electric alarm clock with me; I had no place to plug it in, but there was a rooster outside, along with some scraggly chickens and other barnyard animals who stepped around their own manure and into the hut when they chose.

I lived in the mud hut all summer. I bathed in the lagoon once a week; I could have done so more often, but the snakes kept me away. My job was building a barbed-wire fence around the jungle estate. I worked in the tropical heat, the only North American and English speaker in a crew of cowboys. I learned what one does when one needs to survive. I drank water from a worm-filled puddle, I got dysentery, I survived on a core diet of black beans and rice, and I slept in a hammock under a leaky roof during the rainy season.

In that mud hut in South America, I came to see, almost forty years ago, a process that the Internet generation coming of age today sees constantly—that we are all part of one interconnected whole, a true global village. I refer to these life experiences as "transcendental moments," flashes of keen insight about things deeper than my five senses could show me. I was still a boy that summer, but my experiences opened my mind; later in life, the things I learned in Venezuela would combine with other lessons and set me on the path I walk today.

The lesson I learned, and that has stayed with me, is that what is done by a society in one part of the world has an effect on all the other parts. The butterfly effect is not just a metaphor. Our lives are affected by the way that Peruvians tend their copper mines and Africans mine their diamonds and Brazilians care for their rain forests. And Peruvians, Africans, and Brazilians are affected by the way Americans heat their homes, grow their food, and buy their cars.

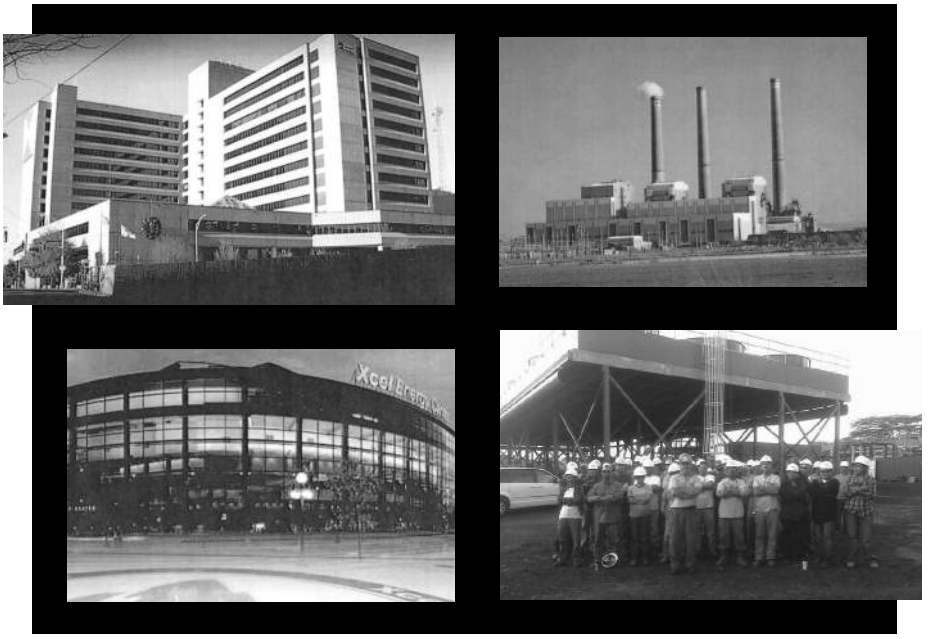
My life experiences and study of energy have helped me to see clearly the connection between energy and hunger. We are all part of one big round-the-world economy, and what happens in the lives of two billion inhabitants who lack basic necessities such as adequate food, sustainable electricity, and clean water affects us directly here in the United States.

ON-THE-JOB EDUCATION

When I came back from Venezuela, I finished high school and went on to college. I earned a B.S. in engineering from Michigan Technological University, and an MBA from the University of Utah. I began a career in executive management, engineering, construction, and project development. I managed the construction and development of dozens of major projects, ranging from coal and copper mining facilities to industrial complexes, high-rise hotels, power plants, shopping centers, and condominiums. The sites I worked on were diversified, including an energy center in North Carolina, a concert hall at the University of Minnesota, a copper mine in Utah, a geothermal power plant in Hawaii. My work was hands on; even though my role was sometimes supervisory or administrative, I always got down in the dirt and knew what was going on at every level of every project. By necessity, I learned about carbon and greenhouse gas emissions measurement and reduction strategies, developing high-payback and high-impact energy strategies at all levels including the personal, corporate, state and local governmental, national and international. After many years and many successful projects, I found that I was recognized as an expert in sustainable energy, energy efficiency, and conservation.

I have done a great deal of research and read many books about sustainability, in and out of school. But most of my knowledge of sustainability has been gained on the ground, finding solutions to specific problems in both my personal life and my professional career as an engineer. I have a library full of books on sustainability, but many of the answers can't be found in books—they can only be found when you are dealing with real situations and are charged with finding solutions. And those solutions have to work not only on the day you implement them, but long-term. That's one thing that makes this book different from many of the others on its topic—I am writing about things that I have actually done.

As valuable as the technical know-how I picked up along the way, is the insight I gained into how human beings work. I have seen ventures founder because of shortsightedness and greed, because people at all levels put their own needs and prejudices above everything else, or because they were too incompetent or lazy to do their jobs. I have seen small and large groups of people come together and literally move mountains, act-



ing in unison, with intelligence and innovation. And I know that the difference is inspiration—when we act because we have a firm grasp of what we are working for and what the consequences of our actions will be, we have a much better chance of surmounting all obstacles and getting where we want to go. I hope that this book, and the others in this series, will inspire those who are working on the great problem of our day.

Along the way, I got married and became the father of four beautiful children. And as a father of a special-needs child who requires full time care, I have also learned that there are challenges in life that we have absolutely no control over, regardless of our level of inspiration, skill, or motivation. But when we focus on and take positive action by changing things within our circles of influence, we can begin to change the world.

Above: Just a few of the projects I've managed over my career. Top left: Duke Energy Center; Top right: Hunter Power Plant, Castle Dale Utah; Bottom left: Xcel Energy Hockey Arena, St. Paul, MN; Bottom right: Building a geothermal plant in Hilo, Hawaii, 2010.

GREAT LAWS

I often think of one of the many lessons my father taught me. He struggled with cancer for the last several years of his life, which ended in 1995. Toward the end, he needed a wheelchair for mobility. One day I went to visit him, and I found him in the yard on his hands and knees aside his wheelchair planting a tree. This was a tree that he would certainly never see grow to maturity, but he was planting it anyway. My father was acting out one of the practices that author Stephen Covey described in his book *The 7 Habits of Highly Effective People*, "Begin with the End in Mind."

I learned another version of this in the late 1990s, when I had the privilege of planning, developing, and building a school project for the Yankton Sioux Tribe in South Dakota. In their traditions, the Sioux taught the Great Law of the Iroquois, which said: "In our every deliberation, we must consider the impact of our decisions on the next seven generations, even if it requires having skin as thick as the bark of a pine tree."

This Great Law, my Father's tree, and Stephen Covey's advice are the foundations of all the work I've done on sustainability over the past ten years. We have to consider the consequences of our actions, to understand that we are not living separately from the rest of the world. I started seeing this in the Venezuelan jungle; I saw it in every job I had; I saw it in raising my kids. And I was about to find my own way to put it into practice.

STARTING A JOURNEY

All of this led me to a particular spot and time that changed my life. It was January 2002, and I found myself single after a seventeen-year marriage, living in a fixer-upper 1905 farmhouse in Prior Lake, Minnesota. The locals called my house "the Sewell House," after the family who last lived there when it was a farm. I had just come through a nasty divorce, and found myself without purpose or focus. I didn't know what to do next. One night, sitting listlessly on the sofa, I closed my eyes and just prayed for guidance, for something meaningful and useful to fill the void left when I became a live-away dad.

My prayers were answered immediately. The messenger was the U.S. postal service and the response came in an envelope from the gas company. When I rose from my evening of prayer, I went to the desk to pay bills,

and opened an exorbitant natural gas heating bill—the rate was triple what it was the year before. That evening I wrote in my journal: "Do energy retrofit project on house and share results with family, friends and neighbors." I made a simple covenant: I was going to make a case study of the remodeling and energy retrofit of my house.

At the time, it did not seem like much of a challenge, but I found out differently. I looked at alternate heating systems like corn furnaces, woodstoves, pellet stoves, solar, geothermal. I figured out that there was not enough corn grown on the planet to heat our homes! And in the 1800s, when we all used wood, there were only about 50 million of us in the U.S. Back then, there were so many trees that a squirrel could have traveled from the Atlantic to the Mississippi without ever touching the ground. There is no possible way that 350 million people can "go back to the way it was." In fact, many areas now have wood-burning bans in place. When I looked at my hundred-year-old farmhouse, I could see the history of energy use in the United States etched in its structure. The fireplace chimney that was used to heat the house when it was first built was still intact. There were remnants of a coal chute that was used to slide coal to the cellar. The old natural gas-burning furnace had once been an oil-burning heater—I could see where the old oil jets had been cut and replaced with natural gas jets. The only insulation in the 15-inch-thick, three-course brick walls was the air space between the layers of brick. A 1950s wood-frame addition had little to no insulation, and I could feel the wind blow through on cold winter nights. I had spent a career building new things, but engineering school had taught me little about how to take an "energy basket case" like this one, and make it work more efficiently.

The Sewell House

TANZANIA

In 2005 I experienced another one of those moments in life that forever altered my perception and changed my behavior. I was standing on the altar of a remote village church in Tanzania talking to a packed church through a Catholic priest who translated my words. I was in Africa as a guest of Bishop Alfred Maluma of the Njombe Diocese, trying to make connections between churches in Africa and my home state of Minnesota to form "sister church" relationships. I was talking about the benefits of being part of a sister church partnership, where people from different places could encounter each other in solidarity and shared humanity. I found it useful to recount the commandment: "Love thy neighbor," and struggled to find words that explained why a "neighbor" was not just someone who lived in the same neighborhood, or someone who shared the same religion, or someone who had the same skin color. No, love thy neighbor, as I saw it, was something more universal. The sister church concept, I argued, was one approach where this kind of human solidarity could grow and flourish. At that moment, my interest in mission work and energy merged into one common thread and abstract concepts like love and solidarity crossed with concrete concerns like oil prices and hunger. My commitment to share my energy lessons with family, friends, and neighbors suddenly expanded to a global mission.

Oil rose to $147.00 per barrel and food commodity prices tripled around the world in 2008. Those who spend 40, 50, 60 and 70 percent of their income on food were literally priced out of the food market and knocked back out of participation in the world economy. The two-horned devil of the energy and climate crisis is also a hunger crisis around the world. I am afraid to say that the recovery of the global economy will be nothing more than a wish until these issues are successfully addressed and our brothers and sisters living on a

Left and opposite page: Meeting new friends in Tanzania

dollar a day can climb out of their subsistence lifestyle. This is a lesson we already learned in the Great Depression when, under the New Deal, we electrified the rural countryside in the U.S. We should have started addressing these issues more than ten years ago. Unfortunately, we face a difficult road ahead for a while.

CONNECTIONS

Feeling a sense of solidarity with the Earth's seven billion people, I can't ignore the fact that so many of us are suffering from hunger and deprivation. As I listen to the arguments about health care in the U.S., I am struck at how good we have it in this country. People in some parts of the world simply die when they get sick or hungry. I find it difficult to rest knowing what I know. When energy and food prices spiked in 2008, so did the email and phone calls from my African friends, asking for help in their communities.

So finding the answer to America's energy crisis does not, and cannot stop at our borders. What I learned in Venezuela so many years ago has come back into play: America is not alone in the world. We are all part of an interconnected world economy. My quest to find a sustainable heating solution for the Sewell House in Minnesota is one tiny strand in the world's effort to achieve sustainability. If this house is to remain livable in the Minnesota climate, iron ore and copper mines around the world need to be effective, which means that I, and all of us, have a direct connection and dependence on the populations of the countries in which they are located.

ANOTHER STEP IN THE JOURNEY

On my return from Africa, I became an independent energy consultant and Energy Auditor for a couple of years, advising homeowners and businesses on how they can reduce their energy costs. In this role (which included work for Xcel Energy Company), I talked with dozens of home and business owners about their homes, facilities, and energy use. After seeing how little people knew about energy, and seeing a billboard with the quote: "An Informed Populace is Essential for the Function of a Democracy," I formed the Energy Education Institute. Based on my energy auditing experience and research, I began giving talks about energy to community and professional groups, homebuilders, architects, and commercial developers.

Goaded by a request from an energy customer, I began to investigate using heat pumps in Minnesota. I did a feasibility study and found them to be less than ideal—they just did not work without electrical backup when temperature dipped below 32 degrees. Then, in the fall of 2006, I read third-party test results about a "Cold-climate Heat Pump" being developed by a company in Bangor, Maine, which had a special dual stage compression technology, able to operate at temperatures as low as -30 Fahrenheit while maintaining heat pump efficiencies, not relying on electrical resistance heat. I ran some numbers; I was truly excited and jumped on a plane to Maine. I found a truly revolutionary technology (see Part II, Step Five, for more information about the all-climate heat pump and why you should consider installing one). After six years of searching, I had finally found a sustainable and affordable heating system for the Sewell House.

CHASING ELECTRICITY

My quest now changed focus, turning to the question of where the sustainable electricity would come from; even though the heat pump used less electricity, it still used a good deal of it. I turned to the wind energy of the Great Plains where the winter winds complemented the demand for winter electricity to meet the space heating needs.

In 1997, while developing a school for The Yankton Sioux Tribe in South Dakota, I had prepared a feasibility analysis for the Tribe to develop its wind resources, and learned that the lack of electrical transmission

Atacama Desert, the sunniest place on Earth.

was the missing link for the Tribe's ability to sell any wind energy it could generate. I learned that the U.S. was blessed with the best wind resource of any place on Earth, and the Great Plains states had much more than enough wind potential to provide the entire U.S. with sustainable electricity. The wind industry refers to North Dakota as "the Saudi Arabia of wind."

In July, 2008, the U.S. Department of Energy published their report: "20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply." This report contained a vision for electrical transmission that I had been looking for: A national high voltage, direct current, electricity highway with very little line loss! Finally, there was the space heating technology, the wind resource, and now a vision for the transmission system needed to make it all happen. But wait; there are other considerations. It takes about 300 tons of steel to make a wind tower/turbine, and all of that electricity needs copper and aluminum to travel on. I was now faced with another sustainability question.

By 2008, I had taken a position with Rio Tinto, the world's second largest mining company, with operations on all continents. I was the engineering manager for the development of a large-scale underground copper mine in Utah. And one of my responsibilities as engineering manager was to evaluate the eventual power demand of the operation, and factor that into our planning and design. Coincidently, in 2008, the global mining industry faced electric power shortages all over the world, impacting mine production on every continent. And right here in the United States, the power company in Utah could not commit enough power for us to run the mine. We had to fend for ourselves. Working on my own time, over weekends and evenings, I learned that Utah was surrounded by sus-

tainable power sources, with vast wind resources in Wyoming, solar and geothermal in Utah and Nevada. I found that there were almost limitless sustainable power resources within reach, but again, the problem was the lack of transmission.

I was beginning to get a vision of the big picture of global sustainability for the seven billion Earth's inhabitants. Pieces of the puzzle were falling into place, one after another. With the end of fossil fuels in sight, our shift to sustainability was going to require large amounts of strategic minerals and metals to make the machines and build the infrastructure needed to sustain life for seven billion people (predicted to grow to nine billion.) For example, it takes about 300 tons of steel to make a wind turbine and tower. And a plug-in car requires three times as much copper as a gas or diesel vehicle. My curiosity drove me to evaluate the other copper and iron ore resources around the world, and discover their proximity to renewable energy sources.

Northern Chile and Peru produce 42% of the world's copper. The world's largest copper mine, Escondida, produces 7% of the world's copper supply alone. In 2008, this mine had to curtail output by 15% due to power shortages. (Indeed, I could see the Olduvai cliff approaching.) The Atacama Desert overlays this copper producing region, and it is the sunniest place on Earth, receiving more solar radiation than any other location. It also has a smattering of geothermal and wind resources which are under development. In my study of the world's copper producing regions, I learned that about 75% of the copper mines in the world are either directly in, or, in proximity to a solar energy resource desert. I learned that the Department of Energy forecasts a cost of between 5 and 7 cents per kilowatt-hour for solar thermal power by the year 2020.

Another important mining area on the planet is the Pilbara region of Western Australia where about 30% of the world's iron ore is mined. I could see that developing the renewable power resources of places like Northern Chile and Western Australia was going to be essential to allow us humans to operate the mines, to produce the metals, to convert to sustainability. Coincidentally, in June of 2008, the president of Chile, Michelle Bachelet, visited the U.S. to tour some of the concentrating solar power (CSP) plants in the Southwest, and declared that Chile was committed to solar power in the desert to power the mining industry there. Then, in

August of 2008, mining giants BHP Billiton and my employer Rio Tinto launched planning work on a 250 MW solar power plant in Western Australia to power the iron mines there. I could now see that some of the world's largest copper and iron ore mining regions and companies were embarking on a path to sustainable power to run their operations

So, in the winter of 2008 to 2009, I wrote a white paper about developing sustainable mining in Chile and Peru, and sent it off to some contacts in Santiago and Lima. In March 2009, I traveled to Santiago, Chile where I gave my presentation to representatives of the power, mining, and government agencies to discuss their plans for sustainable power for the mines in Northern Chile. So, while staying abreast of the thinking in the global mining industry, I have completed the full circle of sustainable energy for the "Sewell House" project. I can confidently tell you that the technology, the plans, the people, and the resources are in place to make the conversion to sustainable electric power to run your plug-in car and your high-efficiency heat pump.

CLOSING THE CIRCLE

We are at a critical juncture in the history of civilization. Unless the world works for everyone, it's not going to work very well for anyone. This became apparent to me in a very personal way in the summer of 2008. The U.S. and European ethanol industry was ramping up production of corn to make ethanol for cars, consuming vast tracts of cropland. At the same time, corn, rice, and soybeans tripled in cost on the international commodity exchanges. The price of natural gas, a component in the fertilizer used to grow these crops, was also rising due to the energy squeeze in 2008.

In the U.S., people were more affected by the rise in fuel costs—this was the time that gas cost more than $4.00 a gallon—than by the rise in food costs. But in places like Tanzania, where people live on a dollar day—most of it spent on food—the increase in food prices led to starvation. One of the direct costs of filling our gas tanks with ethanol was people dying of hunger.

CHAPTER 3

ENERGY OF THE FUTURE

"The Stone Age didn't end because we ran out of stones. It ended because there were better ideas about how to meet society's needs." — AMORY LOVINS, ROCKY MOUNTAIN INSTITUTE

If all the news about peak oil, diminishing gas reserves, and energy crises has you worried that life is going to be dark and hard from now on, let me assure you, the current situation isn't a catastrophe, it's an opportunity. We're going to change the way we produce and use energy and it's going to make us stronger and more prosperous. And when I say "us" I don't mean only the people in the United States and other developed countries—the end of oil is going to be the beginning of a global community that embraces every human being on Earth.

You may ask why we've depended on oil and other fossil fuels for so long if other resources were available. We've known for a long time—certainly since the 1950s—that these fossil fuels would eventually diminish and we've also known that they cause pollution and ultimately global warming. And, the resources that will replace them were not cooked up in a laboratory in the past few years—we've known about them for centuries. Is it possible that our greatest industrialists and leaders have ignored the obvious answers and led us into near-disaster when the solution was at hand?

In many cases, the answer is yes. On the other hand, there are brilliant scientists, industrialists, and leaders in the United States and all over the world who have advanced our abilities to create clean sustainable energy. These technologies are now coming of age—they are becoming more cost effective than the conventional fuels. In 2009, for the first time ever, the worldwide investment in new renewable power generation exceeded the investment in conventional power plants. Scientists and industrialists have been working on renewable energy for decades; they will become our leaders as the shortsighted people who have championed fossil fuels lose their power and political control.

CHANGING LANDSCAPE

Prior to the development of commercial airlines and construction of the interstate highway system, most commercial travel was done by rail. The railroad companies in this country and around the world missed an opportunity to reinvent themselves as transportation companies, instead of just railroad companies. For a long period of time, the railroads suffered from the loss of their passenger traffic, because of the competition from the airlines. This analogy helps us understand what is happening with the fossil fuel businesses. Although there are some exceptions, instead of embracing the coming revolution in the way we produce energy, they are lobbying hard against it, and filling the airways with misleading propaganda. This is not only a corporate strategic failure, but it is also slowing progress toward converting to a sustainable and domestic renewable power industry.

OIL: Big Oil has depended on two methods to acquire oil so that they could persuade Americans to keep their homes and cars running on this non-renewable resource. The first was to import oil from all over the world. Since 1970, we've been unable to produce enough oil for our needs and we now import more than half of the crude oil that we use every year. Our dependence on foreign oil, much of it from the volatile Middle East, has led to our involvement in foreign conflicts. I don't want to get into the politics of the Middle East here, except to say that our position would be much less complex if we didn't need these countries to keep producing oil. Besides which, even many of these countries are seeing a decrease in production.

The Deepwater Horizon oil spill in the gulf of Mexico, as photographed by NASA

The second way that Big Oil tries to maintain production is by drilling. In case I haven't made it clear, there really is no shortage of oil on the planet (at least not yet)—there's only a shortage of oil that we can get to with reasonable ease. It has been accepted that offshore drilling, particularly in the Gulf of Mexico, is a safe and economically feasible way of acquiring oil. Oil companies have promised that there's very little chance of catastrophic failure. Those promises will be looked at a bit more carefully after the oil spill off the Louisiana shore in 2010; we still don't know all the effects that we'll suffer from that disaster. But even if we accept the dangers of offshore drilling, we can't count on this source forever either—production from this source has peaked and is decreasing as well.

NATURAL GAS: The domestic natural gas industry has had a major reversal in the last several years. With the development of advanced drilling and hydrofracking techniques, many pundits in the industry claim that there is enough natural gas in shale deposits to "last 100 years." But that statistic does not consider the cost of extraction and distribution and the potential impact of environmental regulations of the hydrofracking methods. It also does not take into account the possibility that hydrofracking might cause health and other problems; it is difficult to determine how significant these problems will be.

Facing rising gas and heating costs, the public tends to wrap themselves with the shale gas story like a warm security blanket. Just a few years ago, during the massive pre-election banter about energy, many people took false comfort in the idea that Alaska could provide the nation with energy security. During my talks about energy, someone invariably asks: "What about Alaska?" or "What about natural gas?" or "What about nuclear power?" All of these energy sources are certainly there, but they are based on finite resources. And our work at the Energy Education Institute is about sustainable living, and the infinite resources which we will all rely on one day.

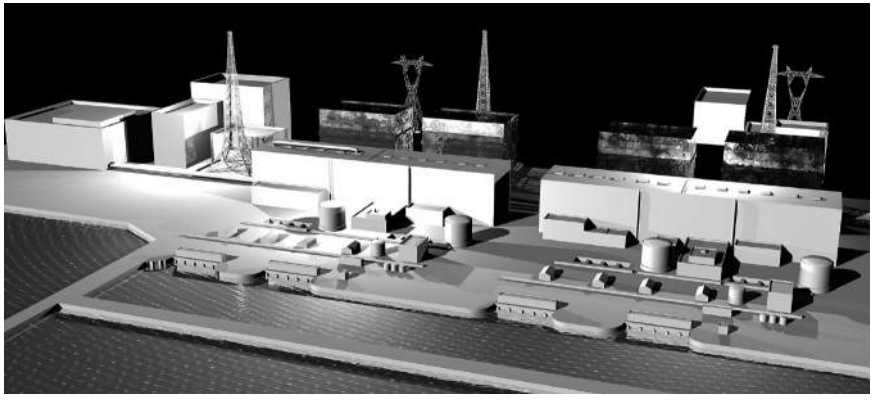
This book is about sustainable living. The case for conservation and sustainable energy will have been made within the next ten years. By then, the facts will have spoken. Our message will be common knowledge well before then.

COAL: Even though coal reserves are down drastically and it's fairly common knowledge that carbon emissions from coal are unacceptably high, the

coal industry is trying to rejuvenate itself. When all else failed, they tried advertising, paying for a 35 million dollar public relations campaign to make people think that there is such a thing as "clean coal." They even got the current federal government to invest almost two billion dollars in clean coal. The project has been shut down; coal is a commodity whose time has passed. A recent study concludes that coal production is reaching a peak, the same phenomenon that we are witnessing in global oil production.

NUCLEAR POWER: Though not a fossil fuel, nuclear energy is connected to oil, natural gas, and gas in that it's a power source that has no place in the modern world; it's just too inefficient. After studying the pros and cons of nuclear power, physicist Joshua Pearce of Clarion University of Pennsylvania determined that there are insurmountable problems that make it an unworthy option. There are also growth limits set by the grade of uranium ore.

Some utility companies are pushing hard for nuclear power. Nuclear power development would help support the status quo system—central generating stations connected to hub-and-spoke type transmission and distribution systems which are a remnant of the early days of electrification. Nuclear and coal help some of the big utility companies maintain their monopoly position over the market while essentially locking out the limitless and ever more cost-competitive renewable power sources—wind, geothermal, solar, and biomass.



Is nuclear power safe? Usually, it is--but there is potential for disaster, as we learned when an earthquake and tsunami hit Japan. How many nuclear power plants are located on fault lines in the U.S.? Above: A model of the Fukushima nuclear power plant in Japan.

THE GOVERNMENT'S ROLE

Every individual, household, corporation, university, city, Indian Tribe and state have roles to play in the conversion to sustainable energy. But the most critical player is our Federal Government and, unfortunately, our Federal Government is the most broken link in this interdependent circle.

Many people fervently believe that the only and best way for the Federal Government to act is to tweak tax credits. But tax incentives did not give us the interstate highway system, or put a man on the moon. The energy crisis that is coming right at us is going to demand far more from our Federal Government than anything we have seen since the Great Depression. In the 1930s, when the country was reeling from a financial crisis, the Federal project to electrify the South through the TVA jump-started the economy. We're in a similar situation today and we can achieve similarly spectacular results. The minimum that can be done by the Federal Government is to change the laws regarding interstate trans-

A MANIFESTO

In the May 2008 issue of *Vanity Fair* Magazine, Robert Kennedy Jr. outlined some ideas for our new President to adopt as a Manifesto. Describing it as a strategic masterstroke, he called on the President to "push to revamp the nation's antiquated high-voltage power-transmission system so that it can deliver solar, wind, geothermal, and other renewable energy across the country. Right now, a Texas wind-farm manager who wants to get his electrons to market faces two huge impediments. First, our regional power grids are over-stressed and misaligned. The biggest renewable-energy opportunities—for instance, Southwest solar and Midwest wind—are outside the grid's reach. Furthermore, traveling via alternating current (A.C.) lines too much of that wind farmer's energy would dissipate before it crossed the country. The nation urgently needs more investment in its backbone transmission grid, including new direct-current (D.C.) power lines for efficient long-haul transmission. Even more important, we need to build a new grid allowing it to intelligently deploy the energy along the way. Construction of this new grid will create a marketplace where utilities, established businesses, and entrepreneurs can sell energy and efficiency."

mission of electricity, and influencing the governance over the location of critical national electrical distribution infrastructure. Some suggest that a massive federal effort to develop renewable energy sources can and should be the way out of the economic downturn that has left so many people unemployed and in despair. In fact, seed money and incentives for sustainable power development is part of the economic stimulus packages, and the U.S. Department of Energy has become the largest power development bank in U.S. history. We know what has to be done—including the number one priority, building a national high voltage low loss electrical grid—and it's time for the politicians to be bold enough to make it happen.

ELECTRICITY AND WWS

With oil, gas, coal, and nuclear power off the table, what will we turn to? Here's where the whole focus of our search for energy has to change. Again, I'll stress the one-word answer: Electricity. And I'll add an acronym, WWS, which stands for Water, Wind, and Sun. The homes and cars of the near future will be powered by electric energy and that energy will be created by renewable sources. The role of our government, of industry, and of the world's leaders in developing and expanding these new sources of energy will be fully explored in Volumes II, III, and IV of The Oil Addiction Cure Book Project. But I'd like to briefly describe the most important elements of future power. Individually, we can't do very much to develop these elements right now—but knowing about them will allow us to think about our own energy solutions in an informed manner. And, at least for me, knowing that the solutions are available and sustainable is incredibly encouraging.

A recent study at Stanford, led by Mark Z. Jacobson of the Department of Civil and Environmental Engineering and Mark A. Delucchi of the University of California, Davis Institute of Transportation Studies concluded that there is enough energy on the Earth to give us all the power we need for centuries to come. Jacobson and Delucchi considered only sources that give us absolutely no carbon emissions and are fully renewable. They evaluated all the pros and cons of each technology and showed that, though there are hurdles to overcome, we're in excellent shape.

Based on figures from the Energy Information Administration, the world uses about 12.5 million watts of electricity every year; by 2030 we will need 17 million watts. Our current sources break down this way:

Oil: 35%
Coal: 27%
Natural gas: 23%
Nuclear power: 6%
Other sources: 9%

In other words, 91% of the energy we use today is derived from sources that are non renewable and unsustainable. In the long run, we will not be using significant amounts of these resources in the mix. In the future, the "other" sources that are giving us just 9% of our energy today—wind, water, sun, plus biomass and some other lesser technologies—will supply all our energy needs. And they'll do so without the carbon emissions that have been causing global warming and pollution.

WATER

The energy that can be derived from water falls into three main categories: Hydroelectric, tidal, and geothermal. Hydroelectric power is generated by water that drives a turbine when gravity forces it to drop; in most cases, a dam forces the water to flow and also stores the water. Tidal power uses the ebb and flow of the tides, which move turbines that are mounted on the floor of the sea.

There are already major hydroelectric dams in the Tennessee Valley and the West. Hydroelectric power is one of the least expensive sources of energy; small and even micro hydroelectric systems can be constructed to power individual homes and factories. This resource is limited because it needs to be connected to a water source such as river or stream and can damage the ecology of that waterway. But when it works, it's clean, green, and cheap. Small-scale hydro projects have been an economic boon for rural villages and communities in Africa. Experts estimate that there are 5 gigawatts of undeveloped hydropower potential in Tanzania, a country which only uses about 1 GW currently and where 85% of the population has no access to electricity.

The most exciting water-based new energy is geothermal; the word is a combination of "land" (geo) and "heat" (therm). The technology has

been used for centuries; the boiling core of the earth has provided heat since cavemen built homes around thermal springs. But we're now learning how to capture that heat and use it to create electricity. Geothermal power plants revolve around boreholes—one to access steam or hot water way beneath the Earth's surface, another to return the condensed, cooled water back beneath the surface.

An MIT report states that there are about 14 million quads of geothermal energy reasonably easy to access underneath the earth in the U.S.A. alone. That amount of energy is about 140,000 times our current annual usage.

Geothermal power plant

WIND

The wind that can be so destructive when it runs free can be harnessed to do our bidding, turning huge wind turbines that generate electricity. There's no shortage of wind in the world and it's been used for power for a long time, but it's come a long way from quaint windmills to the huge turbines that could supply a big chunk of our energy. There are many areas of the world—including the Great Plains between Texas and the Dakotas —where wind is particularly concentrated and blows reliably all year.

North Dakota is considered the Saudi Arabia of Wind Energy. Wind Energy in North Dakota alone could produce 55 times as much energy as the Nuclear Power plant being planned by Progress Energy in Florida. Combining the wind energy potential of North Dakota with Texas and Kansas could produce all of the electrical energy the U.S. needs!

Multi-turbine wind farms—some of the largest ones, such as the Roscoe in Texas and the Viore in Albania, have gathered hundreds of these turbines in relatively small spaces and connected them on a "super-

grid" of power lines. Wind farms have proliferated all over the world—China is building them at a steady pace and the United States is just behind them—and could supply up to 40% of our power in the future. The United States government's EPA has stated that 20% of all energy in the United States should come from wind power by 2030. Their vision, created with the input from a broad range of industry and government participants, is based on the development of a national high voltage overlay grid which would interconnect all of the renewable power sources in a smart grid system.

Wind power has strong advantages. It's totally renewable; we're never going to run out of wind, the planet just keeps making more. It's totally green, with no emissions or combustion. It's relatively easy to harness. The big disadvantage is that it needs those great big turbines, which are made of steel and other materials that have to be mined, milled, and otherwise created. Recently, there was a shortage of wind turbines and about a five-year wait for new ones. Running the turbines requires some non-renewable elements; there are substitutes and the elements can be recycled, but it's an issue that has to be considered. And there are environmental issues as well. Although wind power emits no carbon or other pollutants, it can be noisy and the turbines can disturb wildlife and farm animals (though some say that most animals ignore them). Locating wind farms in isolated areas removes that problem, as does creating offshore facilities. As improvements are made to the individual turbines used locally as well as to the devices that capture the energy that is generated by the wind, wind power will become a vital part of our new energy grid.

Above: A wind tower

Renewable power naysayers cite the problem of intermittency of wind power. But the wind is always blowing somewhere and our national laboratories, researchers, transmission companies,

manufacturers and developers are finding ways to store and distribute wind power. The U.S. Department of Energy has endorsed a vision for development of a national high voltage power grid, akin to an interstate highway system for renewable power. The first portions of that system are likely to appear between North Dakota and the population centers of the Midwest, and between Wyoming and Las Vegas. ITC Corporation is developing the Green Power Express, a 12,000 MW, 765 KW transmission system to link the extensive wind power of the Dakotas, to the major

THE WIND STORY

In 1997, I owned and managed a small Construction Management firm that had a design-build construction management (CM) project with one of the Indian Tribes in South Dakota. While driving back and forth between Minneapolis and South Dakota every week for three years, I was blown off the highway more than once by the high winds. Unless you have experienced the constant and strong winds of the upper plains, you cannot imagine what that is like. So, why has North Dakota not been a leader when it comes to wind energy development? That is a fascinating question that I discovered while looking into a way to help the Tribe with some wind energy development.

Basin Electric is a large energy cooperative and producer that touches nine states in the upper plains states, with some of its primary production assets located in North Dakota. It has been and remains a vital entity in the economic development of that part of the country. Its structure is like a cooperative of cooperatives, encompassing a patchwork of "consumer owned" energy coops located in ten districts. There is very little room on the electrical grid for wind energy in Basin Electrics service area. In general, if a local coop wants to produce wind energy for itself, it cannot because of the take or pay contract that it has with Basin Electric.

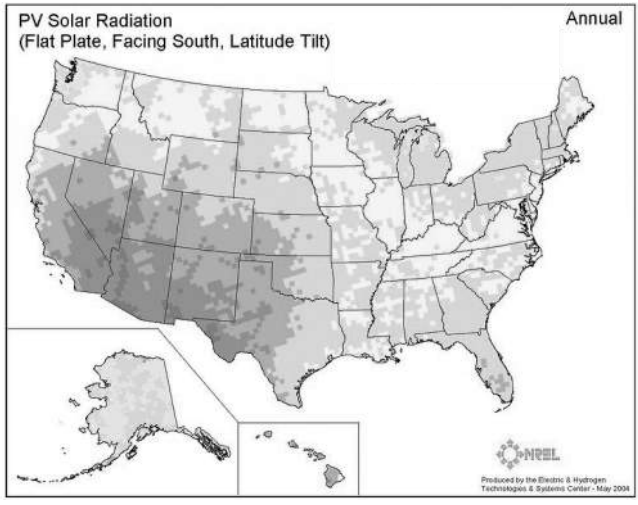
Our laws of free speech protect the right of the coal industry to make its case. The wind resource of North Dakota is staggering compared to the electrical power that is generated by coal in that state, so the stakes are quite high, to say the least. One can understand why the carbon interests in the U.S. have spent a half billion dollars in the first half of 2008 alone, through advertising and lobbying. Given the structure of Great Basin and its coops, the only way to get wind energy going in the Dakotas is to transmit it out of the region, and that is exactly what is happening now, ten years later.

Midwest load centers. Oil and gas billionaire Phil Anschutz is investing in a $3 billion, 900-mile Trans West Express transmission line to strengthen the grid between the wind farms of Wyoming and Las Vegas. As these initial phases of the national grid are developed and linked together, they will provide a diversified supply from across a wide geographical area.

SOLAR

The sun has always been a major source of power in our lives; it provides abundant heat and light without any machinery or effort at all. It warms our homes for part of the year, lights up our world, dries our clothes, and provides the energy to stimulate the photosynthesis that gives us food. But it can do so much more, and we're learning new ways to use the unlimited, renewable power of the great ball of energy in the sky.

Solar thermal power plants now under development in the Southwest U.S. desert will be producing power for ten to fifteen cents per kWh when commissioned. The U.S. Department of Energy's Solar Energy Technologies Program aims to reduce the nominal levelized cost of energy (LCOE) of concentrating solar power (CSP) plants to a target of 7 to 10¢/kWh by 2015 and 5 to 7¢/kWh by 2020. Department of Energy (DOE) estimates that satisfaction of these cost targets could lead to installation of



Darker areas indicate the highest concentration of solar potential.

16,000 to 35,000 megawatts (MW) of new generating capacity by 2030. This would result in a savings of 36 to 80 million tons of CO2 emitted to the atmosphere each year relative to coal plants of similar capacity. In fact, if all of the solar land claims in the Mojave Desert were to be developed with CSP plants, they would produce a whopping 65,000 MW of generating capacity, about double the total needs for the large state of California. A recent study by solar thermal energy company, Ausra concluded that it would only take a 94-mile by 94-mile square area in Nevada to produce enough solar power for the entire United States.

Solar power falls into two broad categories: solar photovoltaics (PVS) and concentrated solar power (CSP). A solar photovoltaic system uses materials such as silicon, arranged in cells to convert the sun's rays into electricity. Concentrated solar power is achieved by using mirrors and other reflective panels to focus the sun on a collector, usually passing a molten salt solution; the hot molten salt is sent directly to the power generating plant and converted to electricity. Some of the molten salt is stored in insulated tanks, and used to generate power during the night when the sun is not shining. Another form of solar power is passive solar energy—making use of the sun without material technology; this can be as simple as using the heated water in the garden hose for showers or washing dishes. One of the advantages of solar power is that it can be—and is—used in small doses. In millions

STORING ENERGY

The national grid will alleviate a large part of the problems with intermittence and variability of the wind and solar plants. Energy storage solutions are also being deployed to fill in the gaps when there is no wind, such as the Iowa Stored Energy Park. When the wind power exceeds the demand needed on the grid, the excess power is used to compress air into air voids in underground rock formations. When the wind energy is less than needed by the grid, the compressed air is released and used to run power turbines on the surface. Xcel Energy is deploying a sodium sulfur battery storage system to provide peak demand power and alleviate the intermittence issue. Developed over more than two decades with Tokyo Electric Power Co., Asia's largest power generator, the system was originally sold to save energy produced overnight so it could be used during the day.

THE GRID TIMELINE

2001: Siemens and Black & Veatch proposed National Grid to Western Governors.

2003: Institute of Electrical and Electronics Engineers (IEEE) Advanced the Vision for a National Grid: "Shaping the Future of Global Energy Delivery"

2005: Sandia Lab sponsored multi-constituent study concluded need for a Nationalized grid. Energy Policy Act Called for National Congestion Study and Designation of National Interest Electric Corridors.

2006: National Electrical Congestion Study is published, identifying significant risks and opportunities related to the electrical infrastructure in the U.S. This overview map depicts the stranded nature of the multiple fuel types and resources we have.

2007: The American Wind Energy Association, in collaboration with American Electric Power, rolls out a vision for a national high voltage electric grid.

2008: DOE releases a report outlining a vision for generating 20% of our electricity by 2030, including a scenario to boost wind electric generation from its current production of 16.8 gigawatts (GW) to 304 GW by 2030. The analysis concludes that reaching 20 percent wind energy will require enhanced transmission infrastructure, streamlined siting and permitting regimes, improved reliability and operability of wind systems, and increased U.S. wind manufacturing capacity.

of homes in areas of the world where the sun shines warmly most of the year, simple solar systems have been part of the energy system even before we talked of energy crises.

New materials for capturing solar power are being patented every day. They're becoming cheaper and easier to install. At the same time, more elaborate structures to collect solar energy and convert it to electricity are making solar power one of the most effective forms of energy. Areas such as the Atacama Desert in Chile are being developed as sun farms; these farms will amass huge amounts of power that can be distributed all over the world. When the full global energy grid is finally in place, solar power will be one of the biggest components in it.

BIOMASS

Biomass is simply all the plant and other organic material that the Earth grows. If you've ever pulled weeds from your garden, you have some idea of how much plant material the Earth can sustain—even the poorest earth will send out an

unlimited supply of new plants every year. So we'll never run out of biomass, and burning it will supply heat that can be converted into energy. There is work being done to refine this process; it's now more elaborate than throwing logs into the fireplace. On the other hand, it's still a combustion process, and combustion releases carbon and other greenhouse gasses. Compared to the technologies that emit no carbon and no pollution, biomass is less desirable. However, plant growth also removes carbon dioxide from the atmosphere, so, ideally, a biomass plant creates a circular loop of carbon dioxide, with a net zero effect on carbon dioxide in the atmosphere over the long term. But it's still a useful fill-in source of energy and some people think it can be refined to become a major source. An added bonus is that using biomass as fuel also eliminates the need to remove it as waste.

THE POWER GRID: THE NUMBER ONE PRIORITY

As you can see from the above review, the earth holds enough energy to give us all the power we need. But much of the energy exists in concentrated doses in specific areas and many of these areas are far away from where people live and where manufacturing plants need the energy to run their machines. A big part of the challenge of converting from fossil fuels (which are moved around by trucks) to electricity will be to find ways of transferring electricity to where it's needed. The interstate high voltage transmission system will be as important to America as the Dwight Eisenhower Interstate Highway System has been for our domestic economy since the 1950's, if not more so.

In the very near future, power lines will deliver renewable energy from where it's available to where it is needed.

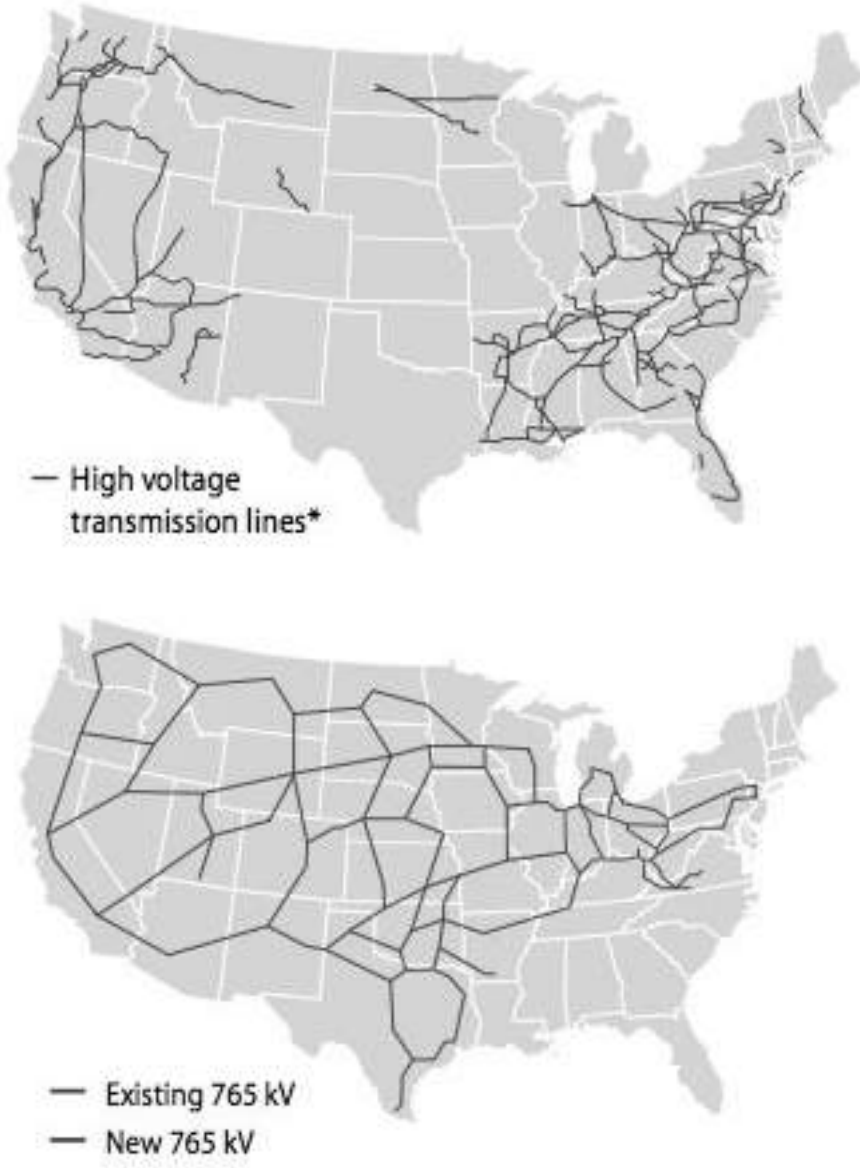
The National Electrical Congestion Study, published in 2006, identified significant risks and opportunities related to the electrical infrastructure in the U.S. This overview map depicts the stranded nature of fuel resources, including coal,

wind, nuclear, and solar thermal. The development of our electrical transmission infrastructure resulted in a system that resembles a set of hub and spoke patterns, with electricity being generated at the hubs located near major population centers. The spokes coming out from these population centers reached out to rural areas as the system developed beginning during the Great Depression. Now, as the cost of renewable energy generation becomes less expensive than the non-renewable fuels such as coal, natural gas, and nuclear, we need a way to gather the energy from those sources where they are located and transmit it back into the urban areas.

After the National Electrical Congestion Study was completed, the Department of Energy called on industry to collaborate in the improvement of the national electric grid. In 2007, the American Wind Energy Association, in collaboration with American Electric Power, rolled out a vision for a national high voltage electric grid that will accomplish several goals:

1. It eliminates the congestion in the existing electrical infrastructures.
2. It provides a means to gather and transmit the renewable and abundant wind and solar energy.
3. It establishes a distributed energy system which, when interconnected, would reduce the problem of intermittence in wind and solar installations.
4. It links the solar energy of the Southwest, and the wind energy of the Midwest which ultimately will reduce the need for total installed capacity because of the seasonal nature of the sun and wind supply and the winter heating and summer cooling demand. The wind is strongest in the upper Midwest during the winter when the heating demand is the highest. And the sun is most intense in the summer when the cooling demand is the highest.

This interconnected system will reduce the capital cost of energy all over the country and its implementation is the most important energy-related job that our federal government can do in this century. It is also important to be able to store energy; many of the new energy sources are variable—they aren't available consistently; a cloudy or calm day reduces the amount of solar or wind power. But great strides are being made in the development of batteries that can catch energy and save it for a rainy day. In China, a battery the size of a railroad car is powering a small city. Although these batteries use rare elements such as lithium right now, this



Top map: **Right now, areas where wind and solar resources are strongest are not connected to the high-voltage power grid. That will change in the next decade.** ***Bottom map:*** **The future.**

CARS AND THE POWER GRID

The U.S. Department of Energy has conducted studies to evaluate the effect of a national fleet of battery based plug in cars, all connected to the grid. Using current technology and battery capabilities, the typical plug-in car with a 100 mile battery only range can store enough electricity to power the average home for a day. This array of millions of car batteries provides a cushion to smooth out the ups and downs of electricity demand and supply during the day, and with differing wind conditions.

Large electrochemical and high flux battery systems are being developed and deployed to connect to wind turbines, providing wind generators the opportunity to supply a more stable electricity supply, and return on their investment.

technology has the potential to smooth out one of the last barriers toward our transformation to sustainable energy.

Developing a national transmission highway is perhaps the number one national security issue facing us today.

Despite these obstacles, plans are moving ahead in many areas across the U.S. for the High Voltage Grid. In the Midwest, the Green Power Express is a $12 billion transmission project under planning to bring the wind power of the Dakotas to the heartland of Chicago and other Midwest energy loads. In 2008, the Anschutz Corporation acquired the rights to develop a $3 billion, 900-mile high voltage line to connect the wind resources of Wyoming to load centers in Las Vegas, Phoenix, and Southern California. That Phil Anschutz is an oilman, speaks volumes about the changing economics of renewable power.

ALL OVER THE WORLD

The United States is not alone in developing new energy sources:

- In 2008, the Queen of England purchased the worlds largest wind turbine, 100-metres high, that will supply 7.5 megawatts of power to the national grid when it is installed off the North East coast of England.
- Prince Hassan Bin Talal of Jordan presented the DESERTEC plan to develop a renewable energy network to transmit power to Europe from the Middle East and North Africa. It calls for 100,000 megawatts of CSP to be built throughout the Middle East and North Africa by

2050. The World Bank recently announced that they will fund the construction of an east west high voltage network spanning North Africa and the Middle East, coincidental with the DESERTEC vision. The development of CSP plants in the vast Sahara desert region presents an unparalleled opportunity to provide jobs and an industrial base for the North African and Middle Eastern societies, now stressed by the global economic slow down and rising food prices.

- China has rapidly become the number one wind power developer, and is among the first to accelerate development of high voltage lines from the heartland of the country where the wind and solar resources are located to the population centers in the East.
- At long last, the South American countries of Columbia, Peru, and Chile are entering discussions toward greater integration of their power generation sources, many renewable.

All over the world, in countries large and small, the changes are taking place. Our grandchildren won't remember gas pumps and coal chutes and their world will be cleaner, their lives happier because of it.

PART II

Part II provides 12 concrete, practical steps for curing our addiction to oil. If you follow all these steps, you'll save about 60-70% of your current energy consumption.

STEP 1

ACCEPT REALITY

We won't fix the problem until we recognize it.

As members of a modern, industrial society, we have come to take some things for granted. We expect that the law of supply and demand will always work. When there is greater demand for an item and its price rises, someone, somehow, will find a way to supply it.

We rely on our scientists' ability to circumvent problems, to find ways to keep us comfortable. Whatever the need and the complications, we believe that the ingenuity of our inventors and industrialists will overcome all obstacles.

We rely on Mother Nature; we live in a land of vast natural resources, a land that can support us and our unquenchable hunger for more, bigger, better of everything. Our land has yielded its arable soil, its millions of trees, its limitless troves of fossil fuels.

But not anymore—the word "limitless" just isn't true. Yes, there is a great deal of untapped fuel—but it's untapped because it's just too expensive and destructive to reach. We still find more oil, gas, or coal, but the cost to extract it is increasing so significantly, not only in dollars but in the protection of the foreign governments who own it, that we just can't afford it. The true cost of oil is much higher than its market cost when you factor in the indirect cost of subsidies and military cost to occupy the Middle East.

A century or two ago, it seemed that there was no bottom to our stockpiles of fossil fuels. We used them without considering what would happen if they disappeared. We built our lives around coal, then oil, then gas—and we assumed that they would always be available in whatever quantity we wanted. Our system of growing food, of heating and cooling our homes, of getting where we need to be are all based on the use of fossil fuels.

And now we see that these fuels are running out. For centuries, we increased production of fuel; now production has reached its highest rate and is decreasing. And new words have come into our daily conversation— renewable, sustainable, peak oil. We are faced with a crisis that could destroy the way we live—or allow us to create a new sustainable civilization that will support all humankind at a level of prosperity that we never enjoyed before. The first step in the right direction, Step One of The Oil Addiction Cure, is accepting reality and understanding that things have to change.

SUPPLY AND DEMAND

One reason we have not faced the reality of the energy crisis is that we assumed that classical supply/demand economics would take care of the problem. In the classical supply and demand model, when prices for a commodity rise, production increases to meet the increased demand.

But what happens when the price goes up, but quantity does not follow? What happens when the demand curve turns back on itself? This happens when the resource is finite, and the limits of production are reached. We call this phenomenon "peak oil", and it shatters our conventional economic thinking about supply and demand.

Unfortunately, we are so conditioned by our training and belief in classical economics and cornucopian philosophy that we have walked right into a trap with fossil fuels.

CRISIS AFTER CRISIS

A few decades ago, we worried about nuclear proliferation, about human rights, about the destruction of the environment. And these were, and are, all important issues. So when I tell you that we have to change the way we use energy—that a crisis is at hand—I understand that some of you

will assume that it's one more crisis that our scientists, our politicians, our activists will handle. We don't have to do anything.

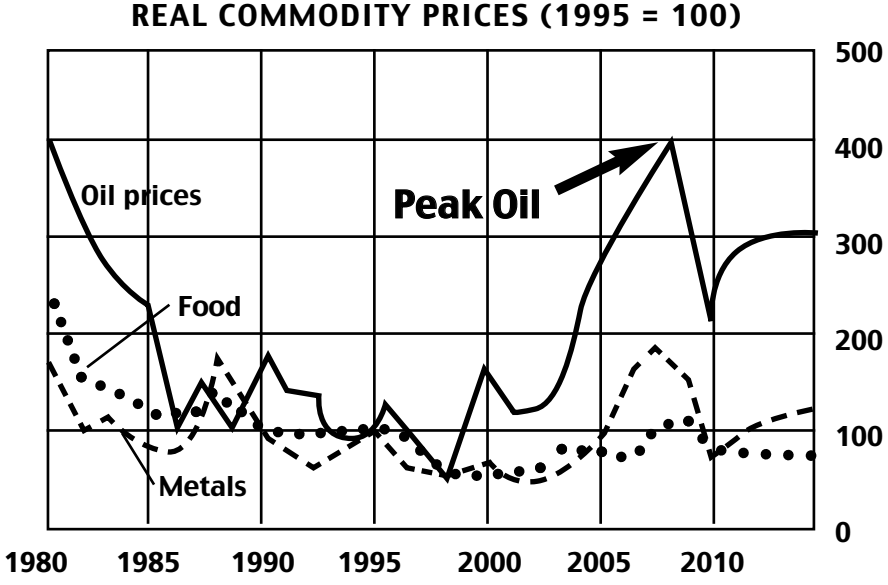
But the energy crisis was caused by the way each of us uses energy and it will only be solved if each of us gets involved. And to get involved, we have to understand what is going on. Educating ourselves about this issue is crucial in breaking our addiction to oil. We have to understand the difference between the fossil fuels that we've been using—coal, gas, oil—and to recognize that they are not renewable, that they are not being produced anymore. We have to learn about sources of energy that are renewable—sun, wind, geothermal, biomass—and how we can transform our way of life to include them. These are complex concepts and they contradict a lot of our long-held beliefs. But if we accept reality, we will see that these are things that we must do. And we must do them very quickly.

Above: **A group of oil-coated pelicans are one of the visible effects of the Deepwater Horizon oil spill in the Gulf of Mexico.**

PEAK OIL

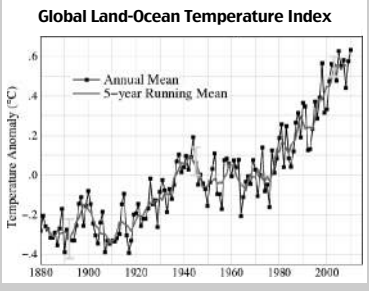
The term "peak oil" was first used in 1956, by M. King Hubbert to describe a trend in oil production that showed oil peaking and then diminishing, then running out entirely. Other scientists and politicians paid him very little attention—until now, 50 years later, when his predictions are coming true.

On May 22, 2008, for the first time ever, the IEA (International Energy Agency) admitted that oil supplies had plateaued. For years, the IEA has forecasted that oil production would rise to beyond 116 million barrels per day by 2030, up from around 87 million barrels a day currently. These projections were not based on science, but politics. But now, after undertaking a field-by-field, country-by-country assessment of actual production and proven reserves, their data is falling into line with that of industry insiders. The consensus is that 87 million barrels per day is the peak. It is important to recognize that the IEA is an organization representing oil producers and consumer countries. Naturally, you can follow the money to the producers, and it has not been in their interest to admit the truth about oil, and drive people to seek alternatives. They only came to this admission when the facts could no longer be hidden. The peak occurred



GLOBAL WARMING

Global warming is not the focus of this book—but it is another reality we have to face. Issues involved in the energy crisis and global warming overlap and when we solve the energy crisis, we will also alleviate global warming. The burning of fossil fuels is one of the greatest sources of greenhouse gasses that cause global warming. Renewable energy sources produce, indirectly, a small fraction of the amount of greenhouse gasses that fossil fuels emit. Two big, bad birds will be killed with the single stone of converting to renewable energy sources.



in December 2005, and production has not grown since then, despite the high market prices of oil. Five days after the IEA released their statement, OPEC followed suit with their own release when the OPEC chief said that the price of oil will rise and output will fall. This is completely contrary to the law of supply and demand, as most of us understand it.

What does peak oil, or, resource limitations mean for civilization? Many thinkers over time have given thought about this subject. Probably the first and most well known was a Social economist by the name of Thomas Robert Malthus who lived from 1766 to 1834. Malthus' basic theory was that exponential population growth would eventually come to reach the limits of the carrying capacity of the earth, until a point of crisis was reached. In his time, mechanized farming based on the internal combustion engine and petrochemical fertilizers was not in sight. But his theories are still viewed as relevant, particularly with today's situation.

How does Malthus' theory apply to modern conditions? Richard Simmons, author of *Twilight in the Desert, The Coming Saudi Oil Shock and the World Economy* writes, "Without energy our system shuts down. Water, food, healthcare all wind down in a few days. Food Scarcity is Social Chaos 101. Raw Materials, Mineral Extraction, and Refining, all extremely energy intense." Through a cold and rational analysis of the oil situa-

tion, reserves, production, and consumption, he and others have marked the years 2012 to 2013 as the point when there will be an unavoidable 8 to10% per annum sharp decline of global oil production.

Another theory about the impact of peak oil was developed by Doctor Richard Duncan, who founded the Institute on Energy and Man in 1992. He developed his Olduvai Theory in 1999 (see page 17), which predicted that energy would peak in 2007, and industrial civilization would begin to collapse back to conditions found in the Olduvai Gorge of Africa, considered the cradle of civilization. His prediction of a 2007 energy peak was essentially correct.

Here in 2011, we are on the portion of his graphic called out as the "slide", leading up to the "cliff" beginning in 2012. This is consistent with the analysis by Mathew Simmons and a host of others.

NATURAL GAS IS NOT EXEMPT FROM THE CRISIS

Most of us are concerned about oil because we notice the price when we go to fill up our gas tanks. But the new energy crisis coming includes natural gas as Julian Darley so clearly documented in his recent book, High Noon For Natural Gas. According to Darley, we will need to find ways of living on 10% of the natural gas that we now use.

According to statistics by the U.S. Energy Information Administration (EIA), the U.S. has a mere 3.2% of the world's natural gas reserves, yet we use 25% of the annual global consumption. The only way we could possibly keep up or expand this consumption is with a massive campaign to build new terminals up and down our coastlines to receive liquefied natural gas (LNG) from import markets. As a result, the forecasts for natural gas availability are widely different.

In the last few years, new drilling technologies have been used to extract natural gas from shale. Some natural gas "bulls" have written that we have 100 years of natural shale gas available in the United States. A temporary glut of natural gas has driven its cost to a ten-year low. Now, instead of plans to import LNG into the United States, companies are planning to build LNG liquefaction plants and export terminals. The world price for LNG is about triple the equivalent domestic price for natural gas.

The growing delusion about natural gas defies logic. It perpetuates a state of denial within the American public. There is a simple fact that most

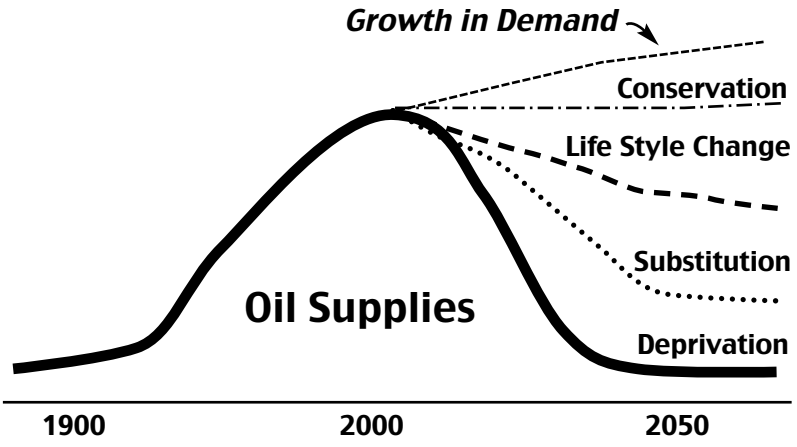
people overlook. The energy content in fossil fuels is measured in BTUs. And a BTU is a BTU is a BTU. Over the long term, the cost of these BTUs trend toward parity because when one fuel becomes too expensive, industry switches to a less expensive fuel. The cost parity ratio between oil and natural gas is about six to one. When oil costs $100, natural gas should cost about $15. Fossil fuel BTUs are finite. Wind, solar, geothermal, and biomass energy is infinite.

What does the future hold? Ronald B. Swenson described how a society reacts when resources become scarce. On a graph (right), he showed how Conservation, Lifestyle Change, Substitution, and Deprivation resulted. Unfortunately, we are seeing effects of deprivation throughout the world. Among the poorest people, who earn less than $1.00 per day and spend more than 70% of their income on food, malnutrition, starvation is the end result. In other places, like here in the United States, we're seeing home foreclosures, another form of deprivation. But Lifestyle Change, Substitution, and Conservation are not deprivation. They are measures we can take; with small changes in the way we do things—carpooling, using renewable energy sources. I will show you with facts how switching to renewables is actually cheaper now than using conventional energies, but it is a substitution than cannot happen as quickly or easily as switching from copper to aluminum wire.

If there is any good news out of this story, it is that we waste a great deal of energy here in the US, and could conserve household energy to match that of Europe. In the short-term, we can reduce our reliance on fossil fuels so that we don't drown in the expense of running our lives with ever increasing fuel prices. It will take a significant effort by each of us—but when we consider how much we waste every day, we will see that we can live just as well with much less energy.

In the long-term, our government and the governments all over the world will have to develop energy policies that convert the world from fossil fuels to renewable sources. The sources of renewable energy—sun, wind, and geothermal power—have been around since the dawn of time. Governments and industry ignored them because they thought that coal, oil, and gas would be around forever—and because the people who were making money from coal, oil, and gas liked it that way. But government and industry have to face reality as well. They need to make informed,

wise choices and investments to move the world into a new era of sustainable prosperity for all of us.



Above: The Swenson Curve, a depiction of how society reacts when natural resources we have come to depend on disappear.

STEP 2

CARPOOL TO WORK

A full car is a sustainable car.

In 2008, the CEO of Kennecott Utah Copper (a unit of global mining giant Rio Tinto) held a suggestion contest. I wrote a proposal for a ride-sharing program, and I won. The company immediately put a "six sigma" black belt team on it, and developed the program, complete with posters displayed around the facilities to promote the idea to 3,500 employees. Other divisions around the world picked up on the idea and the ride-sharing program is still flourishing.

I wasn't surprised that the management of this huge corporation saw the benefits of my proposal, because carpooling is good for everyone—employers, riders, everyone who breathes or drives, and the planet. Empty seats in commuter cars are one of the greatest untapped energy sources in the world. When I watch one-passenger cars whiz by me on the highway—or, during rush hour, crawl through traffic with me—I feel like I'm watching gasoline spewing into the atmosphere and dollars flowing to the Middle East. There are so many good reasons to fill those empty seats, and it's such a feasible, practical, easy method of saving energy that I've made it Step Two of The Oil Addiction Cure.

I could have suggested that you bike or walk to work, or take light rail or other mass transit. These are all great ways to cut down on driving. But the average commute is 16 miles each way; walking and biking are not going to work for most people. And, outside of a few major cities, most areas are not adequately served by mass transit. If 25% of commuters decided to switch to rail or bus, the systems would be overwhelmed immediately. We would need to—and we should—invest a lot of money in light rail and other mass transit to achieve enough capacity to make a difference. But those empty seats in commuter cars are just there, going to waste when they could be used to slash—by 50% or more—the number of miles driven, the number of gallons of gas used, the

*of transportation energy

time wasted in stop-and-go traffic, the amount of emissions and pollution, and the resultant health problems.

DRIVING IN THE U.S.A.

There are almost 250 million cars in the United States. We drive about 3 trillion miles in them every year, and about 40% of this travel is to and from work. On average, we commute 16 miles each way, about 32 miles round trip, five days a week. In total, commuting accounts for 1.2 trillion miles driven; at 20 miles per gallon, that's 600 billion gallons of gas. Only 12.3% of us get to work in anything but cars; 4.7% of us use mass transit and 50% of mass-transit riders live in the nation's ten major cities (Baltimore, Boston, Chicago, Houston, Los Angles, New York, Philadelphia, San Francisco, Seattle and Washington D.C.). Another couple of percent walks, rides bikes, or works at home. Eighty-seven percent of us get to work by car. And of that 87%, 77% of us travel alone. And of that 10% that do not travel alone, 90% have just one more person in the car.

It's that 77% that we need to work on. If we could add one person to each of those vehicles or two people to half of them (or a combination of three people to a quarter of them, two people to a quarter of them, and one person to a quarter of them, and leave a quarter of them with a stubborn single driver), we could instantly cut our use of gas by half or more. Since

40% of the personal energy used in this country is used for transportation, and 40% of that is used to get to and from work, we would reduce our national energy use by 8% if we used the empty seats in automobiles.

BENEFITS FOR THE WORLD

The first benefit we will see when carpooling becomes popular is a significant reduction in the amount of gas used. But that's just a start; reducing the number of cars on the road will impact our health and well being in many ways.

Even though the main focus of this book is not global warming, that problem should not ever be far from our minds. And automobiles are the

FREEDOM'S JUST ANOTHER WORD FOR NOTHING LEFT TO LOSE

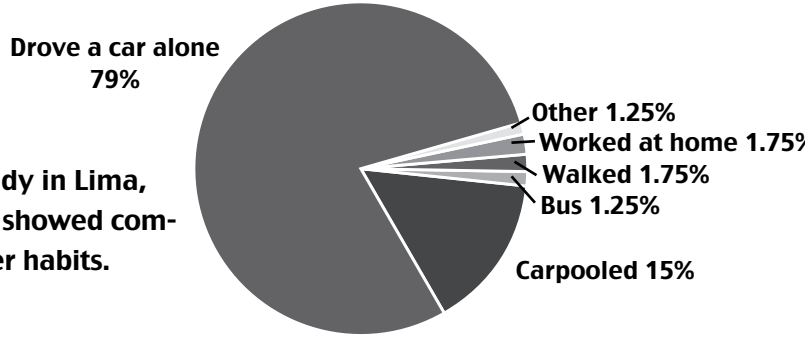
Most people who refuse to carpool say that it restricts their freedom, that when they are in a carpool, they can't come and go as they please. So here we have another one of those cost-vs.-benefit issues. Yes, you give up some freedom when you join a carpool. You are required to get to the pickup point on time, you can't choose your route or your speed all the time. But you are saving a significant amount of money (and you are free to spend it in any way you choose); you are helping the planet; you are improving air quality; and you are driving a wedge between yourself and rising fuel costs. So think about some compromises:

- **Fill your car, but allow everyone days off; the first three people who call in get to take "freedom days." On your freedom days, you can come and go as you please in your own vehicle and there will still be at least two people left in the carpool. You might want to specify how many freedom days each passenger is allowed each month, but it will still give everyone the opportunity to avoid the pressure of having to be in that car five days a week.**
- **Make arrangements with a local car service to provide a discounted rate when someone needs to stay at work late or get in early. Once you know this is in place, you won't have to feel that you are tied to the pool.**
- **Switch pools. Have three or four carpools form a sort of club and switch off every once in a while. You will be able to meet new people, ride at different times and at different routes, and avoid carpool fatigue.**

largest contributor to greenhouse gasses—some say that as much as 33% of carbon dioxide emissions are produced by cars. Assuming a mileage rate of 20 MPG, and 50 five-day workweeks a year, the total carbon dioxide reduction is 640 pounds per year per single car driver. If 1000 employees left their car at home for a year, the annual reduction would be 320 tons of carbon dioxide! Right now, single-passenger rides are increasing as commuting becomes more prevalent in countries like China and India; it is critical that we set an example in the U.S., by reversing the trend.

Reducing the number of miles driven will also reduce air pollution. The smoke, carbon dioxide, and other toxic substances that are produced by running internal combustion engines have fouled our air and our lungs. This effect is multiplied in areas surrounded by mountains or tall buildings, where the pollution is trapped in a phenomenon known as thermal inversion. The effects are disastrous to our health; according to the Utah Department of Environmental Quality, "Particulate matter, carbon monoxide, and sulfur dioxide affect breathing and respiratory function. Existing respiratory and cardiovascular disease may be aggravated, the body's defense system against bacteria and viruses may be altered, and lung tissue may be damaged. Some studies indicate that particulate matter decreases the heart's ability to respond to physical stress. When the heart cannot adapt well to changes in the heart rate, its

A study in Lima, Ohio showed commuter habits.



BRING BACK 55

You might think that getting to your destination faster—in other words, speeding—saves gas. It doesn't—the faster you go, the more fuel you use. In fact, for every mph over 55, you are using about 1% more gas. If you drive at 65, that is 10% more gas used, or 30 extra cents per gallon if you are paying $3.00 at the pumps.

That is why governments reduced the speed limit to 55 mph on most highways when the energy crisis first surfaced during the Carter administration. Why they have allowed those laws to lapse now is beyond my comprehension.

One other thing that people noticed when we were driving at 55 miles per hour: there were many fewer deaths and injuries in car accidents; one study shows that over 12,000 deaths and over 35,000 injuries can be attributed to speeds over 55 mph. So I ask you—how much faster do you think you will get to your destination if you're dead?

For more info about how much smarter it is to drive 55, check out drive55.org on the web. You'll find research info, tips, and bumper stickers.

oxygen-carrying capacity in the blood is reduced. When carbon monoxide enters the bloodstream, it too reduces the delivery of oxygen to the body's organs and tissues. Health threats are most serious for those who suffer from cardiovascular disease, asthma, emphysema, influenza, and bronchitis. Children and the elderly are also likely to be adversely affected by heavy concentrations of these pollutants."

Not only does air pollution aggravate asthma—which now affects more than 20 million Americans—recent studies have shown that it actually causes it. More than 30% of childhood asthma is the direct result of environment and bad air can cause asthma-like symptoms even in people who don't have the disease.

It seems a bit crass to talk about money when it comes to our health, and that of children, but I have to point out that treating the illness and disease caused by air pollution has been pegged at a conservative two billion dollars a year. And the cost of work lost by illness is not calculated into that sum. Getting a big percentage of cars off the road will also ease traffic. The bumper-to-bumper scene during rush hour

isn't good for anyone; it wastes time, gas, and peace of mind. Think of how much easier your commute would be if half of the cars suddenly disappeared.

PERSONAL BENEFITS

But altruism is not the only reason to carpool. Carpooling is one of those practices that, once you get over the minor inconvenience, truly improve the quality of your life. Instead of battling traffic, you can sleep or read the paper several days a week. Some people say they like driving, that it relaxes them for the day ahead—in most cases, your fellow carpoolers will let you take the wheel if you want to, but being able to sit back and take your eyes off the road is a big plus for most of us. The possibility of forging a long-lasting friendship is another benefit. I agree that there's just as much chance of finding out that you truly loathe your car mates, but it can go either way.

Your car, getting less wear and tear, will last longer. You'll save a big chunk of change—average cost for a commuter car is $7,000 per year and if you split that with two other people, you can save several thousand dollars. Your car, left at home several days a week, can be used by someone else—the nanny, your high-school age kids, a neighbor in need.

Many transportation and highway departments have added another cool benefit— high-occupancy vehicle (HOV) lanes that are open only to vehicles with two (or in some cases three), or more riders. The people who are responsible for keeping our roads safe and swift understand the value of carpooling; HOV lanes are a great incentive, allowing some cars to whiz through on lightly trafficked roads. If avoiding traffic jams doesn't get you into a carpool, maybe saving on tolls will; in many states, fares for bridges and tunnels are lower for HOVs.

STARTING A CARPOOL

The hardest part of starting or joining a carpool is deciding to do so. It is a low-tech process; notes on school, church, or work bulletin boards will allow you to find people going in your direction. If you live in a suburb near a big city or near a big plant with many employees, you'll probably be able to find a car full of commuters with similar origin and destination points. Then it is just a matter of making sure everyone is

reasonably compatible and setting up a list of rules (which is important for smooth operation—see below).

There are also many web resources, including icarpool.com that will help you find or set up carpools in your area. If your neighborhood, house of worship, civic organization, or local schools don't have a carpool program, talk to someone about setting one up. It can be as simple as a bulletin board with pushpins or a computer user group that allows people to find each other.

Most big companies, and even small ones, have a vested interest in getting their employees involved in carpooling. People who arrive to work in carpools are usually on-time; they have another reason to feel tied and loyal to the company, which raises company morale; and they get a chance to talk about their work with people who work in different parts of the company, which can lead to workplace interaction that no number of supervised meetings could create. And in time, it will allow the company to cut down on the amount of space needed for parking. These reasons, plus all the other benefits of carpooling that are listed above, make corporate leaders amenable to supporting carpooling programs. So if your company does not already have a carpooling program in place, you may earn points if you suggest one. Gather a list of reasons why carpooling is good (see a rundown of benefits on page 71) and list of ways that the company can help (see some ideas on page 71). Make an appointment with your supervisor, or with someone in the HR department; find someone else in the company to join you. Not only will you get a better carpooling program, but your company's management will recognize and appreciate your leadership, and possibly understand that the company would benefit from promoting you to the position you deserve.

CARPOOL ETIQUETTE

Joining a carpool is not as complicated as getting married, but it does share some attributes. You're in close quarters with your car mates for a significant amount of time day in and day out, you're working toward a common goal (getting to work) and there is tension and pressure, in order to get to your job on time, you depend on the other people in your car to be punctual and to drive safely. Having a solid list of rules will make the going easier, and help you avoid awkward conversations later. A printed list of rules

might seem a bit anal, but you can laugh as you go through it. You might even want to copy the list below and blame all your rules on me and this book—but when you are done, everyone in your group will know what's expected.

PUNCTUALITY: You can't tell your boss that you were late to work because someone in your carpool had to find his dog. Once you have determined how you will meet—at a central location, or with the driver of the day picking everyone else up—you have to decide on how long you will wait for latecomers, how many times someone is allowed to call and ask everyone to wait, how many times someone can no-show before he or she is kicked out. Of course, there are exceptions to be made for illness and extreme circumstances, but everyone has to understand that jobs are at stake.

DRIVING: It is probably a good idea to take a short trip and give everyone a turn at the wheel before you commit. Some people are just bad drivers and you don't want to feel that you're taking your life into your hands every time you get into the car. Once the general roadworthiness of each driver is accepted, you should decide on speeds, rotation of driving duties, and routes. Does each driver get to choose? If one driver likes to drive more than others, is that allowed? If people want to switch the driving rotation, will that annoy other passengers?

CARS: Will you choose one or two of the groups' cars and use those or will each carpooler use his or her own car on the day that they are driving? How will you pay for gas or tolls—will each person pay on the day they drive, or will drivers of roomier cars get a bit extra for the comfort they provide? If you choose to drive in just a few of the groups' cars, how will expenses be divided? If there is an accident during the commute, who is responsible for repairs not covered by insurance? Is insurance on each car adequate?

DAYS OFF/SUBSTITUTES: There will be days when one or more drivers won't be there—vacations, sick days, overtime. How will the others be

alerted? How will the driving rotations be adjusted? Everyone has to be flexible on this issue (tell them I said so); if the carpool becomes a jail, it's only going to work for people with very rigid lives.

FOOD: Do you want to outlaw smelly foods, or require that anyone who brings them must bring enough for everyone to share? Coffee is probably the only thing that people cannot live without on the commute; you can decide whether anything else is acceptable. If someone's bacon sausage breakfast burrito is going to make someone else nauseous for the rest of the day, you might have to enforce a no-solid-food rule. It will keep the car cleaner, too.

MUSIC: This is probably the most controversial carpool topic; classical music can be torture to a lover of rap, and vice versa. Choose acceptable music, a driver-decides policy, earphones only, or blessed silence.

PERSONAL HYGIENE: Make rules about this right at the beginning, before you have to point fingers at transgressors. Everyone has to make every effort to smell reasonable when you are cooped up in a car with him or her. List habits that are not acceptable, just in case anyone is not aware. If you come down with a contagious disease, stay home until you are not infectious.

CONVERSATION/CURSING: You don't have to agree with your car mates on every topic, but screaming battles on religion or politics are probably not conducive to peaceful commutes. On the other hand, sharing ideas and finding solutions to world problems can be stimulating. Everyone should be able to veto uncomfortable topics. And if swearing bothers some passengers, everyone should be able to avoid it for the length of the drive (you can start again as soon as the car doors open).

GENERAL CHUMMINESS AND PDAS: Sometimes, carpools become friend pools; and sometimes that friendliness makes the ride unbearable for some of the passengers. If you don't want to know whose birthday it is, let alone be responsible for bringing cupcakes, tell people right away. Go easy though—carpool friendships can be real and valuable. Some friends told me a story of a couple that joined a carpool and used the time to make out in the backseat when it wasn't their turn to drive. You might want to put this on a taboo list—or not.

WORK CONTACT/TALK: If your carpool includes people who work for the same company or in the same industry, the drive to work could turn

BENEFITS: AN OVERVIEW

Here is a little cheat sheet on the benefits of carpooling; you can use it to convince potential car mates or to persuade your company's management to set up a carpooling program.

PERSONAL BENEFITS

- Save money on gas, tolls, wear and tear on car
- Save time by using HOV lanes
- Get an extra few minutes of sleep on the days that you are not driving
- Have an extra vehicle at home

COMMUNITY BENEFITS

- Less air pollution because there are fewer cars on the road
- Saves fuel, helps lessen the energy crisis
- Less traffic overall, need less road repair
- Cut down on the diseases caused by air pollution

CORPORATE BENEFITS

- Get your employees to work on time
- Fewer parking spaces necessary
- Employees save money, less financial pressure
- Improves employee morale and attitude; employees will be calmer and more ready to work if they have not just battled traffic
- Public relations benefits; companies with good carpool programs are lauded in the press
- Global warming will affect companies very soon; carpooling cuts down on global warming.

CORPORATE SUPPORT

Your company can be a strong ally in setting up a carpooling program. Discuss the following support tactics:

- Monetary or vacation privileges—a cash benefit for carpoolers or mass-transit riders, or a day off every six months.
- Posters displayed throughout the company (see sample on p. 73)
- Website or bulletin board postings to help employees find carpools; articles in corporate communications.
- Setting up a system for carpoolers who have to work late, possibly arranging with a local car service for discounts .

TELECOMMUTING

Carpooling slashes commuting costs; telecommuting eliminates them. For the employer, there's a huge savings in office space, parking space, and time lost in transit. For the employee, there's no traffic, no schedules, and no gas costs. What could be better? Why doesn't everyone do it?

Many employers have embraced telecommuting; others not so much. There are two main objections. One, it's hard to supervise someone who is not visible; it takes a very reliable employee and a very trusting boss to agree to this practice. Second, there is something to be said for the energy generated by sitting in a room with your colleagues, and no amount of computer conferencing will make up for the fact that you don't look your colleagues in the eye on a daily basis.

If you want to telecommute, convince your boss that you will set up a dedicated area for work, keep to a strict schedule, and behave as you would if you were in the office. Do visit the office on a regular basis—you don't want to be forgotten. And if youre saving time and money by telecommuting, make sure that your employer benefits as well, by your dedication and care.

into an extension of the workday. That could be great or awful for all or some riders; decide ahead of time how much office talk is allowed.

FLEXIBILITY: No matter how many rules and discussions you set up, nothing is more important than everyone staying calm and accepting a bit of annoyance without letting it get to them. Remember how much you are gaining with your carpool and ignore the tiny irritations. If you can't, just find another carpool.

OTHER WAYS TO SAVE

Carpooling to work is not the only way to cut back on gasoline. Consolidate trips whenever you can, and share rides to the supermarket or

longer distances with friends. Shop locally—you might not be saving much in the big box stores if you factor in the cost of gas. If there's mass transit in your neighborhood, use it. If there isn't, lobby and advocate for it whether it's light rail or weekly bus service. Maintain your car regularly and keep your tires inflated—save a drop here and there and it all adds up.

DRIVING SMART

During World War II, when gasoline was at a premium, a poster appeared with the words "When you drive alone, you're driving with Hitler." Pundit Bill Mahre updated that a couple of year's ago, saying "When you drive alone, you're driving with bin Laden." Here is my take—when you drive alone, there is someone in the car who is not taking advantage of a very significant and easy way to save money, save energy, improve the environment, and make life easier. Why would you want to be that person?

STEP 3

GET A HOME ENERGY AUDIT

Is your home leaking energy?

Considering the large amount of money that can be saved through a professional energy audit, it is surprising that more homeowners and businesses don't make the effort to get one. This chapter is going to focus on the building envelope—air leakage, insulation, and air conditioning. Other chapters in this book cover the subjects of appliances, lighting, space heating and cooling, and hot water, but a home energy audit will help provide you with an overview of the cost-saving possibilities in these areas as well.

In 2005, shortly after Hurricane Katrina, I began a stint as an energy auditor and consultant for Xcel Energy in Minnesota. Although I had been involved in design, development, and construction of all types of buildings and facilities, there is a completely different body of knowledge related to making existing buildings energy efficient. With new construction, one starts from scratch and finds the best materials and methods. Now, I would be working on buildings that were created decades, and even centuries ago and figuring out what could be done to improve them. I went from macro to micro projects—and I've never had a better opportunity to learn about how we use energy in America.

My work as an energy auditor dovetailed into my overall plan to understand this country's energy needs in a way that working on major new construction could not. I knew in 2005 that making new construction energy efficient was not going to be where the most impact would be. I could see where peak oil would take our economy, and new construction was going to take a breather for quite a while, as it has. While I am a fan of passive solar and superinsulation design concepts, depending on your climate, I recognize that we are going to have to make the best of our current housing and commercial building stock. Only a small percentage of us will live in brand new homes that take full advantage of current technology, but there are many ways to improve even vintage houses.

WHY DO YOU NEED AN ENERGY AUDIT?

1. **Average energy costs for a single-car household have risen to over $5,000 a year. Unless you are very rich, that represents a considerable percentage of your disposable income. Of that $5,000, 40 to 60% is used for home energy (costs vary depending on where you live and the cost of electricity and other fuels); most of the rest goes for transportation. But no matter where you live, your energy costs can be reduced, often significantly, if you understand how you are spending your energy dollars—and a home energy audit can do that for you.**
2. **A full service home energy audit will reveal energy efficiency investments that provide the best rate of return, or payback. A competent auditor will help you understand how spending a little money can save you much more.**
3. **New methods and technologies in home energy efficiency are coming to the market all the time. There are many unscrupulous contractors and suppliers in the market, making false or misleading claims about the benefits of their products. An energy auditor will help you sort fact from fiction.**
4. **A new system of labeling and ranking home energy efficiency has been developed by the government to allow homebuyers more reliable and comparative data when making home-buying decisions. This program, along with the older Energy Star program, can have an impact on the value of your home.**
5. **Most homeowners are unaware of how their energy bills are impacted by their habits and behaviors. A home energy auditor will break down your energy bills into line items, so you can see where the money is going.**
6. **If you care about the environment, your home energy use has a correlation with your environmental footprint.**

A home energy audit can pour money into your house.

In my work as an energy auditor, I was surprised, befuddled, entertained, and sometimes touched by the way Americans approach their energy needs. Showing someone how to save money and energy in their home or business is very gratifying. Crawling through basements and climbing onto roofs to find out where energy is leaking and using diagnostic equipment to test air transfer and efficiency is like being a detective; having good, solid information to impart made me feel like a benefactor. There is much information out there, many ways to tighten up our homes that will keep heat where it belongs. Building codes don't require that homes be built as efficiently as possible. An energy audit can show you how a small investment can lead to big savings; it will show you how to scale back on luxuries that you don't really enjoy and make your home more comfortable and easier to maintain. That is why having an energy audit performed on your home is number three on the twelve-step list.

WHAT'S AN ENERGY AUDIT AND HOW DO I GET ONE?

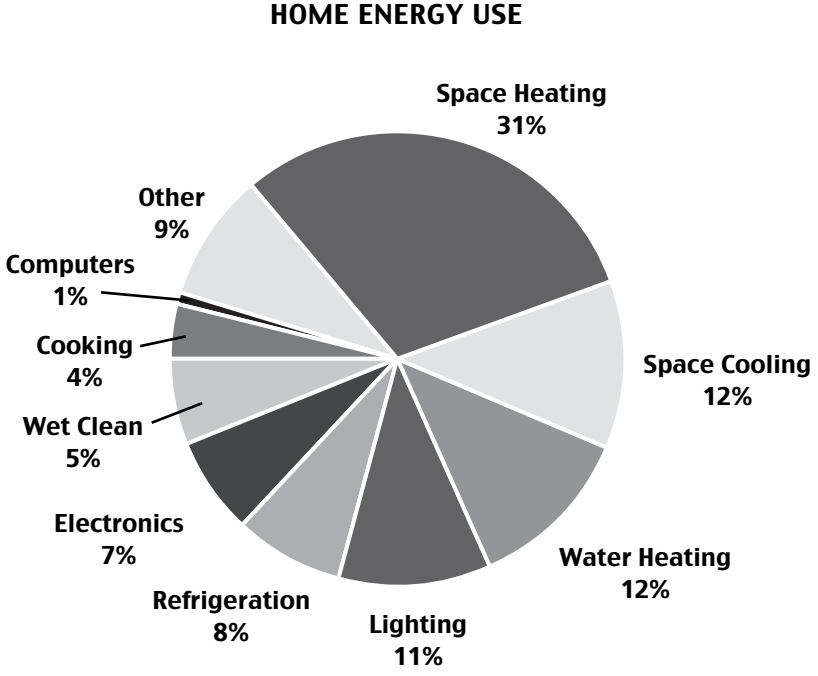
When I worked as an energy auditor, I made appointments to visit homes and commercial buildings, inspected them from top to bottom, reviewed all the energy bills, used very cool diagnostic equipment to figure out how air and energy was moving through the building and then made recommendations for improvements. Even though I knew a lot about construction and energy when I took the job, I sought special training before I went out into the field. So my first recommendation is find a professional auditor to do that type of assessment—these audits are usually not expensive, and sometimes, they are free. In the long run, they will save you money.

You can conduct a self-audit. But a professional auditor has equipment and information that are not available to individuals; they can diagnose problems that you'll probably miss on your own.

FINDING AN AUDITOR

As with all services, some auditors are better than others. Some will help you save thousands of dollars for years to come and improve the quality of your life. Others will help you waste an afternoon and a couple of hundred bucks. The trick is knowing the difference.

Word-of-mouth is the best way to find an energy auditor, but this process is fairly new, so you might be the first person you know who is get-



ting an energy audit. The next place to look for an auditor is your utility company; when I was an auditor, I contracted my services through a utility company . Some utility companies have excellent training programs and cutting-edge equipment; they often pay more than an independent auditor will earn, so they get highly qualified, intelligent people. And they often provide this service for free, with state funds channeled through them. And the company auditor will know the ins and outs of the company's special rates; they can tell you, for example, that electricity charges are reduced at certain times of day or that you can get a rebate for installing certain types of meters. On the downside, you won't be able to choose the individual; the company will send whoever is next on call. And you probably won't be able to ask for individual tests or results. Another downside: Although some states funnel their energy program money through regulated utility companies, getting an energy audit from a profit-driven utility company may be a bit like asking the proverbial fox to guard the henhouse. Still, if your utility provides a free audit, why not take advantage of it.

If your utility company doesn't provide this service, ask at your local lumber or home supply shop, even the big box stores. The managers in these stores usually know the contractors operating in the area, including auditors. And a web search will connect you to the regional and national services that are popping up all over the country to fulfill this need. Getting an auditor to visit for a few hours can be difficult if you live in a remote area; this is one case where joining with a few neighbors makes sense (and your Oil-Anon group might think about setting up some Home Energy Audit days). The auditor gets a full day's work in one neighborhood and saves gas—a good way to start an energy saving program.

Here are some questions to ask an auditor:

- Where and how was he (or she, but I'm just going to use he from now on) trained? There are some excellent training programs, some done over the web or with software, some done in classrooms. Your auditor should be able to tell you about it.
- Is he certified? There is not yet a national certification program for home energy auditors, though several states and some companies do provide certification. There's a website called Energy Circle (see resources) that lists different certification programs.
- What tests will he perform? Your auditor should have a list of tests, though he might have a good reason for not performing some of them.
- What equipment does he have? At the very least, he should have a blower door and a scanning device for a thermographic inspection.
- How will he present the results? Will he email a standard form with recommendations?
- How long will he spend in your home? Will he inspect all parts?
- How much will it cost?
- Does he recommend specific products, and if so, does he have a financial connection to the products he recommends?
- Does he work as a contractor as well—in other words, can he implement some or all of the improvements he suggests? This can be good or bad; if he can take on the job of implementing the improvements, you have a one-stop shop for all your needs and you'll have a contractor who has inspected your home with an eye toward energy savings. On the other hand, an auditor who does only the auditing has no

THE BTU AND YOU

In order to understand what your energy auditor is telling you, you have to understand the terms that he uses:

BTU: A BTU, or, British thermal unit, is approximately the amount of energy required to heat one pound of water one degree Fahrenheit. All fuels have a known energy content, expressed in BTUs per unit. For example, the BTU content in some common fuels is listed in the following table:

BTU Content of Various Fuels

Electricity 3413 BTUs per kWh	Oil 140,000 BTUs per gallon
Propane 91,500 BTUs per gallon	Shelled Corn 352,800 BTUs per bushel
Natural Gas 100,000 BTUs per Therm	Hard Wood 20,790,000 BTUs per cord
Kerosene 127,000 BTUs per gallon	

Source: American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

SF: Equals the square feet of conditioned space in your home.

Heating Degree Day: A Heating Degree Day is a quantitative measure used to define the demand for energy required to heat the space in a home or building. Its calculation is quite simple. If your inside temperature is 65° Fahrenheit, and the average outside temperature for a particular day is 40° Fahrenheit, then the number of Heating Degree Days (HDD) for that one day is 25. (65-40=25)

BTU/SF/HDD: BTUs per square foot per heating Degree Day. This is a common denominator used by The Energy Education Institute and other energy analysts to evaluate the overall thermal efficiency of a home or building. With all things equal, this metric gives a comparative benchmark to use when comparing a structure with other similar structures.

Many factors influence the thermal efficiency (BTU/SF/HDD) of a building envelope, and there is a wide range in the measured efficiency between different homes and buildings. For example, a well-built "Superinsulated" home can have a thermal efficiency as low as 1.0 BTU/SF/HDD. This is about 1/4th to 1/3rd of a typical home, which means that it uses 1/4 to 1/3 as much energy to heat or cool.

incentive to suggest work that is not totally necessary. Maybe it's because I did the job myself, but I tend to think that auditors are not

out to rip you off, and you are pretty safe with an auditor/contractor. But you should know this fact before you get started.

- And of course, ask for references and check them; check with the local Better Business Bureau as well.

PREPARING

The more information you give the auditor, the more help you will get from him. Only the first item on this list--gathering your invoices--is crucial. The auditor should be able to figure out the rest himself, though your input will save him some time.

- Your utility bills; have electricity, gas, and any other bills for at least one full year, two years will be even better, allowing him to compare. You might want to flip through the bills yourself and take note of any anomalies—spikes in costs, differences from one year to the next for the same month. If you don't have your bills, call your utility company; they will be able to provide not only the bills, but a summary of your energy use.
- A list of all the appliances you use, with the year purchased, and the warranties if possible. If you have info on their Energy Star ratings, pull that out, too. You don't have to list the electric pencil sharpener, but do list all major appliances and electronics. If you have time, create a chart of how and when each is used—the refrigerators that are on all the time, TVs that play for several hours a day, washers and dryers that are used three times a week, etc. If you use any freestanding heating or cooling units, list those, too.
- Collect all the information you have about what kind of insulation was used on each part of the house. If you don't know anything about the insulation, you might want to contact the previous owner or the contractor who originally built it.
- All the sources of energy in your home. If you have a heater at the pool, he should know about it. If there is an electric box in the attic, you should know where it is so you are not crawling around looking for it when he comes.
- If some of the people in the household won't be around when the auditor is there, ask them to tell you how much time they spend in each room, what temperature they prefer in each season, whether

they are comfortable with the current temperature, what they would like to learn from the audit.

- If you have time, make a list of each room in the house and how much it is used, how it is heated and cooled (if you don't have a central system), and how it is lighted.
- Your auditor will probably be performing blower door tests. To prepare for them, close all windows and doors turn down thermostats, close up fireplaces. If you have exposed wood ashes, cover them up—or they will blow all over the house. You might want to put open containers or potpourri away as well.
- The auditor is going to be nosier than your mother-in-law. If he is doing his job right, he is going to look in closets and cabinets, go down to the basement and into the attic. He won't care if it is messy (as long as he can see the bottom), but if you are going to be embarrassed, this might also be a good time for the cleanup you've been putting off.

WHAT THE AUDITOR WILL DO

The auditors' basic job is figuring out how energy is used in your home and how air (and the heat and cold that it carries) moves in and out of each space. He will also advise you on whether your appliances are correctly selected for the jobs they are doing. The end result that you are looking for in an audit is a list of potential home energy improvements, their cost, and potential savings.

The things he is looking for are insulation, leaks of moisture and air (either from inside to outside or from room to room), appliances that are either inadequate or too big for the work they are doing, luxuries that are more expensive than you think they are, landscaping that either improves or detracts from your energy efficiency, windows that allow drafts and precipitation to invade your space. He will inspect walls, floors, doors, roofs, and windows. He will look at electric devices, lighting, electronics, and especially heating and cooling units.

One of the first things I do when performing an energy audit is to evaluate the energy use patterns on a seasonal basis. This is simple if you have gathered the utility cost records for the last 12 to 24 months. (Again—if you don't have your records, ask the utility company for your bills and for an analysis of your historic monthly use.) This analysis

SAMPLE HOME ENERGY USE PROFILE

Opposite is an actual sample of a home energy use profile from an audit. The following comments refer to the graph to explain how this works.

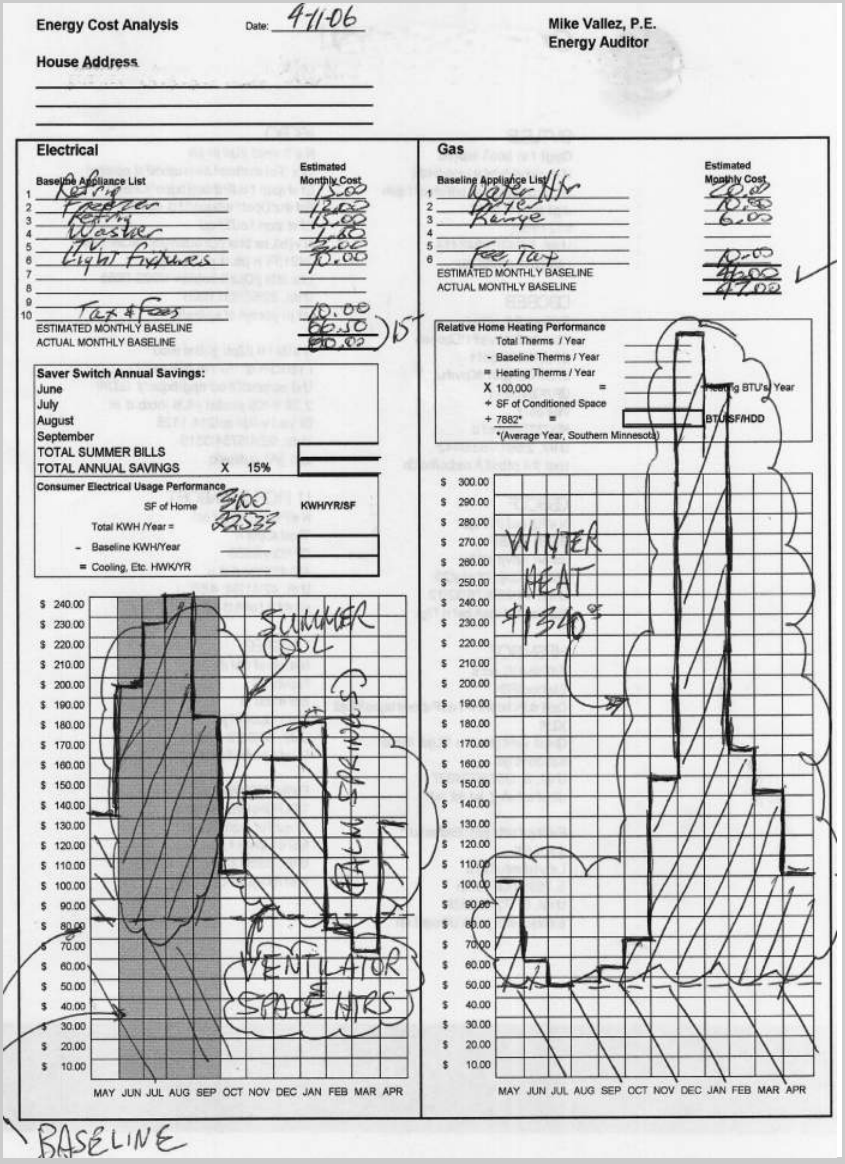
BASELINE USE Every home tends to use a baseline of electricity and fuel. This baseline represents the amount of energy that the home uses just to keep working, year in and year out, regardless of the season. In the above example, this home was heated with natural gas (right side) and cooled with electricity in the summer (left side). Heating and cooling represent the major seasonal variations in electricity and fuel use. The baseline electrical use for this home was estimated at $80.00 per month. This was much higher than most homes in the market area and it was attributed to the use of three refrigerators and numerous architectural recessed can lights that the owner kept burning in the kitchen and great room most of the time. In Minnesota, June through September was considered the cooling season, and you can see the summer spike in electricity use during those months. The "shoulder" month of October was the lowest electric bill, which stands to reason – this is between the summer cooling and winter heating, when the furnace fan contributes to the electrical cost to run the home. In addition, this homeowner had a three-season porch that used electric baseboard heaters to take off the chill.

Note the rise in electric costs in November, December, January, then the sharp drop in February and March. When I interviewed the retired couple on this audit, they confirmed that they left town in February and March for Arizona.

Now look at the right side of the graph, the natural gas side. This home used natural gas heat, natural gas hot water heater, and also had a natural gas fireplace. When I saw the large spike in the gas bill for December and January, the two coldest months of the year, I knew that there was a problem in the attic. Although this home was just five years old, it only had the code-required amount of blown insulation in the attic. It was a large one-story rambler with a walk out basement, so it had about 2000 square feet of attic area. Why the spike in the cold months? It turns out that even though blown fiberglass insulation is the cheapest and easiest to install by contractors, some brands don't work right: below 20 degrees F, they begin to lose R value through convection*. So even in new homes, inadequate attic insulation is one of the most common energy problems in very cold climates, and it is one of the least expensive problems to remedy.

This problem was identified by the U.S. Department of Energy in controlled tests at the Oak Ridge National Laboratory in 1992, Numerical Analysis of Heat Transfer by Conduction and Natural Convection in Loose-Fill Fiberglass Insulation.

Some energy auditors exclusively recommend blown cellulose insulation. However, some of the manufacturers of blown fiberglass claim that they have addressed the problem. Every climate and every situation is different, so we cannot address all of these in this book. But if you find that your home lacks sufficient insulation, your energy auditor should be able to recommend what to do for your particular situation.



results in a graph as depicted on previous page. By doing this analysis at the beginning of the audit, the auditor can quickly identify and focus in on the problem areas. An engineer would want to create a graph of the actual kilowatt hours and units of heating fuel used to be technically correct. But I have found that consumers are more interested in the monthly and annual cost of their energy, and can identify with these numbers better than with the units of energy consumed.

INDOOR AUDIT

After evaluating the energy cost history for your home, and inspecting the exterior and landscape, the auditor will move inside. He will perform a blower door test on your home. The blower door is a powerful fan that's mounted on a frame mounted in one of your exterior door openings. The blower doors microprocessor is able to take data from the fan amperage, and air pressure inside and outside of your home, to calculate the amount of air leakage in your home in a simulated 20 MPH wind.

Two homes that look the same on the outside can have dramatically different blower test results. The chart at right depicts a sample of blower door results from a group of Minnesota homes that I tested personally. An energy auditor in your area can tell you what to expect in your home. Note the large variation in home leakage. A "good" home will not leak more than about 1200 to 1300 CFM in a standard blower door test. But I find homes that are more than double that amount as seen in this chart.

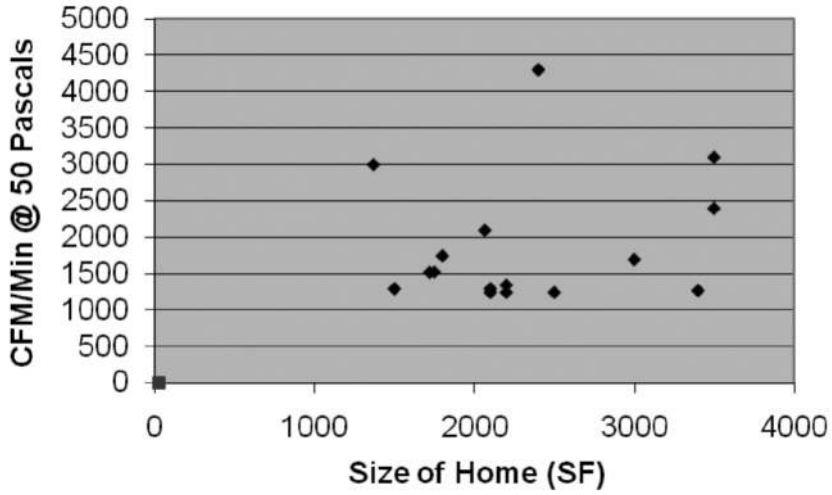
A blower door

Often the blower door test will reveal problems with exterior wall insulation. It always determines if your home is sufficiently airtight.

MY FAVORITE TOOLS

One of my favorite tools was a thermographic scanner. This is another way to discover problems with wall insulation in a cold climate when the outside temperature

BLOWER DOOR VERSUS SIZE



is low. You need an adequate temperature differential between the inside and outside to get a good thermal image of an exterior wall, depending on the sensitivity of the device. I scanned interior and exterior surfaces and got an image showing relative temperatures; cooler areas showed up dark, warmer areas showed up as light colors. I could see heat moving from one surface to another, sometimes crossing a whole room. These thermographic inspections allowed me and the homeowner to see where heat was leaking from their home. If it was not in the place they wanted it, we could discuss remedies. I usually did the thermographic inspection at the same time as the blower door test; the big fan exaggerated leaks and cracks so that they showed up more clearly on the thermographic scan.

WHAT YOU SHOULD DO DURING THE AUDIT

Follow him around and take notes; ask if he minds being videotaped or recorded. He is going to give you a report, but it won't include every crack that he mentions. He is going to see things that you have missed in your own inspection and you will want to remember every crack and leak he turns up. Ask him how he feels about questions; you don't want to be annoying, but you do want to get all the information you can. If he asks you to leave a room, it is because the test he is performing might require protective gear. If he asks if he can make a small hole in a wall, it is to

check in-the-wall insulation. These holes are usually easily repaired, so just ask him to do it somewhere that it will not be seen.

REMEDIES–APPLYING THE TWELVE STEPS AND MORE

Getting information on where your home is leaking energy is an important step. But that is only half the journey. Now, we have to learn how to correct the problems that are uncovered. Lighting issues are discussed fully in Step 7 (Switch to LED lighting; see page 90); appliance issues are handled in Step 8 (Get an Energy Star Refrigerator, see page 138); new heating systems are presented in Step 6 (Convert to a Cool-Climate Heat Pump, p. 96). But for most people, an energy audit revolves around three elements: insulation, sealing, and windows.

Here is a list of steps to be taken by the homeowner whose house was audited on page 83 to enable an annual cost reduction from $3,700.00 to $910.00 per year:

1. Add 6 inches or more of blown cellulose insulation to the attic, raising the R-value to 50 and eliminating the conduction through the fiberglass fluff insulation.
2. Eliminate the use of the three-season porch during the cold winter months, eliminating the need to use the baseboard electric heaters in that room.
3. Reduce the number of refrigerators in use from three, to one energy star refrigerator.
4. Replace the incandescent light bulbs in the recessed can lights with fluorescent lights.
5. Convert the gas furnace to an all-electric, high efficiency, all climate heat pump for northern climates.
6. Use either electric or gas on demand hot water heater system.

HERE ARE SOME COMMON INSULATION VALUES FOR ATTIC AND WALL RE-INSULATION:

Insulation Material	R Value
Cellulose (loose fill – attic)	3.6-3.8
Fiberglass (loose fill – attic)	2.2-4.3
Fiberglass batt –3-1/2”	3.14 – 4.3
Polyurethane (foamed in place)	6.25

INSULATION

If you take time to talk to professionals in your area about insulation, you will find that insulation preference is like religion. Everyone "believes" in one kind of insulation or another for different applications. The other thing you will learn is that insulation solutions are highly dependent on where you live. Is it a cold climate or a warm one? Is it a humid or dry area? What is the elevation? It is windy or calm?

Many insulation contractors, manufacturers and distributors have developed trademarked systems with fancy names. These are often standard materials put together in certain combinations. Don't pay too much attention to warranties from insulation contractors, unless they carry a seal from the underlying national scale manufacturer. Many insulation contractors go in and out of business over time, so a warranty from some of them is not worth much.

For example, in the residential market, one of the big concerns of new home buyers is the insulation and water tightness of their basements below grade. In response to this buyer concern, contractors have developed proprietary systems that are guaranteed to resist water infiltration into your basement for 20-30 years. Don't believe them. I have never seen a residential foundation insulation system that was designed to fulfill the alleged warranty that was offered. If you are really looking for performance, you will need to move up to the commercial grade products including rubber membranes, either hot applied or applied in sheets.

Insulation and thermal protection in any structure is complicated, and many professional books have been written about it. Architects are trained in the design for thermal insulation and my recommendation is that you consult with an architect if you are in doubt after talking with the insulation contractors. Many insulation contractors know what they are doing on standard applications. But if you have anything that is outside of the norm, then my advice is to consult with a local architect.

Calculating thermal performance Thermal efficiency of a wall system is stated in R Value. The R value is equal to 1/U Value.

The U Value is the overall heat transfer coefficient, and it measures the heat transfer of an assembly over given conditions. The higher the R Value for a wall, the better it is at controlling heat transfer. You want a higher R value to reduce energy loss and energy cost for heating and cooling. U values are additive. To determine the value of a certain wall assembly, you need to add up all the values for the various components and layers of the wall.

One of the most common insulation projects performed on an existing home is to blow additional insulation into the attic space. I have done this myself on my own home, and have arranged for it to be done on many others. For more information, see page 190.

This hypothetical application of the 12 step plan to this particular home shows that it does not require a drastic change in lifestyle to achieve major energy cost savings. All of the investments have a positive rate of return. Here are steps your auditor might recommend.

Caulking is an inexpensive and effective way to keep warm and cool air where it does the most good.

SEALING

Your energy auditor probably found dozens of cracks and leaks in your exterior envelope. Because warm air rises, the air you have heated in winter will escape through leaks in ceilings and attic spaces. Cold outside air will want to enter through gaps in your basement. Your auditor will find these leaks during the blower door test. And it's time to get out the caulk and seal them up. A $20 dollar caulk gun and a $7.98 tube of caulk can save you hundreds of dollars in heating bills. A couple of packages of weather stripping around doors and windows help as well. We all know how to do it; the trick is to be methodical and get all the leaks sealed up—and to keep checking them throughout the year. I don't have any recommendations on type of caulk; they're all pretty much the same. If the holes are big, you might want to patch them with drywall instead; caulk is most useful for small areas.

WINDOWS

Many people think that window replacement is the best place to spend their energy efficiency dollars. But a recent study concluded that window replacement has a typical payback of 15 to 30 years, and it is one of the highest cost possible improvements. It might cost over $30,000 to replaces all the windows in your home. I recently came across an innovative alternative to window replacement that achieves even higher energy efficiency than new windows in most cases, at about one-fifth of the cost. If you currently have single pane windows, or, if you have old storm windows that leak or are inefficient, you should consider the R+ Window insulator.

The R+ Window Insulator is a double paned polycarbonate insert made by Proactive Energy Concepts LLC. It is placed in front of existing windows on the inside, and held in place by a unique rubber gasket. For more information about this innovative product, see Resources, p. 190. I don't usually recomment one brand over another, but to my knowledge, this is the only company that makes this innovative product, It costs far less than new windows yet is more attractive than plastic sheets and double-sided tape.

SEALING GOALS

Don't aim to seal up 100% of the cracks in your house. Especially in Northern climates, a house needs to breathe, to allow enough air exchange with the outside to avoid humidity buildup, congestion, and mold problems in the walls. Most building codes now require a fresh air ventilator on your duct system to ensure an adequate amount of fresh air exchange. Ask your energy auditor about the ideal level of air tightness.

KEEPING A TIGHT SEAL

Don't think that sealing up your house is a one-time job. Once you have seen how the home energy audit detects leaks and cracks, conduct your own audit every year or two and replace crumbling caulk, seal up new holes, watch for drafts. Always look for leaks and moisture—if water is getting in, so is air.

Your house will last longer and be more comfortable when air leakage is within acceptable limits. You should sleep better knowing that you have created a solid barrier between you and the outside world. The philosophy of the energy audit is one that should be applied to all your dealings with energy—gather the best information you can; keep an open mind to new technology; take advantage of other people's expertise; follow through and don't give up. Maintaining your home's tight seal is a lifetime job.

STEP 4

USE HIGH-EFFICIENCY LIGHTING

Shine a light, sustainably

When Thomas Edison "invented" the light bulb, he not only perfected a device that was previously inefficient, dangerous, and dirty—he also founded the first power station in the United States. Electric light bulbs had been available since 1809 when an English scientist named Humphrey Davy made a piece of carbon glow by attaching it by wires to a battery. This glowing filament was the basis for the incandescent light bulbs that lit the 20th century. In the 1870s, Herman Sprengel and Sir Joseph Wilson Swan improved on Davy's invention; Sprengel added the power of a mercury vacuum pump to the bulb and Swan found a new carbon filament that provided a more consistent glow. Many other inventors made improvements over the years, but the light bulb was still not as good as gaslight. Gas was expensive, depleted oxygen, caused fires, produced soot, gave poor illumination, and needed to be replenished constantly—but it was the only reliable source of light when Edison invented the light bulb.

Edison and his largely forgotten team painstakingly experimented with thousands of filaments before they found one that glowed brightly and stayed bright for hundreds of hours; soon thereafter, they increased the length of the bulb's life to 1,500 hours. But even more important, Edison set up a power station on New York City's Pearl Street to provide electricity for his new light bulb. That first station served only a small area—less than a square mile—but the idea took hold and led to the electric grid that services the United States today. So I'm not knocking Thomas Edison when I say that the era of the incandescent light bulb is over. It served its purpose and Edison is a true hero. But we have better sources of light and we should embrace them.

Better bulbs will save energy and provide cleaner light; they're available right now.

The traditional incandescent light bulb will be phased out in the U.S. in 2012. Fluorescent lights have been available for several decades and many energy activists recommend them as a green source of light. Light-emitting diode (LED) lights are also becoming available for common lighting. Widespread adoption of LEDs could save the nation over 70 gigawatts in electricity demand, cut more than 100 million tons of carbon emissions annually, and save more than $42 billion a year. Step Four of The Oil Addiction Cure is to investigate the way we light our homes, cut back on unnecessary artificial lighting, and become pioneers in the use of LED lighting

DIFFERENT KINDS OF LIGHT

SUNLIGHT: Light was a luxury even the earliest organisms enjoyed; the first, and still the best light is the sun. Though it is millions of miles away, it is bright enough to provide abundant light even on cloudy days. It's our cleanest, most efficient source of light and it is absolutely free. We should take advantage of it any way we

LET THE SUNLIGHT IN:

We have a great, free, clean source of light and we should use it. I hate walking into a room on a sunny day and seeing the electrics blazing and the blinds shut tight. If you are building a new home, make sure that the windows are spaced to allow maximum sunlight. Consider skylights on upper stories to let the light come from above as well. Whatever window coverings you use should be adjustable so that you can close off the light when it will mean that you need to use more air-conditioning, but otherwise, use sunlight over artificial light whenever you can.

can, including building houses that let the sun shine in. As you will see at the end of this section, there are even ways to store sunlight.

Thomas Edison's first lightbulb

FIRELIGHT: Unfortunately, sunlight is not available all the time, and it's not available in indoor spaces that don't have enough windows. Early humans found that fire provided light (as well as other essentials, like warmth, cooking and keeping away animals). No one is sure just when people developed the ability to create fire, but it was probably not stolen from the Gods by Prometheus! It was not easy to start or maintain a fire, and preserving the fire became an important task. Early tribes banged drums to indicate when fires were to be stoked and needed work. In medieval France, there were strict laws about how late a fire could be kept strong. A bell was rung when the fires had to be covered and protected until morning—the term for this time was "couvre feu," French for "cover the fire." That is where our word "curfew" comes from.

CANDLELIGHT: Eventually materials that burned more slowly were discovered; this made it possible to keep the light burning for longer than wood could be chopped down. The first long-burning material was animal fat, or tallow; ancient Egyptians are credited with creating the first candles, made of reeds dipped in tallow. In the middle ages, beeswax was found to be a good burner; whale oil became the next big light source, followed by gas in the nineteenth century. But all of these provided poor, flickering light and byproducts like soot and polluted air.

INCANDESCENT LIGHT: As we saw in the start of this chapter, scientists in the nineteenth century used electricity to heat a filament in a glass vacuum to create a better glow, culminating in Thomas Edison's invention of the modern incandescent light bulb that is still with us today. It provides a lovely light—diffuse and soft—but uses a great deal of electricity.

FLUORESCENT LIGHT: Fluorescent lights work differently; instead of using heat, a fluorescent light used chemical reactions caused by heat on gasses that are trapped within the glass vacuum chamber. The heat makes the gas fluoresce (the word comes from fluorite, one of the gasses used). The first fluorescent bulbs were sold by General Electric in 1938; their light was harsher than incandescent, but they used considerably less electricity. More recently, compact fluorescent lamp (CFL) bulbs have been introduced. They are made to fit into the same sockets as incandescent bulbs, shed a softer light, and use much less energy. They also last a lot longer. Many energy activists recommend CFLs as a basic energy-saving step.

LED LIGHTS: The newest—and most energy-efficient—source of light is the light-emitting diode, a true breakthrough. These lights use very little energy at all because they do not depend on heat to create their light. Instead, they use electronic components called diodes that are composed of two electrodes (the anode and the cathode) made from semiconductor materials such as silicon, germanium and selenium. These diodes conduct electricity beautifully and have many useful applications; they can regulate voltage, switch signals on and off, and rectify power surges. It was discovered that some of them can emit light; once the proper materials are combined, an LED light will last for an extremely long time with no added materials or fuels. Sounds great—but there are limitations, which are described below.

SOLAR LIGHTING: We're now back where we started, with light from the sun. But today, we can store sunlight in photovoltaic cells and with solar light devices and use the light after the sun goes down. Solar lights combine LED devices with photovoltaic cells and reflectors so that the sun's energy is stored on the cell and light can be produced and reflected. Solar lighting needs good exposure to the sun, so it's used mostly outdoors, but it allows the sun to shine at night, without cost or pollution.

Outdoor solar lights can last for years without any cost after the original purchase.

ALL ABOUT LIGHT EMITTING DIODES

When scientists first found that diodes could emit light, they thought that its uses were limited. They used LEDS as indicator lights on instruments, in traffic signals, in autos or for concentrated lights in small areas. After all, LED lights don't spread; they're concentrated in a very small area. And the first LED lights were red; there are only a few areas of life where red lights are common, and most of them are not in your home.

A Russian scientist discovered the light-emitting properties of gasses in 1907; more breakthroughs were made in the 50s and early 60s, but the light emitted was weak and barely visible. Then, in 1962, Nick Holonyak—who is known as the "father of the light-emitting diode" created the first visible-spectrum LED; the first one was red, but an even brighter yellow version soon followed. By the 1970s, LEDs were ten times brighter than the originals and very expensive. But industrial applications made them cheaper; by 1976, tiny diodes cost less than a nickel and Hewlett-Packard was putting them into calculators.

In 1995, Shuji Nakumura developed the first super-bright, white LED; suddenly home lighting applications became reasonable. In the past 15 years, the brightness and efficiency of LEDs have doubled every three years; there are now LEDs with a brightness of up to 300 lumens.

LEDs are electronic; they function by moving electrons around. When the lamp is switched on, it shoots electrons through holes in the device; this releases photons, a form of energy. The LEDs themselves are pretty small—usually less than 1/32 of a square inch, but the lamps use reflectors and lenses to diffuse the light to some degree. LEDs are small and easy to transport; they're fast—they switch on and off very quickly, as opposed to fluorescents; they use very little energy; they are cheap; they last about 10 times longer than even the longest-life incandescent bulbs; they don't emit any pollution; they don't break easily like glass bulbs. On the other hand, an LED device that is strong enough to light a room is probably more expensive than an incandescent or fluorescent light.

BLENDED LIGHT

Right now, LEDs cannot cover all our lighting needs. But if we use them where they belong, we can save money and energy on our lighting. We

should use all kinds of light in our homes. LEDs are perfect for task lighting, casting light on a small area where we are working. A strategically placed LED over a kitchen counter or a garage worktable will allow us to lower or eliminate the light in the rest of the room. And reading lights, aimed directly at your page, can certainly be LEDs. LEDs are also good for lighting the way; when the whole room does not have to be lit, an LED can show the way from one point to another. I predict that in a few years, all nightlights will be LEDs. And they make great, energy-saving Christmas tree lights, twinkling points of colored lights that keep the holidays sparkly but not splurge-y.

For other lighting, CFLs are much more efficient than incandescent bulbs (and you are not going to find incandescent bulbs after 2012 anyway). Great strides have been made in softening the glare made by fluorescent lights. Lower light is less harsh, so save the highest wattage for when it is really needed—for when you are performing surgery, for example. Other than that, we can live in bright light when the sun is out. Night is dark for a reason; we can use light to get our work done at night, but still follow nature by letting light and energy diminish as the day fades away.

COST COMPARISON BETWEEN LEDS, CFLS, AND INCANDESCENT LIGHT BULBS

	LED	CFL	Incandescent
Light bulb projected lifespan (hours)	50,000	10,000	1,200
Watts per bulb (equiv. 60 watts)	6	14	60
Cost per bulb	$35.95	$3.95	$1.25
KWh of electricity used over 50,000 hours	300	700	3000
Cost of electricity (@ 020per KWh)	$60	$140	$600
Bulbs needed for 50k hours of use	1	5	42
Equivalent 50k hours bulb expense	$35.95	$19.75	$52.50
Total cost for 50k hours	$95.95	$159.75	$652.50
ENERGY SAVINGS OVER 50,000 HOURS, ASSUMING 25 BULBS PER HOUSEHOLD			
Total cost for 30 bulbs	$2398.75	$3993.75	$16,312.50
Savings to household by switching From incandescents	$13,913.75	$12,318.75	0

STEP 5

CONVERT TO A COOL-CLIMATE HEAT PUMP

Game-changing technology in home heating and cooling

On a national average, we use 35 percent of our home energy on space heating, or staying warm. In northern climates, it is more like 50 percent. A large part of the American population is gathered in northern cities, places where we couldn't live comfortably if we didn't have heat. In large parts of the Northeast, oil furnaces are the norm, and homeowners have been hit hard with the rise in oil prices. For example, an average-sized New Hampshire home uses about 800 gallons of oil every winter. When oil cost under $2 per gallon, heating cost about $1,600 a year—not great, but affordable. With oil at $4.50 per gallon, that house now costs almost $4,000 to heat. And when oil becomes scarce and even more expensive, the cost and the possibility of shortages become absolutely frightening. Even politicians see the threat; in 2008, Governor Deval Patrick of Massachusetts begged for federal aid, stating that high oil prices could lead to people freezing to death. And some analysts think we might actually all have to leave our northern cities and move south, at least for the winters.

The majority of our fuel for space heating comes from heating oil, natural gas, propane, and electricity. In 1850, when there were fewer than 50 million people living here and our forests were abundant, the majority of our heating fuel was firewood. But we can never go back to wood as a primary fuel for heating.

If we have accepted reality about energy, we must realize that the shift to sustainability is not a project that we can put off to the future. It is something which we should have started ten years ago.

What will sustainable space heating look like? We are starting to see the answer with technological advancements that are under development

and coming to market; these advances are based on electricity as fuel. In Part 1, Chapter 3, we discussed the abundance of wind, solar, geothermal, and biomass energy which will ultimately be the sustainable power solutions. This trend is well established and is poised to accelerate. In 2009, the world spent more on sustainable power construction and development than it spent on the non-renewable kind.

Simple electric heat is not a viable alternative. First, the cost of electric resistance heat is prohibitive because simple electric heat can only reach an efficiency of 100% by definition. Second, the amount of electricity required to sustain a broad adoption of electrical resistance heat would far exceed the capacity of our electrical generating and distribution system. Our analysis indicates that the peak residential electrical demand in the winter would be approximately three times the peak summer demand for air conditioning! And we know that the summer heating load consumes close to 100% of the system capacity, as evidenced in the rolling black outs and brown outs that have been seen in the Southwest in recent years during the summer.

HEAT PUMPS

The technology that will allow us to heat our homes sustainably is based on heat pumps. Heat pumps are not new; the theory behind them was first presented by Lord Kelvin in 1852. A rudimentary version of the heat pump was developed and installed in an Austrian salt factory in 1857 by an engineer named Peter Ritter von Rittinger, who declared that it would save over 80 percent of the cost of burning wood.

The heat pump's task is to move heat from one place to another. To do so, it has to overcome the second law of thermodynamics, which states that heat won't move from a colder place to a warmer one. So the pump has to do some work and uses a system of compressors to extract and move warm air.

Though heat pumps are used for heating, they are more commonly employed in air conditioning and refrigeration. One of the advantages of using a heat pump is that it can both heat and cool a home. A central heat pump completely replaces a conventional air conditioner/furnace combination. It looks like the air conditioning unit that sits outside of your home, but simply reverses itself in the winter to pump the heat in the other direction.

There are two basic types of heat pumps. One type called a geothermal or ground-source pump, uses ground, rock, or a body of water as a

source of heat and transfers that heat to air or water. The second type, the air-source heat pump, extracts heat from air—in the winter, that would be cold air—and moves it to another space, either air or water.

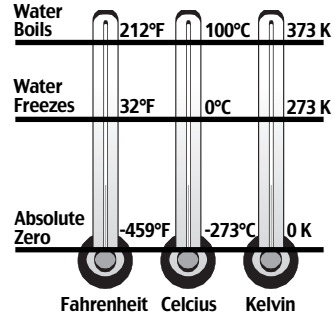
FREE HEAT

If you have been following this, and if you don't already know about heat pumps, you are probably asking a very reasonable question right now. If the air feels cold, where does the heat come from? Well, even cold air has heat. The air is cold relative to our 98.6-degree body temperature, but there is still a lot of usable heat in it. Until the air gets down to absolute zero—which is minus 273 degrees Celsius—, it holds some heat. Using that heat, which is as free as air, is not magic; it's just plain smart.

So why aren't we all using heat pumps for heating in cold climates? The problem with traditional air-source heat pumps—those in existence before 2006—is that they do not work well when the temperature dips below 32 degrees Fahrenheit. This makes them fairly useless in northern climates, because when the temperature falls below 32 degrees, they need to rely on electric resistance heat for the bulk of their energy. And for the time being (until we have fully developed sustainable and inexpensive electricity) that energy is very inefficient and expensive. Alternatively, some people install a traditional air-source heat pump in combination with a natural gas furnace to handle the situation when the outside temperature is below 32 degrees.

ABSOLUTE ZERO

Thermometers compare Fahrenheit, Celsius and Kelvin



Here is the problem. Our entire electrical generation system is sized to meet the peak air-conditioning demand of the summer months. How much electricity do you think would be required to keep our buildings warm in the winter using electric resistance heat? In northern climates like Minnesota, it would require three times as much electricity to heat your home with resistance heat as it does to cool your home in the summer. In other words, there is simply not enough electricity to go around to keep warm in the winter with electrical heaters.

GAME CHANGING TECHNOLOGY

Every once in a while—just a few times per century—a new invention appears that makes a significant difference in how we live. Think about the wheel, the cotton gin, the telephone, the silicon computer chip, and twitter—all of these were game-changers. Today, some game-changing products that will revolutionize the way we heat and cool our homes are appearing on the market. As yet, very few people know about them. But I predict that, within a decade, everyone will understand their importance. The inventions I am referring to allow the use of air source heat pump technology in colder climates. Step Five of The Oil Addiction Cure is to learn about these new products and, in most cases, get one for your home. I also believe that you should know about these technological innovations as part of your energy education as a citizen. With so much "noise" in the marketplace for political ideas, you need to know that there are sustainable and affordable solutions, and that they are based on electricity that can be produced abundantly and sustainably within our own borders.

THE ACADIA HEAT PUMP

Where there is a problem, someone usually rises to the occasion. In the case of the heat pump and cold climates, the person who stepped up was David Shaw, a lead engineer for Carrier Corporation. Soon after retiring from Carrier in 1995, he received a $400 monthly bill for his condo's electric heating and cooling system. The system ran with an air-to-water heat pump and worked great until the weather got cold. Shaw set up a small R&D lab that he called Shaw Engineering and began looking for a way to make the pump work at low temperatures. It took him ten years, but he did it. In 2006 he formed a partnership with Hallowell International to produce the Acadia Combined Heating and Cooling System. Their tag line is "Nothing heats like the cold."

It's interesting to note that Shaw says that he used no new materials or even new knowledge to create his revolutionary pump. He remembers that all the elements and theories that he fiddled with in his small R&D lab were known to him when he got into the heating and cooling business in 1958. As long as fossil fuels were cheap, there was no need to look for new devices. But the rising costs of oil and natural gas and the prospects of shortages suddenly made looking for a solution seem urgent.

I read about Shaw's invention while I was researching heating systems for the Sewell House that I remodeled in Minnesota. I was looking for a sustainable system and I did a feasibility study on a standard heat pump, but rejected it because I knew it would be inefficient in Minnesota's cold climate. About 60 percent of the winter heating load in Minneapolis occurs when the outside temperature is below 32 Fahrenheit. So, a regular heat pump would only cover the early fall and late spring seasons. Every mechanical engineer I spoke with agreed that below 32 degrees Fahrenheit, these traditional heat pump systems encountered operational "frost-up" problems. Xcel Energy, the electric utility for most of the Twin Cities, had a "dual fuel" promotional rate structure for electric heat, which was masking the real cost of operating a heat pump and encouraging people to install the single-stage heat pumps—but I knew that they were doing this just to sell their excess electrical generating capacity during the winter months, because their system was designed to handle the peak summer air conditioning load.

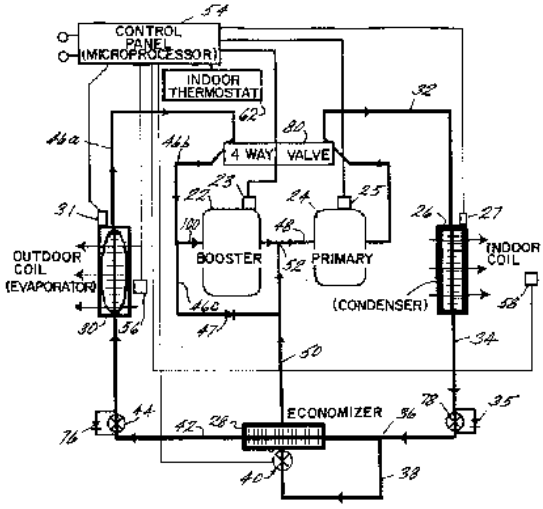
I also considered a geothermal heat pump—a great technology, but the quotes for installation were around $30,000. Drilling wells for the system would be problematic and would require complex and expensive systems. Furthermore, I was looking for a system that I could recommend to others, and as I looked around the typical Twin Cities neighborhood, I realized that few homes had the space to do the loop field or drilling necessary to install a geothermal system. All these reasons combined were deal-breakers for geothermal in the case of the Sewell House.

Then, in the fall of 2006, I read Hallowell's third-party test results for their "All Climate Heat Pump" system, which could operate at temperatures as low as -30 Fahrenheit –that's minus 30 degrees—while maintaining heat pump efficiencies, not relying on electrical resistance heat. After running some numbers on the efficiency of this system, I was astounded at what they had accomplished, and immediately purchased a plane ticket to Hallowell International in Bangor, Maine, to visit the president and their facilities. I had to see this for my own eyes. It was true: This technology was able to achieve efficiencies similar to a ground-source heat pump system, and for a third of the cost!

The physical difference between an all-climate heat pump and a regular heat pump is simple. Most heat pumps are based on a single com-

pressor, and cannot operate below 32 degrees Fahrenheit or 0 degrees Centigrade. But Shaw figured out a way to put two compressors in series so that they could extract the heat energy out of air, even at temperatures well below zero. This is what the working end of the heat pump looks like. Standard heat pumps use refrigerants, materials that are very good at absorbing thermal energy. The refrigerant evaporates and condenses, changing from liquid to gaseous states. The part of the unit that is mounted outside the home collects air, compresses the heat in it, and moves it indoors, where it deposits the heat to a "sink" of water or air. Fans then force that warmed air or water into ductwork, doing the job in the same way as a furnace.

Illustration from patent application for the Acadia



HEAT PUMP WITH BOOSTER COMPRESSOR
(HEATING FLOW PATH SHOWN)

Shaw's second compressor works in series with the main or primary compressor to "boost" the system's performance. When temperatures fall

Fuel Prices	Annual Home Heating Cost
Heating Oil Cost: $4.00 per gallon	$2,588
Natural Gas Cost: $1.40 per therm	$1,268 (80% efficient cient furnace)
Propane Cost: $3.50 per gallon	$5,080
Electricity: $.096 per kilowatt hour (2009 average retail cost, Minnesota per EIA)	Whole-House Electric Heat: $2,038

All-Climate Heat Pump: $700

below 32 degrees Fahrenheit, this booster compressor is engaged and we see a considerable jump in heat output while maintaining operating efficiencies of almost 300 percent.

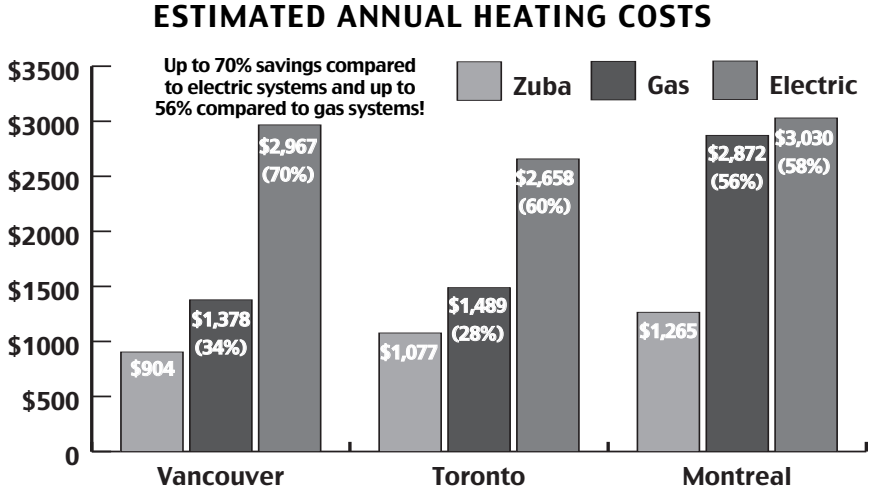
Unfortunately, people didn't hear about the Acadia system fast enough and in 2011 (just as this book was about to go to press), the Hallowell Company ceased production. But I'm confident that the Acadia will come back—the technology is just too good to forget.

THE ZUBA CENTRAL SYSTEM

An alternative to the Acadia system is currently on the market in Canada, and we expect to see it in the United States soon. The Zuba Central system by Mitsubishi has some impressive statistics and performance.

In Vancouver, a 2,500 sq. ft. house with a gas furnace and a COP of 0.85 would spend approximately $1,633 in heating bills in one year. If this same house were equipped with a standard electric heater, one year of heating could cost you an enormous $2,571. Zuba Central, on the other hand, would only cost about $778. Even though Zuba Central also uses electricity, it is staggering how much more efficient it actually is. This means you would save $855, or 53%, a year on energy costs over a gas furnace, and $1,793, or 70%, over electric heaters. That's a potential savings of almost $18,000 in your pocket over 10 years.

This system is not yet available in the United States, but it will be soon.



Estimated Annual Heating Costs (Savings) for a typical 2,500 sq. ft. house.
Source: Mitsubishi Industries Zuba Central website

DUCTLESS MINI-SPLIT SYSTEMS

In my energy audit practice, I came across many clients who tried to isolate different parts of their large homes so that they could heat or cool only the parts of their homes which they were occupying at any given time. This is difficult but not impossible to do with a ducted heating and cooling system, depending on the layout of your home. An alternative is to retrofit with a ductless split system. Mitsubishi is one manufacturer of such systems, and they come in a variety of configurations, with attractive cold climate efficiencies and performance.

Mitsubishi's heat pump has a dual advantage. Not only is it able to function in temperatures below 32 F., it is also a ductless system, so it can be used in homes that do not have duct systems. And to make it even more attractive, it is a ductless split system—you can isolate several areas in your home with units that are connected to an outside heat pump and heat or cool only the areas that need it. These ductless systems are smaller, quieter, and more efficient than central heating systems. They also provide a more even heat and avoid heat loss in the ducts (some forced-air central systems lose 20-30% of their energy while moving air around). And they work even when the temperature outdoors is low, providing comfortable temperatures. Ductless mini-split systems are available through many companies.

MEASURING EFFICIENCY

I have talked about the fact that all-climate heat pumps operate at a remarkable 300-percent seasonal efficiency. That is an industry term that refers to the amount of energy generated versus the amount of energy input. If the efficiency of your heating system is 80 percent, then for every unit of energy you put in, you get only .8 units of output. Anything less than 100-percent energy means that you're wasting energy—and that's the norm in gas and oil systems. Since the all-climate heat pump has a 300-percent efficiency rating, you can expect about 3 times the energy output as input.

The Zuba Cental has a "COP" which ranges from 1.4 to 3.19 depending on the outside temperature. That means this system efficiency ranges from 140% to 319%. The warmer it is outside, the higher the efficiency. That is one of the reasons why the cost comparison charts for the three Canadian cities are all different. The other reason is that the cost of electricity varies from place to place.

This is a remarkable—some say unbelievable—level of efficiency. Unfortunately, the industry does not measure air-source heat pump performance with a true efficiency rating, and this leaves you, the consumer, at a severe disadvantage. The industry uses the Heating Seasonal Performance Factor (HSPF) to define the "nameplate" performance of a heat pump. The problem with HSPF is that it measures the performance of a heat pump above 32 degrees Fahrenheit, where all air-source heat pumps operate at about the same efficiency. So, if you compare the HSPF for a cold-climate heat pump with a regular heat pump, the HSPF may be the same number for both, but in a cold climate, the cold-climate heat pump will beat a regular heat pump hands down! Since the American Society of Heating, Refrigeration and Air-conditioning Engineers is dominated by the manufacturers of the standard heat pumps and other professionals who are trained and experienced in designing traditional heating and cooling systems, it is unlikely that the industry will change its methods of determining nameplate efficiency on heat

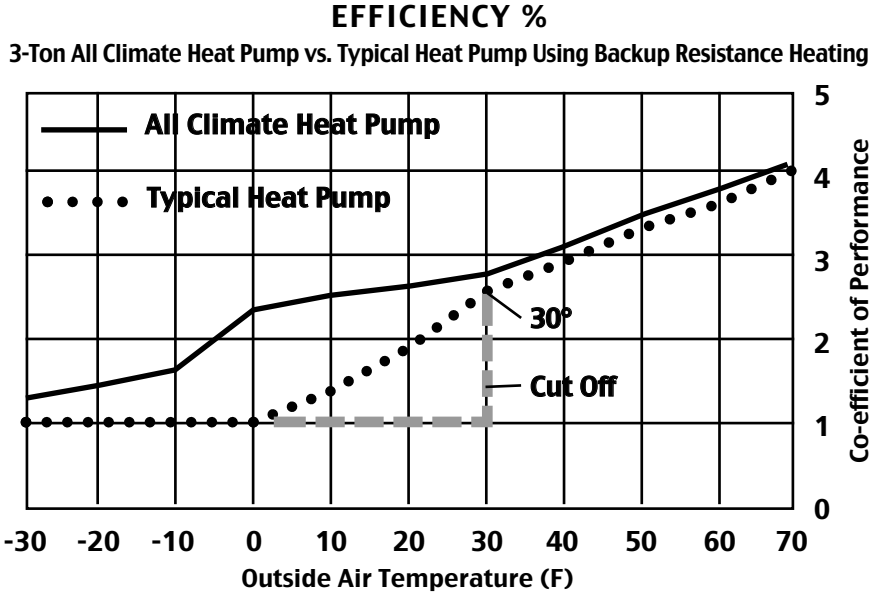
WHAT ABOUT APARTMENT BUILDINGS?

If you live in an apartment building, you probably will not be able to use an all-climate heat pump—yet. Hallowell International is working on a rooftop version for commercial use. Ripping out a huge furnace in a big apartment complex and replacing it with a heat pump is probably not cost-effective. But if your building is ready to change furnaces, it is a great idea to check out this technology.

And living in an apartment is no reason to ignore energy efficiency. Whether you are a renter, building owner, co-op or condo owner, or building manager, there are ways to make your building more efficient—and every tenant in the building should know about them. First, get an energy audit (see Part II, Step 3). Make sure your heating and cooling systems are right for your building.

Some other heating tips for apartment dwellers:

- **If you have radiators, keep them clean. Hot-water radiators operate most efficiently if they are filled with water. Have them checked before winter to make sure they are in good shape. If your radiators run on steam, check the air vents and make sure they're not obstructed with paint or dust.**
- **Draperies keep heat in.**
- **Make sure windows and doors close tightly.**



pumps anytime soon. As an energy professional who is dedicated to offering sound advice and analysis, I personally developed a computer program to assist in calculating the comparative efficiency and operating cost of various heating systems in multiple climate zones and locations. For a complete technical description of how the program works and its application, you can visit The Oil Addiction Cure website at www.theoiladdictioncure.com.

CARBON FOOTPRINT

The Oil Addiction Cure Project is more concerned with energy usage and cost than with combating global warming or air and water pollution. We are not climatologists. I am an engineer. However, you might be happy to know that the all-climate heat pump is a paragon in reducing one's carbon footprint and produces little or no pollutants in your home. Even with the way electricity is produced today, buying an all-climate heat pump will reduce your carbon footprint by 20 percent more or less, based on the average utility fuel makeup of coal, natural gas, and so forth. And when we continue to generate more clean, pure electricity through renewable sources, the carbon generated by this system could be reduced to zero. Yes, zero—you could heat and cool your home without adding any greenhouse gases at all to the environment. If your electric utility compa-

FINANCING A NEW HEATING SYSTEM

There are state and federal grants and rebates available for installing sustainable systems. Every state has its own guidelines and opportunities. Consult your local or state reps for information on programs available in your region; see page 190 for information on how to find them.

ny offers a green power option, you can purchase clean electricity and reduce your heating and air conditioning carbon footprint to zero immediately.

OTHER WAYS TO SAVE ON HEATING

Whether you have a heat pump or not, it is always a good idea to keep heat from leaking out of your home.

FIREPLACES AND THEIR MORE EFFICIENT RUSSIAN VERSIONS

There are many good things about fireplaces, but in most cases, energy efficiency is not one of them. Most fireplaces have an efficiency rating of about 15 percent; most of their heat goes right up the chimney instead of heating your room. Even with inserts, which direct some of the heat outward, you're losing more than you're using.

However, there are fireplace equivalents that do provide the warmth and beauty of conventional fireplaces and are also energy efficient. Called Russian fireplaces or masonry heaters, they are usually made of soapstone or other stonework and have been used in Europe and Asia for centuries. These heaters, which burn wood, employ a series of baffles to capture and hold heat in the stone mass. Once a good, hot fire is going, the unit is engineered to circulate the warm gases, which heat up the stone before exiting the flue. One version that I recommend is the Tulikivi, made by a Finnish manufacturer. My friend Marty bought one and raves about it; it heats his 2,200-square-foot cabin in Michigan's Upper Peninsula for just about all of winter--and he only has to make two fires a day. If you are interested in building a home with a fireplace or putting an energy-efficient fireplace in your existing home, why not make it one that does not rely on electricity to run a fan, or gas to make the flame?

You will find more information on insulation and other heat-saving devices in Part II, Step Three, "Get an Energy Audit." But this is a good place to remind everyone that you can save up to 50 percent of your home heating costs by insulating your house properly. There is no one-size-fits-all solution. You will have to do your homework by talking to energy auditors, referring to government publications, and discussing the issue with knowledgeable contractors. Whether you're building a new home, remodeling an old one, or just improving your insulation, research is key. Some contractors will recommend what is in the code—but the code is the minimum, not the optimum.

And don't forget the simplest, low-tech tips, which work whether you live in a house or an apartment. Close the door, and don't let the heat out or the cold in. If you are using only a few rooms of a big house, look into zone heating, which allows you to close off some rooms until you need them. And finally—turn the thermostat down. We have become used to temperatures that are not necessarily healthy, and getting accustomed to a slightly cooler room will not hurt us. A little nip in the air will keep us moving a little more, thinking a little faster, and maybe sitting a little closer to those around us.

WHAT ABOUT THAT "BLACK BOX"?

In my conversations with hundreds of people about energy, I have found that there is a myth out there that seems to defy explanation. Many people believe that there is some kind of "black box" out there that will spontaneously generate electricity and be the solution to our home energy challenges. This box will supply electricity, heat, and all the energy needs of a home like some kind of Star Trek contraption. While there are some fuel cell technologies in development that purport to be revolutionary, the ones I have reviewed all use some kind of fuel to operate. And they are prohibitively expensive. As we saw in Part I, Chapter 1, natural gas is a nonrenewable resource. If we are truly seeking sustainability, then this "black box" technology would be merely a stopgap along the road to eventual natural gas depletion.

The all-climate heat pump, powered by wind, solar, geothermal, biomass, wave, and other sources of renewable electricity, is the closest thing to a "black box" for space heating that is on the market.

STEP SIX

CONVERT TO A PLUG-IN CAR

Going electric

An average American family with four people and two cars drives about 22,000 miles every year and gets about 20 miles per gallon of gas. When gas is priced at $2.80 per gallon, this average family spends about $3,000 at the pumps. Suppose that the price of gas dropped to 75 cents a gallon, and your gas expense decreased to $825. What would you do with an extra couple of thousand dollars every year? Would you renovate your home, buy a new computer, pay more for your children's education, travel, or donate a little more to charity? Can you imagine the effect that such an economic stimulus would have on the economy if we all suddenly had a substantial increase in disposable income?

Get ready. It's coming. In the next few years, as we convert to electric plug-in cars, we are going to find that our cost of driving is equivalent to paying 75 cents per gallon of gas—and that's with current costs of electricity. When we finally and fully develop renewable energy sources to generate electricity, the cost will go down even further. Instead of subsidizing foreign oil cartels—with all the associated political turmoil – we will be putting our money into our businesses. The money we save on gas will allow us to improve our lifestyle, which will improve the overall economy so that our lives will improve even more.

CHANGES: 1908 AND 2010

Yes, some changes will be necessary for the conversion to electric cars to take place. It won't be the first time that such changes were needed. In 1908, when Henry Ford introduced his Model T, there wasn't a single gas station in the country, nor a paved highway. It didn't take all that long for the necessary infrastructure to appear to support this new invention—assembly lines, roads, and gas stations were ubiquitous within a few decades. We fell in love with the automobile and with the gasoline that

*of transportation energy

made it run. Unfortunately, the fuel that was used for this first version of the automobile was petroleum-based gasoline, which turned our love affair with cars into a fatal attraction. We spend a billion dollars a day on imported oil. Automobiles represent the biggest use of that oil, in a system that is sucking up our personal and national wealth and spoiling our environment. The American Lung Association reports that over 175 million Americans live in areas with unhealthy levels of air pollution, much of it caused by emissions from gas-powered cars. As the petroleum we use to make gas becomes scarce, we become involved in dangerous international politics to keep the oil flowing.

Now, a little more than one hundred years after the revolutionary Model T, the current decade will go down in history as the era when the plug-in electric vehicle began to earn its place as the car of choice among consumers around the world. Numerous car companies—start-ups as well as the established global automakers—are introducing all electric and hybrid plug-in electric vehicles for the mass market starting in 2010. National organizations are pushing for legislation to fund the electric plug-in infrastructure to support the expansion of this market, and this

Electric cars are not new; the first cars on the road were electric. Above: Thomas Edison with his electric car in 1913.

legislation is making its way through the political process. Tax incentives have been adopted in Europe, Japan, Asia and the U.S. to support the development of this nascent industry. These changes are no longer theoretical; they are happening.

If you have not already done so, it's time for you to learn about electric cars. The next time you buy a car, there is every reason for it to be electric. Because in ten years, that is the kind of car we are all going to have. And that is going to improve our lives dramatically—our air will be cleaner, our economy will be more vigorous, and our energy will be renewable and come from sources that don't require wars.

WHAT ARE ELECTRIC CARS?

Electric cars use electricity to make them go. In gas-powered cars, an internal combustion engine creates a mini-explosion to cause propulsion; this explosion produces smoke and other emissions, resulting in deadly air pollution.

Right now, most batteries aren't practical enough to store enough energy for long-range travel. By 2011, the all-electric range of plug-in vehicles will vary from about 40 to 150 miles without a charge. Most current electric cars are hybrids; they have a back up gas-powered engine as well as an electric motor. If the battery loses power, the gas engine takes over. Batteries could be charged overnight, with chargers that can be plugged into home outlets. But research is extending the life of batteries; there are already batteries with ranges of up to 160 miles and that will increase as time goes by. At the same time, government and industry are planning to

Jaguar Electric Racing Car at the Paris Auto Show

deploy charging stations, where electric car drivers will be able to charge their vehicles outside their homes; it will take about ten minutes for a charge. This will make pure electric cars possible and the hybrid will become unnecessary.

Electric cars were actually popular in the late 19th and early 20th century; they were faster than any other cars. In 1899, Camille Jenatzy, a Belgian race car driver achieved a record-breaking speed of 62 mph in his electric-powered, rocket-shaped vehicle, which he named Jamais Contente (never happy). For a few decades, electricity and gas ran neck-and-neck for supremacy. But perfection of the internal combustion engine and Henry Ford's success with the model T put electric cars on the back burner. It wasn't until the 1980s—when air pollution was choking us and we realized that oil and gas would eventually be less available—that car manufacturers started looking at electric cars again. In 1990, at the Los Angeles auto show, GM unveiled an electric car and announced that it was developing models for the public. At the same time, government agencies were legislating emission controls that wouldn't be possible with the internal combustion engine. The Toyota Prius, a hybrid, went on sale in Japan in 1997 and was available in the U.S. in 2001; it immediately became a hit with environmentalists and there was a long waiting list to buy one. Tesla Motors manufactured a roadster in 2004 and began selling them to the public in 2008—but they cost over $100,000. There were a few other models available, but electric cars garnered a very small portion of the market—until now.

CARBON FOOTPRINT

Although plug-in cars eliminate the burning of fossil fuels on board when they run on all electric mode, some raise concern about the production of carbon dioxide in the generation of the electricity to charge the vehicles. With the current U.S. electrical energy mix of coal, natural gas, nuclear, and renewables, the plug-in car still results in a 30% reduction of associated carbon dioxide emissions, higher or lower depending on the mix of these fuels in a particular area.

CARS OF THE VERY NEAR FUTURE

In the fall of 2010, two mainstream auto manufacturers introduced electric plug-in vehicles, the Chevy Volt and Nissan Leaf. The Leaf is an all-electric battery powered plug-in car, without any petroleum fuel back up. The

Electric cars from most major car companies are hitting the showroom in 2011. According to industry sources, if we all plugged in during off-peak hours to power our daily commute, we could cover 70% of our energy needs without building any new power plants.
Clockwise from top left:
GM EV; Mitsubishi MIev; Toyota Prius; Nissa n Leaf; Tesla roadster

Chevy Volt will have a 70 hp electric generator on board to recharge the batteries after an initial 40 miles have been driven. Over the next few years, there will be other plug-in hybrid and pure plug-in models to choose from. Their sticker prices will range from under $30,000 to over $100,000 (for the sporty, Hollywood-favorite Tesla roadster). The pure plug-ins will be able to travel from 100 to 244 miles on one charge; the vehicles with gas back-up will travel from 20 to 40 miles on one charge, and up to 300 miles with a back-up generator. And speed will not be sacrificed; the Chevy Volt can achieve a speed of 100 mph, the Nissan leaf will go 87 mph. Toyota will also be bringing a new version of its hybrid Prius to market in 2012.

Until now, electric cars were a novelty; there was little choice and they were marketed mostly to people who were interested in environmentalism. Soon, there will be electric cars for every use. The Chevy Volt and the 2012 Prius have very different propulsion systems. The Volt has a primary electric motor drive system, with a back up generator that produces electricity to drive the electric motor. The 2012 Prius plug-in is basically the same as the original Prius, except with a larger battery and plug-in charging capability. On battery only mode, the Prius will have a range of 12 miles and top battery-only speed of 62 MPH. The Volt will travel 40 miles on battery only, and have a top speed of 87. Toyota says that most trips are less than 12 miles. And that if all cars operated like the 2012 Prius, the gas savings would be 60%. So consumers will be able to choose the electric car that meets their specific needs.

To understand the depth to which the car industry has accepted the electric car, we can look at a handful of introductions that will be made in the next few years.

- **Tesla** is the glamour darling of the bunch; their current roadster, introduced in 2008 and priced at over $100,000 has a range of 244 miles according to an independent analysis from the U.S. EPA, a speed of 125 mph, and an efficiency of 120 mpg. It has been purchased by Hollywood stars including George Clooney. Tesla is also working on their $57,000 "Blue Star" and a model S that will sell for under $30,000—Teslas will be available in most people's price ranges.
- In 2011, Ford will enter the market with its **Focus EV**, a low-priced mass-market vehicle. Mitsubishi's **I Miev**, another plug-in, will be priced under $30,000 and will also appear in 2011.

- In 2012, Toyota's **Prius** hybrid will be on the market with a beefed-up battery, allowing it to travel up to 40 miles on one charge. Toyota has concluded that most car trips are less than 20 miles, and their entry will be perfect for that kind of trip.
- China's **BYD e6** is scheduled for retail introduction in the U.S. in 2011; the company has plans to become the biggest car company in the world by 2025. The e6 is claimed to travel 186 miles on a single charge.
- BMW recently completed its U.S. field test with 600 electric-only plug-in **Mini E**s in the hands of consumers; they will be using the results of this field test to refine the 2013 production rollout of the first in its planed lineup of all-electric BMWs. It will be the first car to be designed as a plug-in from the ground up. BMW is going further than the other car manufacturers to achieve efficiency in their entry. Their car will be built of lightweight, high-strength carbon fiber material. Even though this may cost a little more than conventional materials, its light weight makes up for the cost by giving the car a greater range for less cost in the battery pack and better efficiency. Theoretically, the decreased battery cost more than offsets the increased cost of the fiber.
- Two luxury car manufacturers, Fisher Karma and Daimler, will also introduce electric cars in the next few years.

Note that all this is happening in the next three years; the electric car industry has already passed the experimental stage. Development has reached a critical mass and momentum can only increase. As it increases, more infrastructure will appear, which will further increase the momentum. The electric car industry has already passed the point of no return; I don't like to make predictions, but I think I am pretty safe in saying that if you buy a car in five years it will be electric. Though I'll keep a gasoline clunker for long trips, my next new car will certainly be electric.

Charging station in San Francisco

A CLEAR WINNER

The car industry has known for a long time that gasoline would not remain the main fuel for cars. Several alternates were considered, researched, and developed before electric plug-in cars became the clear favorite for many reasons. I'm not the one who chose this winner—the technology and economics of this concept has drawn the industry leaders to this conclusion, and the market is responding accordingly. But for old time's sake, here's what is going on with all of these different technologies.

ETHANOL: For many years, ethanol was considered a prime candidate for the fuel of the future. Made from plant materials, mainly corn at first, ethanol was first used by Henry Ford; the models Ford built before the Model T used ethanol as fuel. More than 10 million gallons of ethanol-blended fuel (with 10% or more ethanol) was used in the U.S. in 2009. Though the system still has its proponents, the fact that it would use a ridiculously high proportion of our agricultural system—diverting food crops and possibly contributing to starvation—has reduced most people's enthusiasm for ethanol and it has been largely abandoned.

HYDROGEN: Hydrogen is a fuel carrier, but it requires large amounts of energy to make hydrogen. On-site production of hydrogen is being promoted in some areas for use as a motor fuel for specially equipped vehicles. The equivalent cost of hydrogen is over $3.00 per gallon. Ford Motor Company, General Motors, and French Renault-Nissan have dropped their plans to research and develop hydrogen cars. In October of 2009, GM CEO Fritz Henderson noted that the, "Volt will likely cost around $40,000 while a hydrogen vehicle would cost around $400,000."

NATURAL GAS: Users of natural gas vehicles are enjoying a temporary reduction in the cost of their fuel, but it is not going to last. Historically, the ratio between the price of oil and natural gas is about 6 to 1. Oil at $100.00 per barrel, natural gas should tend toward the mean price of $16.00 per million BTU. The reason for this is simple and it has to do with fuel switching. The energy content of a barrel of oil is about six times the energy content of a million BTU of natural gas. So, over time, the market will tend toward equilibrium in the cost of the unit of energy, the BTU. Many industry pundits have rejoiced in the "discovery" of shale gas, which has become more feasible to drill because of new extraction and horizontal drilling methods.

The marginal cost of extracting natural gas from shale has been analyzed from some of the early shale gas fields. At $8.00 per million BTU production cost for shale gas, $12.00 per million BTU normalized market price, the natural gas vehicle story does not look as good as it sounds on paper. And even some oil and gas industry insiders have cast doubt on the viability of natural gas for transportation. Even Exxon CEO Rex Pickerson doubts the viability of natural gas in cars; he says that refueling stations are too expensive (as much as $1 million), conversion of vehicles is too costly, and that we'll need all our natural gas for power generation.

ALGAE BIODIESEL: While better electric propulsion systems appear to be taking the lead with passenger vehicles and light trucks, algae biodiesel is showing promise as a long-term cost-effective sustainable fuel for other uses. The 170 member Algae Biomass Organization predicts that this fuel can reach price parity with petroleum-based diesel within three to seven years. Algae yields up to 20 times more energy per acre than corn, according to estimates. And it can be grown in areas that are not suitable for farming, eliminating a competition with food.

ELECTRIC BENEFITS

Schools of business and economics teach a concept referred to as "creative destruction," which describes the process of technological obsolescence brought about by innovation. The economic concept of "substitution" refers to the case where the scarcity of one resource causes the replacement of that resource with a less expensive and more abundant one. Through the process of creative destruction and substitution, the internal combustion engine will make way for alternative forms of transportation. Reductions in battery cost, increases in battery energy density, scarcity of oil, and abundance of renewable electricity are the drivers of this revolution in personal transportation which will sweep away a century of tradition with the internal combustion engine.

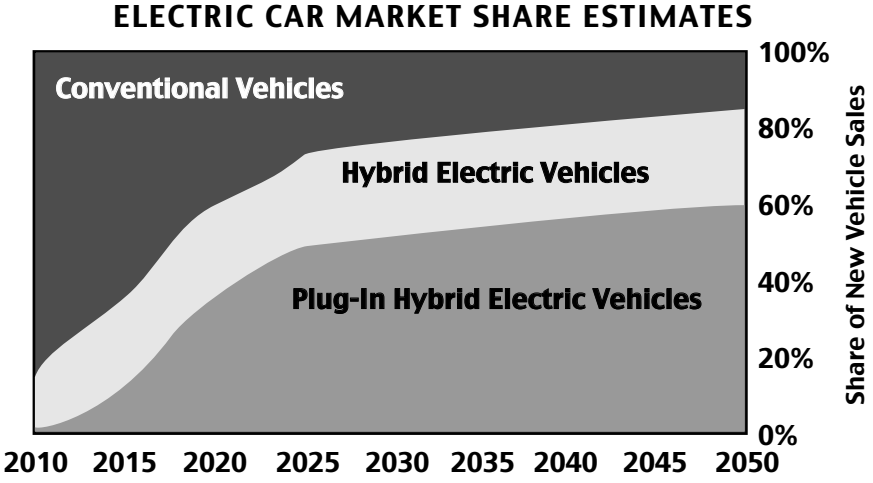
Think back over the last hundred years. Knowing what you know now, would you have invested in an expensive horse drawn buggy in 1908, the year the Model T was introduced? What about the eight-track tape, which was replaced by the cassette, then the CD, and now MP3 technology? Or what if you purchased a new coal-burning furnace, the year before they stopped delivering coal to your neighborhood and everyone

got an oil burner? Or, what if you purchased an oil burner, the year before the natural gas pipelines were brought to your neighborhood? We are standing at such a crossroad right now; everything is going to change in the next few years. The battery operated plug-in vehicle will have the most utility for the broadest number of consumers. I would not suggest that you should abandon your gasoline vehicle just yet—my personal plan is to keep one of the "relics" around in my garage for another five years or more, for longer trips. But for the close-to-home trips, living in the city and suburbs, you will be seeing me in a plug-in vehicle before long and I recommend that when your next car purchase comes around, you do the same.

The factors I have considered in making this recommendation include sustainability, up-front cost, operating cost, technological momentum, breadth of market served and availability, access to fuel, and resale value.

SUSTAINABILITY: If up-front cost were the only consideration, a conventional gas or diesel-fueled vehicle would be the best choice. But sustainability should be a real concern to you as a consumer, especially when considering a major expense like an automobile. In the coming years, electricity will be generated by renewable sources—wind, solar, biomass, and geothermal power. Using solar panels in our homes, we'll be able to literally plug our cars into the sun. Solar power will be green and won't generate even a fraction of the pollution that current cars do.

I've spoken to many people who think that spending a few more dollars to get a plug-in electric vehicle is not worth it. They take out their calculators and look at the current price of gasoline, do some simple math about the miles driven per year, and say: "When gas gets to $XX dollars per gallon, only THEN will I get a plug-in or hybrid car." So it's time to decide—do you want to be on the front line, supporting a technology that will be better for all of us? Or do you want to sit back and let other people pioneer? You won't go wrong with an electric vehicle, even today. Just look at the other factors.



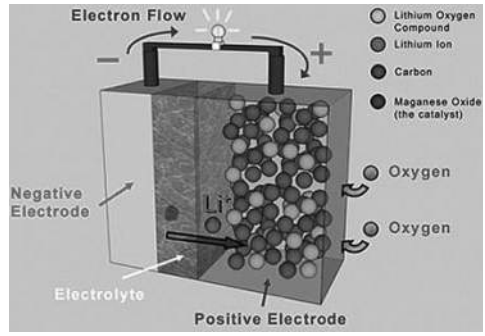
Source: EPRI, Environmental Assessment of Plug-In Hybrid Electric Vehicles, Volume 1: Nationwide Greenhouse Gas Emissions, Electric Power Research Institute and Natural Resources Defense Council, July 2007.

UP-FRONT AND OPERATING COSTS: The biggest perceived consumer objections to the plug-in electric vehicle include high up-front cost, lack of driving range between charges, and time required to charge the vehicle. Yet, with ranges of up to 180 miles between charges, charge times of ten minutes or less for an 80% charge, and at a cost of $30 thousand dollars, I am impressed that this technology is ready for "prime time" even now, in its first year of introduction to the mass market.

The average U.S. car fuel efficiency is 22.5 miles per gallon. Assuming a gasoline price of $3.00 per gallon, this equates to 13.3 cents per mile. A typical plug-in will get about 4 to 5 miles per kWh of electricity. National electricity price is 10.2 cents per kWh, so this equates to 2.55 cents per mile or about $0.60 per gallon equivalent. Suppose that you could buy a conventional car for $10,000 less, with a savings of about 11 cents per mile you'll make that $10,000 up in 91,000 miles, about four or five years for most families. And think about the resale value—how much will a conventional car be worth in five years, when sustainable electricity costs have gone down and batteries are improved to give us charges that will carry us for hundreds of miles?

TECHNOLOGICAL MOMENTUM: As I've shown above, most other alternative fuels have been abandoned, while major carmakers are poised to

introduce a whole fleet of electric cars. Not only are these car manufacturers working on the cars, they're improving the batteries and the charging stations. These elements will feed each other; as more cars are driven off the lots, more charging stations will appear; as more charging stations become available, more people will see that electric cars are the best choice. Another area of exciting technical innovation is the lithium-air battery; these batteries promise to afford ten times the energy density of conventional lithium-ion batteries and a lighter weight that will allow it to extend the range of electric cars.



Lithium air battery

BREADTH OF MARKET SERVED AND AVAILABILITY: Carmakers are developing models for every price range, from luxury Teslas, BMWs, and Daimlers to family-priced Volts and Focuses. With more than a dozen models to choose from, and more than a dozen car manufacturers getting into the act, the waiting lists for electric cars will soon be gone.

ACCESS TO FUEL: This is the crux of the issue. Until we can charge our electric cars as conveniently as we could our gas vehicles, they are not going to catch on. And that's why charging stations, solar panels, and photovoltaic cells get special sections in this chapter.

CHARGING STATIONS FOR PLUG-IN CARS

Just as gasoline-powered cars need gas stations, plug-in cars need charging stations. And they're coming, very soon. In November 2009, a coalition of executives from major U.S. corporations banded together to form The Electrification Coalition. On the launch of their coalition, they released a 135-page "roadmap", which is the most comprehensive analysis and review of electric transportation available anywhere.

Government is also stepping up. In May 2009, both parties and both houses of Congress introduced legislation to support the development of electric cars and the infrastructure to support it. This legislation echoed the goals of the Electrification Coalition, which suggested that regions compete

SOLAR POWER/THE SMART GRID

A few years ago, Sandia National Laboratories analyzed the idea of integrating the plug-in battery operated vehicle with the "smart grid" concept which is beginning to be deployed around the world. With the transition to all electric cars, the stationery parked cars which are plugged into their sockets become energy storage devices to help compensate for fluctuations in energy supply and demand throughout the day in a solar and wind powered America. At any given time, there are millions of cars sitting idle in their owners garages across the country—eventually, they will be plugged into their sockets which are interconnected with a "smart grid".

Let's check this out - the 100 mile range all electric cars which are first coming to market will have a battery with an average storage capacity of 25 kWh. The average US household uses about 12,000 kWh per year, or, 33 kWh per day. This idea makes sense! The first year roll out car battery can store enough electricity to run the average home for about an entire day! In practical terms, you would not want to go to your car in the morning and find it all discharged. So you will be able to program your "smart car" with a "smart outlet" to determine the time and amount of charge you want to have, and the grid takes care of the rest. If you need 40 miles for your daily commute, you will program your "smart car" and outlet to make sure that you have that much when you are ready to leave for work.

for financial incentives to set up services that would allow electric transportation. Another bill, the Electric Vehicle Deployment Act of 2010, would provide billions of dollars in additional subsidies for plug-in vehicles most of which would go to up to 15 "deployment communities," each of which would be flooded with electric vehicles and charging stations. The current version of the bill includes a $10,000 federal electric vehicle subsidy and funding to subsidize the building of charging stations within the deployment communities; communities would be required to add to the subsidies. The bill would also fund research into batteries. And there's another innovative element to the bill, a $10 million prize to the first company that produces an efficient battery with a range of 500 miles. The goal of the bill is to put half a million electric cars on the road in five years. Some optomistic analysts believe that there will be a million electric cars on the road by 2015.

PLUGGING INTO THE SUN

Installing solar panels didn't make it into The Oil Addiction Cure as one of our twelve steps because solar panels and photovoltaic cells are too expensive for most people, there are more effective conservation and substitution measures, and the cost of electricity obtained through photovoltaic electricity is more than double that of electricity that we get through the national grid. But I'm going to sneak it in here—because in some places and for some uses, photovoltaic cells, which capture the energy of the sun are not only feasible but extremely efficient. The energy density of batteries has improved dramatically in recent years, primarily as the result of increased battery research and development related to mobile electronic devices—cell phones, computers, and cameras. But the energy density, or the amount of energy per pound of battery, is still a fraction of what gasoline is. Right now, plug-in vehicles can be charged with solar panels at an equivalent cost in the range of $1.50 to $2.50 per gallon, without taking into consideration tax credits, rebates or other incentives. But advances in solar cell efficiency and battery technology are paving the way for truly sustainable personal transportation. As these technologies improve, photovoltaic electricity will be one of the frontrunners in clean, efficient energy.

I end this chapter where I began in 1960—as a child filled with fascination about energy, and how it works. I remember that the price on the pump back then was 32 cents per gallon. Adjusted for inflation, that 1960 gallon of gasoline would be $2.24 per gallon today. The cost to operate a plug-in electric vehicle today is one third that cost, and falling. And it's even lower if you purchase discounted nighttime electricity. Looking forward, we expect that this cost will continue to decline as battery technology and volume of production results in cheaper, better batteries which will allow longer distances between charges. The electric car has a pivotal role to play in the prosperity of our sustainable civilization.

Why hasn't the electric car already become the standard? There's a history of political and industrial intrigue that shows how the electric car was almost killed by special interests; this tale teaches us that we need to be involved in the political process that can help or hinder our path to sustainability (See Step Twelve: Vote).

STEP 7

REDUCE ENERGY USED TO HEAT WATER

The long, hot shower and how we can keep it sustainable

In most homes in the United States, there is an 80-gallon tank of water that is kept piping hot 24 hours a day. It just sits there, soaking up energy, waiting for someone to use it. This tank is kept hot while we're fast asleep. It's kept hot when we all go out to work or school, and even when we leave for a two-week vacation. All day long, while we do all the things we do that do not require hot water, we are burning fuel and money to keep that water nice and steamy—just so that it's there for the few hours each day when we want it. Think about how much time you actually use hot water. If there are four people in your household and you each take a 20-minute shower every day, that's 80 minutes. Say there are a load of laundry and a load of dishes washed daily; that's another 90 minutes. And if everyone washes their hands five times a day, that's another 30 minutes. So we actually need hot water about three-and-a-half hours a day. The other 20 plus hours are just so we do not have to wait.

Suppose I suggested that we keep our cars running 24 hours a day so that we could keep the air conditioner on in summer and the heat on in winter—so that we would not have to wait to cool or warm the car when we first entered it. You'd think I was crazy or spoiled or just immensely thoughtless and self-centered. And that's what the world thinks about us because of the way we heat water. Ours is the only part of the world that's become addicted to the 80-gallon, 24-hour hot water tank, the only part of the world where these tanks are readily available.

For me, these tanks are a symbol of American self-indulgence, complacency, and impatience. We like our long, hot showers and we want them now. It has taken an energy crisis to make us look for other ways to get hot

AVERAGE HOT WATER USE	
Activity	**Gallons Per Use**
Clothes Washing	32
Showering	20
Bathing	29
Automatic Dishwashing	12
Preparing Food	5
Hand Dishwashing	4

Though we can't always eliminate our hot water use, it's good to understand how much we're using.

water when we need it. Eighteen percent of the energy used in our homes goes to heating water all day long—and we need that water for about 12% of the time that it's hot. It's time to turn off that tank and to find other ways to get the same, or almost the same, results. Step Seven of The Oil Addiction Cure is reducing the amount of energy we use to heat water.

ON-DEMAND HOT WATER

I do not think turning off the tank is a very practical idea in the long run. If you are not willing to do it, then the next ideas I have will also decrease your energy use. In most parts of the world where people have electricity, the on-demand hot water heaters shown on the next pages are used; these are also called Tankless Hot Water systems. If you really want to cut your use to the bone, and still have hot water when you want it, I suggest that you install an electric demand heater on your kitchen sink, with a gooseneck spout so you can easily fill up a bucket with hot water for using in other areas around your home. The next option would be to have one in your kitchen, and one in your bathroom shower, where you can also fill up a bucket or bowl with hot water for shaving and hand washing.

Most homes in America include one of these: a hot water tank that keeps hot water hot all day long.

In a tankless system, cold water passes over a coil that is heated by electricity (there are also gas-fueled versions). The water goes directly from the coil to your faucet; it is not collected in a tank and it's heated just before you use it. It provides instant hot water—or if not instant, then pretty darned fast.

LET THE SUN DO IT

In the warmer parts of the world, solar energy is used to heat water. Tanks are routinely placed on roofs during construction, with pipes connecting them to indoor plumbing. The tanks and pipes are insulated, like giant thermos bottles, to keep the water hot at night and on days when the sun does not shine. There are often electric backup systems for long periods of cloudy days, but in poorer areas the backup system is taking cold showers when the sun does not provide hot water. Using the sun to heat water is not new, though the system has been improved by technology it was used by cavemen. And America is starting to join in. In the Sunbelt, most new construction includes some form of solar panel. A solar water heating system includes some sort of solar panel to concentrate heat, a tank to hold the hot water, and pipes to send the water down to where it's needed. Some systems, called active systems, use pumps to move the hot water around; passive systems use gravity.

As I've said before, most of the energy-saving we need to do has to be done on our existing housing stock, and more than half of that is in areas that don't get enough sun to give us

Left: **Inside a tankless water heater.** ***Opposite top:*** **This small tankless heater delivers hot water immediately.** ***Opposite bottom:*** **A low-flow showerhead reduces the amount of water used; new versions make the loss almost undetectable.**

more than 60% of the hot water we need. When I was retrofitting my Sewell farmhouse, I looked closely at solar hot water systems. One vendor in Minnesota sells a roof mounted solar hot water system for about $7,000 that promises to produce 60% of a home's hot water needs; similar systems go for $6,000 to12,000 across the country. In 2008, the average Minnesota natural gas hot water bill was about $15 to $20 per month and rising. So, in most circumstances, a flat panel rooftop hot water system is going to take more than 15 years to pay for itself. Since the panels are only guaranteed for 20 years, and since $7,000 is a daunting sum for most people, I cannot recommend solar heating as the across-the-board answer. I think tankless, aka on-demand systems are a better option outside the sunbelt.

OTHER SAVINGS

We've said that we're only looking at the most significant savings, but there are two other methods that, though less dramatic, should be considered.

SHOWERHEADS: The first is a low-flow showerhead; these can reduce overall hot-water usage by about 10% and some states have made it a law to use them when new showerheads are installed. According to their proponents, we won't feel the difference.

LAUNDRY: The second is washing clothes in cold water. Cold water does a fine job of cleaning our clothes and is gentler on fabrics. Unless there's a reason for your clothes to be sterile—for

newborn babies or people with compromised immune systems, cold water is a better choice for laundry. Some washing machines use hot water even in the cold-water cycle; ask about that if you're buying a new washing machine. About 14% of the hot water we use is for laundry; just turning to the cold-water cycle is an easy way to save energy.

NAVY SHOWERS: If you really want to save water while showering, follow the navy system: get wet; soap up; rinse off. The water stays off when it's not needed; it's on for less than two minutes altogether. It's the ultimate no-frills shower and lets you show how tough you are. Sailors refer to long, hot, steamy showers as Hollywood showers—and they're only for the spoiled and the soft.

In areas on the world where there is abundant sunshine, people have been using the sun to heat their water for centuries. The process is called passive solar heating and consists of placing a tank on the roof of a building; water in the tank is heated by the sun and is piped down to individual housing units. Recently, the system has been improved by focusing reflective panels on the tanks, which makes them heat faster.

OUTDOOR SHOWERS: Navy showers save energy, but they're not luxurious. But an outdoor shower—standing naked under the sun as water pours down—is one of the most satisfying ways to get clean. Outdoor systems, including hoses and showerheads, can be bought for under $100. The sun heats the hose, which can contain several minutes' worth of water. You probably want to build some sort of privacy enclosure, but anyone watching from above in a low-flying airplane is going to get a free show. And you should choose your soaps carefully—you don't want anything caustic or chemical-laden running into your vegetable garden. Other than that, it's just you, the sun, the sky, and the water—and no fossil fuels at all.

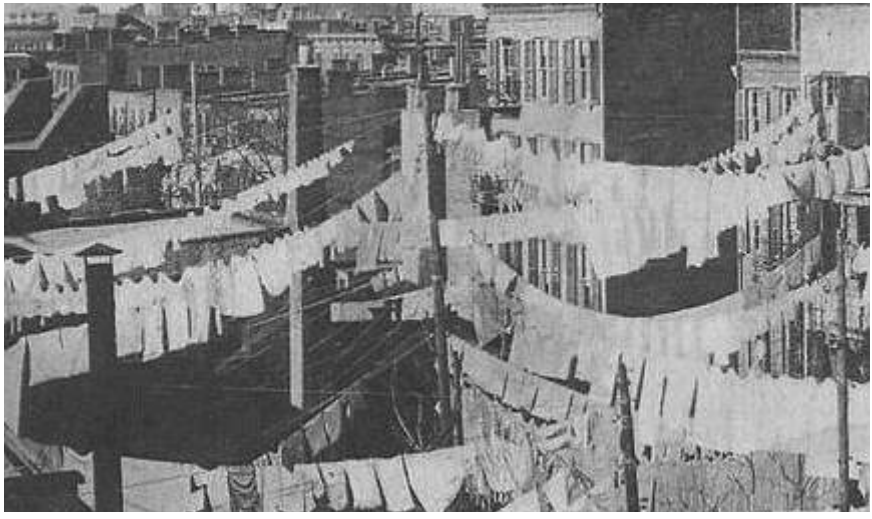
STEP 8

AIR DRY YOUR CLOTHES

Good clotheslines make good neighbors

Until the 1950s, only 10 percent of U.S. households owned clothes dryers—and everyone else seemed to get along just fine without them. Even today, less than half the homes in Europe (in Italy, it's only 4%) find the need to own this appliance; I have a wealthy neighbor who moved to America from Europe a few years ago and had never had a clothes dryer before. In Japan, one of the world's most modern countries, clothes dryers are rare.

But in the U.S., more than 75% of all homes and 92% of single-family homes include electric or gas clothes dryers, and many people wouldn't think of giving them up. Perhaps they would think differently if they realized that between 7 and 12 percent of our residential energy is used to dry our clothes. And while it can't be denied that the dryer can be convenient at times—certainly, anyone stepping into a pair of stiff, freezing blue jeans taken off the line on a winter day thinks fondly of the dryer—that's an



awful lot of energy to use for a task that can be done for just about free by the sun, the air, and a bit of time.

TIME AND EFFORT

Before we get into the joy of clotheslines, I want to take a minute to point out an underlying dichotomy that this step illuminates. On one side, we have an appliance that can do a job quickly (though it has significant drawbacks, as we'll see soon). But that appliance requires a great deal of money and energy; it costs $500 or more to purchase and probably has to be replaced every 12 to 15 years; it takes up space in our home and makes noise and heat when we run it. On the other side, we have a simple device that costs under $50 and lasts pretty much forever. But it takes a little more labor (not that much, once you get used to it) and a little more time (though on a sunny day, you can sometimes dry a whole load of laundry in half an hour). And here in America, we've become accustomed to automatically choosing

Until recently clotheslines were a colorful part of the urban landscape. Opposite page: New York in the 1940s.

FACTS AND FIGURES

- **Right now, only 8% of us air dry our clothes, and most of those do it only for 5 months a year. If we all started using clotheslines 80% of the time, we'd save 12 million metric tons of carbon dioxide.**
- **There are an average of 17,700 dryer-related fires in the U.S. every year. They result in an average of 15 deaths every year, 360 injuries, and almost $200 million dollars in property damage.**
- **Clothes dryers decrease the life of our clothes; line-drying can increase the lifespan of most fabrics by about 50%. We use 2.4% of our farmland, and about 25% of all the insecticides that are used worldwide on growing cotton for textiles. If we doubled the life of our clothes by line drying, we could save a significant amount of these petroleum-based chemicals.**
- **About 4.2 kg of CO2 are released with each load of clothing dried in an electric dryer. In all, clothes drying adds 12 million metric tons of carbon to the air every year. Air drying releases no CO2 at all.**

Hanging laundry is a nice, clean job to enjoy with family and friends.

the way that's a little faster and a little easier, without thinking about the effect on the environment. I am not saying that our time and effort have no value—just that we have to weigh them against the cost and not immediately choose the paper plate, the gas-powered leaf blower, or the clothes dryer without considering whether there's a slightly slower or more labor-intensive method that will achieve the same results.

And I'm going to take one more minute, to talk about labor and time. I've always found it odd that people will buy the latest labor- and time-saving devices—and then spend thousands of dollars and hundreds of hours at the health club so that they can gain back some of the strength they've lost by leading sedentary lifestyles. In the past, few of us had to take time to exercise—we could not get through life without constant physical activity. Now that we've found ways to avoid work, we need to replace it in order to keep our bodies in shape, and we're very willing to take time to do so. So, I ask you—can you really insist that hanging your clothes to dry is too much work or takes too much time if you're willing to spend a couple of hours a week on exercise machines or doing sit-ups?

THE JOY OF CLOTHESLINES

So, now, to the clothesline. It's a simple device. Your grandmother had one; her grandmother had one. It takes some common sense and some knowledge to use it effectively and you'll have the knowledge by the time you finish reading this chapter. Besides the fact that you'll save 7 to 12 percent of your overall household energy costs, there are several advantages to the clotheslines. The first is the scent of line-dried cloth; instead

of smelling like the inside of a machine, your sheets and clothing smell like grass and sunshine. You might think I am being a little Pollyannaish, until you try it yourself; there really is a subtle but delightful difference.

Your stuff will last longer if you do not subject it to the heat and rough-and-tumble of the dryer. All that lint in the dryer trap is little bits of your clothing and linens that the dryer detaches. And heat breaks down elastic very quickly; you'll be surprised at how less often you're buying the items that have elastic (all your underwear and socks, for example) when you line dry. Dryers also set in stains, fade colors, and shrink fabrics, sometimes ruining them completely.

Not only are dryers dangerous to your clothes, they are hazardous to your life as well. An average of 17,700 fires are caused each year by clothes dryers, some of them deadly. So if you do decide to keep using your dryer, look into safety precautions.

Some people think that hanging clothes out is a tedious chore. But it does not take much longer than throwing them into a dryer. The simple, repetitive motions of lifting a garment, pinning it to the line, then reaching for the next one is a good, light exercise—it burns about 135 calories an hour, about the same as a slow bicycle ride or bowling. It's a good time to think deep thoughts, or to talk to neighbors who are doing the same thing on the other side of the fence. Reconnecting with our neighbors while performing a task that was done in our grandparents' days—that has a value that cannot be calculated.

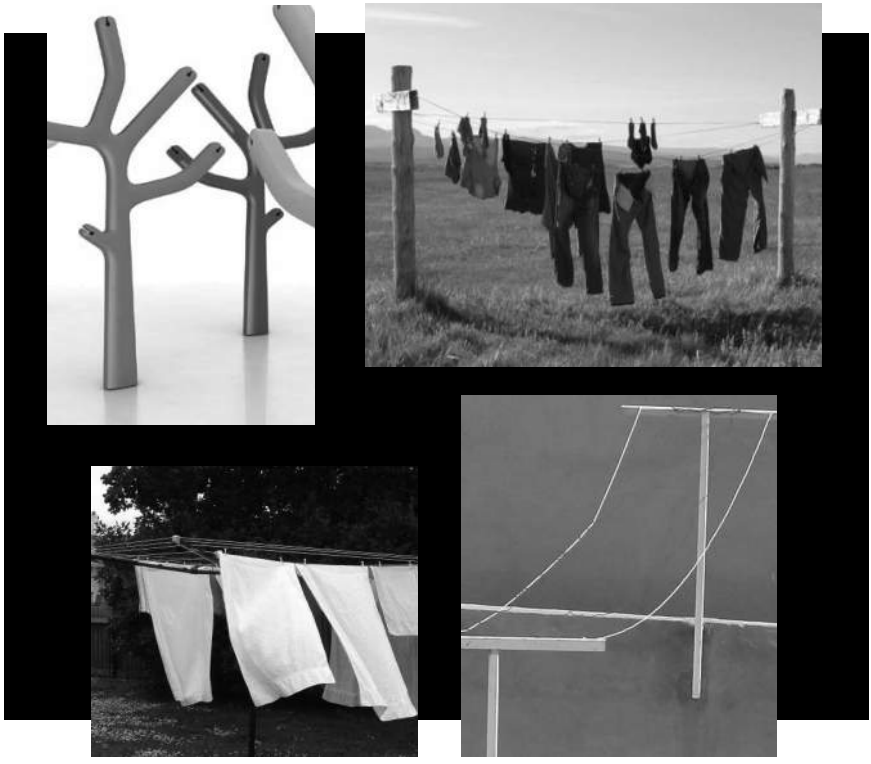
LET'S BE REAL

I won't try to tell you that there are no disadvantages to air-drying. There's that sudden, unexpected rainstorm that has you racing outside to bring in the laundry (and sometimes the soup burns on the stove while you do so). There's always that day that the local birds choose your clothesline as a dumping ground or when a passing motorcycle gang (or a group of local teens on bicycles) spew dirt on your fresh laundry. There's that freezing day in winter when you just don't want to be outside (indoors is an option, see below) and when your fingers are too cold to hold that clothespin. And then there's the issue of fluffiness. I've tried and tested many tips, but I have to be honest: you can't get towels to be as fluffy from the line as they are from the dryer. So if you're not ready to

take the full step of getting rid of your dryer, save it for the coldest days of winter, for hurricane weather, or for emergencies. And take your towels off the line while they're still slightly damp and machine dry them for the last five minutes—they'll be just as fluffy and you'll have run the dryer for a few minutes instead of an hour. But once you start using a clothesline, you'll find that you rarely want to go back.

WHAT YOU'LL NEED

Although the basic function of all air-drying equipment is the same, there's a dazzling array of choices. You can buy lines that are permanently attached to poles or to the side of your house, freestanding moveable racks, retractable units that can be affixed to balconies. In many European and Asian homes and apartments, one small porch or balcony is designated for clothes drying. Pulley systems can make all parts of the line accessible (and they're a lot of fun). The most important thing to look for in a line is drying space; the hanging surface should have maximum exposure



PROJECT LAUNDRY LIST

The air-dry movement has an organization to back it up. Project Laundry List was founded in 1995, after Dr. Helen Caldicott told students at a Middlebury College symposium that "if we did things like hang out our clothes, we could shut down the nuclear industry." Founder Alexander Lee took the concept and ran with it. He created a strategic plan to promote air-drying. By 1998, the group had helped pass the first Right to Dry law, introduced by Senator Dick Mccormack of Vermont. 1998 was also the first year for National Hanging Out Day.

Project Laundry list seeks to educate consumers on the effectiveness and benefits of air-drying clothes. They maintain a comprehensive websites, support Right to Dry laws with effective literature, and forge partnerships with corporations and associations to spread the word. They have been covered in articles in The New York Times, The Wall Street Journal, and many other publications. Check out their website for more info: www.clotheslineproject.org.

and the lines should be angled so that the clothes won't overlap. Look for sturdy metal that will last a long time. Or, forget all the fancy equipment and just hang a rope between two trees.

Other than the poles, you'll need some clothespins, which you'll probably find at the dollar store. Here, too, there are some higher-tech items, some decorative, some designed to minimize marks on clothing; personally, I do not think it makes a lot of difference, but if having your clothespins in the shape of jungle animals makes air-drying better for you, then go for it. If you're crafty, you'll find lots of websites that give instructions for making clothespin holders from cloth or old milk jugs. Again, I've never had such a need, but they're easy to make and might save a clothespin or two from the undergrowth.

GETTING THE HANG OF IT

More important than the equipment is where you put it. I've usually put my clotheslines in the sunniest spot I can find, but I've been told that's not the best option. Filtered or indirect sunlight (such as a spot shaded by a tree or house) won't fade colors the way bright, direct sunlight does. But the drying time will be longer. If you have space, setting up two lines is the optimal choice—one line in indirect light for bright colors and delicate fab-

WASHING IN COLD WATER

While we're on the subject of laundry, here's another energy-saving tip. There's no reason to use hot water on most clothing. You might want to use hot water on clothes being used for newborn babies, to reduce bacteria. But other than that, a little soap and a normal laundry cycle get your clothes clean just fine. And you don't need much soap; it's the movement of the washing machine's agitator that brings the cleaning power. In other words, most of the energy and pollution that we cause by getting our stuff clean can be eliminated without any significant effect.

rics, a second line for speed on stuff that won't suffer from a little fading. Stay away from pine, maple, and other syrupy, sappy trees—you do not need sticky stuff on your clean laundry. And if there's an area in your yard that the birds love—like near the vegetable garden—stay away from that. Birds and laundry are just not a good combination.

I do not think I need to spend a lot of time talking about how to pin the clothes to the line, but I have learned one thing that has eliminated those little clothespin mark on my shirts and pants: just hang them from the bottom, where the marks are not as visible. Some people complain that air-dried clothes wrinkle more than machine-dried, but I've never found that to be a problem as long as I give each item a good shake before I pin it to the line.

Here's a trick for towels and linens: hang them with the fold on the bottom and pin the open ends to the line. The wind supposedly whips through them and keeps them soft and fluffy. People have different standards for fluff. I've found that it works well for sheets, not so well for towels, but it does keep some of the stiffness away from the towels as well.

THE RIGHT TO DRY

Now that we've all seen the benefits of air-drying and are ready to start, some of us are going to find that there are actual laws, or at least community ordinances, that forbid us from doing so. More than sixty million Americans live in private communities such as housing developments, trailer parks, retirement communities, gated subdivisions—and the vast majority of those have outlawed outdoor drying, stating that clotheslines are unsightly and reduce property values. And in most places, it's perfectly legal for them to do so: community covenants, landlord or co-op rules,

and even zoning regulations can enforce bans on outdoor drying with fines or even evictions. To some community leaders, clotheslines are a reminder of the evils of yesterday—poverty, slums, backbreaking labor—and not the good things like clean air and healthy bodies.

But things are changing. Activists are advocating statewide laws that will make it illegal to ban outdoor clotheslines. Several states, including Florida, Colorado, Vermont, Maine, Hawaii, and Utah already have such laws on the books, and many other states are already considering them. Project Laundry List estimates that pro-clothesline laws will be enacted in at least twenty states in a few years.

If you live in an area that bans outdoor drying, you can try to change the rules either by working on a statewide law or changing your community's rules. Find people who agree with you and marshal your resources. Show why air-drying is good not only for you, but for the neighborhood and the planet. Find ways to reduce its impact. Convince one person at a time, and have each new convert convince someone else. This is one of those little things that can make a big difference—remember, it's 7 to 12% of home energy costs, 12 million metric tons of carbon that do not have to enter the atmosphere, 15 people who won't die in dryer fires each year.

GOOD NEIGHBOR POLICIES

While you're enthusiastically advocating for your right to dry, consider your neighbors' needs as well. You can't really blame people if they don't like watching your underpants flap in the breeze as they sit on their porches trying to enjoy the view. The easiest way to get them to join you rather than fight you is to eliminate the discomfort you're causing them. Placing your clotheslines where they won't be seen is a good first step, fencing them in another option. If your property is too small or too close to your neighbors' to do these things, look into freestanding units that can be folded and moved indoors when they're not in use. Try to find a time when you won't be annoying anyone, such as early morning (that's also a time when the sun is a bit weaker and less damaging to clothing). If you live in a private community, you might be able to set aside a small, unobtrusive area where everyone can hang out their clothes—and hang out for fun as well. What better way to get to know

Right: **Retractable indoor clotheslines save space; they almost disappear when not in use.** ***Opposite page:*** **Here's another energy-saving, labor-using device that works: hand mowing in small spaces.**

your neighbors than to bring some drinks or snacks along with the laundry and chat while you work?

There's no reason to be confrontational. You'll find some people just won't listen to reason, but if you present your case calmly, and take your neighbors' needs into consideration, you'll get enough people on your side to tip the balance. If there are zoning or landlord prohibitions, getting a group together, possibly with a petition in hand, will help convince the powers that be that it's not just the lunatic fringe or a lone tree-hugger who is rooting for an unpopular cause, but an assembly of rational, responsible neighbors who have good reasons for what they're doing.

AND WHILE YOU'RE AT IT

Involving your neighbors in a right-to-dry campaign can be the start of something bigger. Once you've found the people in your community who understand the importance of saving energy, go with it. Form an Oil-Anon group—see page 185 for more information—and decide what else your neighborhood needs to do. Is there a recycling center that needs publicity—or do you need to start one? Do the local farms need support? Can you get enough people together to train a technician to install energy-saving heat pumps? Remember Margaret Mead's famous quote: "Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has."

INDOOR AIR-DRYING

Sometimes, outdoor drying is just not practical—like when it's snowing outside, or when you live on a busy, grimy city street. But there are good indoor options—lines that can be installed above the bathroom and retract to near invisibility, folding units that can be used overnight. If you hang

the laundry just before you close the lights for the night, just about all of it will be dry by morning. Pack away the equipment and you'll never know that your apartment was a laundry room while you were sleeping.

TURNING OFF

Now that you've become used to employing nature and a little labor to do work that was previously done by gas-guzzling machines, you might be interested in extending your savings. Turn off the drying option on your dishwasher; just open the door and let the air dry the dishes. A day spent raking leaves instead of using the leaf blower is great exercise. And there are new rotary hand mowers that get the job done without gas and allow for quiet contemplation and the fresh smell of grass while mowing the lawn instead of engine noise and the smell of gasoline. Every time you turn on a machine, take a few seconds to think whether your life could be better if you just turned it off instead.

STEP 9

USE A SMALL ENERGY STAR REFRIGERATOR

Cold sense

Your refrigerator uses more electricity than any appliance in your home other than your air conditioner; refrigeration averages out to about 13% of your home electricity costs. (Your hot water heater and furnace do not count as appliances.) But there's a difference between the refrigerator and the air conditioner, and between the refrigerator and most other appliances. With all your other appliances, you can regulate their use, turning them on and off to conserve energy. But you're not going to turn off your refrigerator—it's on all the time (though the motor does not actually operate 24 hours a day—it cycles on and off and it's active only about one-third of the time). So it's important to buy the most energy efficient refrigerator you can find and to make sure that it's just the right size for you.

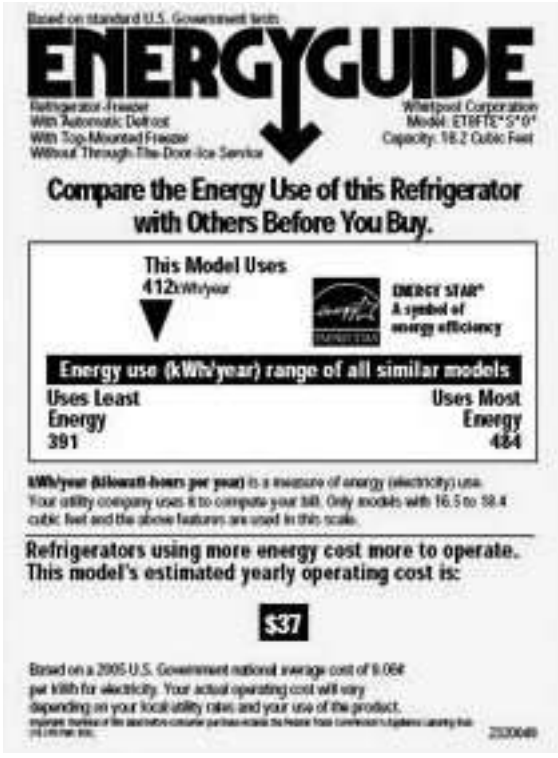
A STAR FOR ENERGY-SAVING

In 1992, the U.S. Department of Environmental Protection created the Energy Star program. The task that the EPA took on was evaluating products based on their energy use and gas emissions; computers and computer monitors were the first items it looked at. The program distributed information to manufacturers so that they could alter their products and make them as green as possible. Energy Star then evaluated each product and provided a label to manufacturers. In 1995, the evaluations and labeling were expanded to include more office equipment and some residential heating and cooling equipment. In 1996, the Department of Energy joined the program and Energy Star kept growing. Today, more than 17,000 companies and organizations, both public and private, are connected to Energy Star. The program covers all major appliances, as well as new construction, automobiles, and lighting. It has been estimated that

the program saved consumers more than 17 billion dollars in 2009 alone, and eliminated greenhouse gases that are equivalent to running 30 million cars for a year.

The program advances the goals of both the DOE and the EPA: it helps us conserve energy by helping consumers buy products that use less energy and it protects the environment because these lower-energy appliances require less use of the fossil fuels that cause pollution and global warming. And, oh, yes—it saves money for everyone (including industry and consumers) except for those who want to produce and sell energy-wasting appliances.

There are two elements in the Energy Star program. The first is a strategic partnership with industries that provide consumer and business-to-business products. Energy Star provides resources that allow businesses to produce their products more efficiently and at the same time produce more efficient products. An innovative rating system allows management to measure energy performance and correct their shortfalls. The labeling system devised by Energy Star allows consumers to see where


Based on standard U.S. Government tests

ENERGYGUIDE

Refrigerator-Freezer
With Automatic Defrost
With Top-Mounted Freezer
Without Through-The-Door-Ice Service

Whirlpool Corporation
Model: ET8FTE*S*0*
Capacity: 18.2 Cubic Feet

Compare the Energy Use of this Refrigerator with Others Before You Buy.

This Model Uses
412 kWh/year

ENERGY STAR®
A symbol of energy efficiency

Energy use (kWh/year) range of all similar models

Uses Least Energy	Uses Most Energy
391	484

kWh/year (kilowatt-hours per year) is a measure of energy (electricity) use. Your utility company uses it to compute your bill. Only models with 16.5 to 18.4 cubic feet and the above features are used in this scale.

Refrigerators using more energy cost more to operate. This model's estimated yearly operating cost is:

$37

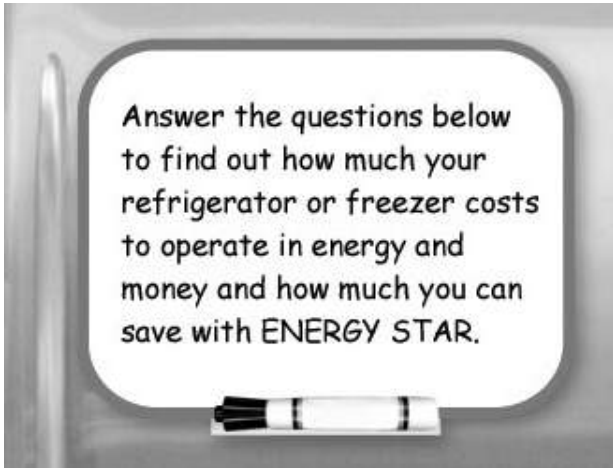
Based on a 2005 U.S. Government national average cost of 9.06¢ per kWh for electricity. Your actual operating cost will vary depending on your local utility rates and your use of the product.

2530040

The energy star label will tell you how the model you're looking at stacks up against others in energy consumption. Buying the right model can save energy year after year.

each product falls in the energy-consumption scale—which lets them know how much they will save by buying a more energy-efficient product. Industrial leaders have accepted the marketing value of a high Energy Star rating. This is a good example of capitalism at work—since many industry leaders have children and grandchildren, they must be somewhat concerned over the future of the planet, but knowing that their bottom lines can be improved by staying green and saving energy is surely an incentive.

For consumers, the Energy Star label provides a clear, objective view of what we're buying. The Department of Energy estimates that consumers can save about one-third of the cost of running their appliances by purchasing the most efficient products. And these products usually cut down on greenhouse gases by one-third as well. There is very little downside—the price, features, and initial cost of the more efficient appliances are usually about the same as the less efficient ones. So most consumers opt for products that are better for them, better for the world. The Energy Star program is a great use of government resources and we should all support efforts to expand it. And of course, we should all be looking carefully at the big Energy Star sticker that appears on just about every new appliance; we should be especially aware when we shop for a refrigerator, the appliance that works round the clock.



The Energy Star program provides a simple calculator to help you decide whether replacing your refrigerator is a good idea. You'll find it at: http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator

REFRIGERATORS AND ENERGY

Technology and industry have made great strides in reducing energy use in home refrigeration. Since 1970, the annual cost to operate a refrigerator/freezer, in today's dollars, has fallen from $180 per year down to $50 per year for the right unit. And finding the right unit is easy—just look for the fridge that wears the star. In order to earn the Energy Star label, a refrigerator must use at least 20% less energy than models that meet the minimum federal requirements for energy efficiency. And they must be cost-effective as well; if a unit costs more than similar, less-efficient ones, it must earn back the additional costs within a few years. You do not have to settle for a refrigerator without the features you want—convenience is also figured into the Energy Star rating.

GREENFREEZE

If you happen to be living in Europe, Asia, Africa or South America and planning a move to the US, think about bringing a Greenfreeze refrigerator with you. In 1986 when it was discovered that chlorofluorocarbons (CFCs), caused ozone depletion, the US refrigeration industry switched to hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs). HCFCs are also ozone depleting substances but less so than CFCs. But the Europeans adopted refrigeration technologies which do not include any ozone depleting substances, and produced a refrigerator which is much more efficient than the energy star units that we have in this country. For example, some of the best US energy star units consume about 550 Kwh per year, while the greenfreeze counterparts use about half that much. Vestfrost of Denmark is one of the leaders in this technology. Over 150 million greenfreeze refrigerators have been sold worldwide so far, but you cannot get them in the U.S. for various reasons.

OUT WITH THE OLD

So here's the question—if you have a working refrigerator, should you chuck it and buy a new one? If you bought your refrigerator before 2001, you probably should. As I've said, refrigeration is an area that enjoyed great reductions in energy use in the past ten years—you're likely to save 50% or more of your refrigerator's electricity costs with a new model. If your savings are

about $100 per year, and the new unit costs about $800, you'll make back your investment in about 8 years—and you'll have a new fridge to enjoy during that time.

But you have to buy the right new unit—one that serves your needs but does not exceed them. The Energy Star gives you great information on which model is most efficient—but it's up to you to decide which size and features you really need:

SIZE MATTERS: Bigger refrigerators cost more to use. The smaller your unit, the less your bill will be. So—how much room do you really need in your refrigerator? If you organize carefully—and do not just shove everything in when you come home from the supermarket—can you downsize to a smaller unit? Do have to put the whole pot into the fridge, or can you remove the food and wrap it carefully (that will make the food last longer and stay safer as well)? When you make this decision, do not base your needs on Thanksgiving Dinner or the Labor Day barbecue—you can make other arrangements for these once-a-year events (sharing neighbors' fridges, using dry ice, putting an old, non-efficient fridge to use for a few days). Take a week or so to see how you can arrange your food to save space without having to make extra trips to the supermarket (you certainly don't want to spend your electric bill savings on gas). In most cases, you'll find that you can reduce your fridge size by a few cubic feet.

Two importabt questions to ask when buying a refrigerator: What's the right size? Can you manage with a small fridge on the left, or must it be the enormous one on the right? What's the right location? On the opposite page, the refrigerator is placed far from sunny windows and drafts.

FEATURES: Automatic icemakers use a lot of energy—about 14 to 20% more than a unit without an icemaker—and come on, how hard is it to make ice? This is one of those times when you can save energy and money with a minor change in lifestyle. Unless you're willing to admit that you're incapable of keeping the ice trays filled, you'll probably want to buy a unit without an icemaker.

CONFIGURATION: Refrigerators with freezers on top or bottom are more efficient than side-by-sides.

SO, TO REVIEW: Your new Energy Star refrigerator should be the smallest one that will hold enough food for your family for an average week and your freezer should be on the top or bottom of the fridge because side-by-sides use more energy.

COOL SAVINGS

Even with the most energy-efficient model, you can increase or decrease your refrigerator's electricity costs by the way you position and handle it.

LOCATION, LOCATION, LOCATION: Finding the right spot to put your refrigerator will help it work efficiently. The cooling unit in the fridge reacts to the temperature of the air outside it. Very warm air will slow it down, so keep the fridge as far from the oven, dishwasher, heat vents, or any other heat-producing appliance as you can. You should also try to keep it away from sun-drenched areas of your kitchen; sun hitting a metal

surface can make the temperature spike to over one hundred degrees, even on a cool day.

THE RIGHT TEMPERATURE: Most refrigerators have dials that allow you to adjust the temperature. You may have to experiment to get it just right—you don't want the lettuce to freeze or the milk to go sour. Every refrigerator has colder and warmer spots—follow the manufacturers' directions so that you keep the items that need the lowest temperatures in the spots that are coldest so that the overall temperature is the lowest it can be. And you probably don't need to keep the dial at the same place throughout the year; temperature can be a bit higher in winter when icy cold drinks are not as beneficial.

DON'T BLOW YOUR GASKET: A leaky gasket makes your fridge work harder. Gaskets don't last forever. It costs only a few dollars to buy a new one and you can probably do the replacement job yourself. Check your gasket frequently to make sure it fits tightly. And while you're at it, clean the gasket of dust and spilled food that accumulate in the crevasses. Not only will your kitchen be less yucky, your refrigerator will be more tightly sealed.

CLOSE THAT DOOR: Standing in front of an open refrigerator while you decide what you want means that you're cooling the whole room. Keep your fridge organized and keep basic items in set places so you do not have to rummage through every shelf to find the beer or the mustard.

SUPER-EFFICIENT FRIDGES

If you'd like to be a pioneer, you might consider investing in a super-efficient refrigerator. They are still in the experimental stages and are much more expensive, but there are some that are more than 50% more efficient than even the ones with the best energy-efficient ratings. Sun Frost has a 16 cubic foot model that uses only 372 kWh a year.

If you're really going whole-hog, you can even make your own refrigerator from a chest freezer. These freezers have more insulation than refrigerators and are sealed more tightly. They're certainly not as convenient as a regular fridge, but they can use as little as 50 kWh a year. You'll find instructions on the web: http://www.energyconservationinfo.org/chestfridge.htm

Decide what you want before you open that door, then go for it and close it quickly.

HOT AND COLD: Do not put hot food in the refrigerator; let it cool on the counter instead. But when you take a package out of the freezer, let it defrost on the refrigerator shelf and not the counter; it will lower the temperature inside the refrigerator so that the unit can work less. Food safety experts say that you should never defrost perishables outside the refrigerator, so there's a double reason to use the fridge for thawing.

CLEAN THE COILS: Dusty coils lose their heat transfer efficiency and cause your refrigerator to work harder.

CASH BACK FOR ENERGY SAVINGS

In many states, you can get a cash rebate (or a low-interest loan) when you purchase an energy-star-rated refrigerator or other appliance. If the salesperson you're working with does not know about these programs, ask for the manager or call your local Department of Energy. Find out about the program before you make your purchase and ask for all the pertinent paperwork so that you can get the maximum advantage.

CASH FOR CLUNKERS

Remember the "Cash for Clunkers" program for gas-guzzling vehicles? Some states and localities have similar cash reward programs for those who turn in their old refrigerators. If your local government does not have such a program, why not join with some friends and neighbors to propose one?

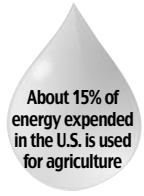
OTHER APPLIANCES

Your refrigerator uses more energy than your other appliances—but you should check the efficiency of all the electricity users in your home: dishwashers, televisions, computers, garage-door openers. The Energy Star program makes it easy to do so. You might find that buying new, more efficient appliances will save you significant money in the long run.

STEP 10

GROW FOOD

"The way we eat determines, to a considerable extent, the way the world is used." —WENDELL BERRY



The simple act of eating has effects all over the planet. Every time we buy food, we are supporting the agricultural system that produces it. And you might be surprised at how heavily those decisions are tied to the energy crisis we're facing. There is fuel in every bite we eat, more or less of it depending on how careful the producer who raises it has thought about conservation. I think that by now we all understand that the end of fossil fuels will make it impossible for us to heat our homes and drive our cars the way we do now, and we should be worried about that. Here is a new wrinkle: we're not going to be able to eat the way many of us do now—and unless we get ready for the change, we might find that we're not able to eat at all. When fossil fuel becomes too expensive to afford, we are going to have to find a new way to produce and transport our food.

THE FUEL WE EAT

Right now, most of the food we eat—up to 75% of total spending on all food products nationally—is produced by large corporations that grow, process, package, and sell in the most efficient way they can. And we can't deny that they are keeping prices down; we spend, on average, less than 10% of our disposable income on food, down from 24% in the 1930s. And fewer of us have to work on farms to produce that food. In colonial times, about 70% of the American population engaged in farming; today, that number is down to 1%.

To sum up, we can get food cheaply and easily. But in order to keep prices low, large food companies consolidate most of their production facilities in central locations and grow each item in massive fields dedicated to that item. This allows them to use huge machines for processing—it would not be cost-effective to set up these machines for small quantities.

FEASIBLE FOOD AND VICTORY GARDENS

Can people who have no background in farming actually save money and energy by growing their own food? The answer is yes and The Victory Garden campaign is proof of that.

During World War I, Charles Lathrom Pack initiated the National War Garden Commission, urging people to start gardens in public parks and private backyards so that manpower, transportation, and farms needed to produce food for the troops could be used for the war effort. The practice multiplied during World War II, when more than five million Victory Gardens were started; they produced over 1.2 billion dollars worth of produce and accounted for more 40% of all the vegetables consumed in the U.S. during the later war years. Instead of eating rationed can goods, people in America ate fresh vegetables during the war. They grew what they needed in urban parks and apartment rooftops, in tiny suburban backyard plots and vacant lots. Some people dug up their lawns and replaced them with vegetables; vegetable gardens were installed in New York City's Riverside and San Francisco's Golden Gate Parks. Many of these gardeners were growing food for the first time and didn't know what they were doing, but they were patriotic and motivated. They were helping our soldiers abroad by allowing commercial agricultural products to be sent to the people who were fighting the war and making sure that their own families would not go hungry.

Don't we have just as much motivation today? We know that our commercial sources of food are flawed and that many kids are not eating the way they should be. We know that the energy that goes into growing and transporting the food we buy is going to be scarce. And to top it all off, we are in the middle of an economic downturn and many of us are not working. Athletic programs are being cut, parks budgets are decimated, unemployed people have time on their hands—so labor and public space is available. We face the possibility of food shortages, and the probability that getting to the supermarket is going to cost a lot more. We know that the food we grow tastes better and is more nutritious. And the victory gardeners have shown us that it can be done. What more motivation do we need?

But growing on these single-item fields means that a pest that is attracted to that item can wipe out the whole field in a short time. So large amounts of pesticides must be used to avoid that risk. Single-item fields also deplete the soil quickly—so chemical fertilizers are needed to keep the soil fertile. These pesticides and fertilizers are made mostly of petroleum. Animals raised on large factory farms also use extra energy. They are fed a diet of corn; about 70% of the corn raised worldwide is used to feed animals. This corn needs copious amounts of fertilizer to grow, most of it petroleum-based. Now let's look at how that food gets to your supermarket—by truck, usually. Food travels an average of 1,700 miles from the farm to your plate, again using fossil fuels to get there.

In other words, most of the food we buy requires a huge amount of fossil fuel to grow. Every time we take a bite of food, we are also consuming the energy used to create it. In 1940, when small farmers were still using old-fashioned methods, it was estimated that 1 calorie of fuel went into every calorie of food. In 1974, studies showed that 2.3 calories of fuel were consumed with every calorie of food. And today, for every calorie of food we eat, another ten calories of hydrocarbon energy is used. Eighteen % of our total U.S. energy consumed is used in the production, transportation, processing, merchandising, and selling of food.

THE TRUE COST OF FOOD

As the energy costs of food increased, the nutrition decreased. Food starts losing nutritional values as soon as it is picked; after it travels thousands of miles in a refrigerated truck, it has less of the vitamins that it started with. And all those trucks transporting our food—using fossil fuels, of course—across the country are a major contributor to the pollution that is causing asthma and other health problems. So all those food-miles that are racked up by the efficient process of consolidating production end up costing us in lost nutrition and medical bills.

Food you grow yourself (left) tastes better, is more nutritious, and uses less energ than the food you buy in a supermarket (opposite page).

Processing is another practice that reduces the value of food. Adding sweeteners, preservatives, other chemicals, and lots of pretty packaging makes food more saleable to consumers—and reduces its nutrition value significantly. The processed, packaged foods that account for about 40% of our food bills provide us with less nutrition than we've ever had. They are causing diabetes, obesity, and other health problems. With all our wealth, we are eating worse than ever.

And the problem is becoming more difficult to rectify as small farms disappear and agribusiness takes more control. As food production concentrates in a few areas, mainly in the Midwest and California, local food systems wither. Recent activism has promoted small farms and allowed responsible farmers to keep a toehold in the market, allowing us to keep the promise of a better food system. But large food companies still have control over our most basic need, and use immense amounts of energy in doing so.

FOOD AND THE ENERGY CRISIS

Knowing how much fossil fuel is used in food production, and knowing that this fuel is about to become scarce, I am sometimes beset by a feeling that borders on panic. How will the energy crisis affect our ability to feed ourselves in this country? More dire, how will it affect over a billion people in the world who live on less than a dollar a day, whose food cost represents the largest part of their expenses? When oil prices peaked in 2008, grain prices tripled, causing untold hardship, even starvation, in countries from Bangladesh to Tanzania to Haiti. Will we face the specter of food shortages, malnutrition, and hunger in America and around the world?

ONE POOR HARVEST FROM CHAOS

Food is a life-and-death issue. The energy crisis affects us in many ways; in third-world countries, where people live on a dollar a day, the rise and fall of energy prices contribute to starvation in a world where people are already in dire straits. In his recent book, *World on the Edge*, Lester Brown tells us that "Things could start unraveling at any time . . . we're one poor harvest away from chaos." Experts believe that rising food prices, caused by a spike in energy costs, were a trigger for the riots and unrest in the Middle East.

Learning to grow our own food and paying close attention to our food choices is a step in the right direction.

ANTICIPATING NEEDS

Let's not panic. The idea that our food sources are located thousands of miles from us should give us worry. But rather than wringing our hands, let's do something about it. Step Ten in The Oil Addiction Cure is learning to grow our own food. There are a multitude of grass roots and institutional efforts promoting the idea that we can all grow food. For example, a group called Food Not Lawns is turning yards into gardens around the world. This group, and many others, offer educational, organizational, and hands-on services, such as garden design, events organizing, writing, research, and interactive community workshops. Vegetable gardening has to become a major activity again, and it has already started—so many people started growing vegetables during the economic downturn that garden centers ran out of supplies. Two hundred years ago, most Americans knew how to eat without walking into a supermarket; somewhere along the way, we lost that ability. It is time to get it back.

REALISTIC EXPECTATIONS

Knowing that growing our own food is possible does not mean that it is easy or that we do not have to work hard and prepare well if we want to be successful. This is not a gardening book; I do not have room here to give you all the information you need to become a successful food grower. But I do have room to show you how it can happen and to introduce you to the requirements and concepts that you'll learn.

The first thing I want to do is manage your expectations—a term I usually hate because it means that everyone is not expecting full success on every level. But in the case of growing food, we have to understand that there are a lot of factors in play that are not in our control. Weather is the biggest issue; plants need sun and heat (but most do not like it too hot) and water (but not too much); we can provide some of that, but unless we're growing under domes, our plants are going to be deeply affected by climate. Then there are the elements that we call pests—bugs, animals, and weeds that think they have just as much right to grow as our lettuce and tomatoes. You're not the only one out there trying to survive—the dandelion, the hornworm, and the rabbit are going to fight you for every inch of land. So the first thing I would suggest is starting small; take a year to see what works and what doesn't.

SQUARE-FOOT GARDENING

Square-foot gardening, as promoted by garden writer Mel Bartholemew, is a particularly efficient method that involves planting many different varieties in small, intensively cultivated plots. Each plot is divided into squares in which several of each variety is planted. Care is taken to combine plants that complement each other—leafy squash above lettuces that need shade, marigolds that repel nematodes that attack beans. The plants support each other and each one produces well. See Bartholomew's book, *Square Foot Gardening* for more information.

SETTING BOUNDARIES

One of the first things to do when you start a garden is mark off your space. That can be one pot on a sunny windowsill or half an acre—but trust me, unless you've done this before, you want to stay small. Jon Jeavons, author of *How to Grow More Vegetables Than You Ever Thought Possible On Less Land Than You Can Imagine* says that you can grow all the food a person needs on 4,000 square feet—a plot of about 40 x 100 feet. But you'd be surprised at how difficult even that can be for a beginner. I'd suggest no more that 200 square feet to start; you can get a lot of experience and a lot of vegetables from a plot that size. You can increase the size as you go along and you'll be able to judge how much bigger you can go the

next year. What you don't want is to become overwhelmed and discouraged. Planting 100 tomato plants and 50 squash plants might take only half a day—but taking care of the jungle that appears a couple of weeks later might make you throw in the trowel and give up.

Or, you might want to start even smaller than that. One long bed intensively planted or a couple of containers on a patio or terrace will get you started without stress. If you live in an apartment or a house without a backyard, that might be all you can ever have—but that doesn't mean that you can't enjoy your own vegetables.

And you will enjoy—not only the harvest, but also the whole process. I've yet to meet someone who does not take satisfaction in the food that they grow. It is not only the taste; it is the ability to take care of oneself in so basic and important a way. When we grow our own food, whether it is a weekly salad or a full diet, we are declaring our independence from the producers who grow their products in ways we do not approve of. We are making sure that we can feed others and ourselves without depending on outside sources—and that joy is priceless.

WHAT TO GROW

You are going to be amazed by the variety of vegetables available to you, especially if you start with seeds. When you shop in a supermarket, you might find 6 kinds of lettuce, 4 types of tomatoes, and green and yellow squash. When you peruse a seed catalog, you'll find literally hundreds of varieties; for some people, this diversity is a good reason in itself to grow your own. It is fun to be the only one to have yellow beans with purple speckles, black tomatoes, orange cauliflower, green-and-white striped zucchini. Some of these are new and improved varieties, bred for flavor, vigor, or disease resistance. Others are old-fashioned heirlooms that some people take pains to preserve. And there are varieties of vegetables that never make it to the stores because they are too fragile to pack and transport, but have unbeatable flavor. I'll list some of my favorite varieties, but the choices are endless. If you garden for the next 50 years, you'll never run out, and new varieties, as well as refound heirlooms crop up every year.

But if you are a beginner, it is a good idea to stick to the classics, the varieties that are going to give you the most bang for your buck. Luckily, some of the most delicious vegetables are also the easiest to grow. Sungold

cherry tomatoes are as sweet as candy and grow like weeds, pumping out trusses of tiny bright orange fruit for two solid months; Early Jersey Wakefield cabbage is about the most flavorful around, and also the easiest to grow. (See list of the easiest vegetables). But besides ease of growth, I also look for the most nutritious vegetables. If we are growing to make sure that we'll have food in an emergency, we should also be looking for the food that will sustain us.

A GARDEN PRIMER

So here's the bare-bones short version, the executive summary. It's not everything you need to know, it's everything you need to know before you start learning what you need to know; it's everything you need to know to show you that you can do this. You might decide to do more research and reading (see page 190 for ways to get information) or you might decide to just start and see where trial and error leads you. Whatever you do, just start.

WHERE? Your first job is picking a spot. There is one key factor, and that is sun. Your vegetable garden needs at least six hours of full sun every day. You might have some success with lettuce, herbs, and cabbage in a shadier spot, but most food wants full sun. Everything else is a matter of choice, where you think the vegetable garden blends with the rest of your landscaping, proximity to water sources, how close it is to the kitchen (because you want to be really close to the garden when you pick the corn and throw it in the pot that is already boiling). If you can find a spot that's protected by trees or one side of the house (but still far enough from shade), that's probably a good idea because sooner or later animals are going to find your garden and you are going to start thinking about fences. Avoid areas that are near treated lumber, like porches or decks, unless you are sure that no CCA-treated lumber was used. The "A" in CCA stands for arsenic, something you really do not want leaching into your fresh food. Flat ground is convenient, but do not reject a slope out of hand—squash vines love to run down a hill.

THE PLAN: Once you know what you are growing and where you are growing it, you need a plan for what goes where. There are two schools of thought on how you should do this. Some people like plain straight rows, one kind of vegetable in each row, with wide even spaces between plants. Others swear by intensive planting methods (sometimes called square-foot gardening), with different plants interspersed, planted as

close together as possible, shading each other as they grow. There are advantages to each. If you plant in rows, your plants will get more air circulation and will be better able to avoid fungus and other diseases. You'll have an easier time getting your hoe through each row when it is time to get rid of weeds. And you'll know what is in each row—no searching for the cabbages under the squash vines. Intensive plantings allow more plants per square foot and devotees insist that the plants help each other. Tall plants like tomatoes shade low-growing plants like carrots and make good use of the same space. By trellising and staking plants, you're making your plot work harder and increasing your yields. It is a matter of taste and work habits. Try both and see which you like better.

LIVING SOIL: It might look like dirt, but soil is a teeming empire of life and structure. Tiny organisms eat their way through the soil molecules, leaving room for moisture and nutrients to move around; the roots of your plants grow through and toward these spaces, and drink in everything they need. If our soil is good, it can nourish our plants; it is our job to keep it full of what our plants need.

Different regions have different types of soil, which naturally contain some or all of what plants need. Soils can be sandy (allowing water to seep through quickly), clay (heavier soil, which holds water and does not let it drain), or loamy (a happy medium). To determine what kind of soil

Opposite page: **Growing in raised beds (beds in which you've put soil into enclosed areas) takes a lot of the guesswork out of gardening.** ***Right:*** **Delicious Heirloom tomatoes; they cost a fortune in the supermarket, but not if you grow them yourself.**

you have, dig a hole about the size of a 2-quart bucket. Pour 2 quarts of water into it. If the water is gone in less than 5 minutes, you have sandy soil; you'll need to add compost and other soil conditioners to enhance it so that water and nutrients do not leave too quickly. It the water is gone in about 1/2 hour to an hour, you have loam; say a prayer of thanks. If your water is still standing after an hour, your soil is clay; water does not drain easily from it, and plants don't like that. You can adjust soil by adding compost, greensand, and other lightening agents.

Plants grow through photosynthesis, taking in carbon dioxide and turning it into oxygen in the process; they need certain nutrients to do this effectively. Vegetables and other plants pull nutrients from the soil; you can't expect soil to keep giving year after year, you have to put back some food if you're taking so much out. The main ingredients in a plant's diet are nitrogen, phosphorus, and potassium; plants also need a bunch of trace elements like magnesium, iron, and copper. It is easy to find out what your soil is lacking; every garden center carries soil test kits, Just follow the instructions; some kits give you answers on the spot, others need to be sent away. Your soil test will also tell you if your soil is acidic or alkaline. Most vegetables like a mildly acidic to neutral soil and there are amendments that you can add if you need to adjust.

Chances are your soil test will indicate that you need to add something to your soil. There is an easy way to do this—just buy bags and bags of expensive chemical fertilizers—they work, producing big, bright vegetables, for the short term. But in the long term, they destroy the soil, replacing the delicate balance of life-giving microorganism with quick-release fast food. And these chemicals run off into our water system; the largest cause of pollution in our water is run-off from lawns and agricul-

ture and these chemicals have caused dead zones in large bodies of water. They have also been proven to cause birth defects. So if you want short-term gain and long-term tragedy, chemical fertilizers are the way to go.

The right solution, like most solutions, is slower and requires more effort and research. There are many ways to enrich your soil using organic products, which are made from products like fish, kelp, well-rotted manure, and decomposed leaves. These products serve two purposes. They condition the soil, improving its texture, its ability to move water and nutrients and to hold the plants upright. And they add nutrients, which the plants will use to grow and produce fruits. Once you know what your soil needs—and that depends on what you are growing, because different plants need different nutrients, you are ready to start preparing your soil.

THINNING THE PLOT: If you're gardening on a plot that hasn't been used for a long time, you are going to have to spend some time getting it ready. It is probably full of weed roots and seeds and unless you get them out, these weeds will compete with your plants, and probably win. Again, there is a short cut, using chemical weed killers that might be dangerous to humans. But the slow (and safe) method of turning over the soil, shovelful by shovelful, works as well. Until recently, garden experts advocated a deep tilling, going two shovelfuls deep and adding soil amendments as you go along. This process called double digging, which a lot people still think is best, is hard work. Luckily for us lazy people, recent studies have shown that it's just as effective to dig down just one trowel deep; in this way, you don't disturb the complex structure of the soil and the plants' roots know how to navigate the depths. You also avoid bringing us millions of dormant weed seeds. Whichever way you choose, get out all the roots and rocks you can, rake in the nutrients you need and smooth out the bed. Do this as early in the season as you can, so that you can allow the first flush of weeds to come up before you plant. Rake these under while they are still young and shallow-rooted, and that is one set of weeds you won't have to pull.

WHAT TO PLANT: Now that your plot is prepared, it is time to think about planting. You can buy ready-to-plant seedlings and just pop them into the ground and there are definite advantages to this route, especially the fact that it is easier. There's no shame in going the transplant route; it is more

expensive than starting from seed, but transplants remove a lot of the possibility of failure. Seeds are tricky; they need the right conditions to germinate and grow, and they need to be watched and fussed over for several weeks. The garden center has the equipment, staff, and time for that.

On the other hand, that moment when the seeds germinate is pretty exciting. Plus you have a greater selection of varieties to choose from, seeds are cheaper, and since we are looking for independence, the ability to grow food without making major purchases should eventually be part of the program. Some food can be grown from seed pretty easily; if you scatter a handful of lettuce seeds on a prepared bed, you'll have salad pretty soon (as long as the rabbits don't get it first). For other vegetables, like tomatoes and eggplants, seeds need 6 to 8 weeks of consistent care before they're planted out; there are times when you'll decide you

TAKE IT EASY

If you're a novice gardener, you might want to stick to the vegetables that will give you the best chance for a good harvest. Your climate and soil will make some vegetables harder to grow than others, but these will work pretty much anywhere:

Lettuce, arugula, greens: Just sow seeds directly in the soil, Provide a bit of shade and keep them watered on hot days and you'll have harvestable greens in about six weeks.

Summer squash: Plant the seeds directly into small mounds of soil. Space the plants widely—you'll have a huge, viney plant in about six weeks and lots of squash a few weeks after that. Pick frequently; once the squash get big and seedy, the plants will stop producing.

Cherry tomatoes: Big tomatoes are sometimes finicky, but cherry tomatoes are easy to grow—just give them some support, and fertilize and water regularly,

Radishes: These take only about four weeks to harvest.

String beans: Just plant the seeds in loose soil, weed around the plants, and keep picking.

Get your kids into the garden—you'll all have fun and learn lessons that will improve their lives.

can't leave for a long weekend because your tomato seedlings need you. But once you get into the rhythm of it, knowing how to grow your own food from seeds—especially seeds saved from the previous years' crop—is one of the coolest skills you can have.

Fast-growing vegetables, like greens, lettuce, radishes, and squash can be sown directly on prepared ground; just follow package directions. For slower growers, like tomatoes, peppers, melons, eggplants, and onions, unless you live in a region with a very long growing season, you'll want to start your seeds indoors six to eight weeks before the latest date of frost, so that they can hit the ground running as soon it is warm enough to plant them out. You need the right containers and sterile soil, as well as a protected, sunny spot and patience. Seeds grow at their own pace. If you're an A-type personality you'll need a little attitude adjustment, which might be a good thing.

I heartily recommend seed starting for every human being, from small children to retirees. It is good for your bank account, for your body, and for your soul. Trying, failing, and finally learning is an important experience. But, just to be on the safe side, you might want to buy some transplants for the first few years; learning by mistakes is fine, but ensured success is nice too. You do not want to get discouraged or overwhelmed right from the start.

PLANTS IN THE GROUND: Planting is easy; dig a hole, drop in the plant, shore up the soil, water well. Once your plants are in the ground, your main jobs are keeping them watered and fed. Eventually, you'll probably want to look into a drip irrigation system that waters at ground level, where it does the most good. You'll also figure out which organic fertilizers work best for you.

But most of your work will be keeping the weeds and pests away. If you are starting a new garden, you probably woke up a lot of weed seeds when you prepared your plot; they will be competing with your plants for nutrients and water and if you do not get rid of them, you'll have more weeds than food. You can cut down on weeds by mulching; place a layer of compost, bark chips, straw, or chopped leaves around the base over the

Opposite page: Two of the joys of gardening: watching the first seeds germinate and seeing the first fruits ready to harvest

soil, about an inch up the stem of each plant. Some of the weeds will come through, but not as many. You can also lay plastic mulch before you plant. Sheets or rolls can be purchased at garden centers, lay it over the whole row or plot, then cut holes for each seedling as you plant. Besides cutting back on weeds, mulches help keep the soil moist; they keep it cool in the summer and warm in the fall and early spring, which the plants love. If you use organic (i.e., not plastic) mulch, it also adds nutrients to the soil as it decomposes; at the end of the season, just turn it into the soil.

Insect pests might not find you for the first year or two, but eventually, they will discover that there is a new party in town and will show up. It is amazing how these simple creatures know how to find what they need: the cabbage moths will find the cabbage, the squash borers will end up on the squash, the tomato hornworms recognize tomatoes when they see them. I have great admiration for these tiny beings, but I kill them with no mercy. You might ask, "How much can they eat." Well, they can eat a lot and they can destroy the plant from the bottom up. Spraying with poison is out of the question—why would we want poison on our food and in our soil? There are some organic remedies, non-toxic sprays that get rid of pests, but I find that if I spend a few minutes every evening inspecting each plant, I can keep the populations low enough to avoid damage. I go out to the garden with a jar filled with water and just flick the bugs into it. I also make sure that my plants have air circulating between them, and I stake and trellis plants so that they are not dragging on the ground; that keeps fungal and other diseases from spreading. If I find diseased leaves, I remove them and I sometimes remove an entire plant.

THE JOY OF HARVESTING: And then it is time to harvest. I'm sure there are some people who do not get a kick out of harvesting their own food; I'm certainly not one of them. From the first lettuce and radish of spring to the last winter squash of fall, bringing in the harvest—and then eating it—is thrilling. Knowing that I am saving energy and ensuring that I will always be able to eat is part of the satisfaction, but I think that most of it comes from the fact that I am taking care of myself—that I am able to feed myself without depending on a whole chain of producers who make decisions for me. I have connected to the earth, to the sun, to the rain, and used them to create my own sustenance—and that is delicious in so many ways.

Where I live, I can grow very little during the winter months—maybe a few greens and lettuce. But I can preserve part of my harvest when the bumper crops come in. I freeze some of it; I blanch greens and broccoli, squeeze out the water and place them in plastic bags; I pulp zucchini and other squash; I slow-roast tomatoes. I've also invested in a dehydrator that allows me to dry a lot of my vegetables and rehydrate them in soups and stews all winter. My favorite way of preserving the harvest is canning; an old time method of "putting food by" that makes me feel like I'm living in The Little House on the Prairie. For under $50, I bought a canning pot and a box of jars and lids. I make pickles, sauces, and jams, put them in sterilized jars, and boil them in my canning pot. They do not need to be refrigerated and last for a year, so even when there is snow on the ground, I am enjoying the fruits of summer.

GROWING WITHOUT GARDENS

Even in you live in a city apartment or a house without a backyard, you can find a spot to grow food. You can mix some vegetables with flowers in your front yard—Swiss chard and hot peppers are particularly ornamental. Set up a container on a patio, or some window boxes; as long as they have some sun, you can grow anything in containers. Or try the new fad of growing upside down—buy or make a hanging container and let the vegetables grow down to the ground.

And do not forget the acres and acres of "farmland" available on rooftops. Most of these are nice and flat and get plenty of sunshine. Activist groups (and some people who just want to eat) are converting rooftops into small farms. You'll need to do a little research if you want to

try it—containers for plants are heavy and if you don't give them the right support and spacing, your rooftop garden can end up in your living room. But there's no limit to what can be grown in containers; a school group in Brooklyn, NY has students supplying the cafeteria with all kinds of fresh produce—and learning valuable lessons at the same time.

OTHER PEOPLE'S GARDENS

There are some situations in which you just can't grow your own food, and many situations in which you can't grow all your own food. Luckily, there are still responsible farmers who are happy to do it for you. But these farmers are being squeezed out of the market by rising land costs and competition from huge growers who cut corners to make their food impossibly cheap. Until about a decade ago, small farms were going out of business at an alarming rate; it looked like there might come a time when all our food would be grown by corporations. Well, we the people have turned that around. A small group of activists—restaurateurs, nutritionists, teachers, and activists of all kinds—banded together to support responsible farmers. They established and supported farmers markets all over the country; they formed land trusts to make sure that all the arable acreage in the country would not be developed for housing; they exhorted supermarkets, and restaurants to sell local food. In schools, they helped administrators forage for local food to serve and set up "edible" schoolyard gardens where students learned to grow their own food and then eat it.

One way that people helped save local farms was through CSAs, Community Supported Agriculture Programs. Started in Japan over 50 years ago, CSAs came to America in the 1960s and have grown steadily ever since. There are now more than 3,000 CSA groups in the U.S. Each group forms a bond with a local farmer; members buy shares in the farm, paying for a full season of produce in advance. The farmers, knowing that their crops are sold, can concentrate on growing the best that they can. The members receive their share of the harvest once a week, usually brought to a central location where they can pick it up; it is the freshest, safest, tastiest food around and they get it at a reasonable price. Members also have the satisfaction of knowing that they are supporting the local economy and keeping small, sustainable farms in business. Every CSA runs differently, but most include farm trips for city folks, potluck dinners, and member

Farmers' market in Michigan

participation in running the site. It is a win-win situation, which is why it has grown so rapidly—a decade ago, it was hard to fill CSA membership lists, now there are waiting lists. For information on where you can find a CSA near you, see the resource section, p. 190.

Whether you do it through CSA or another way, it's in your best interest to support local farms. Find your local farmers' market; if you live in rural areas, look for farm stands. Ask managers at the supermarkets and restaurants you patronize to stock and serve local foods—if you will buy it, they will stock it. If you have kids in school, or even if you don't, lobby the administrators to buy local for the school cafeteria and volunteer to help set up an edible schoolyard.

THE MEAT OF THE MATTER

You've probably noticed that most of the food we've talked about is produce; vegetables and maybe a little fruit and grain. What about meat and poultry? Most of us can't raise livestock; I might consider a few chickens at some point, but there is no way I'm getting cows or pigs and you probably won't either. There are farmers who raise meat responsibly, in sharp

contrast to the way most of the meat in this country is produced. These sustainable meat farmers raise small numbers of animals; they feed them mostly grass—no pesticide-laden corn diets for their animals—and control their grazing so that the land can rejuvenate itself each season. Their products are available at farmers' markets and some supermarkets.

But there is no getting away from the fact that it takes more energy to raise meat than it does vegetables, grains, and fruit. A plant-based diet is less taxing on the planet—and better for us. I'm not a vegetarian, but I know that the way we eat meat in this country is not good for our health or for the planet. The fruit, vegetables, and grains that I grow myself or buy from local sources can sustain me; I eat some meat for protein and variety (and because I like the taste). But I am cutting back; there's no longer an 8-ounce portion of meat on my plate every day. And as we move toward sustainability, I think we'll find that we all have to change the way we eat, to find ways to nourish ourselves and enjoy our food with fewer animal products. We are going to be happier, healthier, and safer when we succeed.

STEP 11

COOK WITH THE SUN

Solar cookers for all

I get more flak for this step than for all the others combined. To many, it seems like a hippie-dippy, crunchy-granola concept that is totally impossible to fit into their lives. Besides, they say, cooking costs are relatively low—under $150 per year for most people, slightly lower for electric stove users. Setting up a portable solar oven every time we want a cup of coffee is a hard sell at best.

So I have to defend my decision to place the solar cooker as Step Eleven of The Oil Addiction Cure. First of all—I'm not suggesting that we all throw out our stoves and use only solar cookers, just that we try to cook 30% of our meals on them. I also want to point out that, according to a USDA study, over half of Americans say that they cook outdoors year round, not just in the summer—if you are already using an outdoor grill, cooking with the sun is not that great a stretch. I agree that the sizzle of a steak on a white-hot grill can't be duplicated on a solar cooker. But when you've tasted a spicy chicken stew you've baked in your solar oven or a plate of sun-dried tomatoes that you made yourself, you'll understand how much satisfaction and sheer fun your solar cooker can bring you. Cooking with the sun has become one of my favorite pastimes, both on my small porch and as a convenient way to eat when I'm camping or hiking.

URGENT REASONS FOR SOLAR COOKING

But fun is not what I'm after here. There are three solid reasons why I've included solar cooking as one the twelve steps to curing oil addiction. The first is a change in mindset. Knowing that we can cook our food without the use of any fuel at all frees us from one of our ties to the energy grid. Cooking and eating are essential to life. Humankind's development increased by leaps and bounds when we figured out how to do more than gather leaves and berries. Once we knew how to prepare food, to cook and preserve it, we didn't have to spend all day on basic nutrition; we

could begin to build shelters, to form tribes, and after centuries, to move away from the source of the leaves and berries. Today, tied to our gas- or electricity-fueled stoves, we've regressed in a fundamental way. Having a solar cooker and knowing how to use it means that we can once again feed ourselves even without the help of the electric and gas companies.

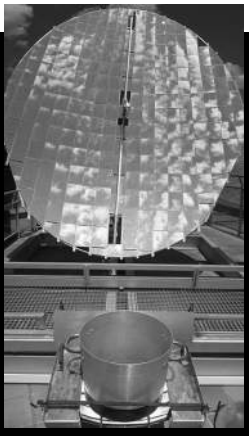
Solar cookers in Africa

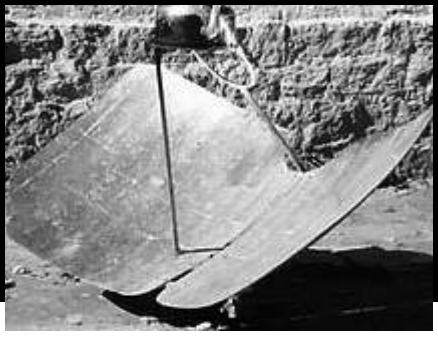
Second, let's not forget that even though the cost of cooking fuel is not huge, it is not negligible either. Cooking with electricity costs about $12.00 per month, and produces about 1500 pounds of CO2 for the average household. If we can save that with a small investment and change in habit, why not?

But it's the third reason that's the kicker; this third reason doesn't apply directly to us, but we can't ignore it. The discussion of solar cookers will extend the reach of this book to the global community, where the rain forests are being depleted as people use wood for cooking fuel. When we talk about the destruction of the rainforest, we often focus on the way the urban world is using the rainforest wood for our luxuries—and we are certainly plundering the forests for our comfort. But we must also take into account that fully 40% of the wood that is taken from the forest each year is used by local populations as cooking fuel. This has been true for centuries; it is part of local culture to cook with firewood from their forests, just as pioneer Americans used virgin forests for cooking, building, and heat. But the destruction of the rainforest is one of the chief causes of global warming. Cooking with the sun, as a cheap alternative to cooking with precious rainforest trees, is a practice that must be adopted by a larger group of people around the world to maintain sustainability. And if we are going to suggest that people in other parts of the world turn to solar cookers, we should at least know what they are and how to use them.

CAPTURING SUNLIGHT: WHAT IS A SOLAR COOKER?

There are many devices available for solar cooking—over 50 designs have been patented. The technology involved is pretty simple, but it does the job—there is much more to solar cooking than cracking an egg on a sidewalk to see if it fries. There are four basic components to solar cookers; some units employ all of these devices, some combine two or three of them. The first task is concentrating sunlight; to do this, the ovens use reflective metals or mirrors, sometimes arranged in a fanlike pattern to





Solar cookers come in many shapes and sizes

gather as much light as possible and divert it to the cooking surface. The next job of the cooker is to convert that light to heat; that is done by using some sort of black pan with good conductive powers—the heat that is absorbed by the pan does the actual cooking. Next, the cooker has to trap the heat so that it doesn't escape during the cooking process; a glass or plastic lid does the trick and installing some insulation material keeps the heat longer. Finally, a plastic shield under the cooker keeps liquids from dripping out or condensing outside the oven.

Cookers have been designed in box, panel, parabola and kettle shapes. Even the simpler box cookers reach a temperature of about 150 degrees; hot enough to cook meat and vegetables over a period of time (box cookers take longer than conventional ovens). The most effective cookers (parabolas and kettles) can heat water to boiling, so they can be used to cook rice and other grains. Kettle cookers often include vacuum tubes, which keep the heat longer—they can even be used on cloudy days if they are fully "charged." Ingenious inventions combining elements of all cooker designs are available. They are not expensive—most cost under $200, some are under $50—and they really work.

SOLAR COOKERS SAVE LIVES

When disaster hits, having a solar cooker can make the difference between discomfort and tragic deaths. Having a device that can cook food and boil water means that the diseases, dehydration, and starvation that cause millions of deaths after earthquakes, floods, and other natural disasters can be averted. Organizations brought solar cookers to Haiti after their devastating earthquake, but it took a few days before they were operational. Solar cookers should be a part of every country's preparedness programs and should be in place now.

You can also make your own solar cooking device; there are plans on the internet that show you how to do it.

THE JOY OF SOLAR COOKING

What can you make in a solar cooker? Pretty much everything, but I'm not into haute cuisine and I usually keep things simple. Most foods cook more quickly when they are cut into small pieces, so I usually go for things like stews and casseroles instead of pot roasts and baked potatoes. I learned that, if I gave it enough time, I could make rice dishes, soups, and even bread and cookies. As with conventional cooking, developing a knack of combining flavors and textures is what makes you able to create delicious foods. If you can do it in an indoor oven, you'll be able to do it in your solar cooker.

Most slow cooker recipes will work for a solar cooker; the low heat of a solar cooker approximates that of a slow cooker. Slow-cooked beans retain their shape and texture—they're a high-protein, easily portable food, great to take along with your slow cooker on hikes and fishing and camping trips.

Your solar oven works best when the sun is strongest (duh). Plan to do most of your cooking in the two hours before and after noon. Set your cooker up in a spot with unobstructed view of the sun, on as flat a surface as you can find. If you can find a place with a brick wall, place it there—the brick absorbs heat and gives your cooker a jumpstart. In fact, you can use bricks inside the oven—leave a brick in the sun for a few hours, then put it into your solar oven for an extra dollop of heat. Or create a bed of bricks for your cooker and allow it to heat up before you set out your cooker so that they will receive heat from below as well as from the sun above.

An important lesson that I learned the hard way: protect your cooker from wind and animals. If your cooking site is subject to either, you have to watch it constantly. Trust me; there is nothing more disappointing than watching your perfectly cooked meal spread over the ground by a gust of wind or galloping away in the teeth of your neighbor's dog. Patience is a part of solar cooking. It takes about twice as long to cook a meal on a solar cooker as it does on an electric or gas range. Other than that, the tips are just common sense. Don't leave your solar oven in the sun without food

in it; it can overheat and self-destruct. Keep it clean with soap and water. Use it often—you'll find new ways to create delicious food, just as you do in your indoor kitchen.

THINKING GLOBALLY

About 2.3 billion people rely on firewood for cooking and heating and 1.6 million die each year from indoor smoke inhalation. In the developed world, the promotion of solar cooking might not seem urgent. We have no trouble finding enough fuel for our stoves and it costs us less than 50 cents a day. And here's where I want to make a jump, to focus our attention on the billions of people who don't live the way we do. Even in the 21st century, there are more than one billion people who live on one dollar a day, people who are one step from starvation for most of their lives. We share this Earth with all of its inhabitants; we have to consider their needs not only out of compassion but because they affect us.

Many of these dollar-a-day people live in areas near rainforests in Asia, Africa, and South America. As they struggle to subsist, they use whatever means and materials they have at hand—and for many, that means collecting wood from the rainforest for cooking and heating. We in the developed world have been pillaging the rainforest for exotic woods; we've been clearing jungles for grazing land for the beef we eat so much of. And that accounts for a large portion of the deforestation that is causing global warming. But the use of rainforest trees by local populations for cooking and heating takes away another significant percentage of the

Gathering cooking fuel in Tanzania.

rainforest—some say up to 40%. This is not new—people have been using this wood for centuries, but when combined with rising populations and logging operations by the developed world, it's now a crisis. When we consider energy use and availability worldwide, cooking with the sun becomes an important consideration.

Let's look at the situation in a country like Tanzania in Africa, where most meals are cooked with firewood. Usually, women have the job of collecting firewood for the family, often walking many kilometers to find wood. In the large cities, people use charcoal that can be purchased for about $4.00 per sack. An industry has formed around charcoal cooking fuel. People earn a living gathering wood, burning it to make the charcoal, and then setting the sacks along the roadside where semi trucks pick them up for distribution in cities like Dar es Salaam, which has a population of 4 million people.

According to the World Resources Institute 95% of the total energy used in Tanzania is derived from biomass, including wood and dung. And of all the energy used in the country, 79% of it is residential and domestic. In other words—people in Tanzania are not manufacturing goods for export, they're not driving around in gas-guzzling autos, and they're not planning and building a thriving economy. Instead, they are chopping wood from the rainforest and using it to cook and heat their homes; they are using it to survive. And we have to be aware that there are populations all over the world who live this way. I learned this first-hand in the summer of 1969 when I lived in the Venezuelan rain forest for three months, surviving on a diet of black beans and rice cooked over an open fire, drinking water off the floor of the jungle. I saw the results of this way of life when I visited Tanzania in 2005. I was taken to a forest, or the remains of a forest that had been decimated for personal use or for charcoal for cities. We are

The author, cooking over a fire in the Venezuelan rainforest, 1969.

feeling the effects of the poverty of Tanzania and other countries like it all over the world as we try to overcome the devastation that climate change threatens.

There is one more major benefit that a solar cooker can provide. About one quarter of the world's population does not have access to clean water; drinking unsanitary water is a leading cause of disease and death in areas where people drink untreated water. These people can't afford to boil their water using cooking fuel that they have to pay for—but once they have a solar cooker, boiling or pasteurizing water becomes feasible. And longer healthily lives become possible.

FIXING THE PROBLEM

Bringing solar cookers to the developing world will free the people who live near rainforests from one of their hardest tasks. Gathering enough firewood to cook for a family can sometimes take half a day of hard labor. Buying fuel, usually in the form of charcoal, costs about 40 cents a day—not a problem if you are earning a Western salary, but close to half your funds if you are living on a dollar a day. Access to a solar cooker would make lives in these areas easier. That is why several non-profit organizations are dedicated to spreading solar cooking to the developing world. Solar Cooking International, based in Kenya with offices in Sacramento, states its goals:

1. Influence local, national, and international agencies and related networks in support of solar cooking, water pasteurization, and testing.
2. Develop international programs, in partnership with international agencies, government ministries, educational institutions, non-governmental organizations, and/or community-based organizations, for the purpose of promoting solar cooking, water pasteurization and testing.
3. Facilitate broader access to solar cooking, water pasteurization and testing knowledge and enhance SCI expertise. (Secondary goals: Increase information-exchange and synergy among solar cooking promoters and experts worldwide; Market educational materials including solar cookers, ovens, instructional guides, books, DVDs and other products that focus on solar cooking, water pasteurization and testing.)

INDOOR EFFICIENCY

Until you get your solar cooker (notice that I'm assuming that I've convinced you to buy one), here are some ways to save energy on money when you cook:

- **Fill your oven. A conventional oven cooks just as well when it is full. Plan your meals so that you can put several dishes into the oven at the same time. Space them so that they are not blocking the heat, and don't use more than 2 shelves in the oven at the same time.**
- **Bake once, eat twice. There are many dishes that freeze beautifully. Prepare enough for two meals and bake them at the same time, then freeze. Thaw the frozen dish in the refrigerator before you reheat.**
- **Think raw: Raw foods have more vitamins, are easy to prepare, and are delicious. Instead of cooking all your foods, choose vegetables that you can chop and serve raw with tasty dressings.**

4. Partner with other relief agencies to assist refugees and disaster relief with solar cooking, water pasteurization and testing, training, and follow-up services.

Solar Household Energy (SHE) another non-profit has taken on the mission of "harnessing free enterprise to introduce solar cooking where it can improve quality of life and relieve stress on the environment. Working with private entities, governments, and NGOs, SHE designs and oversees training and distribution projects in Mexico, Central America and Africa."

These organizations, and others like them, understand that this simple device can make a difference in the energy crisis, in global warming, and in the lives of billions of people who are struggling to survive around the world. I hope I've convinced you to consider supporting the solar cooking movement; every time we buy and use a solar oven we join the critical push toward worldwide sustainability. We connect ourselves to the effort to live simple, pure lives, to reduce our carbon footprint, and to produce products that all our fellow humans, all over the world, can enjoy. We cease our thoughtless consumerism and replace it with a slower, more considerate way of living. And don't forget—we can make fresh-baked chocolate chip cookies on camping trips.

SOME SOLAR COOKING BASICS

RICE: Mix two cups of water with one cup of rice. Add spices and other seasonings, and then bake. It will take about 30 minutes.

BREAD: Any bread recipe will work in the solar cooker; it just takes longer to bake. Here's one bread recipe: Dissolve 1 packet of yeast (2 1/2 teaspoons) and 1 tablespoon of honey or sugar in 1 1/2 cups of warm water; set aside for 5 minutes. Add 1 teaspoon salt and 3 1/2 cups flour. Knead briefly, then form into a ball. Let it sit for an hour, then punch down and knead briefly again. Form into a ball or rolls and place on a baking sheet. Let it sit for 20 minutes, then poke holes in the dough and place in the solar cooker; it will be done in about 40 minutes.

BEANS: Soak beans in water overnight, then drain, cover with water again and place pot in solar cooker until the beans are soft.

CHICKEN OR MEAT: Cut into small pieces (you can also cook in large pieces, but it will take longer). Marinate for a few hours, then place in pot; add seasonings and vegetables after the meat or chicken has cooked for a half hour, then allow to cook for another half hour. Check for doneness frequently after an hour.

VEGETABLES: Cut into chunks and place in pot, you don't need water, or use just a little. Let the vegetables cook for 20 minutes, then add spices and seasonings and cook for another 20 minutes. When cooking potatoes, add water to cover, add salt and a splash of lemon to the water to prevent discoloration.

A WORD OF CAUTION

As much as I promote the use of solar cookers, I have to pass on some warnings from the USDA. According their site, some microbiologists "question the adequacy of cooking temperatures inside the solar cooker. . . They question how long the foods will be in "the Danger Zone" (temperatures between 40 and 140°F). They are concerned about how long it takes for the food to start cooking, and how hot the cooking temperature ever becomes."

So use caution when cooking in your solar cooker. Use a food thermometer and measure temperatures during cooking--and don't leave food in your cooker for long periods of time.

STEP 12

VOTE

Decisions are made by those who show up

Our actions as individuals are critical to the transition to sustainability, but so are the actions of our government. Individuals can't build power plants, fund research, or support the development of renewable energy. But there is something we can do to make sure that our elected officials want the same things we do and keep their eye on the target. We can vote; we have the right to participate in the decision of who is running our government. So the final step in The Oil Addiction Cure is to join the political process.

Fewer than 60% of eligible voters turn out in most presidential elections, and the numbers for state and local elections are even lower. Allowing for the fact that some people have the flu and can't get out of bed and some people are under such tight deadlines that taking a half hour off would destroy their careers—I still can't fathom that almost half of us just don't bother. I think most non-voters would say that one vote doesn't make a difference or that we can't really buck the political machine. But a look at two recent presidential elections shows us that those excuses are not valid. In 2000 the presidential election hinged on a few hundred votes, and in 2008 a small group of people with big ideas were able to rise to the top, just on determination and confidence; the victory of Barack Obama is a testament to the ability of a small group of people who show up and work hard to win even the highest office in the land.

GOVERNMENT AND ENERGY

Our government's record in the area of energy is dismal. We can't blame Republicans or Democrats—both parties fell down on the job. It is not so much that they had a bad energy policy as that they didn't have one at all. Major energy projects were chosen not by analyzing needs and opportunities but by listening to lobbyists who were promoting contractors who

could profit handsomely. Our record on controlling offshore drilling is another example of how we are allowing the search for rapidly vanishing fossil fuels to blind us to impending catastrophes. And the fact that we are now buying over 60% of our oil from foreign markets—it was only 24% in 1970—should have clued in our leaders that something needed to be done about energy dependence a long time ago.

Resolving our twin energy and economic problems is going to require the mobilization of our human and industrial resources on a scale that we have not seen since World War II. Mike Huckabee, a Republican candidate for President in 2008, has said that we don't have 30 years, or 20 years, to solve our energy problem—we only have ten years to get the job done. Al Gore, a Democrat, has challenged the country to become energy independent using clean energy in ten years.

After the Gulf oil spill disaster, President Obama vowed to make amends. He spoke eloquently on the subject: "Our country cannot afford politics as usual—not at a moment when the challenge we face is so great and the consequences of inaction are so dangerous. We must act quickly and we must act boldly to transform our entire economy—from our cars and our fuels to our factories and our buildings. Achieving this goal will not be easy. Energy independence will require far more than the same Washington gimmicks."

Obama outlined a plan that combined conservation with research and funding for major energy projects. He vowed to put 1 million plug-in hybrid cars on the road by 2015—I think standard marketing will put many more electric cars on the road by then. He plans to invest 150 billion dollars to create 5 million new jobs in industries that will promote clean, renewable energy. He intends to ensure that 10% of our energy comes from renewable sources by 2012 and 25% by 2025.

All of these are good ideas. Two issues prevent me from becoming overly enthusiastic. First, having a plan is not the same as implementing it. There has been a wind energy plan in place for over 25 years; in 2008, the Department of Energy called for 20% of new electricity to be generated by wind. But not all of the interim steps have been taken. Second, I think they fall short of what is needed to pull our country out of the economic slump we're in.

THE MIKE VALLEZ ENERGY PLAN: JUST THE FACTS, YOU DECIDE

After talking with hundreds of people about energy across kitchen tables and boardroom tables, I am convinced that public education about energy is absolutely necessary. The Oil Addiction Cure: Twelve Steps to Sustainable Living was written in a way to empower you with unbiased information that will help you make informed personal decisions that are within your control. When it comes to the energy issue, most people expend their mental energy on things that are largely beyond their control and look past things that are within arms' reach. The problem is that most people do not know what to do other than "follow the crowd." On a national level, the energy debate has been hijacked by special interests that spend hundreds of millions of dollars on misleading ad campaigns and political elections. On a local level, there is an army of "snake oil" salesmen who talk smart about energy. But they often skew the facts about this or that window, fireplace, light bulb, or magic heating device. So the Mike Vallez energy plan is to educate you with the facts and let you decide.

RESEARCH

Before the internet, getting information about elected officials took some time; now it is a snap. All federal and local officials have government websites that list their accomplishments. Most governments also post lists of legislation in progress. Make it a habit to follow what is on the agenda. If you want an unvarnished report of what your leader has done—ask his opponent. You'll get a biased account —give your rep a chance to provide his side of the story as well—but you'll find out all the negatives.

EVALUATING THE CANDIDATES

When I vote, I know the candidate's record and platform on each of the issues. Most candidates are eager to make their opinions known; they appear in public forums and are interviewed in the media and in online chats. Local candidates are usually approachable; they'll make appointments to talk to you, especially if you are part of a group.

ALL POLITICS ARE LOCAL

Some people think that national elections are the most important. In

some local elections, the average number of voters is less than half of that for a presidential election. In fact, our local governments have a huge impact on our lives and on the way we use energy.

Do you know who your representatives to your state legislature and the House of Representatives are? We all know who the President is, and most of us know our Senators—but we forget the members of National and State Congresses who are the ones who vote on laws. These politicians lead smaller constituencies, so they are more likely to listen to you when you call. And many of our most important decisions are made on an even more personal level. Energy utilities are usually governed by local governments; modernizing the way we produce energy is done by people at the local or even community level. So getting to know the representatives who run your town, village, or community is always valuable. Fortunately, it is usually easy to do so. You can't call President Obama to set up an appointment to talk about energy bills. But your state senator or the head of your town council will probably be more than happy to talk to you. Make sure you know your facts and your priorities—but listen to what he or she has to say. He can help you with your agenda, but he will be more likely to do so if you can help him with his.

And don't forget the impact of non-government institutions. Your school board has enormous influence over the next generation, as well as the way their buildings are heated and their students are fed. Your vote in a school board election is probably as important as your vote for president. And when you attend school board meetings, your vote is one of several thousand rather than one of tens of millions. Utility companies are often run by boards, and these boards often enlist community sup-

A town hall meeting in Connecticut

MEETING WITH A POLITICIAN

Most politicians like to meet with constituents. Sure, they're busy, but they know that they need your vote. Here are some things to remember when setting up a meeting with government officials:

- **Get a group together. If you tell the scheduler that you are representing a group, you are more likely to get an appointment. Not only will you be bringing more votes, you will also be making the point that you are not a lone crackpot (which I'm sure you are not).**
- **Make your agenda clear. If you want to talk about a particular issue, let the scheduler know what it is. Even better, tell him about a piece of legislation that you want to discuss.**
- **Be armed. Gather research before you go. Know why the issue is important and what is already being done. Facts, figures, and photos always are impressive.**
- **Be polite. This is not a time to berate or yell. You want to make your opinion clear, but you don't need to raise your voice.**
- **Be brief. Representatives are busy. Know what the time limit is and stick to it.**
- **Listen. Meetings are not one-sided. If you want him to listen to you, you have to listen to him, even if you don't agree with him.**
- **Follow up. Take notes; when the meeting is over, write a letter, giving thanks for the meeting and stating what you think it accomplished.**

port through advisory groups. Not only can you vote for the boards in some towns, you can also join the citizen advisory boards and make your opinions known about how energy can be saved in day-to-day operations and how you can help your town or city join the global green community.

VOTE WITH YOUR POCKETBOOK

There are two ways that spending can make a difference. First, you can support the politician of your choice with donations and by helping raise funds for your candidate of choice. It costs an outlandish amount of money to be elected for any office; unless the candidate is rich to begin with, he or she must spend most of his time gathering the funds to run a competitive campaign. Candidates are not allowed to accept huge donations from individuals or corporations, so every donation counts. Making

a donation to a candidate or hosting a fundraiser will make your name known to the candidate—when you have something to say, it will be easier to be heard.

Second, your decisions about what you buy add up. Candidates follow trends. When people are buying local food, purchasing energy-saving water heaters, and converting to electric cars, our leaders get the message that the population knows there is an energy crisis and wants to do something about it. Moreover, these "pocketbook votes" are heard by industry, and industry leaders are even more eager to follow buying trends.

RUN, RUN, RUN

Even if you don't have the fire in your belly to become President, there are many elected positions where you can make a difference. Town councils are not necessarily life-consuming tasks, PTAs, citizen advisory boards, and other small ponds can make you a big fish. Find out what the requirements are early—you usually need to get a petition together to get on the ballot. Join the organization and see if you are a good fit before you run; try to get allies in the organization who will help you. You won't necessarily win the first time you run, but starting out in a small venue might bring you to a larger one—and even if it does not you will be able to do good on local issues, where are just as important as national ones.

IN CONCLUSION

Vote—not only in national elections, but also in the very smallest ones. Vote intelligently—know the candidate you are voting for. And don't stop your involvement in the political process when the results come in on Election Day. To fully cure our oil addictions, we must be actively involved in the governments that will take the steps that we can't complete as individuals.

PART III

Part III offers an overview of how we can all alter our mindset to make our energy more efficient. Part III also includes a brief look at future volumes coming from The Energy Education Institute.

CHAPTER ONE

THINKING SMARTER

Now that you've read the 12 steps of The Oil Addiction Cure, I think a pattern will be apparent to you. The steps have something in common. All of them require you to think.

We got into an energy mess because we did things without thinking them through. We believed that our politicians and corporate leaders were going to do the right things. We went with the flow—it was not our job to wonder if the flow was going in the right direction. We have many other things to think about—we left decisions about energy to others and just did what was easiest. We have to be smarter than that; we don't have to turn into anal-retentive paranoids, but we do have to spend a little time investigating before we buy or use resources. The easiest way is not always the best.

I'm going to suggest a couple of ways to refine the way you think about your day-to-day activities. I'm not into mottos or catchphrases, but these do cover a lot of good points.

BUY LESS STUFF

I saw a t-shirt the other day that said, "whoever dies with the most stuff wins." Not everything you see on t-shirts is true, and this certainly isn't. From the minute we wake up we're bombarded by ads that try to convince us to buy more clothes, more toys, more food, and more computers. We have to remember that those ads are made by people who want to make money; they have nothing to do with what you really need. Can you get along without a piece of plastic that cuts vegetables into fancy shapes or a device that can store 8,000 downloadable songs (especially if you already have a device that stores 4,000)? The energy used to create and then dis-

pose of all that stuff is enormous. And buying and using it takes a great deal of human energy. As Annie Stevens tells us in "The Story of Stuff" video, we've been convinced that having a lot of stuff makes us happy, to the point where our main recreational activity is going to the mall. For the sake of energy conservation and personal satisfaction, I urge you all to find ways to enjoy yourself that do not come wrapped in plastic.

REDUCE, REUSE, RECYCLE

Some people would argue that our economy runs on consumers buying more and more stuff. If it does, that's not a good thing. Let's change it. Let's make better stuff, buy less of it, and use it until it's worn out. If we're not buying so much stuff, we don't have to work as much—we can spend more time talking to each other, finding beautiful things to look at, smart things to read, good things to eat. We won't need as many laborsaving devices because we'll have more time. So we'll be able to use the limited stuff we have properly, and when we're finished with it we can recycle it so that it can be used again.

READ AND RESEARCH

Our minds are renewable resources; they can stretch to take in a boundless amount of information. And today, there's so much—maybe too much—information out there that it's hard to decide where to spend our time. It's easy to just accept the first things that hit us, which are usually thrust upon us by people who want to sell us something.

We can't abdicate our responsibility to seek out the solutions that are best for us and those around us. It is our right and our duty to seek out information from reliable sources and evaluate it critically. That's the only way we're going to avoid problems like the energy crisis. Every one of us needs to know enough about what's going on around us to make the right choices.

You're on the right road. You're reading a book about the energy crisis, making choices that will help you in both the short and long run. Keep reading the next few chapters; there's more about what's going on in the whole wide world and what you can do to help yourself by joining with your friends and neighbors to tackle the hard job of gathering the best information.

CHAPTER TWO

THE ENERGY EDUCATION INSTITUTE AND ITS PROGRAMS

Now that I've spent a whole book telling you what I think you should do about the energy crisis, I'm going to tell you my plans for becoming part of the solution. I'd love to hear feedback; log onto my website (www.theoiladdictioncure.com) and tell me what you think.

In 2005, after my energy retrofit of my Sewell House, I formed The Energy Education Institute on the premise that The Oil Addiction Cure is education, backed by focused and intelligent action by individuals at all levels. I created a film—which will eventually be a series of films— to be associated with a web portal where people in all roles and walks of life can access the information, products, resources, and support to accomplish their goals to create a more sustainable life for themselves and their neighbors on the planet. Beginning with the U.S., this web portal-education film-outreach program can be duplicated around the world through various partnerships and affiliations.

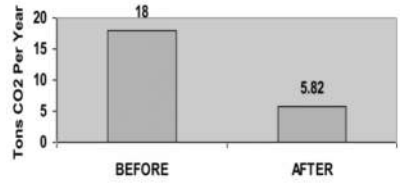
My next project—and you have the results of it in your hands—was to create a series of four books, based on ten years and millions of dollars worth of research. Using an engineer's knowledge and viewpoint, these books, in conjunction with the films, will present a comprehensive look at energy in the world today and how it can transition from a crisis to a green, sustainable future. Each book is part of the whole, and the entire picture cannot be told without all four. Let me explain the logic in the sequence of the four parts:

The first book, this one, starts with the issues of the individual in the U.S. This individual is the most energy consuming person on the planet. With just five percent of the world population, the U.S. consumes 25% of the energy produced. The involvement of the U.S. consumer in a global energy solution will greatly enhance the success of the effort. And because the U.S. consumer votes in the U.S. elections, he/she also plays a critical role.

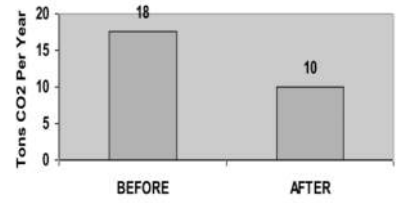
The second book is The Oil Addiction Cure II: The Road to Recovery. This book addresses the sustainable energy solutions for the U.S. as a whole. This might be expanded to include other regions and specific areas such as transportation and gardening. With a forecast rise in electricity demand as sustainable electricity is substituted for the non-renewable hydrocarbon fuels, individuals in all capacities will need and want to know if we have the renewable resources available to power a sustainable and electric industrial civilization. Without that knowledge and confidence, individuals and corporations will be reluctant to commit to electrification of their personal and corporate systems. Part Two then delves into the renewable energy resources in the U.S. including Wind, Solar, Geothermal and Biomass energy, and clearly documents the abundance of these resources, and how they can be linked together in a distributed energy system. The concept and evolution of thought related to the national high voltage electrical grid is explored.

12 STEP PROGRAM CUTS CO2 FOOTPRINT SIGNIFICANTLY

CO2 Reductions-12 Step with Green Power Option

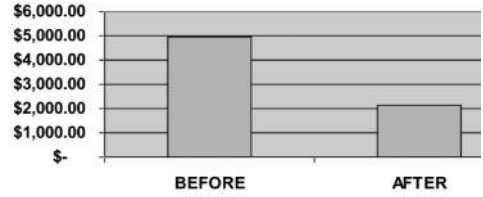


CO2 Reductions-12 Step Program



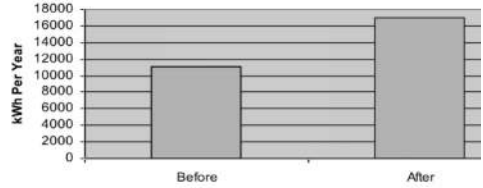
12 STEP PROGRAM CUTS ANNUAL ENERGY COST SIGNIFICANTLY

Energy Cost Savings-12 Step Program



SUBSTITUTION ADDS DEMAND FOR ELECTRICITY

12 Step Program Electricity Per Household



Book Three addresses the path of electrification of critical industries including farming, transportation, mining, manufacturing, thermal processes, and building operations. There are systems already developed with current technology, and technologies ripe for commer-

cialization which will bring about a transformation of the way energy is used by industry and commerce.

Book Four fully develops the global vision for sustainability. The resources of steel, copper, and other commodities required to build sustainability are often found in developing countries and there is an electrical power crisis facing these regions of the world. In Africa, South America, Asia, and even the United States power companies are unable to commit power supplies to industrial users wanting to expand. An analogy is drawn between the situation at the beginning of the great depression when only 10% of the rural countryside was served by electricity and now, when in the developing world there are still two billion people without access to electricity. Many of these people are located in areas where much of the remaining mineral resources are located. These resources, tons of steel and copper, are needed to build the sustainable power infrastructure that will electrify the developed and developing world. For example, in 75% of the cases, the copper minerals are located within proximity to a developable solar power resource. The global effort to bring sustainable electricity to the remaining 2 billion people on the planet has become associated with what has become known as the Global Green New Deal, with the analogy to the Great Depression of the 1930's. Related to that is the Global Energy Network concept created by the late visionary Buckminster Fuller, as well as the present day organization called The Global Energy Network Institute (GENI) whose purpose is to promote the idea of the global energy network.

By the conclusion of this series, the reader should be more fully aware of the micro world and macro world in which they live, and how it is all interconnected. Unless we all do well, none of us will do well. The publication of these books is not the end of my project, it's just the beginning. I intend to set up speaking engagements throughout the country, to talk to as many people as I can about the need and ease with which we must and can change the way we use technology. I'm not the only person who is intent on making these important changes. I am just a small part of the army of people who will make sure that the world of the future is more sustainable, more healthy, and more comfortable for all of us. I urge you to join me. In the next chapter, I'll explain how you can form an Oil-Anon group to do so.

CHAPTER THREE

OIL-ANON

In the early 1990s, during a personal crisis, I sought the help of a therapist. He suggested that I become involved in a community activity, helping people who were worse off than I was. I decided to volunteer at the overnight "bed and broth" for the homeless program that my church organized with other churches in Richmond, Virginia. I talked with to homeless people and got to know some. I heard their stories. I learned more about the problem, that over several decades, all of the residential hotels across the country had been razed for urban progress, eliminating low income housing.

So, one day, I drove down to the homeless shelter in Richmond, and walked in the door and asked for the director. I introduced myself, as a construction engineer, and said that I wanted to do something about the homeless problem. He connected me to Sue Capers, the founder of the Virginia Coalition for the Homeless: Sue and I had breakfast on a Saturday morning and she told me about what had become her personal mission in life. We talked and made a connection. She invited me to sit on the forming board of directors for SRO (Single Room Occupancy) Housing of Richmond, which was being formed to develop an "SRO", modeled after some other projects around the country. I also met Karl Bren, the Chairman of the Board of SRO Housing, and we started meeting weekly to work toward the dream of helping get safe, affordable and clean housing for people who had none. Karl is a great guy, and one of my mentors in the area of organizing. He introduced me to Margaret Mead's great declaration:

"Never doubt that a small group of thoughtful, concerned citizens can change the world. Indeed, it is the only thing that ever has."

Karl shared a book with me called *The Evolving Self* by Mihaly Csikszentmihaly, author of the bestseller, *Flow, the Psychology of Optimal Experience*. Later, I learned of the work of Victor Frankl, the holocaust survivor and founder of logotherapy and author of *Man's Search for Meaning*. I realized that the therapist who suggested that I work on a community project was actually using logotherapy on me, without calling it by name.

I can personally testify that Frankl, Csikszentmihaly and Mead were correct. By focusing your efforts on making a contribution or a difference, your own problems not only shrink, but are replaced with joy. And when you join with others in a group, the effects of your work multiplies.

I do believe that this transition to a sustainable civilization is going to be a huge challenge, and painful for many people. We are into it now, and people are suffering from a "double dip" recession (when did the first dip end?).

It is with this in mind that I recommend to all my readers that they form Oil Anon groups. By joining with your friends, neighbors and relatives—or with people you've never met but who agree that it's time to stop oil addiction—you can support each other emotionally and practically. In some cases, you'll benefit from your group members' research and knowledge; sometimes, you'll enjoy camaraderie and a friendly face that understands what you're doing; and there are also cash incentives in the form of bulk discounts and wholesale pricing. As part of a small group of concerned citizens, you'll be in a better position to change the world.

One bit if advice I'd give is to get your community leadership involved. Talk to the people in charge of your school, community group, faith-based organization, or even local hospital.

There are no rules for Oil Anon groups. You can have as many or as few members as you want. Your programs can be geared toward saving money or toward saving the world. If you'd like to register your group with the Energy Education Institute, write to me—I'll give you whatever help I can. I'm listing some activities below, but your group will doubtless form their own agenda.

If you choose to follow the 12-Step program with your Oil-Anon group, here are some suggestions:

STEP 1: ACCEPT REALITY:

The first step of the oil addiction cure requires that you educate yourself on the energy situation. And that's not easy. There is a ton of information out there, on the web, in newspapers and books, through university courses. Sifting through it all is impossible for an individual. Being part of an Oil-Anon groups makes Accepting Reality much more feasible. If each Oil-Anon meeting starts with reports from several members on a single, narrow topic, your collective knowledge expands without each of you having to spend your lives in research. The group leader, or the group,

can choose a topic and assign three members to study it. Reports should be executive summaries, not long lectures. If your group consists of 12 people, each one will have an assignment once every four meetings.

Another way to cover Step 1 in Oil Anon meetings is to form book groups, either during meetings or at another time. The whole group could read a selected book and discuss it, or several books on a single topic could be chosen, so that different members could report on each one.

STEP 2: CARPOOL

Carpooling is an easy fit for an Oil-Anon group. Encouraging carpooling through school, faith-based, and community groups lends itself to group activity. Carpooling can be a one- or two-month project; use the overviews in this book to contact corporations, both the ones where members work and others, get other groups involved, and find out if local cab companies will support carpoolers as described in the chapter.

Here's another idea: a carpool can become a mini Oil-Anon group, with a few minutes of each commute devoted to one of the steps. Even I don't think you want to spend your whole commute discussing the cure to oil addiction, but a like-minded group cooped up in a car for 45 minutes each day can take a small portion of that time to work on Oil-Anon goals—and then join with a few other carpool groups for full meetings.

STEP 3: HOME ENERGY AUDIT

Finding the right auditor can take a lot of research; share that research with your Oil-Anon group. An auditor may be happy to give a discount to a group that schedules auditors for several homes at the same time, especially if the auditor has to travel to a remote area.

STEP 4: LED LIGHTING

Before LED products become available to individuals, they are marketed to businesses and wholesalers. An Oil Anon group can make a bulk purchase direct from manufacturers and wholesale distributors. A web search will help you find one. Or, if that kind of group activity doesn't appeal to you, you and your fellow Oil-Anoners can report on where new lighting products are available in your area and let the others know the effectiveness of the ones you've tried.

STEP 5: HEAT PUMPS

Cool-climate heat pumps are poised to become a game-changing technology in home heating and cooling. One member of your Oil Anon group (or a few of you) can become thoroughly educated about this new technology and report to the rest.

Once the products are available, you can lobby with local heating and cooling contractors to train themselves in installation and maintenance. One person trying to get service in a neighborhood may be ignored, but if twelve or fifteen people indicate that they're interested, local businesses will respond.

STEP 6: ELECTRIC CAR

Here's another area where there's a vast amount of information to be studied. Perhaps each member of the group could choose a model, gather information about it, test drive, and report. You probably won't all be ready to purchase a new car at the same time, so whoever is first on the block to become an electric car owner can help the others benefit from his experience.

STEP 7: HOT WATER

Communal outdoor showers might work for some communities, but even I don't have the nerve to suggest that all Oil-Anon groups promote them. But there are many devices that save hot water on the market; research and report can become a group activity that's a little easier to recommend than showering together.

STEP 8: AIR DRY YOUR CLOTHES

If your community has anti-clothesline laws, eliminating them is a good cause to take up. Project laundry list (you'll find them on the web) can help show you how to take political action. You can also look into buying clotheslines in bulk and, if backyards in your area are too small for drying, finding a place in the community where lines can be erected.

STEP 9: ENERGY-STAR

Does your town or city has a cash for clunkers program in effect for refrigerators or other appliances? If not, get to work; search "cash for clunkers"

on the web and find the nearest government agency that will administer a program. You can get hard, cold cash for your own appliances when you upgrade to a more energy-efficient model—and the cash incentive will inspire your neighbors to do the same.

STEP 10: GROW FOOD

Growing your own food is easier if you're part of a group, especially if you're doing it for the first time. Some of the benefits are simple—joining with others to buy seeds (a packet of tomato seeds has enough seeds for six people), sharing tools, or getting help with backbreaking work like double-digging. Other benefits are less cut-and-dried, but no less important—getting advice about your area's soil and climate, hearing about the plants that grow best, and schmoozing about successes and failures.

If you live in an urban area, your oil-anon group might want to investigate finding a space for a community garden where each member has a small plot. And if you can't set up your own garden, think about starting a Community Supported Agriculture (CSA) group, so that you can share the harvest of a local farm (see page 190 for more information).

STEP 11: SOLAR COOKER

There are several organizations promoting the use of solar cookers; these organizations supply solar cookers to communities in developing countries and after disasters. See page 190 for contact information; your oil-anon group might want to volunteer with one of these organizations.

STEP 12: VOTE

Although every one of us has only one vote, joining with fellow Oil-Anon members can give your vote more power. Your Oil-anon group can meet with legislators on specific issues, support like-minding candidates, or even choose a member to run for office.

These are just a few of the activities in which Oil-Anon groups can partake. I'd love to hear how your own group is working to make your community and the world more sustainable. Write to me at www.theoiladdictioncure.com/

RESOURCES

For information about sustainable agriculture, local food, and CSA programs: www.localharvest.org/
For information about the Energy Star Program: www.energystar.gov
For information about Solar Cooking: www.solarcooking.org/
For project laundry list: www.laundrylist.org/
For information about insulation: www.energysavers.gov/your_home/insulation_airsealing/index.cfm/mytopic=11340
For general information about sustainability: www.energycircle.com/ or www.energy.gov/forconsumers.htm
For information about financing for sustainable energy improvements: www.pacenow.org
For the Oil Addiction Cure project: www.theoiladdictioncure.com

INFLUENTIAL BOOKS

Fostering Sustainable Behavior by Doug Mckenzie Mohr and William Smith, New Society Publishers, 1999
The Party's Over by Richard Heinberg, New Society Publishers, 2003
Power Down by Richard Heinberg, New Society Publishers, 2004,
Outgrowing the Earth by Lester Brown, WW Norton and Company, 2004
The Oil Factor by Stephen Leeb, Warner Books, 2004
The Final Energy Crisis, Andrew Mckillop and Sheila Newman, Pluto Press, 2005
Twilight in the Desert by Matthew Simmons, John Wiley & Sons, 2005
Gardening When it Counts by Steve Solomon, New Society Publishers, 2005
Peak Everything by Richard Heinberg, New Society Publishers, 2007
Apollo's Fire by Jay Inslee and Bracken Hendricks, Island Press, 2008
Freedom From Oil by David Sanlalow, McGraw Hill, 2008
Plan B 4.0 (Series) by Lester Brown, WW Norton and Company, 2009

Note on energy savings: If you take all the steps recommended in this book and you start with the national average in energy costs, you'll save almost 70% on your energy bill. Of course, no one is average, and your savings will differ depending on your climate and lifestyle. But whether you take just one step or put them all into practice--it's important to start somewhere!

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