FOOTPRINT

A FUNNY THING HAPPENED ON THE WAY TO EXTINCTION

by John H. Patterson

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John H. Patterson

with Suzanne Olsen

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INTRODUCTION

Driving down the street I see buds on the trees
Wait, it's only February, so how can this be?
Growing up, it was April when the blooms came out
Is this global warming they keep warning about?

Back in the 1950's when actor Ronald Reagan did all those commercials for GE with their great slogan, "Progress is our most important product," no one had any idea that progress would have a downside. In fact, progress has always been assumed to be good. Progress was embraced wholeheartedly in this country. Today we enjoy all the technological benefits that have made the work of life easier.

We've come a long way toward being like the "Jetsons," the television cartoon family of the future who had escalators moving them through their house and robots waiting on them hand and foot. We flip a switch and a light comes on. Most Americans don't consider where the energy they casually use comes from, so long as it's cheap and always there. It escapes the general consciousness of most people that for the light to be illuminating, coal or other fossil fuels are burning. With every kilowatt-hour of energy we use, carbon dioxide rises to the atmosphere in direct proportion. Unwittingly we've been on an energy consuming, carbon producing

binge for decades and have only very recently begun to think about the ramifications.

Carbon dioxide itself isn't a bad thing. It enables life on earth by trapping heat from the sun. It acts like a warm, insulating blanket to keep our temperatures in a range that sustains life. CO2 is earth's dominant greenhouse gas. Because it is invisible, it has the amazing ability to allow light from the sun to pass through it and at the same time hold heat radiating out from the earth. In plumbing jargon, CO2 acts like a check valve allowing the energy of the sun to flow one way. In electrical vernacular, CO2 works like a diode which allows current to flow in one direction only. There is a direct correlation between the amount of CO2 in the atmosphere and the temperature of the earth.

A recent study showed that CO2 levels have averaged around 280 parts per million for thousands of years. (The Earth Institute, Columbia University) At the end of 2009 CO2 levels had reached 387 parts per million. This book looks at what has caused the increase, why scientists say we should be concerned, and what we can do as individuals and as a society to bring CO2 levels back into an acceptable range.

Inadvertently we humans have gotten ourselves into a fix.

Our everyday activities produce carbon dioxide from fossil fuel energy use, and the more prosperous our lives become the more CO2 we produce. Sustaining the lifestyle of an average middle class American in a twenty-four hour period results in the release of one hundred pounds of CO2. As affluence grows, and billions of people worldwide ascend to the middle class, carbon dioxide pours mercilessly into the atmosphere as a direct result of modern human commerce and activity. As global prosperity rises, so do CO2 levels.

The rate has escalated through the twenty or so decades since

the beginning of the industrial revolution, and is currently so alarming that ignoring it would be like dawdling on the railroad tracks while a train is fast approaching. No one in the world who's experienced the good life or seen American television or movies will relent in their pursuit of affluence. Therein lies the rub. Can the world's quest for prosperity be achieved without dooming us and our planet in the process?

A poster dating from the 1950's shows a cartoon of a young boy looking on as his dad is standing in the shower with water up to his waist. The son exclaims, "Go ahead Dad, use all the hot water you want. We get our electricity for pennies."

An attitude about energy being "too cheap to meter" took root in our culture. We have been conditioned to not even consider the environmental impact of our energy choices.

Opulent 1959 Cadillac personifies America's post WWII energy culture.

My introduction to global warming came at a solar energy conference in 1990. The speaker, a scientist, gave a graphic presentation that left no doubt about the reality of CO2 buildup intensifying the "greenhouse effect." His final statement to us was that virtually the entire scientific community was in agreement that the greenhouse effect was getting worse. He told us that it was simple math: more CO2 means more heat buildup. A warmer

atmosphere holds more water which can result in bigger and more dramatic storms. (Katrina had not happened yet.)

He predicted there would be a host of other problems due to what scientists now call climate change. Projecting into the future, he and other scientists foresaw the melting of the polar ice caps, accompanied by rising ocean levels as glaciers receded around the world. Every one of these predictions has come true in the twenty years since I first heard about global warming. We have seen the disturbing time-lapse photos showing chunks of Antarctica's ice sheets the size of states breaking free. Many of the actual changes in the climate have turned out to be more serious than those predicted twenty years ago, and are coming true at a much faster rate than originally predicted.

There are many good books, articles, movies and documentaries about global warming. We can spend a few hours on the internet and get the idea, or search for weeks and even months to study the issue and form our own conclusions. It is a worthy endeavor to do our own research. The references at the end of this book are a good place to start.

Even as we witness the destruction from hurricanes like Katrina and record-breaking monsoons that drop five feet of water in twenty-four hours on Mumbai, India, life for most of us goes relatively unchanged.

One might readily concede that we might in fact be changing earth's atmosphere, but ask, "So what? It wouldn't hurt us to be a little warmer." The answer always comes back to balance. There will be no polar ice caps if the average temperature of earth increases by even 5 degrees F. The sea levels rise, and hundreds of millions of the earth's population would be displaced. Where will those people find dry land upon which to live? In the process, millions of square miles of farmland would go under water.

Still we could say, "So, what? Everybody can just move to higher ground and we can develop better ways of farming."

That is far easier said than done. The world's population is increasing. The dry land we have already is close to capacity. If we lose significant amounts of land from the melting of polar ice caps we won't be able to feed ourselves.

"So, a lot of people might starve. This would amount to a population correction, a rather natural event. It wouldn't hurt to cut back to 3 or 4 billion people on this planet."

We're already seeing food wars, and if global warming continues unabated, half of the world's population certainly won't go away without considerable kicking and screaming. Throughout history, and even with today's population, poverty has been a function of distribution rather than the planet's inability to provide.

It would be unprecedented in all of human history to exceed earth's carrying capacity.

Beyond all the myriad considerations affecting human life on the planet, there are a host of considerations that affect other creatures. We've all heard about the polar bear's plight. The threat of extinction of any species has long been recognized as an urgent signal that something is very wrong. These warning signals are flashing all over the place but most of us just don't want to see them. We have plenty to occupy our minds. Yet refusing to recognize danger signals is like continuing to drive when the temperature gauge on our dashboard reads too hot. Severe and perhaps irreparable damage could result from our avoidance of the problem. In Indonesia and Brazil, lush forests are being cut down as a cash crop displacing species from their habitat. Moreover, these vital carbon-breathing trees, taken out of service without being replaced, have the effect of leaving the human family with one lung.

My son told me about a college Asian history class in which the teacher asked the students, "Are humans basically good or bad?"

After giving their responses, the students asked the instructor what he thought. His answer was "bad." He explained that in his study of history he was aware of only one people at only one period in history who chose cultural enrichment instead of pursuing greater economic gains.The Romans, the Greeks, the Spanish, the British, other colonial empires, and the American Empires all went the opposite direction. Only the Japanese people in the Heian Period of 794-1185 embraced an artistic Renaissance, an extended period of peace, prosperity, and cultural excellence. Hopefully there have been other cultures that have made such a choice.

I believe, or want to believe, that America is at the same point and time in history as were the Japanese people of the Heian Period. We have all the prosperity we could possibly want. We live better than kings of a mere century ago. We can choose to be like the Romans and head for the vomitorium to make room for more gluttony, or choose to live with energy awareness and environmental sensitivity. We can decide to let our world go down in flames or preserve a world our children and grandchildren can love and enjoy.

Global warming and the resulting climate change is a formidable dilemma that all the people on earth face together. Those who choose to do nothing will remain part of the problem. Societies that continue with business as usual under irresponsible leadership will weaken the efforts of societies that take bold and decisive action.

The phenomenon of global warming is simple enough to be understood by most people, but the "how" and the "why" and the "what to do about it" are where we need to focus. There are a host of interrelated factors. Many will argue that global warming is mainly about science. Certainly there are political, economic, and social ramifications. Some would even say global warming is a moral issue.

We will touch on several of these elements, since they are

important to the overall understanding of both the problem and the solution. Our goal is to heighten the reader's energy awareness, and to show practical ways we as individuals and as societies can become part of the solution.

I, like millions of others, can no longer continue on the course of business as usual. Even so, as I make new energy choices every day, I'm finding that I am giving up nothing. In fact, my life is gaining in quality.

In riding my bike more often instead of jumping into the car, I am rewarded by fresh air and sun and exercise. In hanging my clothes out to dry, I have the satisfaction of using free solar energy. The only cost to me is a little time in front of the television. I have made dramatic strides over the past few years in reducing my carbon footprint. When I embarked upon the journey I thought it would be a journey of sacrifice. It has been an unexpected surprise that I have increased my quality of life with virtually no sacrifice. Herein lies our present day hope and the hope of the future.

How we are accustomed to using energy permeates every aspect of our lives. We aren't even aware of it because many of our energy choices we've allowed to be made for us. Even if we don't recognize it, how we use energy reflects our attitudes and beliefs. It defines how we live, what we value, even who we are. Ultimately the issue of global warming and how we respond will test our character, our creativity, our innovation, our love of our planet, and our love for one another. If it hasn't always been so, it certainly is now: our neighbor is every human being on the earth. We share the earth, we share the seas, and we share the atmosphere.

PART 1

WHAT IS GLOBAL WARMING

AND WHY WE SHOULD BE CONCERNED

CHAPTER 1

Our Diaphanous Atmosphere

Earth is cloaked in a fine, sheer, delicate and transparent atmosphere. It is the perfect adornment to a stunningly beautiful planet. It protects the earth from foreign bodies hurling through space, consuming them in fire before most can strike the earth's surface. If we were to have a lesser atmosphere, we might have as many craters as the moon, or we would burn by day and freeze by night like the planet Mercury. Our atmosphere warms us like a blanket from the lethal frigidity of space, and tempers the fiery intensity of the sun. Our atmosphere cherishes the earth, and does so with such elegance and grace that centuries pass with the earth remaining at a comfortable temperature, an average of 57 degrees F – perfect for birds, fish, animals and humans.

Other planets in our solar system don't have this protective

atmosphere. Venus, our nearest neighbor, has a thick, denser atmosphere composed mostly of carbon dioxide. Venus' atmosphere traps the sun's light and heat, causing temperatures on the planet to build to nearly 900 degrees F, hot enough to melt lead. There are no cool nights on Venus. The thick carbon dioxide layer holds the heat, forbidding it to escape. This is why it's called the "greenhouse planet." If there is a hell in our solar system, it's Venus.

Mercury, far closer to the sun than Venus, has very little atmosphere. Therefore, during the day, temperatures reach 400 degrees F on the surface of Mercury, and at night, unprotected from the bitter cold of space, Mercury's surface falls to -300 degrees F. Even though Mercury is much closer to the sun than Venus, Venus is the warmer planet by 500 degrees F. Therefore, it is easy to conclude that a planet's temperature has much more to do with its atmosphere than its proximity to the sun.

Mercury is 36 million miles from the sun and is schizophrenically hot and cold because it has very little atmosphere to temper the planet below. Venus is 67 million miles from the sun but has a thick atmosphere consisting mostly of CO2 that traps heat, keeping the planet at a constant brutally hot temperature. Can you imagine how boring it would be to be a weather forecaster on Venus?

"The high today will be 874 and the low, 872. The forecast for the week shows low to mid 870's straight through – pretty typical for every day of every year. Back to you Chuck."

Venus is sometimes called earth's sister planet because of her similar size, gravity, and bulk composition; but with that atmosphere, she is indeed an ugly sister. Imagine a family reunion of the planets. Conversations might go like this:

"That Venus, she's lovely but oy vey, that atmosphere of hers, it's simply impossible!"

"You can't even have a five-minute visit."

"She's smothering."

"She's stifling."

"I'd rather go to hell than to Venus."

"We all feel the same way."

Earth is 93 million miles from the sun and has the perfect atmosphere for life. Carbon dioxide is present in very small amounts. It holds in some of the heat from the sun, but hasn't historically allowed it to accumulate. At a fraction of 1% (0.028% or 280 parts per million), during most of the time of human existence, carbon dioxide has allowed the earth to maintain a constant average temperature. This allows for predictable farming and agriculture. It supports the deep ocean conveyor belt, consistent avian migrations, and a balanced ecosystem of interactive organisms.

Earth's atmosphere is not as massive as most are inclined to think. The oceans of the earth are 500 times more substantial in mass than our atmosphere. In other words, if earth's atmosphere were compressed into liquid form, it would cover the earth less than twenty feet deep, based on calculations done by mathematician Robert Enke. Or, according to a presentation Christopher Dymond of the Oregon Department of Energy gave at the Annual Oregon Solar Energy Working Group Meeting in February 2009, if the earth were the size of a basketball, the atmosphere would be as thin as a sheet of paper.

Think of the earth's atmospheric carbon dioxide as a thin sheet of clear plastic stretched over a raised garden bed. It protects plants against nighttime frost by trapping some of the sun's energy during the day and holding the heat through the night, insulating against freezing temperatures. This allows the plants below to live, just like the CO2 in our atmosphere allows life to exist on earth. However, we know from looking at Venus that too much of a good thing is definitely a problem.

The Irish scientist John Tyndall of London's Royal Institution is credited for the discovery of the "greenhouse effect" in experiments

he conducted in the 1850's. He found it curious that the equation of energy "in" from the sun and energy "out" from the earth did not balance. Something was holding heat in. He placed earth's two dominant atmospheric gases, oxygen and nitrogen, in a glass tube and watched infrared radiation pass right through them. When he added carbon dioxide, water vapor, and methane (less than 1% total) he discovered the greenhouse effect. These "greenhouse gases," even in tiny amounts, allow sunlight to pass through them, but hold in the infrared heat radiation attempting to leave a planet. (Walker)

This of course is a very good thing. Without the greenhouse gases all the sun's energy we received by day would be gone by night.

There are many factors that make earth's atmosphere so perfect for life. They are all interrelated and maintain a balance that sustains hundreds of thousands of life forms, including plants, animals, insects, reptiles, fish, and humans. Balance is at the heart of the global warming issue.

Scientists are alarmed by the activities of humans who take billions of tons of carbon that have resided in the earth for thousands of years, burn them and put them into the atmosphere in the form of carbon dioxide. We are doing two things: 1) we are changing the density of the atmosphere by forcing it to absorb incredible amounts of CO2, and 2) we are changing the chemical composition of the atmosphere, proportionally increasing the amount of carbon dioxide which traps greater amounts of heat. Unwittingly we are making our atmosphere a threat to our own existence. We are flooding the atmosphere with so much carbon dioxide we have to measure it in gigatons (a billion tons). The early Volkswagen Beetles weighed a ton. We are putting the equivalent weight of 30 billion Volkswagens in our atmosphere every year. No wonder so many scientists from every country on the planet are trying to warn us.

CHAPTER 2

The Climate Is Changing

Daffodils in D.C. in December
Water rising at Chesapeake Bay
Strange weather I can never remember
I really don't know what to say.

Halfway between Australia and Hawaii, lies a small group of islands with 12,000 residents. The island nation of Tuvalu consists of a ring-shaped chain of coral islands with a total landmass of 10 square miles. The highest point is 15 meters (49.2 ft). The surrounding waters are rising little by little each year, causing the land to slowly disappear. More frequent and more violent storms lash the island, making it less and less habitable. New Zealand and other countries in the region have agreed to take in some of our world's first climate change refugees.

The weather is whacky. Most people over the age of 40 have noticed some effects of climate change. For years, I brought my winter wardrobe out from seasonal storage in mid-October. Now, it's December and I just brought the warm clothes out.

In the words of perhaps the world's foremost authority on global warming, James Hansen, "We have good reason for being able to say the world will be warmer…in the next decade. It's the same reason we had 10 years ago when we said the 1990s would be warmer than the 1980s: The planet is out of equilibrium." (Boyle)

As a solar energy contractor I have learned the importance of

balance in energy design. In the first off-grid solar electric homes I powered, careful analysis had to be done to determine what the customer's energy usage was and how many solar modules were necessary to meet that load. We had to balance the solar energy coming in with the energy going out. The same held true when I consulted with a client and his architect about a passive solar home design. We would try to put the long side of the house facing south, put most of the windows on the south wall, and create a concrete floor that would absorb the right amount of solar energy during the day and radiate energy at night so that no conventional energy would be needed. It was always a beautiful thing when balance was achieved and the natural heating system of the house worked.

I built my own passive solar home in 1992. There were floor to ceiling windows on the south wall. A concrete floor covered with grey tile created a thermal mass. We moved into the home in October during a week of cold but sunny weather.

A few days before the move I monitored the temperature of my new solar home. During the day sunlight streamed through the windows, landing on the tile floor and charging it with heat. The daytime temperature reached a very comfortable 68 degrees F with no auxiliary heating even though the outside temperature was in the 30's and 40's. During the night the floor released its heat so that the temperature remained about the same, and by early morning when the sun rose, the temperature had dropped by 2 degrees F. The sun streaming through the windows started charging the floor again.

My house worked! It was balanced for utilizing solar energy. If I had too much or too little mass, or not enough south facing glass, it wouldn't have worked. Interestingly, when we moved the furniture in, my wife placed the back of the couch toward the glass. I looked at the long shadow the couch cast on the floor. I wondered if it would make that much difference. Sure enough, with the couch situated as it was, the house overheated by day (went to an

uncomfortable 77 degrees F). The amount of energy stored in the floor was less, resulting in an early morning temperature below 60 degrees F. The gas boiler backup heating system would have come on had we not turned the thermostat all the way down for testing. Graciously my wife consented to moving the couch.

The couch illustrates what can happen when a system is out of balance. The extra CO2 in our atmosphere is creating too much heat energy in the atmosphere and at the earth's surface, a condition that has been termed global warming. The symptom of this imbalance is called climate change. Climate change is the way climate systems respond to the additional heat energy.

There are a host of cause and effect climate change scenarios most of us don't fully appreciate. Spruce bark beetles have flourished in Alaska and many Rocky Mountain states because of warm summers over the last 20 years. They have infested 4 million acres of spruce trees. (National Geographic) Other insects like the mountain pine beetle thrive in warmer weather, enabling them to destroy more trees and crops.

Dr. Phillip Mote of the University of Washington tells us that weeds thrive as CO2 levels rise. Also, diminishing snowpack from warmer weather reduces summer stream flows that serve agriculture. Irrigation water supply diminishes and underground aquifer levels are depleted. (Mote)

This story appeared on the news recently:

> Scientists report that rising temperatures appear to be responsible for cutting the snow pack in Oregon's Cascade Range in half over the past 77 years.
>
> The report from Oregon State University released Tuesday found that the warming trend is seen most in the spring. Temperatures are up almost 4 degrees on average since 1958 in January, March and April. Meanwhile, there has been no significant trend in precipitation.

> Geosciences professor Julia Jones says the shrinking snowpack has been the most visible impact of global warming, and will continue into the future.
>
> The mountain snowpack acts as a natural reservoir for rivers that are crucial to salmon, farming and ranching. (Associated Press)

According to Dr. Michael Zemp, University of Zurich, glaciers are bell weathers of climate change. Since 1980 the reduction has been dramatic, and the rate of glacier mass lost is escalating. "Especially in densely populated high mountain areas such as the European Alps, one should start immediately to consider the consequences of such extreme glacier wasting on the hydrological cycles, water management, tourism, and natural hazards," he says. (Science Daily)

Another consequence of global warming is spring coming earlier, and fall coming later. The extended summer produces drier forests, which are considerably more vulnerable to costly forest fires. (Live Science) This is a double whammy, since the burning trees become carbon dioxide, and the loss of the trees takes away a carbon sink, an element of the environment which absorbs and stores more carbon than it releases. Carbon sinks, such as forests and oceans, help to offset greenhouse gas emissions. For this reason, mass mortality of trees in the Amazon rainforest, one of the world's biggest carbon sinks, would greatly accelerate CO2 buildup and climate change.

These consequences reinforce each other, producing more and more heat. A domino effect occurs. In December, 2009, in an article entitled: "Study: Arctic Sea Ice Melting Faster Than Expected," Randolf E. Schmid quotes Muyin Wang of the Joint Institute for the Study of Atmosphere, co-author of a new report confirming that sea ice could be almost gone within thirty years.

"'The Arctic is often called the earth's refrigerator because the sea ice helps cool the planet by reflecting the sun's radiation back into space,' Wang said in a statement. 'With less ice, the sun's warmth is instead absorbed by the open water, contributing to warmer temperatures in the water and the air.'" (Schmid) Imagine an ice cube more than 3 miles long, 3 miles wide, and 3 miles tall. That's how much of Greenland melted in a single year.

Climate change not only affects temperature, it also affects sea levels, global air movement, weather, and precipitation that farmers depend on to feed the world. Sea levels have risen 11 inches over the last 100 years, covering 5,000 square miles of dry land worldwide. With sea levels rising, land diminishing, and population growing, many feel we have nearly reached the limit of the earth's human carrying capacity.

If Greenland melts, sea levels will rise 23 feet. (Doyle) This means Cairo, London, Miami, Amsterdam, New York, Shanghai, Beijing, Rome and many other cities would have to be evacuated. Where would all those millions of people go?

There is considerable concern that as a result of increased CO2 in the atmosphere the acidity of seawater will increase and may adversely affect organisms living in the water. "Over the past 200 years…ocean surface acidity has increased by nearly 30% since the 17th century." (Garrison) The evidence for this is shown by increasing amounts of dead and dying coral beds.

Climate change isn't necessarily about warmer days, although it can be in some places. It affects different places differently. Weather patterns are disrupted and become unpredictable. A warm place may become colder. A dry place may become wetter. Droughts could become longer, monsoons more intense, and storms and hurricanes more severe.

Anyone who thinks having a warmer world may have some advantages is only looking at the earth as if it were a big static ball. More heat trapped inside our atmosphere means more

climatic instability. It's a misperception to think global warming isn't occurring because some years are colder in some places. The conspicuous differences in the weather and changes in seasonal weather patterns are the result of climate change.

I hear people say, "Global warming can't be happening because of all the snow we've had. The three and a half feet of snow that fell on Washington D.C. in 2010 certainly means global warming is a myth, right?"

Wrong. Daffodils were blooming in Washington, D.C. in December, completely out of season and just 6 weeks before the record-breaking snowstorms hit. It's almost like Mother Nature is trying to give The Capitol a wake-up call.

The conspicuous differences in the weather tell the real story. Unprecedented global weather screams of climate change, a system out of balance, of nature agitated by excess energy in the atmosphere. We know something is different. It's not just the occasional zany weather we used to think is "acting up" but will soon return to normal. We can tell something's wrong with the weather; there's something worrisome going on.

If we are sick with a cold, we show symptoms of a fever and a runny nose. When we run a fever, if the thermometer reads 100 or 101, we're sick. The symptoms tell us something needs to be done.

CHAPTER 3

CO2—Too Much of a Good Thing

I, like many others, have a picture of earth taken from space that greets me each morning when I open my computer. It is profoundly beautiful. Sometimes I pause and look at it for several minutes. I can see the atmosphere itself, looking closely at the perimeter where the edge of the earth meets the blackness of space. It is a fingernail-thin covering that appears like a faint haze seen from the side.

The photo I have is centered on the United States. I love the geographical United States. Since I've spent significant amounts of time in 48 out of 50 states, missing only Maine and Rhode Island, it's easy for me to visualize America waking up. If it's 5 a.m. on the West coast where I live, the East coast is right in the middle of rush hour. Millions of motorists crowd the freeways in Atlanta, Boston, the Beltway in Washington D.C, and up and down the megapolis of south Florida. In Chicago, rush hour is well underway and even

in Los Angeles, at 5 a.m. it has already begun. By days end, three gallons of gasoline will be burned for every man, woman, and child in the U.S. – a billion gallons total, producing ten million tons of CO2 that will rise to our atmosphere and stay there for decades.

Coal plants all over America are firing industriously to provide electricity for a busy country. Natural gas power plants are revved up and firing. Planes are in the air crisscrossing the country in every direction leaving contrails – a visible sign of CO2 deposits. Thousands, maybe millions, of business deals will be made in America today. The greatest economic engine the world has ever known churns away, night and day, fueled by oil, coal, and natural gas.

As a result of all our fossil fuels burned each day, 20 million tons of CO2 pour into the atmosphere over the United States. It gets evenly distributed over the rest of globe. Likewise, another 70 million tons gets dished out from the activities of the rest of humanity. The oceans of the earth and the trees absorb some of the CO2 released each day. The rest accumulates and will remain in our atmosphere for 100 years or more.

I again glance at the world on my computer and see South America, and I can picture acres of rain forest disappearing every day. According to Greenpeace, in the last 40 years an area the size of France has been cleared. (Greenpeace).

The world's rain forests are being cut down at the rate of 90 acres per minute. They once covered 14% of the earth's land mass and now only cover 6%. (United Nations Radio) BBC news reports that tropical deforestation accounts for a huge portion of CO2 buildup, about 20%. (Kinver) This is an amount roughly equal to all the coal that is burned worldwide. Every acre vanquished from the earth for the sake of commerce is a reduction of our planet's ability to absorb the CO2 from man's other activities that are also, for the most part, for the sake of commerce. With each passing day the ocean's ability to absorb our CO2 becomes less, the number of

trees that can breath in our CO2 are less, and the volume of CO2 we produce is more. The end result is rapid accumulation of CO2 in the atmosphere.

A train carload of coal weighing 80 tons pulls into a coal-fired power generation plant and dumps its load. In a half-hour or so it's burned up and nearly 300 tons of CO2 enters the atmosphere. A typical 500-megawatt coal plant uses 40 train car loads per day. By burning 3,200 tons of coal, 12 million kilowatt hours are delivered to the grid – a good thing – but over 23 million pounds of CO2 are delivered to the atmosphere – a very bad thing.

(Calculation: Output for one medium-sized coal plant: 40 train carloads per day x 80 tons of coal per train car x 3.67 [ratio of CO2 per weight of coal] = 11,744 tons or 23,488,000 pounds of CO2).

There are 600 coal plants in the United States and even more in China. Worldwide 172,000 train carloads of coal are burned each day. That's 7,000 per hour, or 120 train carloads per minute.

The weight of carbon dioxide is 3.67 times heavier than carbon alone. We need to let this scientific fact sink in. If we take a lump of coal weighing 10 pounds and burn it, the lump of coal has disappeared. What we don't see is 36.7 pounds of CO2 that lingers in the atmosphere as a result of our burning the lump of coal (which is mostly carbon). We don't recognize that, in the combustion process, the carbon atom (C) has combined with two oxygen atoms (O2) to produce the carbon dioxide molecule (CO2), which weighs more than the carbon atom alone. Since the lump of coal is something concentrated, having weight, having form, having color, and is visible to the senses, it is counter-intuitive that something greater in mass remains after the lump of coal is gone. This is where we have to trust science. Even though we don't see it or feel it, it's there. It disperses into the atmosphere and remains. A pound of CO2 is invisible, but if we were to contain it in a balloon it would occupy a space of about 2 1/2 feet in diameter. (McRandle)

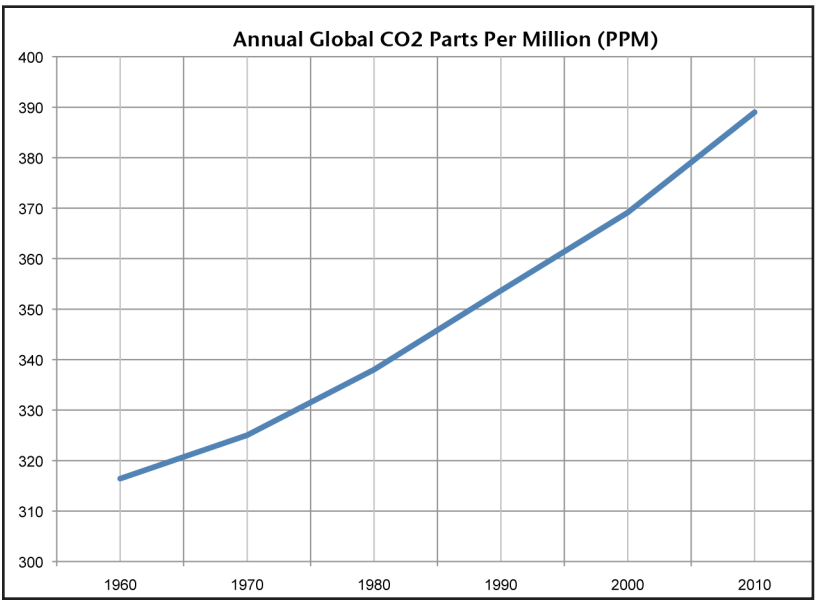
Imagine the size of the balloon that would contain 100 pounds,

which is just a single day's worth of CO2 for one American. The balloon would be nearly 12' in diameter containing a volume of 818 cubic feet, roughly the size of three Volkswagen Beetles. Since there are 304 million Americans, it would be like floating nearly one billion Volkswagen-sized balloons full of CO2 into the sky each day. It's hard to imagine.

Each day Joe, the average American, uses enough fossil fuels to fill a balloon 12' in diameter weighing 100 pounds.

Since the 1930s the scientific community has known that atmospheric carbon dioxide was accumulating, and convincingly confirmed it in the late 1950s when highly accurate measurement techniques were developed. The most famous demonstration of this is in C.D. Keeling's record at Mauna Loa, Hawaii. Dr. Keeling started sampling carbon dioxide in 1958. By 1961, he had data that showed steadily rising CO2 levels. The data, known as the "Keeling Curve," shows that carbon dioxide concentration in the atmosphere has grown from 315 parts per million (ppm) in 1958 to 387ppm in 2009. (NOAA) Parts per million is the number of molecules of CO2 in every one million molecules of dried air. The rate is increasing with each passing decade. In the decade of the

60's, the rate increased at just a little more than ½ part per million per year. In the decade of the 70's the rate of increase doubled to 1 part per million per year. In the first decade of the 21st century, the rate increased to nearly 1½ parts per million per year, nearly three times the rate of the 1960s. We're going in the wrong direction.



CO2 levels have been steadily climbing over the last 50 years. Human activities are putting 46 million tons of CO2 per day over and above what the earth can naturally process. That's 15 billion tons per year. (CNN) Deforestation decreases the earth's ability to absorb the CO2, exacerbating the problem.

Industrialization and fossil fuels are at the heart of the problem. Burning petroleum in an internal combustion engine propels us where we want to go. Burning coal makes electricity for conveniences like air conditioning, washing machines, clothes dryers, dishwashers, toasters, and refrigerators. In the developed countries, these are no longer considered conveniences but necessities. In developing countries, these are also the things

people are striving toward. As population increases, and more people aspire to modern conveniences, CO2 in the atmosphere grows. It doesn't really occur to us that when we drive our car, in essence we are taking the carbon that was in the earth in the form of crude oil, refining it into fuel, burning it, and depositing it in the atmosphere in the form of carbon dioxide.

More CO2 means more heat trapped causing the temperature of the earth to gradually rise. How much heat has built up? To put it into perspective, consider that it takes one BTU to raise one pound of water one degree F. Imagine how many BTUs it takes to raise the earth's surface by one degree. It would be the astronomically large number of 575 quadrillion BTUs. Two degrees F, which we've already accumulated in the last 50 years, represents 1.1 quintillion BTUs of "new" solar energy lodged at the earth's surface. The average temperature of the earth worldwide, one foot or so below the surface, is the same as the average air temperature. In 1950 that temperature was 57° F. Today that temperature is about 59° F. (NASA)

We don't perceive global warming because the change to us is small and it happens over a long period of time. 1.1 quintillion BTUs of accumulated heat spread over the entire surface of the earth goes unnoticed. If, however, we were to take that same amount of energy and focus it in one area of the earth, say the 2,300 mile Mississippi River, we could boil away the Mississippi and 10 rivers like it.*

Now, if the Mississippi, the Nile, the Ohio, the Missouri, the Rhine, the Rhone, the Ganges, the Yangtze, and a few other great world rivers all of a sudden disappeared, that would get noticed. People in Minneapolis would say, "Well, if we'd known the river was going away, we wouldn't have fixed the bridge."

**(Calculation: Mississippi River 2320 miles long, 3,200' average width, 30' average depth = 2.678 x 10^{12} cubic feet x 7.48 (gallons per cu. Ft.) x 8.33 (pounds/gallon) x 152° F (delta T 212-60) = 1.1 x 10^{16} BTUs to bring the Mississippi from 60° F to 212° F.)*

Rest assured the BTUs are coming and will keep on coming because the sun is a constant, endless and powerful source. The more CO2 in our atmosphere, the more BTUs. CO2 is trapping the sun's energy. BTUs are accumulating and the earth is warming. An earth one or two or three degrees warmer is a completely different earth.

We better make the sun our friend or it will fast become our worst enemy.

We know that the oceans and the trees absorb carbon dioxide. The problem is that we're producing CO2 faster than they can absorb it. In fact we are producing twice as much as they can absorb, which means the oceans are becoming acidic and CO2 is accruing in the atmosphere.

Before the industrial era began about 250 years ago, humans burned fires, volcanoes went off, lightning struck and caused forest fires, and other natural events put carbon dioxide into the atmosphere. This happened for thousands of years without consequence. We know this from ice samples taken from Antarctica's polar ice cap. With an atmosphere naturally fluctuating between 250 and 280 parts per million of CO2, a healthy balance existed favorable for life on the planet. With the new industrial activities of humans accelerating, carbon dioxide accumulation is rapidly approaching 400 parts per million.

Scientists say that 450 is the highest number we can rise to and still have a reasonable chance of reversing the trend. After 450 the damage could be irreversible.

With thousands of coal plants worldwide and the number growing, many consider coal the biggest challenge in the climate war. 70% of the enormous industrial boom in China over the past decade has been powered by coal (Britannica p.447). In 2007 China used more coal than the U.S., the European Union, and Japan

combined. China could easily be called the world capitol of coal - she has built her economy on coal, and unless something changes, another decade will bring 500 new coal plants to China. Although coal is the dirtiest fuel, it is also the cheapest, and cheap energy always has universal appeal. It pollutes, but it brings prosperity rapidly, and that's exactly what is happening in China.

Coal, however, is just one of the fossil fuels on the rise in China. In Bejing, 1,000 new cars are added to the road each day.

As of 2009 China produced roughly the same amount of CO2 as the United States in a given day. These two countries account for half of all the CO2 building up in the earth's atmosphere, with every other country combined producing the other half.

The prosperity and lifestyle to which Americans have become accustomed requires over 20 tons of CO2 per person per year from a combination of coal, natural gas, and petroleum. Japan is the second largest economy in the world, behind the United States. But most of the people in Japan take the train, and most of them hang their clothes out to dry. Both of Japan's major automakers build hybrids that get 50 miles per gallon. Tokyo, the world's largest city, runs like a Swiss clock and there's no noticeable pollution compared to large American cities.

Germany and Japan, our technological equals,
require half the CO2 per capita as Americans.

Although China is equal to the U.S. in total greenhouse gas emissions, her per capita is only 4.5 tons of CO2 per person. India is 1.2 tons per person. Therefore, the average American produces twice as much CO2 as our highly advanced counterparts in Germany and Japan, four times as much per capita as the people of China, and 16 times as much per capita as the people of India.

No discussion of America's carbon footprint can be made without mention of America's military footprint. According to

Nick Turse of the "Foreign Policy in Focus Newsletter," the U.S. military has been using over 5 billion gallons of petroleum per year since 9/11. Nearly 2 billion gallons are for jet fuel alone. Even before 9/11 the military admitted to using 4 billion gallons per year. (Turse)

The American military's dependence on oil is far greater than any other single entity in the world. Americans can choose to walk or bike and buy green power and transition to renewables, but our military absolutely has to have oil. We can't fly supersonic jets with solar energy, and army tanks are a bit heavy to be electric vehicles.

It is safe to say that since petroleum has been widely used in the world, wars have been fought over its control. After the United States withdrew Japan's oil supplies during WWII, Japan bombed Pearl Harbor. The island nation of Japan depended entirely on energy resources from the outside. Once oil supplies were withdrawn, Japan realized her industry had less than 2 years to operate. Japan looked at the U.S. decision as an act of war. (U.S. Army)

The Gulf Wars clearly have been fought over the control of oil. If we can't get oil, we can't operate the military, so the military has an obvious interest in keeping the oil pipelines open. For our leaders it doesn't seem to matter how many people protest, or how most of the rest of the world objects, or their approval ratings, and even their place in history, they all seem to do the same thing. If the oil is threatened, we take immediate action even if it means going to war. National and international sentiment doesn't matter.

Since we're the only superpower, we may well be the only country on Earth whose military footprint is for all intents and purposes non-negotiable. America's military footprint is immense, according to an article in the Energy Bulletin from the Post Carbon Institute, a nonprofit organization dedicated to helping the world transition away from fossil fuels:

> …the U.S. military is completely addicted to oil. Unsurprisingly, its oil consumption for aircraft, ships, ground vehicles and facilities makes the Pentagon the single largest oil consumer in the world. By the way, according to the 2006 CIA World Factbook rankings there are only 35 countries (out of 210) in the world that consume more oil per day than the Pentagon. According to recently released "Annual Energy Management Report," in fiscal year 2006 the Pentagon consumed 320,000 barrels per day of site delivered oil. (Karbuz)

By anyone's measure, the U.S. military has quite an appetite for oil. 320,000 barrels is 13 million gallons per day. It is 20 times more than any of the major airlines use each day. According to researcher Daniel Solnit of the Institute for Local Economic Democracy, the U.S. spends well over one-half trillion dollars per year on its military budget, which matches the expense of all other military budgets in the world combined. Solnit believes the U.S. military budget is probably the only place where we can get the trillions of dollars necessary to transition to a renewable energy economy:

> We have to build millions of wind turbines and solar panels, retrofit buildings and create mass transit systems before we lose the capacity to do so. And the United States, which is responsible for 25 percent of global greenhouse emissions, must take the lead. In short, we need the biggest and most ambitious public works project in history, and the money to pay for it.
>
> We have little time left to choose: either we devote all our economic resources to limiting climate change and preserving a livable planet, or we continue with business as usual. We cannot afford to do both. (Solnit)

No matter what politicians tell us about altruistic motives, such as fighting for democracy and American interests, the plain truth is our military must have oil at any cost. Not having oil would render our military incapable of functioning. Every individual, business, and institution in America can take significant steps to reduce and all but eliminate their carbon footprint; the American military is one institution that realistically has limits to what it can do. There will be a need for oil for many decades for our non-negotiable national security.

Still, there are a host of practical energy choices that the U.S. military can and should make. Air conditioners gulp vast amounts of diesel fuel to keep uninsulated tents cool in the sweltering desert heat. Evaporative coolers, commonly known as swamp coolers, could replace air conditioning units in hot, dry climates such as Iraq. Barracks for soldiers could use solar water heaters. Military facilities worldwide could use photovoltaic modules for generating some of their electricity. Conservation and energy efficiency must be utilized throughout the military as rigorously as in our homes and businesses. Some of our country's best ideas have come out of our desire to make things better for our soldiers. M&M's candy is one of them. Soldiers needed a chocolate candy that wouldn't melt, and the Mars Company came up with a candy that met that need. We need innovative thinking about energy use in our military.

Leaders must be very prudent to use fossil fuels responsibly in the national interest. We must hold leaders accountable for how they use energy on our behalf. A president who is successful at keeping peace without going to war and burning millions of gallons of oil in the process is more deserving of our vote than the "hawk" who, when in doubt, brings the tanks and bombers out.

In America during the post World War II period, the die was cast that accelerated our heavy carbon footprint. Immediately after the war we were ready to make a fresh start, happy to get back down to the business of a peacetime economy. While Japan and

Europe invested in mass-transportation train systems, we built the interstate freeway system. Now while Japanese commuters walk a few blocks and take a fast train home from work, we go jump on the freeways of Los Angeles, Seattle, and Atlanta and sit. We take 90 minutes to go a distance that can be achieved in 9 minutes by train in Europe or Japan. What's worse, we're stuck with the situation. As of 2008 less than 1% of Americans had bought hybrid cars whose engines could at least be off while we're stuck in traffic or waiting at red lights. If we need to travel 500 miles or more, most of us fly, some of us drive, while our friends in Japan take the high-speed trains that get them there faster and with far less CO2.

It's not our fault. Nobody except a very small number of scientists knew of global warming in the 1950's when the freeway system was being built in the United States, and nobody would have thought within 20 years it would be crowded and dysfunctional during important commuting times of the day. It's not our fault, but it is our problem.

There is no good reason a high-speed train line like the Shinkasen in Japan can't be built in the United States. We could at least have one on the West Coast between Seattle and San Diego. Perhaps it could run in the freeway median, so people on I-5 could watch the train zoom by at 200 miles per hour while they sit in traffic.

CHAPTER 4

How We Got in This Mess

In 1985 I had the exhilarating experience of flying in a Lear Jet. It was a warm summer evening just after sunset. As the westbound takeoff lifted us toward the top of the Oregon Coast mountain range, through the cockpit window I saw an enormous, magnificent golden light shining up into the sky overhead. As we rose above the mountains I saw it was the sun's reflection off the Pacific Ocean casting a dazzling ambient light into the skies above the western United States. A monitor to the left of the cockpit door (which remained open the entire flight) informed us, the only two passengers, of our speed, altitude, and the outside air temperature. When we took off, it was 90 degrees F on the ground, but as we climbed, the temperature began cooling rapidly. By the time we reached 32,000 feet, it was -55 degrees F. Flying in the upper atmosphere illustrates well the greenhouse effect. A mere six miles below, the earth's surface was 90 degrees F. The difference in temperature from the earth's surface to the thin upper atmosphere was 145 degrees F. If the colorful John Tyndall, the scientist who discovered the greenhouse effect, were on the flight he might have said, "See, I told you."

The truth is we got into this climate mess unwittingly. There is no guilt to be doled out. No one set about to deliberately create the problem. We just carry on life as it comes to us not even thinking that much about energy. We've been rudely awakened and told that ignorance is not bliss when it comes to climate change. The consequences of using fossil fuels to the incredible extent we now

use them has only become a problem in the world very recently. There are several factors that have put us in the unenviable position of being the generation that has to deal with global warming. None of these should be a surprise.

Consumerism

America is the giant consumer market of the world. We buy more stuff than any other people on earth. I once had tenants who were late on their rent. I tried to work with them for several months but they were never able to catch up. Finally when they moved out, I was flabbergasted to find that the basement was full of junk they had been buying instead of paying the rent. The husband's only explanation was that they couldn't resist buying all that stuff. I felt sorry for them, but not enough to perpetuate a bad thing. They didn't even take a lot of the stuff when they left. It was as if they were addicted to just buying things. Most Americans have some degree of this addiction.

We work hard and want to reward ourselves with trips to exotic places where we can rest. We don't think of the gallon of jet fuel burned each second to transport our family to Disney World. Or, we load up the SUV and head out on a road trip in a vehicle that has to be huge to carry all our stuff and consequently gets about 10 miles to the gallon.

We may not be aware of it but every American lives under the power of advertising. It is a highly developed science carefully crafted by sophisticated professionals to create in us the desire for products. It is subtle, subliminal, repetitive, and for most of us, compelling. The ads convince us we can also be like the popular, beautiful, and successful celebrities who endorse their products.

We are relentlessly bombarded by advertising. We endure thousands of "hits" per day from every imaginable medium: television, radio, newspapers, the internet and billboards. An MBA friend told me once that if the people of the world stopped buying

things they really didn't need for just one day, it would totally disrupt the world's economy.

If we said yes to everything we were prompted to buy via advertising, we'd end up enormously in debt with a garage or basement full of useless junk. In actuality the average American family is tens of thousands of dollars in debt beyond their home mortgage. The headline in my local paper recently read, "Consumers Are Spending Their Way into the Poorhouse."

When we buy things, even the things we need, few of us think about the energy it took to make, ship, warehouse, and retail it. The condition of not recognizing the relationship between consumptive living and global warming will be a problem so long as we remain oblivious to the connection.

The economic problem

It almost goes without saying that any serious effort to avert a climate crisis is perceived as a challenge to the global economy and dismissed out of hand. The struggle for the environment is seen as a struggle against the economy. This is the main reason the United States refused to participate in the Kyoto Accord, and it is the central problem that inhibited climate talks in Copenhagen. Paying for a cleaner environment eats into profits.

At its heart, the debate about global warming comes down to a clash between science and economics.

We have a well-entrenched economic industrial machine that very much would like to see business continue as usual because its drivers are doing well selling us products we're told we "can't live without." Chief among them are petroleum-based products, which include plastics and a host of other goods made from petroleum bi-products. Cutting down on petroleum usage would not be good

for a great many businesses and for the thousands of people they employ. The idea of using less coal would not be popular in the coal producing states of West Virginia, Ohio, and Pennsylvania. Fewer airplanes in the air would certainly not be welcomed in the airline industry and in the business community.

National Public Radio (NPR) aired a program on November 20, 2009 claiming the recession has reduced carbon emissions worldwide. In an interview NPR's David Kestenbaum states:

> Carbon dioxide emissions have been growing globally at three and half percent a year. But for 2009, emissions are expected to drop by about three percent. That's nothing to sneeze at. The difference is like shutting down 400 coal power plants or taking all the cars in the United States off the road for a year..." During the same interview, Professor Corinne Le Quere of the University of East Anglia in Norwich, England said, "So that's equivalent to stopping global emissions by approximately three weeks." (Kestenbaum)

The recession effectively shut down the global CO2 engine for 3 of it's usual 52 weeks of continuous operation.

The relationship between CO2 emissions and the global economy is clear when we realize the two have been inextricably tied together for centuries. The GDP (Gross Domestic Product – the total market value of all final goods and services produced in a country in a given year) and carbon emissions run parallel. It's practically an economic law, like the law of gravity. Now, the conundrum we humans face is how to reduce CO2 emissions while maintaining a healthy global economy. The obvious answer is to use energy efficiently, prudently, and to use non-carbon emitting forms of energy. This is what the world has to do. There is no other answer.

Believe what we want

We humans have an amazing propensity to believe what we want. It is a powerful force in our lives that we may not fully recognize. It is uncanny. We believe what we want about religion. We believe what we want about race. We believe what we want about everything. Some of us have gone so far as to convince ourselves that anything we believe is true. I've met people that believe we, the human race, created the universe. If I was part of it, I don't remember a thing. There are criminals who believe they can't get caught. We actually think that if we believe something, then that makes it so, as in the cliché, "If it's right for me, it's right."

Even though we are reminded daily about climate change, and may know that burning fossil fuels is a cause, we don't want to believe our actions play a significant part, or that we can do anything about it. Even if we do believe, nearly all of us tend to underestimate the seriousness of the matter.

If we are convinced that our energy use habits actually contribute to the global warming problem, we would be far more likely to look for ways to change our behavior. On the other hand, if we don't want to believe global warming is a problem, then we close our minds from even considering the proposition. In fact, we'll avoid others who believe differently like an atheist avoids evangelists. We just don't want to hear it; and we especially don't what to change our lifestyle.

There are many who admit global warming is a reality but want to believe it is not human caused. They insist it is part of nature's cycle. The humorist Lewis Grizzard once said, "My grandma thinks men walking on the moon is fake and Saturday night wrestling is real." People are not ignorant. Everyone reads the same newspapers. The point is that our tendency to believe what we want is not just a quirk of human nature; it is a strong and powerful need to give ourselves our own approval for our choices.

The oceans have absorbed so much CO_2 that they are becoming acidic. As a result, coral reefs are dying and the ecosystems of the oceans are being stressed. We don't want to believe this.

In an article entitled "Acid Oceans: The 'Evil Twin' of Climate Change," Associated Press writer John Heilprin reports that reducing carbon emissions worldwide also would help mend a lesser-known environmental problem: ocean acidification.

> Oceans absorb about 25% of the world's greenhouse gases pumped into the atmosphere from human activities each year," according to a U.N. report released at Copenhagen. That helps slow global warming in the atmosphere. But carbon dissolving in oceans also forms carbonic acid, raising waters' acidity and damaging shellfish.

Heilprin goes on to quote Jane Lubchenco, head of the National Oceanic and Atmospheric Administration (NOAH) as saying,

> "I call this ocean acidification climate change's equally evil twin...As the oceans become more acidic, it's harder for corals, oysters, clams, crabs, mussels, lobsters to make their shells or their hard parts, and they dissolve faster...
>
> So ocean acidification, which is a relatively unappreciated problem, is as important as climate change. It's one that most people haven't heard of. Another way to think of ocean acidification is as osteoporosis of the seas."

Andrew DeVogelaere, research director at the Monterey Bay National Marine Sanctuary in California, who observes changes in

water chemistry in the bay states, "We see a train wreck coming." (Heilprin)

I wanted to check this out myself by doing an experiment. I took a pH meter and checked the pH of my tap water at home. Then I went to a fountain drink dispenser at the convenience store and checked the pH of carbonated water (water infused with CO_2). Sure enough, the pH went to the acid side of the scale on my meter. Now when I hear news about the oceans becoming acidic from CO_2 saturation, I believe it because I've seen for myself. So much CO_2 is being absorbed by the oceans, it makes sense that they would be more acidic.

A very astute real estate professional once told me there is another basic aneed that should be added to the list of food, shelter, and clothing: the need to live comfortably. She said this is why people move fairly often in this country. I would add one more: the need to believe what we want. Of course we really do need food, shelter, and clothing. It's a funny thing we've done, convincing ourselves of the others.

Denial

Regardless of what we want to believe about global warming, there is a near unanimous consensus among experts who study the atmosphere and our climate that global warming is a reality. Would we question the Surgeon General and the entire medical community who say that smoking is bad for you? No one argues this point because the evidence is so overwhelming, and the Surgeon General is in fact a doctor who is rendering an expert opinion. I am utterly amazed that anyone in this country would continue to smoke. I can only conclude that those who do are physically addicted or are living in denial of the threat to their health. The preponderance of evidence is so overwhelming no one should choose to begin smoking; yet they do.

The evidence of climate change and its environmental impact is in the news daily. We see on TV and in newspapers stories about the threat of extinction for many animals, fish, and birds because global warming has caused changes to their habitats. Still people cling to the belief that it's just a knee-jerk reaction by overly zealous scientists or left-wing liberals. Even if they believe the doomsayers, they convince themselves that the problem will take care of itself, or that some future invention will fix everything.

In late 2009 a Washington Post/ABC News poll suggested that the public is now less likely to believe that global warming is a problem than they were a few years earlier. (Ellperin) It seems the height of folly to think that the laws of physics are going to regard Americans' public opinion. Yet I am certain that many people aware of the poll were happy to hear that global warming turned out not to be the threat they heard it was. As the comic Larry the Cable Guy says, "Now that's funny! I don't care who you are, that's funny."

The best example I found of denial is a November 2009 Associated Press/Stanford University survey that found: "three out of every four Americans view climate change as a serious problem that will harm future generations if not addressed." However, when asked if they would be willing to pay $10 more on their monthly electric bill to curb global warming, nearly 6 out of 10 balked. (Herbert) I think they should have asked the question like this: "If your child or grandchild were kidnapped and the kidnappers wanted $10 a month to ensure your child would live and not be harmed, would you pay?" So, what's the difference? If we race past the tipping point we've doomed the future of our children. The difference is that anything beyond our immediate lives is not as real to us as the present tight money situation. That which is immediate dominates our thinking. The realities of the future are much easier to deny than those of the present.

Naysayers

One of my students, an electrical engineer named Jayna, sent me a U-Tube link about a presentation that "Debunks the Myth of Global Warming." In less than ten-minutes a weatherman who introduces himself as founder of the weather channel declares that global warming is a total farce. He claims that in its long history the earth has naturally heated and cooled and there is nothing unusual happening today. He noted the weather hasn't been that hot in the past couple of years.

In the video he comes across as a kindly gentleman who claims to know and love the planet. His presentation consists of a great number of graphs covering millions of years of earth's history that whisk by in seconds. He gives the impression that he is an expert on global warming and is rendering an authoritative opinion that can be taken as the final word. He even goes so far as to say that the formula for radiative forcing (which proves global warming) is not valid. He ended by saying in an assuring, grandfatherly tone that we could go ahead, burn all the fossil fuels in the ground, and everything will be fine.

There were 7,500 people who had viewed the video. There were also several viewer comments posted. The first was, "Al Gore is an idiot." Another wrote, "Al Gore is a criminal." Another suggested the newspapers ought to hear about this and bring to light the hoax. With 4½ out of 5 stars, evidently 90% of the viewers were convinced.

What are we to think about such claims? For the great majority of us who are not experts, how can we know the truth about global warming? Is the truth even knowable?

Many have been frustrated by the entire debate and have defaulted to a mindset similar to that of an agnostic. The agnostic neither believes nor disbelieves in God but asserts that it is impossible to know if God really exists. With global warming, there

are a great many "agnostics" who believe no one really knows and, furthermore, no one can know.

There is some logic to this conclusion since there has never been a time in earth's history that humans caused the release of more CO2 than all the forces of nature. Even though there's no human precedent, there are plenty of natural precedents. There is an absolute long-term relationship between CO2 and global temperature. In every case, higher CO2 levels were followed by higher global temperatures.

Even though year-to-year temperatures fluctuate due to a great number of interlocking climatic factors such as el Niño and el Nina, the overall trend is that temperature follows CO2. The global warming periods in eons past were during periods in which CO2 levels were naturally high, mostly due to increased volcanic activity, just as low CO2 levels accompanied the cool periods.

I challenged Jayna to calculate the radiative forcing of two watts per square meter determined by climatologist Dr. James Hansen. Radiative forcing in this context means that the excess solar energy being trapped by greenhouse gases is a continuous two watts for every square meter of the earth's surface.

I told her, "You understand what a watt is. Why don't you calculate how much heat that is in one year for the whole earth? " She emailed back: "Yikes."

Often naysayers deflect the conversation by saying that there can be disagreement among experts. With global warming this turns out not to be the case. The overwhelming consensus among climate scientists whose expertise qualifies them to render an authoritative opinion is that global warming is real and urgent.

No matter what the true experts have to say, no matter what the laws of physics compel or the mathematics prove, naysayers will continue to mislead the unstudied. Present anthropogenic CO2 levels are bringing global temperatures up and proving Hansen's claim of radiative forcing. Even though global warming of 1 to

2 degrees F seems insignificant, the fact remains that when the earth is at equilibrium with the sun, average global temperature remains constant. In nature, it takes thousands of years to change earth's temperature by 1 degree F. Humans have done it in a few decades.

I told Jayna that most of us probably don't believe our weatherman even in his field of expertise: predicting the weather. I certainly wouldn't believe this man's opinion on global warming.

Ethnocentricity

We also suffer from ethnocentricity, a perception that we and our ways are better than other peoples and their ways. Our leaders remind us that we are the greatest nation in the world. Sometimes when they say that I wonder, Are we really? Switzerland is a fine nation. What's wrong with Iceland? Isn't New Zealand a fabulous place? Canada really seems to have her act together. The people of Mexico are very friendly and hospitable. The Japanese are so incredibly loving toward their children. Ethnocentricity causes pride, which can make people feel self-righteous. "That's just the way we do things in this country." Subconsciously we might feel that our country, no matter what it is, deserves to have benefits and advantages. That makes it more difficult to change cultural habits, even for the better. Ethnocentrism is a problem for Americans in the climate crisis because we are accustomed to using energy extravagantly while intuitively believing it is our right and privilege. When world leaders come together for a climate change accord, ethnocentrism is a key element contributing to discord. Some leaders even refused to attend Kyoto.

Global middle class population growth

For many years population growth has been a major global concern. Population growth by itself, especially in undeveloped

countries, has little to do with global warming because poor people in poor countries use comparatively little fossil fuel. However, in countries like India and China where prosperity is motivating millions of people to move to the cities and buy cars, refrigerators, and air conditioners, there is a direct correlation between middle class population growth and carbon dioxide production.

As global industrialization has advanced, largely because of the benefits derived from the use of fossil fuels, world population has nearly quadrupled, from 1.6 billion in 1900 to 6.1 billion in 2000. Fossil fuel energy use has grown at an even faster rate than the population itself.

Thomas Friedman makes the point very well in his book, *Hot, Flat, and Crowded,* that the burgeoning global middle class is a primary concern. He reports bustling cities in China with high-rise buildings that were villages a few years earlier. There are literally billions of people aspiring to the American lifestyle. When these new lifestyles are powered by fossil fuels, the inevitable result is more carbon dioxide.

If the people of China were to use energy per capita equivalent to those of the United States, CO_2 worldwide would soar incredibly. If India were to do likewise, CO_2 would astronomically increase. Friedman characterizes this phenomenal growth of the middle class as "too many Americans." It's happening faster than anyone would like to believe. Projections are that energy demand will increase in developing countries at the rate of about 5% per year. If these energy demands are met with fossil fuels, CO_2 levels will double in 20 years. Game over! We, the entire human race, lose.

It is sheer folly to think we can continue powering the developed world today and the rapidly developing economies of China and India with fossil fuels without consequences.

Friedman and others come to the same conclusion: developed countries must not only quickly reduce their carbon footprint; all countries must reciprocally share technology so that everyone can meet their growing energy demands with renewable energy.

If one were to express it in kilowatt-hours, the standard measurement for electricity, the total amount of energy used in the world today is 312 trillion kilowatt-hours per day, mostly used by the billion or so people living in developed countries. (Dymond) With another billion people in China in the wings in quest of the good life, they are set to demand their 312 trillion kilowatt-hours per day. This will happen by year 2025, a mere 15 years from now. Another wave of a billion, mostly from India, will rise a generation later demanding their 312. At this point, the energy providers of the earth will need to generate an unspeakably large number of kilowatt-hours: one quadrillion per day. If these also come from fossil fuels, the corresponding carbon emissions would triple.

Inertia

One of the most powerful forces in all the universe is the force of inertia. It is the force that allows things to continue unchanged. It's a force that maintains the status quo. It is a strong element in the human mind. Social change will have to overcome social inertia. Everyone who drives a Suburban isn't going to rush out and buy a Prius.

Those living in my country are part of a commercial-industrial engine called the United States of America. It is built on an expanding economy with expanding energy use. It's a roaring locomotive the likes of which the world has never seen. In many ways America is the envy of the world. Developing countries want to be like us and to provide the privilege and prosperity for their people that Americans are accustomed to having.

For this locomotive to slow down, stop, and change direction,

even for the sake of saving the planet, is no small challenge.

I've been in the renewable energy business since 1980. My energy awareness is greater than most, and I've known about global warming for some time, but I have to admit that only in the last ten years has the seriousness of global warming become a compelling concern to me.

Most people have a vague sense that something ought to be done, but I was curious to know how others regard the global warming issue. I sent out the following email to fifty business owners, teachers, a couple of scientists, a labor official, and a smattering of other friends:

Friends and associates,

I'm conducting an informal survey on global warming. Please answer these questions:
The first, how serious of a threat is global warming? The answer choices are:
1) Urgent
2) Very serious
3) A concern, but not a threat
4) No concern at all

The second question is: How well informed do you consider yourself on the issue of global warming? The answer choices are:
A) Very informed, I understand the science and have studied the issue
B) Informed to the extent of what I've read in the newspapers
C) Not well informed, just what I've heard from others
D) Know little or nothing about it

It was no surprise that those who answered that global warming is urgent or very serious considered themselves to be very informed on the issue. The most common response was #1-A. There were no #4 responses. My conclusion was that everyone surveyed thought global warming was at least a concern and virtually all considered themselves well informed (answering A or B to the second question).

Comments ranged from "it's too late" to "it's a hoax." I've spent hundreds of hours at lectures, reading books and periodicals, and speaking with members of the scientific community whose opinions I value most, and knowing what I know now about anthropogenic (human-caused) global warming, my own answer to the survey is #1-A, with reason to hope.

CHAPTER 5

Sold a Bill of Goods – Consumerism, Capitalism, and Patriotism

America is the glue that holds the world economy together. We've heard that in ancient times, "all roads lead to Rome." It could be said that all dollars lead to the U.S. Other countries, especially China, need us to buy their products. We're their biggest account. Recently China passed the U.S. in global warming emissions. In her defense China reported that 1/3 of all the country's greenhouse gases come from manufacturing and shipping products to be sold in America. Therefore, it can be argued that 1/3 of China's carbon footprint should be charged to the U.S.

China is theoretically a communist or socialist country, but today's industrial China is very much capitalistic in function. Countries with free market systems like America believe that capitalism is a better way to propel an economy because it rewards those who work hard with increased profits. It's worked that way for centuries. The problem is that capitalism no longer seems to work that way. There are many people who work long and hard but never get ahead. Some do, but capitalism certainly doesn't assure it.

As a political science major in college, I studied the major forms of government and political ideologies. I truly believe in democracy and capitalism. I go to work six days a week and compete with others in my industry to deliver a service and a product at competitive prices. I choose to live in the United States, the place where I was born, and a place I dearly love for its beauty, the "can

do" attitude of its people, Yankee ingenuity, and its unbridled entrepreneurship.

Some believe that the idea of global warming is an elaborate scheme to bring down free enterprise, and that those professing the greatest concern have a socialist agenda. Socialism thinks of the community first, and uniting the global community to address global warming is the most effective way to bring about positive change. At the same time, what we do individually in our energy choices affects the entire global community.

It's not an all-or-nothing proposition. Even if we decide we will make energy choices that reduce our carbon footprint, this does not mean we have joined the communist party. We can still be capitalists – heartless capitalists if we want. We just have to figure out how we can do what we want to do without putting all that CO_2 up there. If we're worth our salt as entrepreneurs we should be able to figure it out.

In my own case, I've invested a substantial sum in conservation and renewable energy and it's been a great investment. I'm getting a good return.

It has been hypothesized that if the wealth of the world were evenly distributed, within 10 years or so it would be back in the hands of the few who currently hold the wealth. If this is true, those who claim that efforts to combat global warming are an attempt to disrupt the current free enterprise system and redistribute wealth shouldn't be concerned. After the dust settles, you'll be in the same relative place as before.

The United States, with the world's largest economy, continues to be the world's greatest capitalist country. Capitalism and the free enterprise system, in theory, deliver a robust economy, a high standard of living, and the good life to its adherents.

Patriotism, the loyalty to one's own country, is encouraged worldwide and in some places, those who don't show it are punished. In America we're free to be patriotic or not, though

we're much better thought of if we are patriotic. As they used to say during WWI, "My country, right or wrong."

Most Americans are patriotic, capitalist consumers. Some show their patriotic consumerism by buying American products. It's more important for some to buy a Chevy or Ford regardless of its gas mileage. Government fleet vehicles are mostly American made.

Companies often show their patriotism by leasing a fleet of American-made cars. It's rare to see, but a local cab company in my area has decided to go with Prius hybrids. They're the company I'll call for cab service. Some people may view that as being unpatriotic.

Patriotism, along with ethnocentrism, the tendency for people to think of their country as being better or more important than other countries, are problems in surmounting the challenge of global warming. These two dovetail into the conviction that we have earned the privileged life and are entitled to keep it. This is only a problem if we have no qualm about continuing to use fossil fuels in maintaining our own affluence.

The economic advantages that the baby-boomers of America have enjoyed are unparalleled in all of history. It is very likely that I, an upper middle class American, enjoy a more comfortable lifestyle than did kings and queens a hundred and fifty years ago. The automobile, the jet airplane, electricity, cell phones, computers, satellite assisted weather forecasting, and global navigation systems have truly enabled us to live like kings. It's the sort of regal life from which we're not apt to willingly depart. Nor will we have to.

Most of the people of the world understand their own existence in terms of the greater community in which they live. Americans, however, have been steeped in the philosophy of rabid individualism. We work hard in order to benefit ourselves and our families, and we want to enjoy the fruits of our labors. It's

such a societal problem that habitual consumption is considered normal.

We do what we want, when we want, how we want, and if we produce 10 times the CO2 as the average resident of planet earth, that's just another privilege we enjoy. If America is about anything, it's about freedom, right? Freedom to life, liberty and the pursuit of happiness; it's in our very constitution and in the essence of who we are. That's not going to change. If we want to drive our SUV to the NASCAR race, cook 16 ounce T-bones on the barbecue at the tailgate party, watch a swarm of loud, souped-up cars go around and around in circles for 500 miles racing at 200 miles per hour, then by-damn that's what we'll do. If we get drunk and throw up on somebody's foot, that's okay too; it's just part of the fun.

It is arrogant and misguided thinking that any extravagant use of energy is our right and privilege, even if it means the entire earth goes to hell.

A sense of energy entitlement can take on many forms. If we can afford it, who can question us? Having tons of money doesn't give us the right to put tons of CO2 into the atmosphere that will adversely affect everyone else on the planet.

CHAPTER 6

Ambivalent Politicians

If Shakespeare were writing a play on American politics today I'm not sure if he would write tragedy or comedy. Jimmy Carter summed it up well in a speech he gave in 1976:

> What you see too often in Washington and elsewhere around the country is a system of government that seems incapable of action. You see a Congress twisted and pulled in every direction by hundreds of well-financed and powerful special interests. You see every extreme position defended to the last vote, almost to the last breath by one unyielding group or another. You often see a balanced and a fair approach that demands sacrifice, a little sacrifice from everyone, abandoned like an orphan without support and without friends. (Carter)

When President Carter spoke of special interests, none comes to mind more vividly than the tobacco industry which contributes millions of dollars to candidates of both parties to insure that whoever wins will look the other way as they continue selling addiction and death.

The fossil fuel industry is a humongous global enterprise that has a huge stake to lose by admitting that climate change is a problem. Elected officials from oil states are going to be heavily lobbied by the oil industry for favorable legislation. Coal will be there too. Thomas Friedman proves a person cannot be

elected President without the pivotal coal producing states of Ohio, Pennsylvania, Tennessee, and West Virginia. (Friedman p. 376) The vested coal and oil industry will defy any meaningful legislation Congress might try to put forth.

Because of this, we should not, and cannot, expect any real leadership on the global warming front from our national leaders. This doesn't mean we don't try because they need to know what we think. A quick look at how long it's taken to address the health care issue shows the lumbering nature of Congress. Health care is a far smaller issue than global warming. We've spent decades trying to sort out the complexities of health care. At that rate, it could take centuries to deal with global warming. It should come as no surprise when I say we can't rely on political leaders to solve the problem of climate change for us. Even if they promise it during election times, big oil and big coal will likely get to them. It takes tens of millions of dollars to get elected to high office in America. Even candidates in local elections can spend millions. One can't betray those who provide the money. If you want to know what a candidate will really do in office, look at his or her list of major donors.

Even the purest of candidates can't survive long. Jimmy Carter, who initiated the solar tax credits, was practically run out of town on a rail as interest rates ballooned to 19%. Reagan defeated the incumbent Carter, promptly appointed Michel Halbouty, an oilman, as chairman of his Energy Policy Task Force, along with executives from Shell Oil, Standard Oil of California, and Du Pont. (Connelly, Sadler and Schmeal) Practically his first order of business as President was to yank off the solar panels Carter had installed on the White House. He also yanked the carpet out from under energy conservation measures and the renewable energy industry that had begun to flourish under Carter.

Special interests and their influence on politicians are a formidable obstacle to the fight against global warming. New York

Times writer Michael Pollan said it well in an article entitled, "Why Bother?"

> For us to wait for legislation.…to solve the problem …suggests we're not really serious about changing. They will not move until we do. Indeed, to look to leaders and experts, to laws and money and grand schemes, to save us from our predicament represents precisely the sort of thinking…that got us into this mess in the first place. (Pollan)

I've been a part of the legislative process and seen how it works. A person or group puts forth an idea that will benefit his or her industry. They find a legislator to sponsor a bill, which their attorney may have already written. To have a relationship with a legislator usually means contributing to his or her campaign. As little as $200 can buy a personal conversation by phone. Representatives are very busy; they have everyone wanting a piece of their time, and for the most part the people who get an audience are those who have contributed. This is completely understandable. Every elected official is a fundraiser. They can't get into office and stay in office without money. One such person admitted that he had to raise $10,000 per day to have a chance to capture his office. I suppose that was a hint. He must have met his fundraising goals because he did in fact win.

When I call a representative's office looking for a bill to be sponsored, the first thing I say to the staff person who answers the phone is: "Hi, I'm John Patterson, I contributed to the senator's campaign, and I'm looking for sponsorship on an energy bill." The reply, if the senator is in, is: "Thank you, Mr. Patterson, I'll put you right through."

Anyone can call their representative, even if they haven't contributed, but they likely will be handled differently. When you

call and say, "I'm Sara Smith, I voted for Representative Jones, and I'm looking for support on a new energy bill," the likely response for this would be: "Do you have a particular bill, or bill number? I'll tell the representative you're in favor of the bill." Elected officials actually do tally the calls, emails, and letters. Handwritten letters, believe it or not, get the most tally points. They add up the points and consider them in their voting.

Imagine the response with this phone call: "Good morning, this is Warren Buffet…" Just as important individuals have access, well-known and well-organized groups such as the IBEW (International Brotherhood of Electrical Workers) and the NRA (National Rifle Association) have immediate access to virtually any state or national leader. So do organizations like the Independent Petroleum Association of America (IPAA) and a host of other fossil fuel energy associations. Moreover, as Jim Hansen points out in his book, *Storms of My Grandchildren*, "there are thousands of oil, gas, and coal lobbyists in Washington. These lobbyists are very well paid. It is no wonder that government energy policies are so hospitable to the fossil fuel industry." (Hansen p.224)

Once a representative gives ear to your idea and agrees to have staff look at the draft of the bill, and if he or she feels the idea has merit (or that keeping you happy as a contributor has merit), the representative will sponsor the bill. Then a series of committee meetings occur to hear both sides of the issue – that is, if both sides are aware of the bill. If they are part of a group that has a political watchdog staff, like the IBEW, for instance, they will appear at each hearing and declare their favor or objection. Many senators and representatives don't take the time to really study your bill. They are counting on little or no opposition and relish being served up a cream puff bill with no objections. They'll pass it to the revenue committee, which assesses its budgetary impact. If it has little or no budget impact, budget committee will also pass it, then it goes on to the House or Senate floor, and finally

to the Governor's office, or the President's in the case of national legislation. If there is any disagreement at the committee level, the committee will not pass the bill. They will either kill the bill or ask the interested parties to get together to hash out their differences and try again.

The real work of legislation takes place behind the scenes. Most Americans cannot be a part of the process. They're working at their regular jobs. They can't break away to go testify at a hearing that they don't even know is taking place. In this sense government by the people has become a modern day myth. Instead what really happens is lobbyists go from representative to representative securing their support. When enough votes are committed, the vote on the House or Senate floor is a foregone conclusion.

As a young political science major I was excited to go to Washington D.C. and watch our government in action. I sat in the Senate gallery for half a day. There would be a handful of senators debating on a mostly empty Senate floor. They made brilliant speeches to each other, but there were less than a dozen of them present. Then a bell would ring and the room would fill with 70 or 80 senators who would then vote without having heard any of the eloquent debate I witnessed. This seemed funny to me. For whom was the debate? For those of us in the gallery?

The news program 60 Minutes documented with a hidden camera legislators from South Carolina filing in and out of a room where each was given $200 in cash for their vote. Two crisp one hundred dollar bills straight into the wallet, tax-free. Benjamin Franklin, one of our most noble leaders, would have rolled over in his grave if he'd seen the bills bearing his picture passed around in this way. Obviously, exposing South Carolina's back room politics was a gross embarrassment to all Americans. Free box seats at Redskins football games and fishing trips to remote lakes in Canada reachable only by floatplane – these are the refined ways of winning allegiance.

Politicians are not the only ones to do this. Businesses of all kinds buy blocks of sporting event tickets and give them to their clients to secure business. It's a corporate expense that's tax deductible. It's smart business. I've been entertained that way. When I was a realtor, a title insurance company gave me a seat a few rows back of courtside at a Portland Trailblazer basketball game. I sat right behind pro golfer Peter Jacobsen. These were good seats. It was cool watching Jacobsen chide the referees and seeing their personal acknowledgement of his comments. I enjoyed the game so much I gave all my escrow business to that title company for the entire year. They made their investment back many times. To show our gratitude for kindness and generosity is human nature, really, and our elected officials are certainly human. In some countries there's no need to be subtle. In India bribes are the only way to get anything done.

Everyone in politics has agendas, but saving the planet doesn't seem to be one of them.

We, the electorate, have rendered our leaders incapable of really leading. We have tied their hands by requiring them to represent our particular interests and the interests of our region. Their main job is to insure economic prosperity back home. We have not afforded them the freedom to look at larger scale issues. How are they to address global warming even if they understand it is a serious problem that demands their attention? They have a short time of just a few years to prove themselves worthy of reelection. Nevertheless, there are a few elected officials who are capable of leading on the global warming issue: California Governor Arnold Schwarzenegger, Washington State Senator Maria Cantwell, Oregon Governor Ted Kulongoski and a handful of others.

Ultimately the working dynamic with elected officials and the

electorate is inherently reactive in nature. Once politicians are in office, the only power the electorate has is to vote them out of office. Solving global warming will take an immediate pro-active approach for which there is no precedent. All the great pro-active changes in America came first from the people, such as women's suffrage, the abolition of slavery, and the civil rights movement. In those cases government reacted to us by passing laws.

Because of the nature of this relationship, politicians are forced to debate issues in the most vague and general terms possible. They are artists in the use of vocabulary to give an overall favorable impression without taking any real stand. I wonder if there's a school for that? In order to get elected they have to stay within the confines of the lowest common denominator or risk alienating part of the electorate. Entire elections have been lost with a single word or phrase, as with Ross Perot's, "You folks." No wonder politicians are skittish.

The voting records of elected officials are easy to look up on the Internet. Certainly we can become politically active, and those who do can certainly have influence. Keeping track of the issues that are important to us and working strategically toward a goal can easily amount to a full time job. I, along with the concerted efforts of others, have helped push several pieces of legislation through my state. As a result, Oregon is one of the leading states in putting forth legislation that promotes conservation and the use of renewable energy.

The point is that we cannot be passive and rely on political leaders to accomplish what needs to be done on the global warming front. We can only rely on ourselves and upon those we can influence.

Former Vice President Dick Cheney made the statement, "Conservation is an admirable virtue, but you can't base an energy policy on it." Well, yes we can, Mr. Vice President, and we should. I know that I could go into almost any home in America and cut

the energy usage in half through conservation and efficiency. This is exactly what our energy policy should be based upon, along with a commitment to renewable energy.

Since most of the thermal and electrical energy generated in the U.S. comes from burning fossil fuels, the average American could fairly easily reduce his or her footprint from 20 tons per year to 10. This is how the people of Germany and Japan live, though their climate is generally colder and less sunny that most of the U.S. We could have the same comforts and lifestyle as our fellow first-world citizens using half the fossil fuel based energy. With all due respect for the service he provided to our country as Vice President, no one can tell me that if Americans were shown how to use half as much energy that we could not base an energy policy on conservation. Of course we could, especially when that policy includes renewable energy. Although Mr. Cheney is a brilliant businessman, I wouldn't listen to one word he says about energy, and I wouldn't go hunting with him either.

It is foolhardy to believe any political leader is going to lead the charge for an erstwhile campaign to solve global warming. Al Gore may be as close as we ever get.

Dr. William O. Marty, my favorite political science teacher, challenged us to look seriously at the political realities of an election. After studying all the governments of the world he asked if American Democracy was best. In the late 60's when I was in his classes, the students with short hair said yes, while those with long hair said no because of Vietnam. He pointed out the limitations of a representative democracy. He said that when you go to vote, you are essentially expressing your will as a citizen. Let's say there are ten issues in a given election. With candidate "A" you like his position on four of the issues. With candidate "B" you like her stance on five. There is no candidate "C" whose position is the same as yours on all ten issues. So, you vote for candidate "B" because she shares more of your views than candidate "A." This is

an imperfect choice, not an express statement of our will.

Even if our candidate wins there is no guarantee the candidate will deliver on campaign promises. We all remember George Bush, Sr.'s famous words, "Read my lips…no new taxes." Well, for all of us who voted for him for that very reason, guess what? He raised taxes. Those of us who voted for him for that reason were powerless until the next election.

So, unfortunately, government by the people doesn't really exist, and government for the people doesn't seem to either. For over twenty years the polls showed people in America favored renewable energy, yet during the same period there were no Federal incentives. Government did not manifest the will of the people. Some of those elected to high office may have our best interests at heart, and may want to do the right thing, but they soon discover they have to compromise to get anything done, so the end product is diluted to the point of being almost meaningless. A great example of this was the "cash for clunkers" bill. This had been done effectively in Germany. However, by the time it was worked over by our representatives in Washington D.C., you could trade your clunker for another clunker that got as little as 4 miles per gallon more. The intention started out well, but the end result should have been far better.

If our individual vote seems to lack any real power, our collective vote certainly does. Furthermore, we possess great individual power in our ability to make energy choices.

Supply and demand, that great pillar of capitalism, will do the job our politicians won't; and at the same time ease the stranglehold the fossil fuel industry has on our elected representatives.

We have a choice about what cars we buy. For many of us, there is the choice to buy green energy. We can lead our country into its

rightful energy future by choosing clean, renewable energy, buying electric and hybrid cars, and getting serious about conservation.

I remember reading an article once about the ten richest people in the world. If anyone had it made, those guys did. Yet, as they were each interviewed there was one thing they all had in common. They all talked about the deals they had going to make even more money. It was sadly comical. They're billionaires, with everything one could ever imagine, yet their thinking was dominated by how to make even more. Seems a bit obsessive to me.

The inseparable alliance between the wealthy and those wielding political power is part of the permanent landscape in America. It's been that way since the country was founded. George Washington was perhaps the richest man in America in 1776. Adams, Jefferson, and Madison were all rich men. In modern times the rich work behind the scenes and their influence is just as potent as it's ever been. It may have made this nation great economically; but it's a problem now if the rich care only about making more money without considering the environmental toll.

We have a massive global problem that is getting worse daily. When the wealthy and their representatives refuse to provide serious leadership in the climate crisis, they are actually in our way. We have to do what is necessary in spite of them.

This is not to say that our elected officials are worthless in combating global warming. In fact they are among our very brightest and talented citizens. They are lawyers and business leaders. They are graduates of Princeton (Wilson), Harvard (Kennedy) and Yale (Bush). They have effectively led state governments and accomplished a great deal on their way to Washington. The dilemma is that they have to listen to those who give them money because they can't acquire the office without it. If the rest of us are silent, they only hear the money. For this reason, many believe that campaign finance reform should be the first order of business. If the issue of global warming comes down to a clash between science

and economics, we know the side our political leaders will take. Their jobs depend on economics, and they are judged only by what they deliver in the short term; the longer-term scientific problem of global warming is far less relevant to them. That is unless we make it relevant. Don't vote for them if they take a weak stand on global warming, and let them know it.

They won't lead us out of the problem; we must lead them. We have to call, email, threaten not to vote for them, keep calling to remind them that they represent us, write the newspapers, exercise every bit of leverage we can from any direction to move them to meaningful action. It's a bit like dislodging a tree stump. We have to leverage from every angle, pull, dig, pry, get our friends to help, dig deeper, and pull some more until we can finally move it. It takes a long time but the effort must be made. Our elected officials do possess great power. A United States Senator has more real power than the ruler of most small countries in that what he or she does in office can affect far more people worldwide.

In a speech on August 4, 2008, presidential candidate Barack Obama listed three measures to bring in the new energy economy. Step one is to help get American automakers to build one million plug-in hybrid cars that get 150 miles-per-gallon. The second is to require 10% of our energy from renewable sources within four years. Finally, he called upon the American people to conserve by reducing electricity usage by 15% in ten years.

These are good solid goals. They're probably as ambitious as any presidential candidate can dare to suggest. The problem is that they are too little too late. First, there are 250 million cars in the United States. One million of them getting extraordinary gas mileage is way too few. We have to decide with our purchasing power to achieve 100 times this goal, or better yet, 200 times.

Secondly, if all we do is to obtain 10% of our energy from renewable sources in four years, we've not just lost a battle but perhaps the entire war with global warming. The goal should be

to make a behemoth effort, like the effort the country used to win World War II. This really is a war, and our loss will be cataclysmic if we fail. The challenge should be an all-out effort for Americans to generate 50% of our electricity from renewable sources in four years and 80% in ten years. This is what is actually needed.

The third goal of 15% energy reduction through conservation is terribly anemic. Anyone in the energy business knows we've barely scratched the surface on conservation. We've changed a few light bulbs, and that's supposed to be our crowning achievement. Obama is right in characterizing efficiency and conservation as "by far the fastest, easiest, and cheapest way to reduce our energy consumption." If there's a war on, we should be able to go much farther than 15%. I've seen many clients go from 30 kWhs of electricity per day to under 10. Some have gone to 4 or 5. That's an 85% reduction. By and large when people do this, their comfort and lifestyle isn't compromised. All they've done is trim the waste and approach energy usage deliberately and thoughtfully. I got my own energy usage down to 4 kWhs per day. The national average per household is 30. I met someone recently who brought his down to 3.

This is about as far as anyone can go with conservation alone. Those of us who go all the way to zero use a photovoltaic system or other renewable energy system to generate the final kWhs that can't be conserved.

Will our leaders do too little too late? When sea levels rise and large groups of people are displaced, and changing weather patterns wipe out crops all around the world, will they be judged on their short sightedness and inaction? We look at the greatest tyrants in history who slaughtered millions – people like Adolf Hitler, Joseph Stalin, and Idi Amin. How will history remember leaders who had reliable information about global warming and failed to act? Ultimately, leaders who lack the wherewithal to confront the issue, who fear economic repercussions, or who put

their immediate political agenda ahead of the safety of the entire human family could place the fate of billions in peril.

Heads of states – especially presidents of the United States – have the best advisors in the world. I shudder when I read that Dr. James Hansen, a climatologist and one of the head scientists at NASA, has been cautioning presidents regarding climate change for 20 years, only to be largely ignored. With CO2 levels already well over 300 parts per million for the first time in human history, business continued as usual under each administration.

Even though Hansen is regarded by Time Magazine as one of the 100 most influential people in the world, he feels his warnings have been repressed by top American political leaders. Hansen urged immediate policy changes in order to avoid irreversible damage as CO2 levels passed 350 ppm. Years before he had warned that levels above 350 could tip climate change out of control. He has repeatedly issued warnings such as this one:

> We must begin to move now toward the era beyond fossil fuels. Continued growth of greenhouse gas emissions, for just another decade, practically eliminates the possibility of near-term return of atmospheric composition beneath the tipping level for catastrophic effects. (Hansen)

In a 2004 speech at the University of Iowa, Hansen said that, "such warnings as these…are consistently suppressed, while studies that cast doubt on such interpretations receive favorable treatment from the administration." He also said reports that outline potential dangers of global warming are edited to make the problem appear less serious.

Hansen briefed the task force headed by Vice President Dick Cheney, whom he characterized as wanting to hear only scientific results that "fit predetermined, inflexible positions." He felt that

evidence that would raise concerns about the dangers of climate change is often dismissed as not being of sufficient interest to the public. (Associated Press)

Our leaders knew the situation and chose to ignore it. Furthermore, America is such a leader in innovation, had we begun twenty years ago what we urgently need to do now, other countries would have joined us and we'd be well down the road to change rather than racing to avert global climate disaster.

Leaders of the future must be held accountable for what they do about global warming. They shouldn't be elected without a clear commitment, or reelected without a demonstrated follow-through on their commitments.

Leaders in the United States and China, the world's largest polluters, have the greatest responsibility in shifting their energy futures to renewable, non CO2-producing fuels. Certainly all leaders of all countries share the same responsibility. In the fall of 2009, world leaders were positioning for the Copenhagen Summit to take place in December. The Prime Minister of Nepal and 20 of his cabinet members stood at a base camp in the Himalayas. The demonstration was to remind the world of the negative impact of climate change on the Himalayan Mountains. Scientists say that Himalayan glaciers are melting at an alarming rate.

In the island nation of the Maldives off the west coast of India, the cabinet members held an underwater meeting to call attention to the rising sea levels in the Indian Ocean archipelago, and the dangers this represents. Meanwhile President Obama, preparing to commit the U.S. to an agreement to reduce CO2 by 17% by 2020, received a letter of opposition from 20 GOP senators. The U.S. Senate will have to ratify any agreement the president signs for it to be binding.

I went to see Al Gore speak in Portland, Oregon in November 2009. He told a story about a face to face, one on one meeting with The Premier of China, who told him, "There is one big obstacle

to a climate change agreement: the United States Senate." The proposed 17% is far too small a goal; but even that is being opposed by senators who represent entrenched energy interests.

For human existence to continue on earth, 90% of the energy used must be renewable. The transition period is now. If it takes 100 years it's too late. If it takes 50 years it's too late. From my research and from talking with those who have the greatest knowledge on the matter, if it even takes 25 years, it's too late. It has to be done in 10 years, according to the reports from leading climate scientists. It's worth hearing again from James Hansen:

> Continued growth of greenhouse gas emissions, for just another decade, practically eliminates the possibility of near-term return of atmospheric composition beneath the tipping level for catastrophic effects…The stakes, for all life on the planet, surpass those of any previous crisis. The greatest danger is continued ignorance and denial, which could make tragic consequences unavoidable. (Hansen)

Some may ask, "If you don't believe the Federal government can unite and lead the country on climate crisis, what makes you think the people can do it by themselves?"

The fact is in America we do most of what we do without, or in spite of, the government. We can do anything we decide we want to do. We don't have lobbyists pulling and tugging at us. We have absolute freedom to choose where our energy will come from and how much energy we'll use. As an example, Jimmy Carter has been far more effective as a private citizen after his presidency than he was while in office. Obviously Al Gore has been more effective in his post-political career.

The clash between science and economics is a real fight. The scientific expert enters the boxing ring as the proverbial 90-pound

weakling. His opponent is a 900-pound fire-breathing dragon backed by the political industrial might of the entire world. If the dragon succeeds, he will turn on the crowd and scorch them to death. Who can slay the dragon? Only the crowd; and of course, we the people are the crowd.

CHAPTER 7

Slaying the Dragon, or to Kill-a-Watt

The kilowatt-hour is a quantity of energy familiar to most of us. We pay for the electricity we use in our homes by the kilowatt-hour. Each electric light and appliance uses a certain number of watts to operate. To determine the amount of electrical power used we multiply the number of watts the device uses times the hours it's turned on to get watt-hours. A thousand accumulated watt-hours equal one kilowatt-hour. If we were to turn on a lamp that has a 100-watt light bulb for 3 hours, we would use 300 watt-hours of electricity. Therefore, a 100-watt light bulb on for 10 hours uses 1 kilowatt-hour. A 200-watt television on for 5 hours uses one kilowatt-hour. Desktop computers use 100 watts or so; but laptops use 20 or less. For all electric appliances and lighting, most American households use about 30 kilowatt-hours per day, or 10 per person (average 3-person home).

At the gym the exercise bike tells me how many watts of power I generate as I pedal. I can sustain about 200 watts for a solid 20 minutes. This amounts to 66 watt-hours. (200 watts x 1/3 hour = 66 watt-hours). I am covered in sweat and breathing hard after this workout. If I wanted to generate a full kilowatt-hour I would have to pedal five hours. (5 hrs. x 200 watts = 1,000 watt-hours or 1 kWh)

That is a lot of work. Incidentally, I've heard that Lance Armstrong can pedal at the rate of 750 watts, which is equal to one horsepower, in which case we could say Lance is a stud of a bicyclist. There's only one Lance Armstrong, but there are plenty of people like me who can pedal at the rate of 200 watts.

A fit person can pedal at the rate of 200 watts, enough to power a 19" TV, as long as he keeps pedaling vigorously.

Let's calculate what it would take if we were to meet our electrical energy needs by pedal power. To provide an individual's 10 kWh per day, he or she would have to pedal 50 hours per day. (200 watts x 50 hours = 10,000 watt-hours or 10 kWh). This is clearly unsustainable since there's only 24 actual hours in a day. We simply can't supply ourselves with the energy we've grown accustomed to using. Furthermore, electricity is only one part of our total energy requirement, there's also natural gas and petroleum. Since we can't humanly supply ourselves, what do we do?

We go shopping every day for energy. When we pull up to the gas pump we're shopping for energy. When we set up an account with the gas company before we move into a new home, we've done our shopping in advance, though we pay for our usage each month. We hire our local utility to do the work of generating kilowatt-hours for us. In the Northwest, nearly half of our power comes from the dams on the Columbia River. When I order a kilowatt-hour from my local utility, they take the order and release approximately 6,000 gallons of water into the turbine to provide my kilowatt-hour.* It happens automatically, without my calling to place the order. They just do it. This is convenience shopping at its

best. 6,000 gallons of water – enough to fill a back yard swimming pool 16 feet in diameter and 4 feet deep – instead of 5 hours on the exercise bike sounds like a good deal to me. The best thing is that they only charge me a dime to do this. I couldn't pay anyone I know, including myself, ten cents to pedal for me for 5 hours.

**(Calculation: According to Bonneville Power Administration, some dams on the Columbia River require 1,000 cubic feet of water per second through the turbine to generate 4.7 megawatts; therefore, 4.7 mW = 1,000 ft^3 per second/ 7.48 gallons per ft^3 360 seconds per hour = 2.69 x 10^7 gallons per hour divided by 4.7 = 5.7 x 10^6 gallons per mWh divided by 1,000 kWh per mWh = 5,729 gallons for one kWh)*

With the exercise bike, the force of my thigh muscles pushing on the pedals generates electricity. With hydro it's the weight and force of the water falling onto the turbine that generates electrical power for me. Coal, along with other combustible carbon-based fossil fuels like oil and natural gas, are burned to make electricity. Natural gas directly fires the turbine, operating much like a jet engine to make electricity. With coal and oil, the fuel is burned to boil water. The pressure of steam turns a turbine that generates electricity. Even nuclear power plants split atoms in a controlled nuclear explosion, which produces heat that boils water for steam turbines to generate electricity.

Of course, most of the electricity in America comes from burning coal. If I travel one hundred fifty miles up the Columbia River, I come to the Boardman coal plant. We don't hear the clerk yelling, "Drop another 30 pounds of coal in the hopper for the Johnson family today over on Elm Street," but that's exactly what's happening. When we use power, someone in a power plant somewhere is filling our order.

Further upriver are wind turbines, lots and lots of them, gracefully swooping through the air, loping in slow motion. The force of the wind, very similar to the force of the falling water at the dams, turns the turbines. I've driven through the wind zones on my motorcycle and nearly been blown over. I wondered why

the blades didn't turn faster when the wind is stronger. I found out when I got to go inside one. They have gears so that they spin at more or less the same rate in any wind speed. Riding next to the wind turbines feels like riding through the Redwoods, cruising along the Avenue of the Giants.

Although these tall, three-petaled flowers put out millions of watts (called megawatts or mW), in 2009 they account for less than 10% of the electrical power for Oregonians. People have to special order this "green" power. It costs about 1 cent per kilowatt-hour more than the electricity that comes from burning coal. I, along with a growing number of the people of Oregon, Washington, California and may other states, have signed up for the green energy option. It thrills me every time I see a long flatbed truck going up the Columbia Gorge with a single one hundred fifty foot long wind turbine blade. "The Johnson's must have ordered green power; hooray for them!"

The kilowatt-hour brings the work involved in power generation into perspective. The same amount of force exerted by 6,000 gallons of water falling from the dam and into the turbine is the same amount of force I'd have to use peddling the bicycle generator for five hours. It is also the same amount of force exerted by steam generated from burning fossil fuels or splitting atoms. One kilowatt-hour would be the same amount of force exerted by 25 mph winds blowing through the world's biggest wind turbines in just a few seconds.

When we buy green power, we are usually buying wind energy. Giant commercial turbines as tall as a football field can generate a million watts (one megawatt) in full wind.

It is easy to translate all types of energy into kilowatt-hour equivalents. The thermal energy we buy in 1000 cubic foot natural gas increments (called therms) can be translated into kilowatt-hour equivalents. There are 29.3 kWh in one therm. Most of us require more thermal energy to heat our homes and domestic hot

water than we require electrical energy for lights and appliances. Since most of us don't have a good idea of what a therm of energy is, it's more readily understood converting it to kWh equivalents. In addition to the 10 kilowatt-hours of electricity we use, the average American uses 15 kWh equivalents per day in natural gas.

Adding that to our shopping cart gives us 25 kWh so far. Now comes the biggie: transportation. Most Americans use more energy driving their cars than anything else. In addition to propelling our bodies, weighing an average of 170 pounds, combusting petroleum has to do 30 times more work in propelling the two or more tons of steel and rubber we're riding on. If you haven't guessed, kilowatt-hour-equivalents for transportation for the average American are equal to electricity and natural gas combined; yes another 25 kWh equivalents.

So now we have 50 kWh. This could be called a standard American daily energy requirement. It is the direct energy needed to power our lives. But we're not done shopping.

Whatever we have in the cart, we have to double that when we get to the checkout stand. The reason is what I'll call the indirect or "institutional power" we all require. This consists of a long list of services beyond our direct energy needs. The list includes energy to bring our food and commodities to us at the stores where we shop, the restaurants and businesses we frequent, our schools and government facilities, our hospitals, public transit systems, and last but certainly not least, the United States military. All of the energy from these peripheral sources can be as much as the energy we directly use in our homes and for personal transportation. The grand total: 100 kilowatt-hours per day for every man, woman and child in the United States of America.

One way to comprehend the magnitude of the energy we require is to go back to the 200 watts that one reasonably fit person can generate on the exercise bike. If we hired this person to serve us by pedaling 10 hours per day on our behalf, he would generate two

kilowatt-hours per day. We would need 50 such servants for each member of our household.

Before electricity we humans did all our own work. The early colonists did it all and barely survived. Passengers to the New World who couldn't afford passage by boat to America paid by agreeing to work seven years for the person who paid their fare. The workers were called indentured servants. Even with the indentured help, early colonists had a hard time. They couldn't figure out how Native Americans survived on their own.

Back then and until about 1950, animals helped do a lot of the work for us. I can remember my great grandfather plowing his garden with a mule. It was quite humorous as the stubborn mule begrudgingly advanced while my grandfather awkwardly stepped in and out of the new furrows.

With the exception of communities like the Amish, we don't see anything like this in America today. The work being done by others on our behalf is invisible. We don't even realize we have 50 energy slaves. Kids sitting for hours playing video games don't see them either.

It helps to follow energy use in America since WWII from generation to generation.

My grandma drove what we called her "antique" 1938 Dodge to the store, to church, to visit nearby friends in her small town and to pick me up at the Greyhound bus station half a mile away in a small town in middle Tennessee. She had a nice garden in the back yard. She made biscuits every morning from scratch. She lived in a small, comfortable house. She had raised three boys as a single mom in the Depression. She used hot water sparingly, only allowing us grandchildren a few inches in the tub rather than letting us fill it and pretend it was a swimming pool. She washed clothes with a washboard and hung them out on a clothesline. If it was a rainy day, she'd hang them on the back porch. In the winter we piled the covers on, many of them hand-quilted by her and her

friends. I can still remember how well I slept under that thick pile of covers, hearing the comforting sound of the hand wound coo-coo clock ticking off the seconds of the day. She bought vegetables she didn't grow herself from local farmers. Eggs she got from a nearby neighbor. If times were good, we'd have country ham raised locally, and she'd make red eye gravy that was so scrumptious on those homemade biscuits.

She didn't have a television or feel the need for one. We listened to the radio sometimes, never passively, but all sitting in the living room paying close attention to the story being told or the music being played. She must have picked up the habit listening to FDR's fireside chats.

She had no air conditioning. It was hot in Tennessee in the summer. Grandma knew exactly how to deal with it. She'd open up the windows at night and let the cool air in, then close the windows by 9 a.m. to lock in the cool air while the outside air rose to 90 sweltering degrees with at least that much humidity. She'd do active chores in the morning and get through the hottest hours of the day by gently swinging on the front porch swing chatting with the next door neighbors who were doing the same thing. Barely swinging had the thermodynamic benefit of moving her entire body through air, simulating a cooling breeze even on a stagnant air day. This worked far better than fanning, which cooled only the face. Inside, fanning had to suffice on the hottest days.

Passers-by would often stop and join in conversation. Visitors were given iced tea to cool them down. As hot as it was, I loved visiting Grandma in the summer. She lived the simplest of lifestyles. I remember sitting on the porch snapping green beans that the neighbor brought over. She always had a smile. She'd stand over the sink washing dishes by hand, singing softly. She had a shallow pan filled with warm soapy water, and a second pan with cool rinse water, and a third for final rinse. She hand dried the dishes and put them away. We kids would crowd into the assembly line to

help. When we were finished, the wet towel was hung on the stove handle to dry. She'd do a meal's worth of dishes for 5 or 6 people with about a gallon of hot water. She'd do them right away after the meal, before food residue would stick to the plate.

Grandma never let modern ways intrude upon her simple lifestyle. We gave her an electric carving knife for Christmas one year. She never used it. She didn't need to run up the electric bill with an electric knife when she had carved hams and turkeys all her life with a regular knife. Grandma did not accumulate stuff. There were a couple of trunks in the attic mostly filled with old photos and memorabilia. The things grandma bought got used until they were used up. There was no replacing things just to modernize. The radio, built in 1920, worked just fine all the way up to 1980 when Grandma died. Grandma lived 90 years and died the most content person I've ever known. Her life was a testimony of the beauty, tranquility, and peace that comes from simple living and putting people ahead of things.

I don't think Grandma ever flew in an airplane. When she traveled far, she went by train or Greyhound bus. Most of the time we came to visit her, which we always loved. There was something truly lovely about her simple life.

If I were to calculate Grandma's footprint, it would be pretty small I'm sure. She drove perhaps 20 miles per month (I drove 2,000 until recently). Her electricity usage was probably under 5 kilowatt-hours per day. If it weren't for the coal-fired furnace, she'd have had almost no footprint at all.

By stark contrast, those of my generation eat food that has been transported an average of 1,500 miles; nearly everything grandma ate came from within 5 miles of her home. A fair estimate of Grandma's carbon footprint might be two tons of CO2 per year, one tenth that of contemporary American grandmas who use the dishwasher, the clothes dryer, and must have air conditioning even if they live in cooler places like Oregon where it's only really

needed a week or so out of the year.

I am two generations removed from Grandma's. When I grew up in the 1950's my mom washed our clothes with a modern ringer-type agitating washing machine. Scrub boards became obsolete practically overnight. No one missed the scrubbed knuckles. I loved to feed the wet clothes through the ringer and watch the water be crushed out. We'd hang them on a clothesline.

As did most of the young people of my day, I walked or rode my bicycle everywhere I went. We didn't have a family car. My dad lost it in a poker game. We didn't miss it though. We really didn't need one although all of the families in our neighborhood had a car. No one had two cars.

We didn't have a garden, though we should have. We had a big back yard that would have fed an army. In the Philippines a family can live off a 10' x 10' garden. Of course they get three crops a year. Still, a small garden can provide a great deal of good food. Two generations prior, nearly everyone in America gardened to some extent, and canned vegetables for the winter. The prosperity that greeted America after the war did away with that. Now most of us buy all our groceries at the super-market, where tons of food comes in from all over the country and all over the world. Americans can reach out and buy bananas from South America, kiwis from New Zealand, and wine from Italy, France, or Australia.

Growing up, I didn't have air conditioning, but we did have television. There wasn't a whole lot on for a kid to watch – Captain Kangaroo only satisfied the very youngest. We didn't watch much anyway because we were always outside playing or "ripping and romping," as my dad called it. We'd ride our bikes ten minutes to downtown to see a movie, or stay home and get up a softball game in someone's back yard or in the street. Summer nights we'd sneak into Mrs. Shipley's garden and swipe strawberries, or play fox and hounds under the streetlight. Rainy days we played board games or cards or simply sat and talked. People drove back and forth to

work and to shop, but distances were close. Downtown was only five or six miles away, and "the country" was about that far in the other direction.

Modern suburban life requires us to drive nearly everywhere we go. Today, we use electric appliances for just about everything – to dry our hair, shave our face, brush our teeth, tell the time, give us instant hot water for tea, light our fish tanks, charge our portable phones and cell phones, run our computers. There are even electronic versions of common board games that run on batteries. These things didn't exist 30 years ago, and we take most of them for granted, writing the check out to the power companies each month, or having the amount withdrawn from our account electronically so we barely see the energy we're using.

Although it would be hard to imagine life without our invisible energy slaves doing so much work for us, it is possible to live a day or a few days without them. Backpackers know this to be true. In fact, one might go so far to say that we need to do this occasionally, to go back to nature in order to remember from whence we came and to remind ourselves of all we take for granted.

If we couldn't use electricity, petroleum or natural gas even for a day or two, what would we do? We would rise at daylight. That's what humankind did before electricity. Any place we needed to be we would walk to or travel by bicycle. The food we'd eat would be growing around us or swimming in a nearby stream. We'd be bundled-up if it were winter, and we'd go to bed when it got dark.

Even now, when we have power failures, we light candles and slow down. We talk and enjoy one another instead of defaulting to the TV. When the power finally comes back on, it can be a bit of a letdown, but when the electrons start flowing, we're immediately back to "normal."

We've grown accustomed to easy, cheap, comfortable energy that is available at the flick of a switch without having to do anything but pay others a nominal fee to provide it. We grumble if

we feel we're paying too much, but we'd grumble a lot more if we had to provide it ourselves. Our spouse might yell, "Get your butt on that exercise bike so I can finish watching my TV show!"

Becoming more energy aware helps us think less and less about the cost of the energy in dollars and more about the cost of the energy to the environment. When people were worried about the cost of gas, we figured out how to drive less because of the expense. Now the biggest cost is environmental. We need to be thinking about that cost when we use energy.

Someone who is energy aware can easily use one-tenth the energy of someone who is energy oblivious.

When I have to go somewhere, I walk if it's not too far. If I can get there on my bicycle I do. I used to ride my motorcycle when it was too far to bike, but then I got a Prius, which gets better mileage than even my motorcycle.

Energy choices shouldn't be only about cost. There are some who are rich enough to buy energy at any price. $20 per gallon for gasoline wouldn't faze them. $5 per kilowatt-hour wouldn't bother them a bit. I was once working on a rooftop in an affluent neighborhood installing a solar pool heating system when I noticed the next-door neighbor also had a pool and a perfect south-facing roof. I saw the neighbor going to his car, a Rolls Royce, so I hurried down the ladder, grabbed a brochure, and raced over to see him. I introduced myself, held out the brochure, and told him he had a good roof for solar panels to heat his pool. With his car already in reverse, he waived off my brochure, and said, "I'm not worried about it. The pool only costs me $600 a month to heat with gas."

Had I been more assertive at the time I might have yelled to him, "What about the three tons of CO_2 that go into the atmosphere each month you use your gas pool heater?" This might have slowed him

down or made him angry. Many people who are wealthy do care about the environment, but few, wealthy or not, fully appreciate the connection between energy and the environment.

Even if the money were a negligible amount to him, would offsetting 10 tons of CO2 per year for 20 years mean something? Most people don't have the opportunity to make such a dramatic impact with one simple choice. If the money did matter, he would pay back his up-front costs in 3 or 4 years. This fellow is an example of total energy oblivion, because he thought of the money instead of thinking of the energy and the resulting CO2 from burning fossil fuels to keep his pool warm.

At some point we have to stop thinking of energy in terms of money, even though of course the two are very closely related. One might argue that it's more cost effective to throw the clothes in the dryer than it is to take the time to hang them on a clothesline. That's technically true, even if you're making minimum wage. If you're a highly paid professional whose time is very limited and very valuable, it may seem preposterous to hang clothes out. Still, I always do and so does my wife who is a medical professional.

Well-intending friends are always surprised to hear the extent to which I go to save energy. They say, "It can't save you that much money to do that." I say, "I'm not thinking of the money, I'm thinking of the energy." I can honestly say if I were as rich as Bill Gates, I would still hang my clothes out. In the end, the time spent would only amount to ten minutes or so, which translates to a little less time in front of the TV, hardly a sacrifice. It's a good feeling to dry off out of the shower with a clean scratchy towel that dried in the air knowing I didn't put ten unnecessary pounds of CO2 in the atmosphere. Every time I pull a fresh T-shirt over my head and smell that sublime outdoor aroma I am invigorated. I'm gaining an appreciation for energy stewardship. I'm becoming like Grandma.

My new way of thinking about energy manifests in all sorts of

fun ways. It leads me to cook something part way in a pressure cooker, then turn the heat off and transfer the entire pressure cooker to an insulated box where it remains hot and continues to cook on its own residual heat.

"How much do you save, John, about a nickel?"

"Yes," I reply, "I save ½ kilowatt-hour which is in fact a nickel. How astute of you." It's not that I care so much about the nickel, it's that I care about the kilowatt-hour. I care about the 2 pounds of CO2 that didn't go into the atmosphere because I made a small effort to conserve.

There are those who may never be able to think of the energy instead of the money it costs. In fact, conventional energy producers are counting on it. Most of the electricity produced in the world does not come from hydropower. It certainly doesn't come from people peddling an exercise bike. Most electricity in the United States and worldwide comes from the burning of coal. Not surprisingly it is one of the cheapest ways to generate electricity from the standpoint of dollars and cents, it is abundant, but it is by far the most costly to the environment.

When we realize that CO2 can remain in the atmosphere for a hundred years or more, we say to ourselves, "What have we done?" It's not just a question of what we have done; it's a question of what we continue to do. When we hear that China is adding one coal power plant per week to fuel her economy, we think, "What are we doing?"

If coal has a good side, and some insist that it does, it's that there is a lot of energy in coal. By weight, there are more BTUs of heat in coal than in wood, about 13,000 versus 7,000 for dry wood. We get a little more than one kilowatt-hour out of each pound of coal. If we contrast riding the exercise bike for 5 hours versus burning a pound of coal, most people would choose the latter if there were no other choice.

Utility companies that have coal as part of their electrical

generation portfolio generally favor keeping coal plants for several reasons. First they have a major investment if the facility, which, even if it's 20 years old and they've completely depreciated it as an asset, still has economic life and is a profitable asset. Secondly, the energy output is steady, easy to manage and available anytime. Wind and solar generally can't be used all the time, and the utility has to meet load day or night regardless of whether the wind is blowing or the sun is shining. Last but not least, it is cheap. That's what most utility customers want. It's interesting that coal plants are usually located away from population centers. Subconsciously perhaps people want the benefits of cheap energy without having to face the reality of the nasty business.

There are several good renewable options for utilities that have the same baseline benefit as coal: geothermal, hydro, and even wave energy. Hydro stores the energy in falling water behind dams and releases it directly as energy is needed in the system. Geothermal is another essentially unlimited non-polluting resource that has the potential to not just replace coal, but natural gas and oil as well. (Gore) Deep in the ground in areas in the western United States there is 300 degree F heat that can be used for generating electricity or industrial process heating.

According to the book, *The Hot Topic*, the heat of the earth at depths of 6 feet or so can be harnessed by ground source heat pumps that use one-fourth of the energy as other heating alternatives. There is tremendous upside potential for geothermal energy, which provides less than half of 1% of current energy needs worldwide. (Walker 129)

Then there's nuclear. "Nuclear power currently accounts for about 5% of global energy. It is one of the few low carbon technologies that are already on hand, and although it is not... an ideal way to make energy, the dangers of climate change are certainly far worse." (Walker 133) The staunchest advocates for nuclear power; however, admit it will take ten years to bring plants

on line.

In comparing the importance of carbon reduction to the problem of nuclear waste Angus Duncan, president of Bonneville Environmental Foundation, is quick to say "carbon reduction trumps nuclear waste." Oregon is serious about meeting its greenhouse gas emissions goals, but won't be able to as long as a single coal fired power plant continues to operate. Boardman, a medium-sized coal plant, produces 4.8 million tons of CO_2 emissions per year, roughly the same as 845,000 cars. (Learn) Boardman is responsible for 10% of the greenhouse gases for the entire state. (Law)

When comparing fossil fuels, coal finishes dead last in CO_2 produced for each kilowatt-hour. According to a July 2000 report issued by the Department of Energy and the Environmental Protection Agency, for a single kilowatt-hour we get 2.095 pounds of CO_2 from burning coal, 1.969 pounds from burning petroleum, and 1.321 pounds of CO_2 from burning natural gas (U.S. Department of Energy and U.S. Environmental Protection Agency). To calculate the amount of CO_2 that is produced, take the source of the energy and use its coefficient as the multiplier. For this example we'll use coal, with a coefficient of 2.1. For a 100-watt bulb burning 20 hours, we get 2000 watt-hours or 2 kilowatt-hours. Multiply (2 kWh) x (2.1 lb of CO_2 per kWh) = 4.2 lb of CO_2 produced if coal is the energy source. Insert the other coefficients in the same formula to figure out the CO_2 produced by petroleum (1.97) and natural gas (1.3).

According to the Worldwatch Institute, due to its high carbon content coal is responsible for approximately 40 percent of the carbon dioxide emissions from the burning of fossil fuels worldwide, despite supplying only 32 percent of fossil fuel energy. (Worldwatch Institute)

Natural gas compares well to coal in that the amount of CO_2 to produce one kilowatt-hour is 37% less. It is better; however, to

burn natural gas at the point of use, such as cooking with our gas range, rather than burning it to generate electricity. This is due to the losses in transmitting electricity and the losses in converting energy from one form to another. It's not very efficient to burn natural gas at a power plant to generate electricity that has to be transmitted at high voltages to travel many miles, then transformed to lower voltages to be used in our homes to power our electric range that is being used to produce heat to boil water. Burning the gas directly using a gas range saves the efficiency losses of the electrical power generating turbine, the electrical transmission losses, and transformer losses. There are no such losses in burning natural gas at the source.

Even generating electricity with petroleum would be better than coal. From a CO2 standpoint, every form of energy production looks better than coal. Even with the overwhelming arguments for eliminating coal from the energy mix, coal will not go away easily. Coal is a $19 billion industry in the United States employing 100,000 workers. (Union of Concerned Scientists)

When we factor the health and safety problems into the more immediate consequences of burning coal, the picture becomes even clearer. Conservative estimates are that 100,000 people worldwide die each year from emphysema and other disorders that can be directly or indirectly attributed to the burning of coal.

In December 2008, at a TVA coal power plant near Harriman, Tennessee, a billion gallons of coal sludge containing arsenic, mercury, lead, and other toxic chemicals broke through a retaining wall and poured into the Emory River. TVA determined that the Harriman coal plant disaster was 100 times greater than the Exxon spill of 10.9 million gallons. For a tragedy so much greater, there was far less press coverage of Harriman than the Valdez. Rick Hind, Legislative Director of Greenpeace's Toxics Campaign, points out in an interview that clean coal is a myth: "...there is just no way to clean this technology up..." (Hind)

In a song from the East Tennessee State University Bluegrass Pride CD, the female vocalist laments a coal mining accident. The lyrics: "My momma cried and she held to me, she lost seven sons and I a husband to be...in those cold, dark, dingy coal-diggin' mines."(Buller)

In 1993, Americans consumed more than 2 million tons of coal per day – about 20 pounds for each person every day. Coal production averaged around 30 tons per second, enough to fill a railroad car every 3 seconds. (Union of Concerned Scientists)

A large coal power plant spews 2,000 tons of CO2 per hour 24/7

It's funny how everybody knows coal is bad and everybody hates it, but few people are willing to pay any extra money for cleaner sources. Any coal lover should visit Boardman, Oregon and live in the haze for awhile. Even though utility companies like the practical and dependable features of coal and its low cost, when we look at the heavy environmental cost of burning coal for electricity – knowing full well we do have other options – we can come to only one conclusion: **coal has got to go**!

CHAPTER 8

Transportation: Getting Somewhere Is Getting Us Nowhere

When it comes to global warming, transportation is a big, big problem. It accounts for 1/3 of all CO2 generated by human activities. Moving people around and moving goods from place to place is an enormous commerce propelled almost entirely by fossil fuels. No place in the world is it as big a problem as in the United States. There are thousands of planes in the air at any given

time. There are 250 million cars in the U.S. There are actually more cars in the U.S. than there are drivers. Just like turning on the TV, lights, or computer produces CO2 (unless we buy green energy), every time we travel anywhere, by any means except foot or bicycle, we're putting greenhouse gases into the atmosphere.

Passenger Miles Per Gallon

When we talk about any form of group transportation, the term passenger miles per gallon is used. If I were to drive 50 miles per day in a Prius that gets 50 miles per gallon, then my passenger miles per gallon would be 50, because I, one passenger, went 50 miles on one gallon of gasoline. However, if a second passenger and I were to drive the same 50 miles, our group transportation rate would be 100 passenger miles per gallon because two passengers were transported 50 miles each on one gallon of gasoline. A fully packed SUV getting 10 miles to the gallon carrying 7 passengers would be getting 70 passenger miles per gallon. They could thumb their noses at me riding alone in my Prius only getting 50. Of course, I'd give them a "thumbs up." That is, until I caught them riding in the SUV alone.

The energy efficiency of air travel can be rated on passenger miles per gallon (pmpg) based on the average passenger load factor or the percentage of full seating. Traditionally load factor has been about 75%, although in recent years it has increased slightly. For shorter domestic flights, the average jet airliner flew at about 36 passenger-miles per gallon (numbers vary from airline to airline).

According to the U.S. Department of Transportation, the passenger load factor was up 3.0 load factor points, from 74% to 77% from 2004 to 2005. As load factors increase, passenger miles per gallon increases. Also, due to the extra fuel needed for taxiing and take off, the average passenger miles per gallon increases when spread over greater flight distances. For example, a commercial airline flying from Boston to Los Angeles uses about 10,000 gallons of jet fuel. The flight distance is 2,500 miles; therefore, the plane gets about .25 miles per gallon, or one gallon of fuel every quarter of a mile. If there are 200 passengers on board, being carried 2,500 miles on 10,000 gallons of fuel, this works out to 50 pmpg (200 passengers x 2,500 miles divided by 10,000 gallons= 50 pmpg). Therefore a cross country trip getting 50 pmpg is better

than shorter domestic flights getting only 36. A Boeing 747 with all 409 seats completely filled traveling on a long overseas flight can get as much as 70 passenger miles per gallon. This means each passenger is transported 70 miles on one gallon of gas. This is the best an airline can do currently. However, if the plane is only half full, then each passenger is transported only 35 miles per gallon.

The average passenger miles per gallon on trains has a great deal to do with load factor. Because of low passenger train usage in the United States, 40 pmpg is common, but in 1945 when a great deal of military personnel were moving about on trains, the pmpg was over 80. In India, where not only every seat but also the aisles, the floor in front of the seat, and even overhead baggage compartments are full of people, I would imagine a pmpg of 150 is easily achieved. At rush hour in Japan with standing room only trains and people packed in like sardines, it could be 200 or more.

Even in the U.S. today, passenger miles per gallon on some trains is very high. Amtrak reports 83 pmpg between Boston and New York. Airlines reach only 38 pmpg between these two cities. Greyhound claims its buses get 162 pmpg. (Greyhound)

Transportation for some is a necessity for work and thus becomes a necessity of life. I knew a businessman who flew to his job in Chicago every Sunday and then back home to Portland every Friday, year after year. Likewise, it's common to hear people talk about a weekend jaunt to Las Vegas.

People think nothing of taking long trips today that would have been rare a few decades ago.

There's a push in the airline industry for more efficient jet engines and even engines that use alternative fuels. This is well and good and most certainly must be pursued. However, increases

in transportation efficiency cannot even begin to offset our energy consumption due to increased travel, coupled with the affluence that allows more people to travel by air.

Automobiles

In the context of climate change, anytime there's discussion about adding more freeway lanes, something's wrong. Some cities are trying no-driving zones. New York City recently blocked off Herald Square and Times Square to driving, making them pedestrian only. This has been done in Amsterdam and other cities in the world. Some people will initially be inconvenienced, but it should help the livability for the majority.

41% of car trips in U.S. are 2 miles or less. If you can bike to the grocery store, hardware store, or movie, this is good. If you live where you must drive to run these same errands, you're automobile dependent. Progressive, energy minded individuals and families have moved to locations where they can get to work and do most of their shopping and errands by foot, bicycle, or mass transit.

The electric car is well matched for short jaunts and highly energy efficient especially if its electricity comes from renewable sources such as solar and wind.

The movie, *"Who Killed the Electric Car?"* tells the shocking story about an electric car, the EV1, made by GM in the 1990's in response to California's zero-emissions mandate. All 400 cars that GM produced were leased.

Everyone loved their EV1s because they were quiet, required very little maintenance, and were reliable, dependable, and fun. Everyone, that is, except those associated with the powerful infrastructure supporting gas-powered vehicles. An excerpt from the film's website explains why:

> GM, Ford, Honda, Chrysler, Nissan, and Toyota all developed electric vehicle programs in response to

California's zero emission mandate – and most ended up crushing at least part of their EV fleets.

Electric cars are a threat to the profitability of the conventional gas-powered auto industry. GM said that it spent more than $1 billion to market and develop the EV1. Not only would a successful electric car program cannibalize sales of conventional cars, but the electric car costs the auto industry in other ways: lacking an engine, it saves the driver the cost of replacement parts, motor oil, filters, and spark plugs. The EV1's regenerative braking system, in which the car's electronic controls handled much of the work of slowing down the car, spared the car's mechanical brake system from wear. Brake parts and repair is a billion-plus dollar industry alone. The EV1's efficiency was a winner for consumers but a loser for the auto industry. (Who Killed the Electric Car?)

GM put pressure on the State of California with lawsuits and negative advertising. Then they systematically collected all the EV1's, even if lessees practically threw themselves on the pavement in protest and begged to keep them. GM crushed all the EV1's and piled them one on top of the other, and then escalated production of mammoth SUV's. It absolutely boggles the mind.

Anyone who sees this award-winning film, which I highly recommend, will come away feeling that automakers, especially GM, could have secured world leadership in the automotive market by making these smart, energy efficient electric vehicles.

Instead, Toyota leads the pack with their Prius, and our automakers are relying on U.S. taxpayers to bail them out because of their shortsighted, money-grubbing corporate policies. It rankles to have to subsidize stupidity.

In November 2009 in the parking lot of Dodger Stadium in Los Angeles, Nissan previewed its new five-passenger electric car,

the Leaf, to the American market. With a cost as low as $25,000, a range of 100 miles, a top speed of 90 mph, and the acceleration of a BMW, Nissan thinks it has a winner. Since most Americans drive less than 50 miles per day, it would appeal to a broad market. The lithium-ion batteries (weighing 551 pounds – a lot less than an internal combustion engine, cooling system, exhaust system, starting system, and the onboard fuel) can be 80% recharged in 30 minutes, or fully recharged overnight when less demand is on the grid. So committed is Nissan, they are planning EV charging stations in cities across America from Seattle to Raleigh N.C. Nissan's research showed that 8% of U.S. drivers say their next car will be electric. (Hsu)

I, and millions of other Americans, will buy this car. We are chomping at the bit for it to be on the market now. It is ironic that General Motors actually had the jump on the EV market in America but chose to scrap the idea. Live and learn GM.

In a wrestling match with the American consumer, GM gambled it could convince us to stick with gasoline vehicles. What a silly idea. We are bigger and stronger and have more money than GM. Plus, we are sovereign over what we buy. Nissan gets it. Their spokesman, Chief Executive Carlos Ghosn, hardly comes across as a rabid environmentalist. He said Nissan will continue to build internal combustion engines for a very long time. They objectively look at the market.

GM and other old school industrialists still think they can dictate the market, to make us want to buy the products they want to sell. It's a funny thing that they cling to this archaic notion year after year as they continue to lose worldwide market share. The day of the cart drawing the horse is over for GM and any other company operating under the old paradigm.

I have a tip for Detroit: be the first to come out with electric pick-up trucks. In the Northwest we love our pick-ups. There are more trucks in Oregon than there are cars. We need trucks to

haul our stuff. They don't have to be big trucks that would pull a Sherman tank uphill. My wife would buy one just to haul yard debris to the recycling center and pick up a bunch of plants for landscaping.

Mass transit

What ever happened to the electric transport industry? In the first half of the 20th century, many cities had electric buses or trolley car systems. Allegedly, GM, Firestone Tire, Standard Oil of California, Phillips Petroleum, and others used a holding company, National City Lines, to buy out the electric transport systems in 44 cities in sixteen states and replace them largely with GM buses. The U.S. Goverment filed an antitrust suit, but it was dismissed on the grounds that it would be inconvenient (forum non conveniens) for the defendants to be tried in California, where the suit was filed. (U.S. Supreme Court) This effectively eliminated the electric mass-transit system in America in favor of gas-powered vehicles. There is debate whether electric mass transit would have died a natural death with the rise in popularity of automobiles, or whether the lack of easy, electric mass transit helped to contribute to a car culture in America. In either case, conspiracy theorists could have a heyday with this one.

Zoning laws were changed mid-century to require new businesses to construct parking places out front, which pushed businesses further back and limited pedestrian and bicycle access. People often feel they need to drive, even for short distances, just to be safe. The U.S. car culture persists today, nearly 70 years later, despite some local transit initiatives.

One mass-transit success story is the Marin County California SMART Train. A campaign led by the Marin County Bicycle Coalition and propelled by hundreds of volunteers who installed yard signs, made phone calls, and wrote letters, resulted in the passage of a bill in 2008 to build a 70 mile passenger train and

an adjacent bike and pedestrian path in Marin and Sonoma counties.

> SMART will reduce greenhouse gases by about 124,000 pounds per day by shifting an estimated 5,300 daily trips away from automobiles and onto the train. While a two-car SMART train will have at least 200 seats, it will produce the CO2 emissions of only 12 automobiles. SMART's two-to-three train cars fit within a city block and will be coordinated with traffic signals so that there will be no delays on city streets. (Marin County Bicycle Coalition)

Other cities have light rail, subways, and other mass transit systems that will help in the battle to fight CO2 emissions, but we are seriously behind many countries, especially in Europe and Asia, when it comes to mass transit and battling petroleum-based carbon emissions.

Bike lanes and walking paths need the same priority as highways. In some ways the Chinese and American experience is flip-flopping. It used to be that the Chinese mostly got around by bicycle and nearly all Americans got around in cars. Now, the Chinese are buying more cars and Americans are buying more bicycles. I think both countries should embrace the electric bicycle, where pedal power synchronizes with the electric motor to give twice the speed and twice the range with little or no carbon footprint.

If people seriously embraced the idea of biking whenever they could, doing all those short trips by foot or bike, they could reduce their carbon footprint by 70%, 90% or potentially even higher. Walking and bicycling have great health benefits, both to the individual and society. 67% of Americans are overweight resulting in a societal cost of $200 billion yearly in obesity-related health

issues. (Marin County Bicycle Coalition) Getting children to school safely without a car can be done with "walking buses" or gathering groups together to walk to school. If kids walk or ride bicycles, both health care and climate change are favorably impacted. Leiden University in The Netherlands is famous for thousands of bicycles on campus. London, England charges cars a fee to enter the city, whereas bicycles can enter and move about for free.

Rail travel

I am intrigued with the possibilities of rail in this country. Train rails imbedded in concrete are already popular in Germany and Japan. The Shinkasen, or bullet trains, go 177 mph between major cities of Japan. The Chinese have a train that goes 300 miles per hour. As of September 2008, California is planning high-speed trains between major California cities.

There are three reasons trains can be very energy efficient. The first is the rolling resistance of a steel wheel on a steel rail, which is significantly less than a rubber tire on a less smooth bumpy road. The second has to do with wind resistance. Each car drafts the wind of the car in front of it. Finally, the railroad system is laid out in a relatively flat grid. There are not so many hills like those in road systems. Rail ridership is increasing nationwide. Obviously shipping by rail would be superior to trucking or air transport in terms of carbon emissions.

I heard an advertisement on the radio for a rail line claiming, "We get one ton of freight 423 miles on a gallon of fuel." The same ton of freight shipped the same distance by truck would take eleven gallons. The same ton by air would take twenty-eight gallons.

Air travel

Air travel poses a special problem particularly in America. The U.S. Department of Transportation reported that airlines in the United States carried 660 million domestic passengers during

2005. That's more than two flights a year for every man, woman, and child in America. The average passenger trip length, or distance flown per passenger, was 867 miles. Of the 90,000 commercial flights per day in the world, 30,000 (one-third) are in the U.S.

There are 90,000 flights per day worldwide, one-third in the U.S.

Jet planes generally fly above 30,000 feet, dumping millions of tons of CO_2 into the upper atmosphere each day. What we air travelers are doing by flying so much is depositing vast amounts of CO_2 in the upper atmosphere, literally wrapping our planet in a heat-locking membrane. We can watch it happening on any clear

Global CO2 Superdome courtesy of jet contrails.
What happened to our clear, perfect day?

day when the blue sky becomes streaked with jet contrails. As the day progresses the white haze spreads to form a man-made dome covering the entire sky.

Most of the clouds we fly above only reach as high as 15,000 to 20,000 feet. The biggest vertically oriented cumulonimbus clouds extend as far as 30,000 feet. This represents the maximum "reach" the oceans have to retrieve CO2 from airplanes.

As a result, air travel has a disproportionate affect on global warming compared to fossil fuel burning on the ground. The European Federation for Transport and Environment and the Climate Action Network Europe reported that in year 2000 aviation was responsible for as much as 9 percent of climate change impact. Of all human activities that result in CO2 production, aviation has by far the greatest climate impact of any transportation mode. (Climate Action Network Europe and European Federation for Transport and Environment)

Jet travel is the fastest growing source of greenhouse emissions according to the television documentary entitled "Hot Planet" which aired January 13, 2010 on the Discovery Channel. (Discovery Channel) Often we jump on an airplane at first thought, when our

business could be accomplished by other less carbon intensive means. Video conferencing, webinars, and webcasts are usually acceptable alternatives. We can conduct our meetings online and stay home, saving time and money and reducing our carbon footprint all in one. I know HP engineers that have very effective international meetings in a half dozen time zones.

Alternatives to flying

Because of the negative effects of air travel, I've decided not to fly except on very rare occasions when I must travel and the airline is the least carbon intensive way for me to get there. I travel 1000 miles each way two or three times a year to see my daughter and granddaughter. It's important that I do that. It takes 30 hours by train. It only takes 2 hours by plane. However, if you figure all the extra time to go through security, baggage claim, and the commute to and from the airport, a 2-hour flight for me becomes 6 hours in total time. For some reason flying exhausts me, so when I fly the day is pretty much shot anyway.

So, what am I to do? I can take the train. Eight of the 30 hours will be spent sleeping, which I would have to do anyway. Four

meals at 1 hour each brings the total to 12 hours that would be spent anyway. I can therefore rationalize that there are only 18 hours extra, which is 3 times as many as flying. What can I do with the 18 hours? I can read for pleasure and catch up on journals and magazines I never find time to read. I can write, talk to other passengers, and make phone calls. There are 110-volt AC electrical outlets in each row of seats. I can use my laptop to do work. Still, 30 hours is a major chunk of time, and unless the train is fairly full, I haven't really traveled using less carbon. The Greyhound bus is always near full and it will get me there in 24 hours, but that's not much help. They don't have plug in electrical outlets or sleeper cars.

However, there are some amazing characters on the bus. I fondly remember some years ago sitting across the aisle from an astute gentleman who had more "street sense" than anyone I have ever known. It was election time and I told him I hadn't yet decided for whom to vote. He said, "That's easy. If you have money, vote Republican. If you don't, vote Democrat." With all the rhetoric at election time, isn't what this wise man said essentially what most of us do?

As delightful an experience as the Greyhound bus can be, in the interest of time what I've ended up doing is placing an ad on Craig's list to rideshare. Every time I've done it I've been able to get 1 to 3 passengers to travel with me. This gets my passenger miles per gallon between 100 and 200, which is outstanding! It's better than the train, better than the plane, and can be even better than the bus. We drive straight through in 15 hours, leaving at 6 am and arriving at 9 p.m. We share driving and gas. I take along a plug-in AC adapter so I can work on my laptop. I wrote some of this book on one of these trips. The cost can be as little as $30 per person — no cheaper way to get there — and I've met some fabulous people. I traveled once with an artist who showed me some of his drawings and even gave me one as a gift. Another was a writer

who had been on a 150-mile poetry writing/hiking adventure. Still another was a student returning to college after the Thanksgiving holiday. His parents were getting divorced. I listened and offered a little counsel as it was sought. Usually we find ourselves wanting to talk more than we want to listen to the radio. We tilt back the passenger seat and sleep a lot more comfortably than on a bus or an airplane. I've found it to be a very viable option, and it is the least carbon intensive way for me to travel.

My favorite passenger was a young man who was entering the Marines. After many hours in the car together, I asked him why he would want to sign up to go to Iraq and possibly die. My jaw dropped at his answer: "I want to serve," he said. "This is a way I can help people and it's something I deeply want to do." His whole family came to pick him up at my destination point near the University of Southern California. They thanked me for bringing their son safely to them, but I was the thankful one for the privilege of knowing him. He was a truly inspiring human being. As I waved goodbye I had the solemn thought, "I do not deserve to have such a fine young man die for me in Iraq."

I think most people would make some concession in the way they travel to reduce their carbon footprint for the good of the planet, but the people who are the wealthiest and the busiest will be the least inclined to do so. If you're traveling for business you're traveling to make money, and of course time and money are virtually the same thing to those of us in business. Even so, to the busiest traveler I would recommend rethinking how to get where you need to go with the least carbon footprint. I've found a lot of rewarding benefits. It can be a "smell the flowers" experience as we travel through life. I don't miss flying a bit. I was starting to get perturbed at being herded through the security checkpoint, practically strip-searched, and having to hand over my pinky-sized Swiss Army knife used for nail grooming. I've had the same one now for three years.

CHAPTER 9

Tipping Point

As the scientific community has made clear, climate change is not linear; there is a tipping point. Once we pass the tipping point, climate becomes a runaway train and there's nothing we can do to prevent catastrophic impacts.

The first priority of all humans must be to not reach the tipping point. It is the point in which one factor exacerbates another, bringing about an accelerating chain reaction. As the polar ice caps melt, solar radiation is no longer reflected off the ice back out to space but is absorbed by the exposed, darker ocean. Heat accumulates, making the oceans warmer. As they warm, their ability to absorb more man-made carbon dioxide is lessened. Less CO2 in the oceans means more in the air.

The amount of water vapor in the atmosphere rises as the temperature of the air increases. Water vapor is even more powerful than CO2 in its ability to hold heat. A water vapor feedback loop develops where warmer temperatures and more water vapor reinforce each other, escalating global warming. (Encyclopedia Britannica)

Greater warming at the poles causes the frozen tundra to thaw. This is the scariest of all scenarios because the frozen tundra has carbon dioxide and methane equal to 150 years of greenhouse gas emissions at today's rates. (Discovery Channel)

As the tundra melts it releases CO2 and methane trapped in frozen water crystals. Methane is a greenhouse gas 20 times stronger than CO2. More and more greenhouse gases in the atmosphere mean more and more BTUs from the sun trapped in

our biosphere. 150 years worth of greenhouse gases released in a short period of time would almost certainly spell the end of life on earth as we know it.

As we knock over hurdles, at some point it becomes impossible to win the race. Once the tipping point is reached, it is irreversible.

So, how close are we to the tipping point? It's obvious by now we've knocked over the first few hurdles, but can we still recover? Bill McKibben, founder of 350.org, believes that we are already seeing profound effects of climate change at 390 ppm of carbon in our atmosphere, and that we have to return to a safe level of 350 ppm:

> In the summer of 2007, though, with the rapid melt of Arctic ice, it became clear that we had already crossed serious thresholds. A number of other signs pointed in the same direction: the spike in methane emissions, likely from thawing permafrost; the melt of high-altitude glacier systems and perennial snowpack in Asia, Europe, South America and North America; the rapid and unexpected acidification of seawater. All of these implied the same thing: wherever the red line for danger was, we were already past it, even though the atmospheric concentration of CO2 was only 390 parts per million, and the temperature increase still a shade below 1 degree C. In early 2008, Jim Hansen and a team of researchers gave us a new number, verified for the first time by real-time observation (and also by reams of new paleo-climatic data). They said that 350 parts per million CO2 was the upper limit if we wished to have a planet 'similar to the one on which civilization developed and to which life on

> earth is adapted.' That number is unrefuted; indeed, a constant flow of additional evidence supports it from many directions. Just this week, for instance, oceanographers reported that long-term atmospheric levels above 360 ppm would doom coral reefs worldwide.
>
> It is, therefore, no longer possible to defend higher targets as a bulwark against catastrophic change. The Global Humanitarian Forum reported recently that climate change was already claiming 300,000 lives per year—that should qualify as catastrophic. A new Oxfam report makes very clear the degree of suffering caused by the warming we've already seen, and adds, 'Warming of 2 degrees C entails a devastating future for at least 600 million people,' almost all of them innocent of any role in causing this trouble. If the Arctic melts at less than one degree, then two degrees can't be a real target… Physics and chemistry have laid their cards on the table: above 350 the world doesn't work. They are not going to negotiate further. It's up to us to figure out, this year and in the years ahead, how to meet their bottom line. (McKibben)

We are still dawdling on the tracks while the train is fast approaching. We are nearly out of time. Some experts believe that as a result of accelerated levels of CO_2 in recent years, the worst case scenario is already upon us:

> We are headed for it, the scientists said, because the carbon dioxide emissions from industry, transport and deforestation which are responsible for warming the atmosphere have increased dramatically since 2002, in a way which no one anticipated, and are now running at treble [triple] the annual rate of the 1990s.
>
> This means that the most extreme scenario envisaged

> in the last report from the UN Intergovernmental Panel on Climate Change, published in 2007, is now the one for which society is set, according to the 31 researchers from seven countries involved in the Global Carbon Project. (Connor)

Experts went on to say the percentage of human caused CO2 that the oceans are absorbing is measurably less, one of the key indicators of a tipping point.

Others believe we still can do damage control, that we can buy time to postpone the final tipping point and eventually escape disaster.

It all comes down to about 3 ½ degrees F. According to climate experts, that's the maximum temperature increase the earth can warm without reaching the tipping point. Unfortunately, our fossil fuel burning to date from industrial activities, especially over the last 50 years, has already warmed the planet 2 degrees F. Furthermore, with a global industrial engine that can't be stopped or converted from fossil fuels overnight, there's another 1 degree F in the pipeline. That leaves a 1/2-degree F margin to the tipping point as a best-case scenario.

It's so close it should scare all of us into taking immediate decisive action. It's like the time I was driving an old pick-up truck in the hills of East Tennessee with my friend Vince. The horn button popped out and landed in my lap. I was so surprised that it took my focus, as well as Vince's. I fumbled around with it for a few seconds trying to put it back when suddenly Vince yelled, "goddamn!" in the most panicked desperate voice I'd ever heard. I looked up and the truck had drifted off the road onto the grass and was right at the edge of a cliff. I gripped the wheel tightly and steadily veered back away from the edge. We caught our breath and went back to see how close we'd come. The tire tracks in the grass went right to the edge where only half the width of the track

showed for several feet. We had been within an inch of certain death. Had I jerked the wheel we would have gone over. Had Vince not yelled at that last possible moment, we would have gone over. This was, to say the least, an extremely close call.

We are at the edge of the cliff. We have half a tire track over the edge. What must we do to avert disaster? The United States has to cut its CO2 emissions by 80% in the next 10 years. The rest of the world has to do its part, too. China and the other rapidly industrializing nations will have to cut their CO2 emissions by 80%. This is a challenge to end all challenges. It makes putting a man on the moon seem like a cakewalk.

An inventor friend of mine, Dale Costich, was showing me his parabolic solar collector. The device was perhaps 30" in diameter and reflected the sunlight to a focal point where I happened to be standing while warming myself on a cold but sunny winter morning. Dale cautioned me to be careful or "that thing will set your pants on fire." I thought he was kidding until I looked down and saw my pants smoking, on the verge of bursting into flames. I stepped away quickly. It's a funny thing how fast we'll move when we are immediately and directly threatened; but when the threat is gradual or invisible, we don't act until we've seen it with our own eyes, and then it's too late.

I know how strong the sun is. It can kill you with a disease called melanoma. Concentrated it can burn a hole right through you. It pounds the earth relentlessly with over 300 BTUs per square foot per hour eon after eon. Before the industrial revolution the earth was at equilibrium with the sun. We burned wood, the only renewable fossil fuel, for heating, cooking, metalworking, and every other kind of energy needed. Other trees absorbed the CO2 and grew in direct proportional mass to that of the trees used for firewood. The temperature of the earth stayed more or less constant, century after century, millennia after millennia.

In the 20th century, the industrial revolution kicked into

high gear. Total world energy consumption grew by 1600%. Now we have to deal with it. There's really only one mathematical possibility: use less and less fossil fuels, plant more trees, and meet growing demand with renewable energy and other non-fossil fuels as quickly as possible.

If the optimists holding to the best-case scenario are correct, we have a small amount of time to act to avert disaster. If the worst-case scenario is correct, it may already be too late. Let's say CO2 levels reach 450, which they almost certainly will in the next decade or so with business as usual. There is nearly universal agreement in the scientific community that at 450 we will have missed our chance. A slow death for human civilization would be inevitable because we couldn't carry on basic functions required to sustain life. Once the tipping point creeps up on us, we will not be able to undo the damage we've caused. The runaway greenhouse effect which James Hansen calls "The Venus Syndrome" will be upon us. (*Storms of My Grandchildren*, p. 223)

My grandfather, Hugh Lloyd Patterson, was a wonderful, marvelous man. He loved being with people, all sorts of people. Even when he was around rough-talking men he never used profanity. However, on two or three occasions when something so outrageous, so preposterous happened, he exclaimed with a lilt of utter disbelief the single word "Shit!" When I think that in the short and insignificant time of my life here on earth, 1 quintillion BTUs of solar energy have been trapped here on the surface of the earth that wasn't here when I was born, I can think of no better word than my grandfather's expletive!

PART 2

WHAT WE CAN DO TO STOP GLOBAL WARMING

CHAPTER 10

Energy Awareness, Attitude and Philosophy

ODE TO AN EARTHWORM
Happening along I saw you today
Writhing on the sidewalk you lay
Dried up and stuck there in place
From wandering afield from nature's grace.
I stopped and thought should I save you from pain?
A voice said, "Of course not, are you insane?
You can't save each earthworm that gets caught in the sun."
"No," I answered, "but I can save this one."
With a twig I flipped you back into the grass
Where you burrowed down deeply so then I could pass.

The first step to reducing one's carbon footprint is determining what it is. I often begin one of the courses I teach at Portland Community College with a question to my students. "How many kilowatt-hours do you use in an average day?" For most classes, in a room of 40 or more students who generally range in age from 20 to 60, no hands go up. Then I tell them their first assignment is to review their electric bill and determine their average daily kWh usage. I pull out a copy of my own bill, point out the bar graph that shows a whole year of usage, and then glide my finger across the middle of the graph to find the annual daily average.

For the typical American household 30 kilowatt-hours per day is common. If there are three people in the household, we'd divide 30 by 3 to get 10. So that person's average daily electricity usage would be 10 kilowatt-hours.

For the next assignment, we look at the gas bill to determine the number of therms used per day, using the same system. I have a good reason for giving these assignments. Studies have shown that people who know how much energy they use will naturally conserve and consistently reduce their energy usage. Those who pay no attention to energy use naturally increase their usage. For this reason, progressive utilities in the U.S. have started providing power-measuring devices that their customers can easily read and understand.

Once people become aware of how much energy they use in a day, they are curious about how the energy is being used. The easiest way to figure this out is to purchase a plug-in appliance meter that will tell you exactly where the energy is being consumed. Simple point-of-use metering devices plug directly into a wall outlet. The appliance then plugs into the meter which records exactly how many watts the appliance is using at that moment, and records how many watt-hours have been used since it was first plugged in.

One of the more popular metering devises is the Kill-O-Watt meter. I own several of these, and they cost as little as $25. They're handy to take along when you're shopping for a new appliance, for instance a television. There can be a great difference in power draw based on the size and type of television you purchase. If you're going to use something several hours a day for 10 years or more, it's prudent to know how much power it will consume and what the carbon footprint will be.

There can be a tremendous difference in refrigerators. An old clunker with poor gaskets often used as a second "beer" refrigerator can use 3 or more kilowatt-hours per day. Energy Star rated refrigerators, recognized to use less power, use half as much (1.2 to 1.5 kWh per day), and the most energy efficient refrigerator, the Sunfrost, uses less than one kilowatt-hour per day. If every kilowatt-hour represents 2 pounds of CO_2 per day, over a twenty

year period the difference between the most energy efficient refrigerator and the least efficient can be 20,000 kilowatt-hours and 40,000 pounds of CO_2. Energy efficient appliances of all kinds should be our first choice.

I went to Best Buy just to check out appliances. The energy consumption sticker showed most of their products in the middle of the efficiency range. I looked at a dishwasher and asked the salesperson to show me the model that was the very most efficient one made. He said, "We don't carry that model." That's funny, I thought, why would you not? I would buy that model, even if it cost more.

Energy efficient lighting is crucially important. Here's a simple test to determine if a light is efficient: just feel it. If it's hot to the touch, then it's not very energy efficient. Most people look at lighting in terms of how attractive the product is or how well it will work with their decor, but we should be looking for lighting that will accomplish those two things *and* be energy efficient. The difference in a whole house lighting system over a long period of time can easily be 20,000 kilowatt-hours and 20 tons of CO_2.

Awareness

A growing number of Americans are starting to think about their energy usage and taking steps to conserve. Many more, however, view their energy usage only in terms of their electric bill or gasoline price at the pump, and are only concerned when costs are rising.

> *How do we convert a third of a billion people, young and old, from energy oblivion to energy awareness?*

We do that by challenging people to think of every energy transaction during an average day. Most of us wake up to an electric alarm clock, and turn on a bedside light, which probably

stays on as we walk from the bedroom to the bathroom, where we turn on another light and perhaps a fan. Then we jump into the shower where we turn on hot water. We dry off with a towel, which we'll use 3 to 7 times before throwing it into the laundry to be washed and later dried in an automatic clothes dryer. We move a few steps to our bathroom vanity where we turn on a bright array of 6 to 8 lights that enable us to see ourselves well for grooming and applying make-up. We dry and style our hair with a blow dryer. We may use an electric toothbrush or electric razor. We move to the closet, turn on a light, and dress.

The get-up-and-get-going routine common to nearly every American has just involved 10 energy transactions. We've used close to a kilowatt-hour of energy without even knowing it. This may be 5 to 10 percent of our daily load. The heavy-duty stuff, the refrigerator, stove, coffee pot, and toaster, await us in the kitchen. Our furnace, air conditioner, and water heater, three big energy transactions, serve us through the day and night seamlessly, along with a host of other smaller devices we don't even realize are "on" all the time.

Phantom loads – the continuous nominal energy draw of appliances such as doorbells, electric clocks, phone chargers, computers in sleep mode, the home fax machine, portable phones, home and office security systems, receivers for automatic garage door openers, and televisions operated with remote controls, just to name of few – use power 24/7 without our recognizing it. Even though these amount to 1 to 3 watts each, a three-watt phantom load on for 24 hours per day is 72 watt-hours, 20% more than a 60-watt light that is on for an hour. It is estimated that the phantom loads in the United States are greater than the total electrical usage in many small countries. Standby loads account for roughly 1% of global CO2 emissions. (Lawrence Berkeley National Laboratory)

I brought my Kill-a-Watt meter home from work and checked every appliance in the house in order to hunt down my phantom

loads. There are 4 people living at my house, and yes, I'm almost ashamed to admit, we have 4 TVs. They are all served by individual cable boxes. I checked each one and found they were drawing between 29 watts and 38 watts each without the TV even being on! I went through the roof! They were using the same amount of power as two 75-watt light bulbs burning 24/7. They are always partially "on" even when turned "off." How did that happen at my house? Easy – my wife bought them. She is a very intelligent woman, but she didn't know, and neither did I, that when the cable guy hooked them all up they were drawing that kind of power. It was the biggest phantom load I'd ever encountered. I fixed it in a hurry by putting all of them on power strips that remain off the 20-plus hours a day the TVs are off. When we want to watch one of the TVs, we turn on the multi-plug power strip switch and make sure we turn it off when we're done; a small effort that gives big savings in energy load over time.

When we step into our car and turn on the ignition, the roar of the engine tells us a major energy transaction has just occurred. We drive this giant heavy machine to work, park, walk past a cluster of lit-up vending machines, take an elevator to a well lit, air-conditioned and electronically-secured office where a telephone, computer, copy machine, fax machine, printer, scanner, monitor, and hot coffee await our arrival. In the summer you'll see many people wearing sweaters because the air conditioning is set too high.

Midday we may go out for lunch in our car to do some errands, driving up to a well-lit fast food sign and speaking into a microphone to order something we can eat in the car. We might run by the mall that has a huge walkway in the middle with tall ceilings and flanked on each side with stores displaying their goods in spotlighted storefronts.

When our workday ends, many of the lights stay on in the office because a late-night cleaning crew will be there, and even after they

leave, most lights are still on for security reasons. We jump back in the car and stop by the grocery store to grab a few things for dinner. The store is a giant warehouse with very tall ceilings and aisles bathed in light. The smell of coffee brewing in one corner and fresh baked goods nearby reminds us that the espresso machines and industrial ovens are at work nearby. We ask for hamburger at the meat counter and the butcher grinds it fresh, then we grab a gallon of milk from the cooler. A cold blast of air escapes when we open the frozen food door to snatch a bag of tater tots.

Back home, we turn on lights as we pass through each room, and turn on the TV to listen to the news while we're preparing dinner. We unload the washer that was started in the morning and put the clothes in the dryer. We make a quick couple of calls as we're walking around tidying up, read our email, and go online to check in with our social networks and see the stock reports for the day. Then we preheat the oven to 450 degrees, throw burgers on the gas barbeque, and put the cookie sheet full of tater tots in the oven to bake for 20 minutes.

We grab ketchup and mustard out of the refrigerator, toast our buns, and then sit down in the bright kitchen to eat with the family. Once dinner is over, plates get rinsed with continuously flowing hot water and loaded into the dishwasher before everyone goes off to a different room to watch TV, play video games, work on their computers, or talk on their cell phones.

Finally it's time for bed. People take showers and perform various nighttime ablutions under the bright vanity lights, others settle in to read a book by the glow of the bedside lamp, and someone else is watching the late show on the big screen TV or a smaller one in their bedroom. When everyone is ready to sleep, we leave a light burning in the hallway all night long, just in case someone might get up.

We waste a lot of energy in America, even more than we use according to a lecture Al Gore gave in November, 2009 in Portland.

This means, quite literally, if all we did was stop wasting energy in America we could cut our carbon footprint in half. A simple example might be the very popular flat screen TV. I have a rather modest 27" version that, as I discovered, draws 30 watts even while it's off. Over a 24-hour period that would total 720 watt-hours. (30 w x 24 hr. = 720 Wh) While I'm watching the TV it is drawing 138 watts. Therefore, I would have to watch the television over 5 hours per day (720 wH divided by 138 w = 5.2 hr.) to match the continuous draw while the TV is "off." In this scenario, my wasted energy and the energy I used actually watching the TV would match, proving Al Gore's point. Of course if I only watched TV an hour or so per day, the phantom load would mean I'd waste 4 or 5 times as much energy as I used. What's really funny is to go into a sports bar that has a dozen or more TVs going that only two or three people are watching. The meter on the building is spinning like crazy. No wonder they have to charge so much for a beer.

If we're driving a car that weighs three to six thousand pounds, a very small percentage of the energy is actually used to propel us and the goods we're carrying; far more is used to propel the tonnage of the vehicle itself. It's no surprise to me we waste more energy in America than we use.

I've belabored the point, but unless we become aware of how much energy we're using and wasting, we won't be able to do anything about it. Look at our kitchens and bathrooms. It is very common for a whole set of lights to be on when one or two would suffice. It is obvious the lighting system was chosen purely to shed an abundance of light for the entire room, rather than planning for what is needed to do a particular task or function in that room.

Architects know well how to design buildings to make optimal use of natural lighting. One of my favorite architects, Anthony Stoppiello, specializes in making existing buildings more energy efficient. "There's a lot more old buildings that need energy improvements than new," he says. Anthony and his wife Victoria

bought a historical home in Ilwaco, Washington that was built in 1890. The 1200 square foot, all electric home used 11,000 kilowatt-hours per year, or an average of 30 kWh per day. They launched an all out attack on energy losses, tracking down and eliminating air infiltration at every point, fortifying insulation, going from single-pane windows to double-pane, upgrading appliances including a Sunfrost refrigerator, and enhancing natural lighting. They did all this without compromising the historical integrity of the home. When they were done, they had cut the energy bills by 70% to single digit daily kilowatt-hour usage!

Anthony isn't boasting when he says he can cut the energy usage in any home by at least 50% before adding solar. He proved it himself on his own home and has done it hundreds of times during his brilliant career. (Stoppiello)

For months I fretted about my teenage daughter leaving the bathroom vanity lights on after she was finished. The light in the room came from six vanity lights above the mirror over double sinks. I had replaced them with compact fluorescent bulbs, which used 25 watts each instead of the 100-watt bulbs that came with the house. Still, with all six left on, 150 watts were often being drawn with no one in the room. Finally I decided to replace the wall switch with a timer switch. The mechanical timer could be twisted to a 5 or 10 minute setting, or turned all the way up to 30 minutes before it ticked down and turned off the light automatically.

Not long after I'd installed the timer switch, I heard a loud and very perturbed scream from the bathroom. Jenny was in the shower when the light turned off. She had just lathered up with shampoo when it became dark as a cave in there. She demanded the regular switch back but I held my ground. "Be sure to turn it all the way up when you first get into the shower" I advised, and then added, "no one should take a shower that lasts more than 30 minutes!" She came around. Sometimes our biggest energy battles can be within our own households.

Attitude

Energy awareness cultivates something even more important: energy attitude. In my classroom I often draw a circle on the board representing energy use in the home. I designate what portion of the circle represents home heating or cooling (usually about 1/2), water heating (1/4), and lights and appliances (1/4). Then I show how much of each segment can be readily met by using solar energy. Conservation, in all segments, shrinks the circle and enables the solar panels to do a larger percentage. The number one most important consideration in shrinking the circle is our attitude toward energy usage. It is overarching and compels our actions and energy choices. Therefore, it is far more powerful than any other single tool we use in forming our strategy to reduce our carbon footprint. Furthermore, it doesn't cost a thing.

If our energy attitude is that of entitlement, if we feel we are entitled to just flip a switch and have the light go on and not think of how much energy is used or where it comes from, we will always have a big circle and likely do little or nothing to change. If we only think of energy as money, then we may seek energy efficiency only when it represents a noticeable cost savings. We'll buy SUV's when gas prices are low, and more fuel-efficient vehicles when prices are high. During the high $4 gas prices of 2008, the Toyota Prius hybrid was one of the best selling cars in America. When gas prices went back down, Prius sales dropped. There are a great many people in this category. We are laughably predictable. No wonder Madison Avenue marketing executives lead us around by the nose. We let them.

Those who are concerned more about the CO2 than the energy cost will buy the most fuel-efficient vehicle they can afford that meets their needs regardless of the price per gallon of gasoline. This is a more enlightened attitude.

When I go on a sales call to give an estimate for solar panels, I love walking up to a home that has a Prius in the driveway. While

standing on the porch waiting for the owner to come to the door, I'll look at the porch light to see if it is an incandescent bulb or a compact fluorescent. These are clues to the owner's attitude toward energy.

Once in Baker City, Oregon, I was giving a lecture about solar water heating to a group of about seventy-five people. One distinguished gentleman kept asking why anyone in their right mind would spend thousands of dollars on a solar water heater when they had a perfectly good working gas water heater that was doing the job. I showed him the energy savings and the environmental impact. He remained skeptical and added that it seemed a rather foolhardy thing to do from an investment standpoint. Unable to appease him, I recognized another person whose hand was up. This man said that he and his wife had bought a solar water heater the year before and justified the expense based on their calculation that in essence they were pre-paying for hot water for the next ten years. They also saw that they were insulating themselves

Joe signs up for green power, which eliminates coal, and a hybrid car that gets 3 times better mileage than his SUV, reducing his carbon footprint by half.

permanently from higher utility costs, and they were helping the environment. I turned back to the skeptic and said, "Now that's good business!" The skeptic said nothing more.

In scanning from the skeptics to the enlightened, we can identify three distinct attitudes toward energy. The attitude of the skeptic might be called energy oblivion. A water heater makes hot water. When the skeptic asks the question, "Why in the world would I take any action whatsoever when I already have a working water heater?" he has no regard for how the water is made hot, where the energy comes from, and what the environmental impact might be. From an energy awareness and energy attitude standpoint he is a kindergartner. He may well enjoy kindergarten, and wish to forever stay there with his likeminded friends. I know an awful lot of people like this.

The man who spoke up and justified his purchase of a solar water heater as a ten-year investment/payback proposition, with the added benefit of helping the environment, is at least partially enlightened. Let's call him "Midway." He and his wife obviously understand the relationship between money and energy, and have at least some concern for the environment. They are strategic savers and make choices based on sound economic investment principals.

The fully energy enlightened person, in my opinion, puts the environment first with the economic justification being secondary. "It's nice that the system will ultimately pay for itself, but even if it didn't, we'd still do it. We must have hot water. We've determined that the best way to get it with the lowest carbon footprint is to have solar." When choosing a vehicle, the same person would reason: "I must get from point A to point B. The best way to do it with the least carbon footprint is a Prius." As soon as electric vehicles are available, this person will be an early adopter of the EV.

Certainly in our society we need to encourage people along the path of energy enlightenment, but we must be careful not to

become polarized. I see this happening already with resentment going both ways between the oblivious and the enlightened. This is an easy trap to fall into. I already know people who hate the idea of the fat cat driving up to the country club in his gas guzzler to meet three of his fat cat buddies driving up in their big cars for a round of golf. Did all those Tiger Woods commercials convince them to buy Buicks? Couldn't they at least carpool? It's funny what people do.

The point is we must not be judgmental toward those we perceive as being less energy aware than we are. I've been in the energy business for thirty years and consider myself relatively enlightened. Still, there are many people far beyond me. They refuse to own a car and take public transportation or ride a bike everywhere they go. They live where they are able to do this conveniently. Some have "killed" their televisions, and grow much of their own food in their backyard garden. I know a couple who moved from one home to another without a car or a truck. They only moved a few blocks away, but did it with hand-pulled wagons and carts.

It's not so much where you are on the path to enlightenment, but which direction you're going. If you choose to dwell in energy oblivion, your carbon footprint will almost certainly increase. If you are on the path to enlightenment, you will reduce it every year until you arrive at a point that is truly sustainable, or, as I like to call it, energy nirvana.

Of course, true energy nirvana goes beyond reducing one's personal carbon footprint to zero or whatever number it takes so that the trees and oceans can deal with the carbon and bring our atmospheric CO_2 levels below 350. If you are a landlord, will you install the same energy saving and efficiency devices you put in your own home on your rental properties? If you're a business owner, are you keeping lights out in rooms that aren't being used, installing timers, using set-back thermostats to turn down the

heating system overnight, and paying attention to your phantom loads? Are you letting employees know about your business energy savings strategies and asking them to buy in?

Leading by example is probably the best way to bring about change, especially if you are a prominent leader. Going the extra mile will be necessary for many of us in order to help carry some of those who, for whatever reason, remain in energy oblivion. For those of us on the road to energy awareness and energy enlightenment, we must forever be gracious to those who are not. Our attitude should be to help enlighten them by what we do. I'm not a Buddhist, but I think Buddha would go along with this.

Philosophy

Having a healthy and responsible attitude toward energy propels us in all sorts of positive directions in all areas of our lives, and creates a philosophy that helps us make positive energy choices. In my business, for instance, I took a look at how I was getting the products I need. The equipment I use is shipped from places all over the world. I'm located on the West Coast, and get copper fin tubes from Florida, glass from Tennessee, pumps from Pennsylvania, and solar swimming pool panels from Israel.

For a long time most of the equipment I was buying was shipped across country by truck, which was carbon intensive. Now I bring in everything possible by rail that costs less in dollars and much less in CO2. In some instances I was paying as much for freight as I was for the product when buying in small quantities for my solar pool collectors. I talked to the manufacturer and said something had to be done, but his only solution was for me to buy a whole container directly from the factory.

A container is one of those large steel boxes the size of a railroad car that are stacked on ocean liners and shipped across the ocean. It would cost $70,000 for a whole container load of product but the shipping cost per collector was a fraction of the cost. I talked

to my banker and got the money. I was even more pleased to learn that the carbon footprint for products shipped by sea is the least of all shipping methods due to the enormous tonnage of cargo on a large ocean liner. (Federal Highway Administration)

I had to adjust to the six weeks it would take to get my shipment, which went by ocean liner from Israel, through the Suez Cannel, past the horn of Africa, across the Atlantic Ocean, through the Panama Canal, and up the Pacific Coast to Portland, Oregon. I committed myself whenever possible to buying product this way, even if it means holding inventory longer. In this case, reducing my carbon footprint actually benefitted my bottom line. I was happy, the bank was happy, and the planet was happy!

When we embrace the philosophy of energy stewardship it becomes absolutely thrilling to save energy even in small ways. People think I'm funny to think this way. I think they're funny for treading water in energy oblivion their whole lives.

CHAPTER 11

Determining Your Personal Carbon Footprint

The first step in reducing our carbon footprint is knowing what it is. Let's look at the condition of the earth's increasing CO2 as a problem similar to that of a person gaining weight. This is actually a great analogy because gaining weight usually has to do with over consuming. If we consume 3,000 calories per day, but only use 2,000, we will gain weight at the rate of 1,000 calories per day. Since there are 3,500 calories in a pound, we will gain one pound of weight every three and a half days. This can go on indefinitely. The calories are stored in our bodies as fat. We can gain 4 or 5 pounds of fat in a couple of weeks. Anyone who has been on a cruise with all-you-can-eat buffets every meal knows first hand. Our overeating shows itself on the bathroom scale.

We've put "fat" in the atmosphere by using too many "CO2 calories" made from burning fossil fuels. We need to go on a diet because this excess CO2 fat is negatively affecting the health of the planet.

We might say: "Okay, since the oceans and the trees take in half the CO2 we put up there, couldn't we cut our excess in half and still be able to enjoy a little overindulgence?" Unfortunately the answer is "No." We already have too much and there's no way to "burn it off" except by planting trillions of trees. Think of it this way. If we were 20 pounds overweight, and cut back our excesses so that our daily caloric intake matched our daily calorie burn, we would stop gaining but forever remain 20 pounds overweight. Our planet is overweight with carbon dioxide. We have to stop the compulsion for excess, return to a healthy, normal carbon dioxide

level, and maintain it.

Most of us need to go on an energy diet. Food diets usually require people to keep a record of everything they eat so that they can identify the source of the excess calories. Cutting back on food helps take off the excess, and learning healthy eating habits maintains an optimal weight.

I've developed a worksheet to account for how much gasoline, electricity, natural gas, jet fuel, diesel, and other fossil fuels we use so that we can determine the pounds of CO_2 we put in the atmosphere each year. Like the food diary, we can use this worksheet to increase our energy awareness and as a baseline for reducing our carbon footprint in the future. For this reason I suggest that you either complete it in pencil or make a copy. There are a few extra copies of the worksheet at the end of this book as well.

Once you see how many carbon "calories" you're producing, you'll become aware of ways to reduce them. You can be creative in running errands so that everything gets accomplished in one trip. You'll start turning off lights and the TV when you leave a room, and not turn on as many lights when you're in a room. You may decide to skip that weekend trip to Vegas in favor of a spa day close to home. You might start washing your clothes in cold water, hanging your clothes to dry, and taking shorter showers. If you haven't already, you can sign up for green power through your local utility company.

In our quest for reducing our carbon footprint, some are inclined to plant trees. Balancing the global warming equation with trees is a good thought, but it may prove easier and more beneficial in the short run to conserve. According to the U.S. Department of Energy, trees can absorb between 1 lb. and 150+ lbs. of CO_2 a year, depending on the age of the tree and its growth rate. (US Department of Energy)

If we were to plant trees that would eventually be capable of

absorbing 100 pounds of CO_2 per year, the average American would have to plant 400 trees. However, if we were to reduce our carbon footprint by 50% it would take only 200 trees for us to become "carbon neutral" with our personal footprint. Of course, in the early years, trees aren't adding that much mass each year. Since we need to have an intensive carbon reduction effort in the next ten years, our best strategy with trees is to keep the big ones in service. Still, planting new trees helps in the long term. If you have room for them, by all means plant lots of trees. Mother Earth needs all the help she can get. Even if you don't have room, there are tree-planting organizations that will plant trees for you elsewhere on the planet where there is room.

The possibilities for reducing your carbon footprint are endless. The important thing is to start right away.

	Carbon Footprint Calculator Date: _____	
Energy	Formula	Pounds of CO2/Year
Gasoline	Miles per year _____ divided by (÷) ___ miles per gallon = _____ gallons x 20 lbs =	
Electricity	Annual kWh _____÷ # in household ____ = _____x 2 lbs./CO2 per kWh = If you participate in a Green Power purchase option, purchasing 100% of your electricity from wind and other renewable energy sources, enter "0."	
Natural Gas	Therms per year _____ ÷ # in household ___ = _____x 12 lbs of CO2 per therm =	
Air Travel	Miles flown per year _____ x .9 pounds of CO2 per mile =	
Fuel Oil	Gallons per year _____ ÷ ___ # of people in household =_____ x 22 =	
Propane	Gallons per year _____ ÷ ___# in household = ____ x 13 pounds of CO2/gallon =	
Mass Transit	Miles per year traveled _____ x .5 lbs. CO2 per mile =	
Waste Per Person	Average is 1,000 pounds per year. (If you recycle newspapers, glass, cans, and plastic, use 500 pounds) =	
	TOTAL CO2 PRODUCTION or ANNUAL CARBON FOOTPRINT:	

CHAPTER 12

Reducing Your Personal Footprint

In 2003 I was invited to a solar energy fair in Walla Walla, Washington to present a workshop on solar water heating. I was most interested to hear the keynote speaker at the event. On my way in to the large auditorium to hear him speak, I saw a poster with the cover of a recent edition of either Time or Newsweek and a quote about the United States having less than 5% of the world population but using 25% of the world's energy. Someone had crossed out the 25% and corrected it to be a slightly different number. This person had initialed the change: "A.L."

I wondered as I entered the hall, "What kind of person is qualified to correct a major national magazine?" I soon learned that this person was Amory Lovins.

Lovins dazzled us with innovative ideas about how to use energy efficiently and to think differently about it. He talked about the energy future and his experiments at the Rocky Mountain Institute. He told us with such certainty and clarity that from an energy standpoint the way we do things isn't smart; that there are better ways now. Lovins showed us how energy conservation is the one thing everyone on earth can do to bring about change.

> *Technologically solving global warming is no problem whatsoever. The real challenge is not technological, but social.*

Before global warming became a reality for me I was a fairly

typical American, blithely pouring my 24 tons of CO2 into the atmosphere each year. I fully enjoyed every convenience affluence had provided.

No one expects us to give up everything that's fun or convenient for the sake of global warming. I still enjoy motorcycle rides. What's changed for me is that I do an errand when I go for a ride. I combine it with something that needs to be done. I've made a conscious choice to consider whether what I'm doing will affect global warming. You can still indulge, but you can responsibly choose not to indulge every single time the notion strikes. I still have full and absolute freedom to do what I want, and if I choose not to do a CO2 generating activity because I really don't need to, I'm still the master of my freedom. I have come to enjoy making these kinds of choices.

This passive solar home uses south facing windows and a concrete slab as a thermal mass to absorb heat in the winter. Deciduous trees shade the home in summer so there is no need for air conditioning.

I was invited to an international conference on solar cooking in Varese, Italy. I remember traveling by train through the countryside and seeing all the clothes hanging out in the sun to dry. I thought it a dignified practice, one my mother and I had done when I was a child. I smiled in respectful appreciation, and decided to do the same.

Other choices I've made include replacing every single light bulb in my home and business with compact florescent bulbs; installing tubular skylights for natural lighting; installing solar attic fans to reduce the need for air conditioning; installing solar water heaters at my home and business; buying a Prius; moving close enough to work that I can ride my bicycle. Instead of watching a 200-watt TV screen, I try to read more using a 5 watt lamp illuminating the page while sitting in a dark, quiet room; and choosing to buy green power from my utility so that no coal or other fossil fuel is the source of the electricity I use at home or at work. By taking a few easy steps over the last five years I have reduced my personal carbon footprint by 60% to less than 10 tons per year. I can now walk this earth shoulder to shoulder with my brothers and sisters in Japan and Germany, making the same footprint as they.

Having done all this, I haven't given up one bit of comfort or one degree of privilege that I had 5 years ago. I'm not finished either – not by a long shot. I'm going to keep on finding ways to reduce my footprint. My goal this year is to get down to 4 tons. If I succeed – and I intend to – I will have reduced my footprint by 80% in five years. This is what the scientific community says I need to do. When I've reached that goal, I'll be walking with the good people of Turkey and my neighbors in Mexico. I'm hoping to get down to one ton of CO_2 per year, so I can walk with my family in India. To do this I know I will have to bike or go by foot just about everywhere I go, and if I drive it will be an electric vehicle that is charged by wind energy I buy from my utility. I will need to grow some of my own food and eat less meat. I will almost

never board an airplane unless it is absolutely necessary. I won't wash my clothes with a washboard or beat them on rocks, but I will hang them out to dry. I will continue to use electricity that is generated by solar panels on my roof and by wind turbines up the Columbia River Gorge from my home. I would live in a smaller but comfortable home. It would be a zero net energy home, with all the energy supplied on-site from renewable sources.

When my granddaughter visits, I'll ride bikes with her and show her how to garden and how to use solar energy. She will have every means to live a life that puts very little CO2 into the atmosphere.

I believe that if millions of earth's citizenry voluntarily choose to make their footprint smaller, there's a real chance the earth will successfully endure the test that is upon her.

It is urgent for Americans to live more simply. As Emerson and Thoreau told us: "Simplify. Simplify. Simplify." We need to get control of our spending, to buy only what is necessary and buy it from local sources whenever possible. We can always be prosperous. The definition of prosperity is having all that you really need. I am a prosperous man. I can go into a dozen stores and see nothing I actually need. It's not having what you want that's important; it's wanting what you have. Americans buy things just in case they might need them someday. We buy it now because it's "on sale," and we "might" use it later. What happens instead is that we forget we bought it, and even if we remember, by the time we need it we can't find it anymore. Americans in a very real sense are willing victims of savvy advertising that is part of living in a consumer society. It's funny and a little sad.

Everything we buy carries with it a CO2 footprint. Products being manufactured require energy to make, and energy to package, ship and deliver. Beyond the energy we individually use to transport ourselves, keep our homes warm, and power our appliances, there's a vast CO2-producing industry for the products

we use. In a sense, buying more products makes us responsible for the CO2 produced manufacturing and transporting them. These products would not have been made and would not have been transported if we, the consumers, didn't call for them.

Advertising shows us a make-believe world that seems happier than the one in which we find ourselves. It strives to convince us that we can be affluent; we can live in the big house and drive the cool car. In fact, we're told over and over we can have it all and we deserve to have it all. Advertisers want us to believe we can "have it all" so they can "sell it all" to us, in which case they will and their clients will end up being the ones who actually "have it all!" The funny thing is, we buy it hook, line, and sinker; but it's not up to them to decide; it's up to us.

Rather pitifully many of us continue to believe the illusion. We drive through neighborhoods like Beverly Hills or Portland Heights or the rich section of our own towns. When I drive through those neighborhoods I appreciate the beauty of the homes but I wouldn't live in one if it were given to me. I wouldn't want to heat it, or cool it, or clean it, or protect it from thieves.

So many of the movies have characters that are very wealthy, who somehow in the course of the storyline connect with the common folk and discover what really counts. My mother used to sing a song about the moon and stars are for everyone, and the best things in life are free.

I stood behind a construction worker at the checkout of the 7-11 and watched him sign over his paycheck to buy lottery tickets. I thought, "I hope he doesn't have a family that is depending on that paycheck." While gambling on our ship coming in, we sink further into debt. We are even provided the means to go in debt when we receive countless credit card offers in the mail that enable us to take more vacations, buy more clothes, cell phones, cars, vacations, home theatres, MP3 players, computers, outdoor kitchens and on and on. Dave Ramsey says, "Tear those credit

cards up," and he's right!

It is a life-engrossing illusion. The chance that any of us who are busting our buns to get ahead could actually win a lottery is like the thousands of would-be heavyweight boxing champions working hard at the gym everyday to get their shot. Even though we technically have a chance, how many boxing champions have died in poverty? How many lottery players, and even winners, have ended up broke?

When you boil it down, what do humans really need? The Beatles said that all we need is love. For our own well-being, and the sake of the environment, we need to strive toward voluntary simplicity. Instead of "civil disobedience," we need to exercise "consumer disobedience" and just say no to materialism.

When we do make spending decisions, especially when buying things that use energy, do we ever ask, "How much power does it take to operate this device?" Years ago during the waterbed craze, I asked the salesman, who happened to be my brother-in-law, how much energy it cost to keep the bed warm. His stock answer was "pennies a day." I know now it took nearly 12 kilowatt-hours per day to heat the waterbed, which in 1980 was 29 cents per day. So he told the truth when he said, "pennies a day." I would by no means purchase another waterbed regardless of cost knowing it generates 24 lbs of CO2 per day. (Barnwell)

I will never forget a big party I attended hosted by Transamerica Title Insurance Company. There must have been 500 people there. In addition to our hosts, there were lenders, appraisers, and realtors. I had always thought of Transamerica as an institution, headquartered in the famous triangle building so familiar on the San Francisco skyline. As I surveyed the room, however, I only saw people. It hit me so clearly: institutions are just people.

Big institutions have a lot of people and a lot of influence. No matter who we are, where we live, or what we do, life at its core is just people. For those of us who have power and influence and begin

to see our way clear to the solutions for global warming, we can be change agents. We can muster all of our abilities to bring forward the new renewable energy economy. We do this by our personal, business, and community energy choices and commitments, and by winning others to the cause. We do it with our purchasing power and with our votes.

Everyone, regardless of age or financial condition, can take meaningful measures that cost little or nothing, but when added up, make a tremendous difference. Here is a favorite example.

When you're 5 years old, you need nightlights because there can be scary monsters about. On one visit, I checked the nightlights in my granddaughter's room. There were two of them using 4 watts apiece. It's not a lot of energy but the both of them were kept on 24 hours a day. This totaled 192 watt-hours per day or 70 kWh per year. This equates to 140 pounds of CO2. While shopping at Home Depot to replace my daughter's remaining incandescent light bulbs I asked the attendant what was the most efficient nightlight they had. He found an LED unit that only used 1/3 of 1 watt. What's more, it could be switched off during the daytime so as not to waste energy. I bought two and took them to Bella's room. At first she was reluctant to change them because one of them, a gift, illuminated a favorite Disney character. I convinced her it was the right thing to do and explained why. She acquiesced. So, how much energy does it now take to make sure no monsters are in her room? 2 lights @ .33 watts that stay on 24 hours per day = 15.8 watt-hours per day or 5.7 kWh per year and 11 pounds of CO2. What a difference! Maybe when she's a little older she can turn them off each morning and cut the energy by another 60% or so. Then she would be down to 5 pounds of CO2 per year for the nightlights instead of 140. That's a 2,800% reduction! They work just as well, and there hasn't been one scary monster in her room since she installed the new nightlights.

LED lighting is truly amazing. We put up a lot of Christmas

lights at my house. Over the years we have gone from old-fashioned bulbs that use 4 or 5 watts each to the new LEDs. The difference in a dozen 50-light strings at 4 watts per bulb (1152 kWh for the season) and the equivalent in LEDs (96 kWh for the season) is 1052 kWh and well over a ton of CO2.

Everyone can get started in their personal and community campaign with little or no money just by changing their energy habits and eliminating every form of wasted energy possible. Here are some ways to save energy that cost absolutely no money:

1. Set the furnace thermostat at 68 degrees or lower, and the air-conditioner thermostat at 78 degrees or higher, health permitting. 3 percent to 5 percent more energy is used for each degree the furnace is set above 68 degrees and for each degree the air conditioner is set below 78 degrees.
2. Wash only full loads in a dishwasher and use the shortest cycle that will get your dishes clean. If operating instructions allow, turn off the dishwasher before the drying cycle, open the door and let the dishes dry naturally.
3. If it's winter, let the sun shine in through the south windows. This is called passive solar gain. There is always a net gain in energy coming from a south facing window. A whole home can be designed to provide most of its heat this way.
4. When the sun is not directly shining in, close the curtain to protect against heat losses. (*For an additional investment, insulating window treatments like Window Quilt offer terrific sealing and insulating. The system can even be motorized to go up and down depending on the sun.*)
5. Move furniture away from radiators and off of heat vents to allow the warm air to freely circulate to the living space.
6. Block unused fireplaces to keep air from escaping up the chimney. Keep dampers closed between uses of fireplaces. An open damper can empty all the heated air in a room in

minutes.

7. Cook two days worth of meals at once. Reheat the second day's meals in the microwave, which uses 80% less energy.
8. Allow the second meal to cool to room temperature before putting it in the refrigerator or freezer.
9. Defrost food from the freezer by putting it the fridge the night before. The benefit is two-fold, because the frozen item provides free cooling to the refrigerator box as it thaws.
10. Don't allow ice to build up in the freezer. When it reaches one-fourth inch, it's time to defrost. Built up ice serves as an insulator to keep the much cooler refrigerant from absorbing the warmer air inside the freezer box.
11. Check door seals on your refrigerator by putting a sheet of paper or a dollar bill between the door seal and the box. If you can easily pull the paper out, fix or replace the seals.
12. Don't waste food. To the extent that food represents a CO2 load for its procurement, shipment, storage, and retailing, when we waste food we are unnecessarily putting CO2 up there that does not need to be. Save your uneaten food and eat it at the next meal.
13. Drink more water. From a strictly carbon producing standpoint, drinking water from the tap represents less of a footprint than soft drinks and most other beverages we might choose. The manufacturing and shipping of beverages of all kinds gives them a carbon footprint. Even if we live in places like L.A. where the water tastes terrible, we can purify it easily with products such as a Brita filter and have cool, clean water. Dentists attribute many dental problems to drinking sugar-filled pop. Not only will you produce less CO2, your teeth, joints, internal organs, and complexion will be a lot happier.
14. Instead of getting into the car, starting it, putting on the seat belt, then going, try getting into the car, putting on the seat belt, and then starting the car.

15. When cooking, turn off the heat just before you think you're finished and let the residual heat continue to cook for the final minutes. Bring rice, pasta, and potatoes to a boil then turn off the heat and let them set for 30 minutes.
16. Do as much as you can without using paper. Bank and pay bills online. Use electronic, not paper, cards for socializing. What a perfect way to communicate a thank you, party invitation, or announcement of a pending event. Websites like Evite allow you to easily send announcements and invitations. Some eCards can have animation, making them more fun than a written card. The footprint is far less than a paper card made from a tree, then shipped to a store, and carried by the U.S. Postal Service in multiple fossil fuel powered vehicles that deliver it to your home.
17. Use your laptop more than your desktop computer. Laptops use far less energy. The most efficient laptops use 10 watts compared with a desktop that easily use 10 times more.
18. Between uses, make sure your computer is completely OFF. Use a meter to test and make sure.
19. Disconnect your doorbell. It draws a few watts of current all the time. Put a little sign that says, "Please knock" or "Out of Order" on the doorbell. Start checking out doorknockers or come up with your own idea on how to build one using materials you have lying around.
20. Try not to drive if you really don't have to. In my work, for instance, I can look at a satellite photo of a rooftop to determine its feasibility for solar panels. I check orientation and shading and discuss feasibility over the phone with a prospective customer without having to drive all the way to the building when the site obviously isn't good for solar. This not only saves gas and CO2, it saves time.
21. Hang your clothes out to dry. Use an outdoor clothesline in the summer, and an indoor clothes-drying rack in the winter.

22. Recycle almost everything. If recycling isn't available in your area, raise hell until it is. Dealing with recycled goods requires half the carbon footprint that trashing everything does.
23. Riding a bicycle is the most energy efficient transportation there is. There are 125,000 BTUs in a gallon of gas. It takes 110 BTUs to ride a bicycle one mile. Therefore, when riding our bikes, we in essence are getting the equivalent of 1,136 miles per gallon. Do every errand you possibly can by bicycle. Get some saddlebags to haul things. My wife and I have done a week's worth of grocery shopping on our bicycles.
24. Walking takes 500 BTUs per mile, which translates to 250 miles per gallon. Walking and biking are the least carbon intensive methods.
25. Travel light – extra weight means extra CO2.
26. Reuse your water bottles. Be sure to sanitize them between uses.
27. Buy big boxes of cereal and other products, or buy in bulk, to reduce packaging.
28. Re-use whenever possible, and avoid disposables. For

instance, change blades in razors rather than buying the plastic ones you use a few times and throw away.

29. Give unwanted goods to resale shops rather than putting them in the garbage.
30. Choose products that will decompose. Compost food scraps.
31. Pay attention to your gas and electric bills. When your energy use starts going down, you'll know you're on the right track.
32. Buy recycled. There's a whole industry based on products such as tiles made from recycled glass, insulation made from cellulose (newspaper), and a host of other products. Green architects and designers are familiar with these products, many of which cost no more than petroleum based or non-recycled products.
33. If you're a coffee or tea drinker, or use hot water for any beverage, rather than overfilling a kettle and boiling excess water that later cools and wastes half the energy, pour the exact amount into the pan or kettle that fits into the cup you'll use. My personal favorite way to do this is with a kettle I used in India. I filled my teacup with water and poured it into a countertop plug-in kettle, which had an electric element inside that directly heated the water. India uses 240 volts. That cup of water was heated in seconds. I'd seen similar kettles in the US but they're only 120 volts so they take exactly twice as long. I brought a 240-volt model back from India, along with the electrical parts to wire it to 240-volt plug in my home so I could enjoy supercharged hot water.
34. Unplug your cell phone charger from the outlet between charges. The adapter draws energy even when the phone's not there. This is true of nearly all other chargers for laptops, battery chargers, fax machines – anything with a power cube or adapter.
35. Set you refrigerator to no colder than 37 degrees and freezers

to zero. My dad, a retired union electrician, told me he had to replace the thermostat in his refrigerator. The device was failing to turn off. "It was a comical situation," he reported, "the milk has ice floating around in it, the celery is like a green popsicle, and I darest not challenge a carrot."

This is a list of items that cost very little, and can easily pay for themselves in a very short time:

36. Install energy-saver showerheads. New heads can be easily changed or for even less money, low flow gaskets can be inserted into most existing shower heads.
37. Clean or replace furnace and air-conditioner filters regularly, following manufacturer's instructions.
38. Fix defective plumbing or dripping faucets. A single dripping hot water faucet can waste 212 gallons of water a month. That not only increases water bills, but also increases the gas or electric bill for heating the water.
39. If you have single pane windows, upgrade to double pane. If you can't afford it now, use cling film. It's nearly as effective and costs pennies per window.
40. Stop air-infiltration. Air leakage is the biggest energy waster in a home. Weather-strip exterior doors, seal around windows, caulk wherever light is coming in, caulk at the bottom of your exterior siding (otherwise, air travels underneath the siding and up the wall). Buy inexpensive electrical outlet and switch box insulation pads to cut air leakage. Install everywhere, not just on exterior walls. Use caulk or spray foam to seal around any wall penetration for pipes, vents, or other mechanical equipment.
41. Use power strips to control phantom loads. Plug your remote controlled TV into the power strip, then turn it on and off when you enter and leave the room.

42. Use timers on electrical water heaters.
43. Use a tea cozy to keep tea water hot. Radiant insulating material such as Reflextex has all sorts of purposes.
44. As soon as you possibly can purchase and start using a pressure cooker. These amazing devices cook food in a fraction of the time.
45. Purchase a cardboard file box, line it with Reflextex, and use it as a residual cooker. Any food brought to the boiling point can be taken off the stove and placed in the insulated box where it will continue to cook without additional energy input. Combining this with a pressure cooker is amazingly efficient. Once the pressure cooker hisses at full steam, turn off the heat, and place the cooker in the box. You can do a roast, a bunch of artichokes, a dozen hard-boiled eggs, or a weeks' worth of oatmeal this way with one tenth the energy of conventional methods.
46. Locate your freezer outdoors if possible. Placing it in the coolest possible temperature environment will reduce the energy required for it to keep things cool. Experiment with an outdoor or through-the-wall refrigerator.
47. Use only compact fluorescent or, better yet, LED lights. Purge away and recycle all incandescent lighting. DO NOT WAIT UNTIL THE INCANDESCENT BULBS BURN OUT. Get rid of them now. They're evil!
48. Get rid of your old Christmas lights that have hundreds of 5-watt bulbs and replace them with LED strings where all 100 bulbs use less than 5 watts.
49. **Buy green energy**. One cent per kilowatt-hour is the best investment you can ever make in your planet. If your utility doesn't offer a green power purchase option, bug them until they do. Get your state legislator to sponsor a bill.
50. Buy organic produce. Whereas large-scale commercial farming methods increase carbon dioxide in the atmosphere,

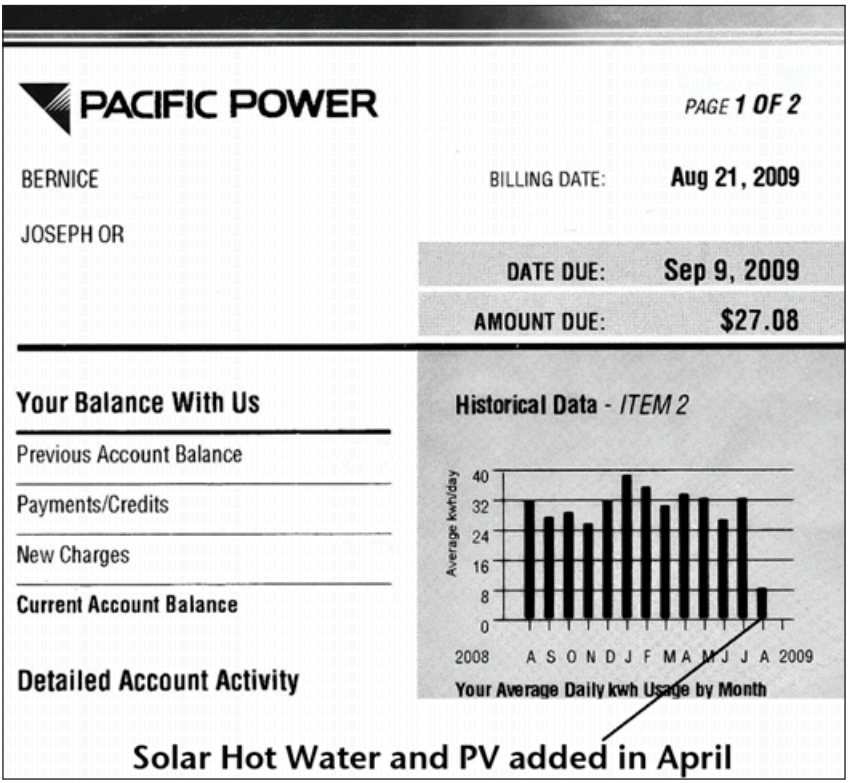
each acre of soil farmed organically captures over 7,000 pounds of the CO2 per year, according to a ten-year study conducted by Rodale Institute. (LaSalle)

This is a list of items that will require more of a capital outlay, but will pay for themselves in months or a few years:

51. If you're about to replace your oven, consider a convection oven, which uses less energy.
52. Insulate the foundation on the outside of the building. Dig down to the footing, line the vertical foundation wall with at least 1" of rigid insulation (more in colder climates). Install a "Z" flashing between the siding and the insulation. Back fill the dirt. This is more labor intensive than materials costly. Get lots of help.
53. Install tubular skylights to bring natural light into a gloomy room and hallway.
54. Invest in a solar cooker, or solar oven. They cost as little as $20 or as much as $500. Use it whenever you can.
55. Install a solar powered attic fan for summer cooling of the hot attic.
56. Install sunscreens on the exterior of south and west facing windows that allow unwanted heat in the summer. Cost is about $2 per square yard, which is very little in relation to the benefit. Payback can be in less than a month!
57. Install interior window treatments to keep heat in during winter. This will cost more but increases the R-value of a window by three times.
58. Install a solar water heater. These save a huge amount of energy, on the order of 2,500 kilowatt-hours per year.
59. Install a solar photovoltaic system. With a big enough PV system you can be a "Zero Net Energy" home or business, producing 100% of the energy used on site.

60. When it comes time to replace your refrigerator, get a Sunfrost or at least the best Energy Star model you can afford.

Our lives consist of a hundred energy choices every day. We are aware of some, and not aware of others. Replacing a single nightlight might seem a tiny and insignificant change. It is small but it is not insignificant. The sum of all of our energy choices affects in direct proportion the amount of CO_2 that enters the atmosphere. Every single energy transaction counts. A million small transactions add up to a big one. When we become aware of all of them, truly amazing things start to happen. When we extend simple energy saving principals to our communities and our world, a miracle can happen.



A copy of a customer's electric bill after installing solar hot water heating and photovoltaics. Notice the amazing reduction on the right side of the bar graph after adding solar.

CHAPTER 13

Reducing Your Community's Footprint

For every unit of energy we use in our homes and for personal transportation, an equal or greater amount is used in the commercial, industrial, and public sectors where we work, shop, dine, school our children, and carry on all the other activities of life. What can we do if we want to reduce the carbon footprint in the communities where we live?

I'll use my own business as an example. I bought a 10,000 square foot building in a light industrial area near Portland International Airport. The previous occupant of the building reported $1,500 per month energy bills while he was there. I calculated 225 tons of CO2 per year. With my 20 employees, that would have been 10 tons per employee added to their personal footprint.

I wanted no part of these high-energy bills and the consequent CO2, and neither did my employees. They were as enthusiastic as I was about rolling up our sleeves and getting to work to make the building energy efficient. Our strategy was to first focus on how to reduce load through conservation, natural lighting, and solar hot water, with a future plan to add enough solar electric modules to bring us to zero net energy.

The building was very cold and dark. Two thousand square feet had been sectioned off as offices. The only insulation was ancient R-11 fiberglass batting haphazardly placed in the attic area over the offices. The first thing we did was blow in eighteen inches of new insulation right on top of the fiberglass. This was an easy way to fill in many holes and raised my total insulation value to R-50.

The outside walls were one-foot-thick concrete without insulation except a layer of sheetrock on the interior office walls. To insulate those walls, we used rigid foam insulation sheets which went right over the existing sheetrock, and then put a new layer of sheetrock over the rigid insulation. This reduced some of the already small offices, but everyone appreciated the immediate warmth.

I found some one-foot square glass blocks that fit nicely into the fifteen inch square garage door panels on the south wall of the office. These provide natural lighting and a small amount of passive solar gain. The lighting in the building came from forty heavy industrial light fixtures using 250 watts each. That's a 10 kW lighting system, which if operated 8 hours per day would be 80 kWh. The offices had no natural lighting, except for a couple of very small windows with cracked panes that were replaced right away. The interior walls were dark and dirty, so we painted them lighter colors, which made the rooms seem less dark, but still cave-like.

Tubular skylights were the answer. The 21" dome in the ceiling was so bright it looked like a little sun. We installed three more tubular skylights in the rest of the office space, and then added five in the 8,000 square foot shop area. The five skylights provide 90% of the lighting for the shop. Then we installed the most efficient auxiliary task lighting strategically where needed. By using natural light, we reduced our lighting load from 80 kilowatt-hours per day to about 2. We were now using 1/40th of the lighting energy the previous occupant used.

These energy improvement projects, along with extensive remodeling activities, took about four months. By then we had moved into the building, and within a year, we installed a solar water heating system. The Sol-Reliant™ system has a 56 sq. ft. thermal collector, which is adequate for a family of four, and works well for the size of our business. The tank is located in the

Tubular skylights and compact florescent track lighting illuminate the office for a fraction of the cost.

showroom area so that visitors can observe the temperature gains from solar energy.

Solar provides 100% of our hot water, mainly because I disconnected the back-up electric water heater. Normally we only need hot water for hand washing. During the summer when solar hot water is abundant, many of us ride our bikes to work and shower there. Workers are encouraged to use up the hot water at the end of the day, especially if they don't have solar hot water at home. This way they're reducing their carbon footprint by using free solar hot water at work. During the summer months, there's plenty of time after everyone has gone home to reheat another batch of hot water for early morning bike riders.

Next I examined the heating system. Fortunately the office area had an electric heat pump system. However, the ducts weren't well insulated, there were several air leaks, and the dirty black filter looked like it was the original one from 1950. I remedied these problems and had an HVAC contractor inspect and service the equipment. For added efficiency, I installed a programmable thermostat.

Heating 2,000 square feet efficiently takes some creativity. I turn the thermostat down to 65 degrees during wintertime work hours. A small 1,000-watt radiant electric heater sometimes supplements the main heating system for one or two people

working in a smaller back office. Overnight the set back thermostat allows the temperature to drop as much as 20 degrees F. However, because the concrete floor is a functional thermal mass and tempers heat loss through the night, our experience is that we can allow the thermostat to automatically turn the heat on about an hour before people arrive at work, and it's just like it was at 5 p.m. when we left the night before. On any halfway sunny day in winter, the concrete floor is partially heated (charged) with solar thermal energy. On the clearest, sunniest days in winter, the heat pump turns on surprisingly little.

During the summer, an overhead awning shades the south facing side of the building, preventing the unwanted heat from charging the concrete floor mass. In summer, the concrete mass acts in the opposite manner of what it does in winter. The cool, 59 degree F earth just below mediates the temperature. Its tempering effect is really felt over a twenty-four hour period. Even on those few days when the temperature is 90 degrees or more, the hottest it gets inside is around 80 degrees. Two solar attic fans in the warehouse help draw hot air out and circulate the air, cooling the area. On the hottest days, office workers are allowed to wear shorts and sandals. We can make it through the worst of summer with almost never having to turn on the heat pump air conditioning.

Any zero net energy home or business must zealously guard against phantom loads, those appliances like doorbells whose transformers are energized all the time with 2 or 3 watts of electricity. We decided to plug our photocopy/fax machine and each computer into a power strip and turn that off at night. All devices that have a power conditioning attachment are also plugged into a power strip so that would-be phantom electrons can't trickle through one side of a transformer. The microwave doesn't have an LED time clock. The building is as phantom-proof as we know how to make it.

Coffee drinkers organized and came to me to put in an

automatic coffee maker. Brewing coffee and keeping it hot all day from an energy standpoint was not something I was excited about. We compromised by installing a coffee maker that we turn off immediately after the coffee is brewed. The hot coffee goes into a pump-type dispenser that keeps it hot all day.

Recently there's been a push to bring in a refrigerator for office workers and production staff to keep their lunches and perishable snacks. I can tell I'm going to have to give in at some point. I could bring in a Sunfrost refrigerator at a rental house I own that uses less than 1 kilowatt-hour per day; but then I'd have to replace the tenant's refrigerator. They may not appreciate the energy significance of an ultra efficient refrigerator. I pay the electric bill, but is it ethically right for me to allow them to use a less efficient appliance and to put more CO2 into the atmosphere than is necessary?

What I'll probably do is buy a small, under-the-counter refrigerator and mount it through the wall on the north side of the office, so that only the door is inside the heated space. I did this once in an apartment and it worked great. Most of the refrigerator is outside where the average annual temperature is 12 degrees lower than the average indoor temperature. This reduces the electric load by one-third.

It took us almost two years to accomplish all the load reduction we possibly could. Finally we were ready to calculate what it would take to get to zero net energy usage. We had a year's worth of utility bills to pore over. Our utility, Pacific Power, made it easy by providing a bar graph with the average daily kilowatt-hour consumption for each month of the year. With this, we determined our average daily kilowatt-hour total was 23. That was the load we'd need to meet with our photovoltaic system.

We decided to size the photovoltaic system to provide 23 kilowatt-hours per day, or 700kWh per month, or 9000kwh per year. In my experience, this is about the same load as a very

efficient, all-electric home with passive solar design and solar hot water in which occupants practice good energy conservation. In our case, besides space heating, we power five computers, a big photocopy machine, a security system, and a dozen or so compact florescent lights.

Next we determined the peak sun hour rating for our area. Peak sun is a standard measurement of the sun at its brightest, and varies depending on the location's weather, latitude, and other factors.

Peak sun equivalents are available for every location on earth. Most places where people live have between three and seven peak sun hours per day. Although there are a number of online services that have charts and graphs of peak sun for a given location, we chose the University of Oregon Solar Radiation Monitoring Laboratory (www.solardat.uoregon.edu/). Dr. Frank Vignola provides excellent, verified, and detailed information on the distinct solar zones of the state. His information is so accurate it shows the effects of global warming.

According to Dr. Vignola, average peak sun hour equivalents for a fixed photovoltaic array in Portland are 3.9 hours per day. It is always good to reduce this number by 10 to 20% to allow for wiring and inverter losses, tilt and orientation, and dust buildup on the modules. Although a 30-degree tilt to the south is optimum for my area, we elected to mount the modules at a 15-degree tilt to fit them in the space we had. We gave up 4% by having the shallower angle, but the concession was worth it for overall appearance.

To calculate the size of the photovoltaic array we'd need, we took the average kilowatt-hour load per day (23), divided by adjusted peak hours (3.5) to get the PV kilowatts needed to reach zero net energy (6.571). I elected to make the system 6,864 watts.

PV systems in our area in 2006 were installing for about $10 per watt. By 2010 they were considerably less. Still, I had to come up with an investment of almost $68,000 to reach zero net

energy. My first thought was, "Yikes! Where am I going to get the money?"

I considered capitalizing the project utilizing a third party investment option. These are popular for much larger systems, where an investor or investor group buys the system, takes the tax credits, utility incentives, and depreciation, then leases the equipment to the eventual owner who pays rent on the system that is roughly equal to the energy savings. I had trouble finding a third party interested in a project so small. I did have one taker, but in the end my CPA and I didn't like the buy-out provision at the end of the lease. I was looking for a buy-out of a few hundred dollars but the language in the agreement said "fair market value." I realized the fair market value might be $50,000 or more. In fact, solar energy systems have been known to hold their value over time as energy costs continue to rise. I didn't want to pay for the system twice.

Borrowing the money seemed to be my best option. There were several low interest loans available including the Solar Energy Loan Program (SELP) through the state of Oregon. I was able to get private financing at 7% unsecured. The SELP loan would have been an even better rate, but required placing a 2nd mortgage on the building, which I didn't want to do at the time. Furthermore, because of tax credits and incentives, I didn't have to borrow the entire amount. The Energy Trust of Oregon gave a cash incentive of $8,580 against the purchase price. In six months time when I filed my Federal income tax return I would get a $17,676 refund (30% of cost less the Energy Trust of Oregon incentive). The state tax credit provided about $27,000, although it had to be taken over 5 years. Still, in the first six months I would reclaim about half what I'd borrowed and by the time all the credits were in, nearly 80%. I can take depreciation on the system, and with the energy savings I expect to have full payback in seven years. I went from "Yikes" to "Done deal!" with just a few pushes of the pencil.

Before we could install the system we had engineering done to make sure our steel awning on the front of the building would support the half-ton of new weight we were placing up there. Ricardo Pitts from RNS Consulting certified that the structure was adequate.

The installation was great fun and the PV system was completed in 4 days.

We planned a "throwing the switch" open house celebration for Saturday, August 25th, 2007 and finished the system the day before. Pacific Power came in and installed a bi-directional net meter. They were quite excited about our project. They told us this was the first truly zero net commercial facility in their service district, which includes six states.

One of Oregon's first zero net energy commercial industrial facilities.

We had a party the day the system came on line. What a glorious afternoon it was! Even though the temperature was near 90° F, the shaded concrete floor and the solar attic fans kept the inside temperatures comfortable. There was a feeling of sublime joy and satisfaction, a celebration of the sun and what it could do. The solar cookers drew a lot of attention as people awaited hot dogs and cookies browning in the oven. For everyone at the company,

the planning and two years of work to achieve this goal was worth all the effort, and for me personally, it was a dream come true.

The Mr. Sun Solar corporate headquarters is a good example of what can be done retrofitting an existing building. If you're starting from scratch building a new building, you can do amazing things when you give energy considerations first priority.

One outstanding example is the Oregon Health Sciences University south waterfront building on the Willamette River just south of downtown Portland, Oregon. Built in 2006, the designers of this 16 story, 400,000 square foot engineering marvel were nothing short of brilliant.

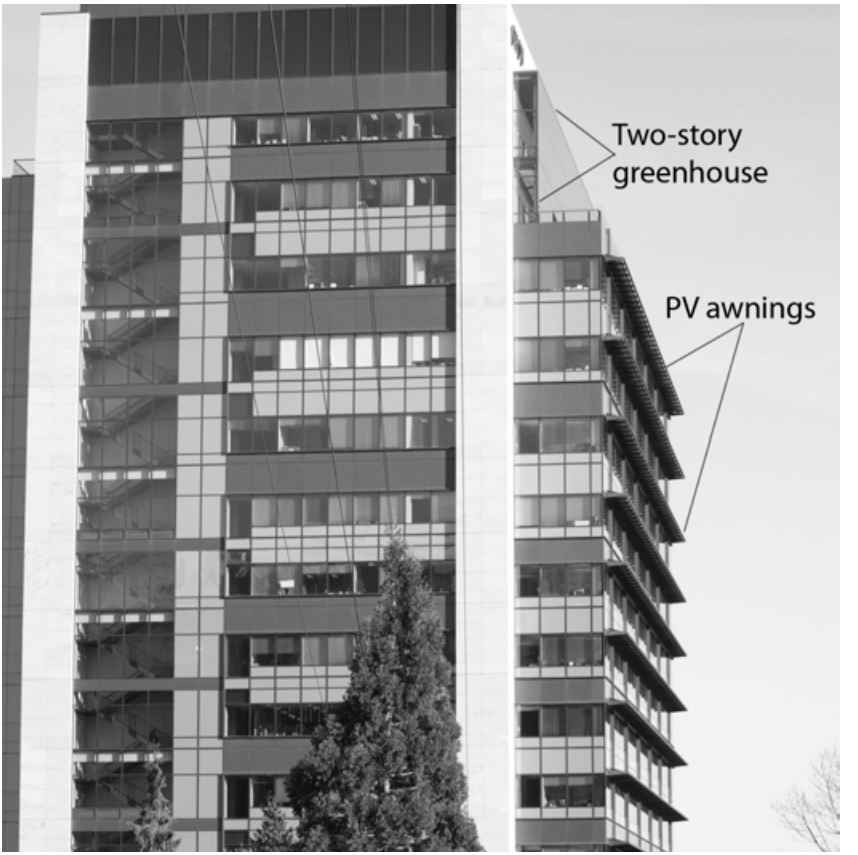
First, they situated the rectangular building with the long side facing south in order to optimize direct solar gain. Next they planned for awnings to shade the windows from the high angle summer sun. Without the awnings, unwanted summer heat energy would add to the air-conditioning load. In a stroke of sheer genius, rather than simply having shade awnings, they used solar photovoltaic modules as the awnings. This allowed for double-duty: providing shade and generating electricity at the same time.

Double-duty was a theme incorporated throughout the building and its mechanical system. They even have their own water waste treatment facility and reuse "gray" water for landscaping, toilet flushing, and as a heat transfer fluid. Even though the building investors were willing to install a wind turbine to extend above the roof-line that would provide electrical energy, the Design Commission voted down the necessary height variance.

The goal at the inception of the project was for the building to use 60% less energy than the already demanding Oregon Building Code allowed. Andy Frichtl, PE Principal of Interface Engineering, believes the goals were met, if one were to calculate the internal rates of return on capital paybacks due to energy saved over the building's life. For their efforts, the OHSU south waterfront building received LEED certification as the largest

health-care facility in the country to earn a Platinum rating. LEED (The Leadership in Energy and Environmental Design) of the U.S. Green Building Council provides a Green Building Rating System to encourage sustainable building.

On the south wall of the OHSU building, two stories from the top, a 20-foot tall greenhouse-looking façade runs the entire 190-foot length of the building. There are no plants inside this greenhouse, in fact, it's barely as wide as a 4-foot hallway inside. Its sole purpose is to make hot air, and does it ever! The total amount of glass area is close to 3,800 square feet. On a clear day the sun



Photovoltaic modules double as awnings in the summer.
The two-story greenhouse heats domestic hot water.

powers down over 300 BTUs per square foot per hour. Adjusting energy input due to seasonal sun angle and loss through the glass still results in an estimated 200 BTUs per square foot per hour on a sunny day. *(Calculation: 3,800 sq. ft. x 200 BTUs x = 760,000 BTUs per hour.)*

The heated air is then efficiently transferred to water via a large rooftop air-to-water heat exchanger. The heated water is stored in a huge 5,000-gallon tank located in an enclosed room adjacent to the lower level parking area. When the stored heat is needed, it is moved to one of the building's biggest heating loads: domestic hot water. The building engineer testifies to seeing 110-degree water in the 5,000-gallon solar holding tank. That's 55 million BTUs waiting to be used. *(Calculation: 5000 gal. x 8.33 lbs/gal x 55 F (delta T) = 54,978,000.)*

The well-insulated 5,000-gallon storage tank resides in a row of 3 other big tanks holding another 15,000 gallons. These other three tanks are heated with the waste heat from the on-site natural gas co-generation power plant, which together with the photovoltaic array, produce one-third of the electrical energy for the entire building. There are five generators producing 60 kW each. Instead of 500 degree F waste heat being lost to the air, much of that heat energy is transferred to the 15,000-gallon space heating storage tanks.

There are numerous heat exchangers at this facility. A heat exchanger is a device where energy can be transferred from one mass or material to another. There are air-to-air heat exchangers that take heat from damp air in the building's laboratories and transfer it to the incoming "make up" air from outside. There are also air-to-water, water-to-air, water-to-water, and fluid-to-fluid heat exchangers. It is relatively easy and efficient to move heat energy from one medium to another, regardless of the source where the energy originates or the load where the energy is used.

Another place where heat can be stored is in the 18" thick concrete slab in the lobby of the building. Tubes run through the

slab to distribute heat in the winter. In the summer, cool water is circulated through the floor. Much of the rest of the building is heated with low profile baseboard hot water radiators, which move heat from the storage tanks, or when necessary from the high efficiency gas boilers, and distribute it throughout the building. Likewise cool water is circulated through overhead coils. Having both radiant heating and cooling produces a steady, even year round temperature which is the ultimate in comfort for medical patients and workers.

Since water can carry more BTUs of heat per volume than air can, heat can be moved more efficiently in a radiant system. The benefit of lower energy requirements and greater comfort inherent in a radiant system are fully enjoyed throughout the 400,000 square feet.

If that weren't enough, heat is recovered from process chilling used to cool the energy intensive MRI equipment, which needs full time cooling. Even heat from dehumidification of the pool area is recovered. Damp air that must be exhausted from bathrooms and other wet areas leaves the building without its heat, thanks to yet another air-to-water heat exchanger.

Lighting throughout the building is very carefully controlled. Photocells, timers, occupancy and motion sensors provide light when and where it's needed. A high priority is given to natural lighting. Even the emergency stairwells, which in many high-rise buildings are encased in a concrete corridor in the center of the building, are placed on outside walls with glass on one side. Natural light is adequate the great majority of the time.

The electricity from the PV array is a relatively small portion of the total energy needed to run the building, but its average of 200 kWhs per day would be enough to power 20 very efficient homes. The energy value from the summer shading the PV "awnings" provide is nearly as much as the electricity generated. It is estimated that the PV overhang offsets 20 tons of cooling load to

the building in the summer. That's 240,000 BTUs per hour.

(Calculation: 20 tons x 12,000 BTUs/ton = 240,000 BTUs per hour.)

On a hot summer day, this can easily amount to a passive cooling value of well over a million BTUs. In wintertime, the low angle sun passes under the awnings through the south facing windows into the building, giving considerable direct solar gain that helps meet the heating load.

While similar sized buildings nationwide are gobbling energy as fast as they can, the OHSU building purchases an average of only 17,583 kWhs per day from the local utility and only 1,170 therms of natural gas. Based on its low BTUs per square foot, the new OHSU building is Energy Star Certified. Only buildings in the top 25% qualify according to Mark Schnackenberg, Senior Chief Operating Engineer, OHSU Center for Health and Healing.

There may not be another 400,000 square foot high-energy demand medical building in the United States with lower energy usage. There are a host of other design features that make this a really special building. The sod-covered eco-roof with no-maintenance ground cover keeps the rooftop cooler in the summer and protects the membrane roofing material underneath from sunlight. Not only does this contribute to lower energy demands, it effectively doubles the roof life from 20 to 40 years. To learn more about the building, visit www.ohsusouthwaterfront.com and click on the Property Info tab, which will lead you to photographs and various links describing the building and green design. The whole building stands tall as a testament to energy efficiency.

Many more new buildings will be erected. 48% of the energy used in America is used in buildings. Transportation uses 27%. Industry uses 25%. (Dymond)

With higher fuel efficiency automobiles, hybrids, electric cars, mass transportation and bicycles, we can make significant improvements in the transportation sector. There is an incredible

amount that can be done to reduce waste and improve efficiency in industry. Large industrial motor retrofits can save megawatts of energy and pay for themselves in a few months or even a few weeks. Industrial engineers have traditionally oversized pumps unnecessarily. "Better to be bigger than needed, just in case." So, a great number of large industrial pumps are in effect throttled down. An analogy would be driving a car with the accelerator always to the floor and using the brake to regulate speed. More thoughtful pump design can save billions of kWhs in American industry. Multi-stage pumps that need greater energy for start up can automatically amp down to sustain flow. Modern advances in steel production and fabrication such as "thin-slab casting" and "direct casting" save enormous amounts of energy and carbon dioxide. Curbside recycling of aluminum saves the energy-intensive aluminum industry gargantuan amounts of energy, 95% in fact, over the production from bauxite. (Gore 252)

Buildings represent the greatest potential for energy savings because nearly as much energy is used in our buildings as in transportation and industry combined. Building designers, engineers, and remodelers should give energy considerations first priority. As illustrated by Mr. Sun Solar and OHSU, there is no reason a building that uses 50 to 100% less energy can't be achieved with a good return on investment to the owner/developer. Obviously such efficient buildings make a much smaller carbon footprint.

There are 450 billion square feet of buildings in the United States, of which it is estimated that 150 billion square feet will be remodeled in the coming decade.

With a philosophy of conserving energy and reducing my carbon footprint at work, I was able to achieve a zero net energy business. Our energy awareness shouldn't end at home. It should

extend to our work and school, the gym, the store, and every building we enter.

If you were to calculate the carbon footprint of your company you would have to ascertain the annual energy usage from natural gas and electricity in its building(s) and, if applicable, the amount of fuel used by company vehicles, and then divide the total by the number of employees to discover your employer's carbon footprint. If the corporate footprint is 100 tons per year and there are 20 employees, then the employer's carbon footprint is 5 tons per employee.

The challenge for any employee is to find out what your company energy usage is. Rest assured that someone knows it. The president knows or should know, the chief financial officer knows, or you can ask someone in Accounting, "How much electricity and natural gas do we use around here?" You can do the math from there. If they ask, "Why do you want to know?" you can answer, "I care about energy from an environmental standpoint and want to know how efficiently our company uses energy and what we're doing to reduce our carbon footprint." If your company has elected to purchase 100% renewable energy you can enter a big "Zero" for electricity. You'll still need to know what the usage is for natural gas. If Accounting tells you, "We don't want employees to know how much we spend for gas," you can say, "I don't want to know the amount in dollars, I want to know the amount in therms because I care about the energy used, not the cost of the energy."

In the U.S., roughly 1/3 of all non-transportation energy comes from the residential sector, 1/3 from the commercial sector, and 1/3 from the industrial sector.

If you work for Parr Lumber, a retail lumber chain in five Western states, you can be proud of your company's footprint. Parr has converted 70% of its vehicle fleet to bio-diesel. At every location where a green power purchase option is offered, they've signed up. This is about half of their retail stores. They're waiting

for green power to be available to their remaining stores and as soon as it is, they'll sign up. They practice recycling in their offices and lumber yards, and only use lumber that is harvested in a sustainable manner as certified by the Forest Stewardship Council or the Sustainable Forestry Initiative.

If you are one of a million Wal-Mart employees you may work in a giant warehouse-type building that uses a lot of energy. A large Wal-Mart draws about one megawatt of power. If the store is open 12 hours per day it uses 12 megawatt-hours or 12,000 kilowatt-hours per day. That's as much electricity as 400 homes would use in a day. There are 4,000 Wal-Mart stores in the United States. Now, if you were to calculate the carbon footprint of all these buildings, the math would look like this: 12,000 kWh per day x 4,000 stores x 365 days per year = 17,520,000,000 kWh per year. If Wal-Mart were buying all those kWhs from utilities who generated them from burning coal, you would multiply the 17.52 billion kWhs times 2 pounds of carbon per kWh to get 35 billion pounds per year or 17.5 million tons.

It turns out that the number is a lot less, and will get even smaller. The reason is that Wal-Mart, with its environmentally friendly initiative, is gearing up to produce a portion of its own electricity by putting solar photovoltaic modules on many of its buildings' rooftops, and buying green energy produced by wind in every market it can. Beyond that, Wal-Mart is seeking to double the fuel efficiency of its trucks and has the goal of zero waste at its stores. To be fair the Wal-Mart carbon footprint should also be spread over the 127 million customers per week who visit Wal-Mart stores in the U.S. That number is more than 1/3 of the population of the country.

The only employer in the U.S. larger than Wal-Mart is the government of the United States. Let's hope the management (Mr. Obama) and the employees of that major "corporation" follow the likes of Parr Lumber, Mr. Sun Solar, and OHSU.

As you walk around your company, look for energy waste and report it. Look for incandescent light bulbs or leaky water faucets (if they're leaking hot water, they're leaking energy and CO_2). If you see an area with lights on during the day that could be served by tubular skylights, put a note in the suggestion box. I think it would be great if individuals took into account a company's carbon footprint in deciding whether or not to work for that company. If you decline a job offer for that reason, be sure to tell them.

Executives and others who fly for business would need to take their miles per year in the air and multiply it by .9 pounds of CO_2 per mile, then add that to their footprint. This could be applied to the entire company footprint and divided by all employees, or taken on the traveler's personal carbon footprint. If we spread it over the entire company, it gets lost. No individual focuses on what to do to improve the situation.

When you anticipate flying you might ask if the trip is truly necessary. A lot of trips could be avoided. I believe I can conduct virtually any business by phone. Many businesses are using video conferencing. Hewlett-Packard uses VC extensively, having international meetings spanning many time zones that save their employees millions of miles in the air each year. Sure, the quality of the personal visit and the favorable impression it makes is undeniable. However, if you're trying to get my business, and you fly all the way out to see me, and we both realize the meeting could have been conducted by telephone, you haven't won any points.

I will admit that there are situations that absolutely require a personal visit. One can't conduct an energy audit or a solar assessment without going to the home or business. When I have to travel using fossil fuels, I claim the CO_2 on my personal direct footprint ledger and I seek ways to reduce that amount. The whole purpose of this book is to get individuals to take personal responsibility for their footprint and seek ways to reduce it every year for the rest of their lives. By keeping the responsibility on

ourselves, we will do more to ask, “Is this trip really necessary?” We might say, “Yes the seminar is useful and I really need those continuing education hours, and the company is willing to pay, but I could get those same hours with an online course instead of flying to Hawaii.” If you have an opportunity like this, it will surely test your character.

If you are a student, chances are you spend 6 to 8 hours a day in buildings that use electricity and natural gas. Rightfully the entire energy usage should be spread over the number of students and teachers who are there. I was asked to attend a high school student conference where students did research and reported on climate change. They made posters illustrating their findings and presented them to selected teachers, a city commissioner, and me. Afterwards, the panel of grown ups were invited to ask questions of the students. I asked what the students had planned to improve the efficiency of their building. I noticed the classroom was too hot and the window was opened on a cold day. They said they had inquired about the situation, but no one understood the rather old-fashioned heating system well enough to correct the problem. I suggested that someone, somewhere in the school system must have knowledge about the way the heater worked, and that they should not rest until the problem was corrected. Persistence, I told them, is our greatest tool for change.

Furthermore, teachers and administrators want to please students. Students have more power than they know. If something isn’t right and if you keep squeaking about it, sooner or later someone will listen or you will find the solution yourselves.

The Beaverton School District in Beaverton, Oregon was faced with a projected $750,000 utility budget shortfall due to unexpected utility rate increase requests. They had the idea of making up the shortage with energy savings. 38,000 students and over 4,000 staff in 49 schools were asked to become energy aware by taking the “Energy Conservation Pledge” to turn out lights when

leaving rooms, shut off computers at the end of the day, increase energy awareness on their campuses, and look for other ways to conserve energy. They implemented 25 specific energy efficiency measures.

One energy-saving strategy was to eliminate the two-hour daily computer start up for automatic updates. 14,000 computers using 150 watts each consumed a total of one and a half million kWhs per year. The savings from this measure alone was $153,000. Every school in the district achieved energy savings, some as much as 25%. All together they saved two million, four hundred thousand kilowatt-hours (2,400,000 kWh) and 171,000 therms.

This represents not only a reduction in energy costs, but an equivalent reduction of CO2. Beaverton School District was able to reduce their carbon footprint by several million pounds per year. Two schools in the district have been awarded the Energy Star rating, and the district is an Energy Star Partner.

By the end of the fiscal year, conservation measures covered more than half of the estimated shortfall, with the remainder of the cost avoidance resulting from a slightly warmer winter and lower rate increases than the utility companies had originally requested. The conservation measures remain in place and are continuing to benefit the school district. (Information provided by Sheri D. Stanley, Energy & Resource Conservation Program Manager, Beaverton School District, at the Energy Management Certification Presentation on July 9, 2009. For more information, go to the Beaverton School District website at www.beavton.k12.or.us and click on the Facilities tab.)

College students at various places have set about to determine the carbon footprint for their university. Students go to the administrative offices and ask to see the electric bills, the heating bills, and the carbon-based fuel costs for maintaining the grounds as well as fuel costs for university owned and operated vehicles. Some go so far as to calculate air travel by faculty. In much the

same way as a family or a business would calculate their carbon footprint, they end up with a quantity of CO2 for the year.

A carbon audit was done at the Rock Creek campus of Portland Community College. Students working with the Sustainable Practices Coordinator and District Plant Manager collected and analyzed data to see how much CO2 was resulting from the college's use of electricity, natural gas, and transportation. They were able to calculate the CO2 emissions per student. (Monday, Norman and Morgan) The audit is being used as the basis of a Climate Action Plan to set long and short term goals to reduce carbon emissions. The college has committed to an LEED Silver building standard for all new construction. The Sylvania Campus at PCC is working toward becoming a net zero campus – meaning they will have all their energy needs met by renewable energy. For more information, go to the PCC website at: www.pcc.edu/about/sustainability/documents/finalclimateactionplan.pdf

There are 70 million college students worldwide, 1% of the world's population. (Shadrach) They are an incredibly powerful group for change. They are the future architects, engineers, environmental scientists and business leaders who will carry out the green energy revolution.

One group of graduates is already hard at work. Lane Community College in Eugene, Oregon has offered an Energy Management Program since 2001, training its students (many of whom already have a 4 year college degree in engineering or other disciplines) to do comprehensive energy analyses of commercial buildings. Equipped with sophisticated data-logging software tools, this army of specialists complete building shell analysis, can do heat loss calculations, automatic controls for heating, venting and air conditioning (HVAC) systems, lighting retrofits, insulation, air sealing, heating and cooling duct sealing, and a host of other energy related analysis. They even do occupant education, suggesting workers avoid bringing individual office

heaters and refrigerators, but rather dress warmer in the winter and cooler in the summer. In many cases they can substantially reduce a commercial building's energy use, which of course results in a reduced carbon footprint of proportional size. The LCC model should be imitated in every community in America. These energy management specialists provide real savings in both dollars and CO2 footprint for their client companies. Their services are well worth their professional fees that are paid back in a matter of months, but the energy savings will last as long as the building is used.

Many utility companies offer both residential and commercial education programs to help customers save energy. Portland General Electric hosts a year round series of one-day seminars for commercial, industrial, and institutional customers. I have been asked to speak on solar energy. Other topics throughout the year include industrial fan systems, pump systems, compressed air systems, energy and water efficiency, chilled water systems, lighting efficiency, high bay lighting, outdoor lighting, and monitoring load shape for energy savings. Over half of the attendees, who number 100 or more per session, are executive or upper management business leaders.

Church, Synagogue, Mosque, Temple, Golf Course

For many of us, a place of worship is part of our carbon footprint. Even those who commune with God on the golf course have a footprint, even if they walk the course rather than ride in a golf cart. The pro shop uses energy, as does the grounds keeping machinery, as does fertilizing, and the energy for its procurement. If the golf course is your sanctuary, be assured that your carbon footprint is probably more than the great cathedrals in Europe. Golf courses require a lot of energy for ground maintenance and fertilization, which is very carbon intensive. Some courses like the renowned Bandon Dunes Golf Course on the southern Oregon

coast make diligent effort to reduce their carbon footprint. They have an on-site facility that recycles water from ponds and ground water. They also have an amazing recycling facility that is powered by solar modules. I could tell by one of the big containers full of glass that the golfers, whether they had a good round or a bad one, drank lots of wine. Bandon Dunes received the National Resort Winner Environmental Leaders in Golf Award (ELGA) in 2005 for its commitment to environmental stewardship. (Grounds Maintenance Magazine) The course purchases green power through their utility, Pacific Power.

Photovoltaic system powers recycling center
at Bandon Dunes Golf Course.

In a building dedicated to the worship of God, the worship hall, administrative offices, kitchen and all other facilities requiring electricity and heat produce carbon dioxide. These facilities exist for the members and represent part of each member's institutional carbon footprint. Even if you only attend services a couple of times a year, you should rightfully claim a portion.

Actually, it's pretty easy to find out how much energy our religious facilities use. There is a line item on every annual budget for utilities. Of course the line item is a number, so we'll have to do a little math to translate that into the appropriate energy units for gas and electricity in order to calculate the CO2.

Many religious organizations have as part of their creed the responsibility to care for the earth. I was delighted while attending

a national solar energy conference in Washington, D.C. in the early 1990's to see on the program a plenary presentation by the Episcopal Power and Light organization. "What in the world is that?" I wondered. A priest named Sally Bingham took the podium and explained to the surprised and delighted crowd of solar enthusiasts that people of faith recognize the moral responsibility of caring for the earth. She explained that global warming was a threat to the life of the planet, and they were finding ways to do something about it. One of their strategies was to encourage congregations to buy green energy, to practice conservation, and to use renewable energy such as solar and wind. For many of us the "moral" idea was new. I happened to be attending an Episcopal Church at the time and I was delighted that Episcopalians had taken such an initiative.

I once attended "Mass on the grass" organized by the Episcopal priest Fr. Scott Helforty. It was a beautiful summer outdoor service with no lighting, PA system, or electronic music. It was very nice. One of the most famous sermons of the Bible, the Sermon on the Mount, was also given outdoors.

Purchasing Green Power is as easy and obvious a choice for institutions of all kinds as it is for families and businesses. As of 2008 about ¼ of the utilities in the U.S. offer green purchase options. Yet less than 5% of the country chooses green power. I'm fortunate all the major utility companies in my area offer a Green Power purchase option. I gladly pay 1 cent per kilowatt-hour more. Even so, less than 10% of PGE's customers do so even though it's been available for several years now. In the city of Palo Alto, California, 21% of their customers have chosen green power in the first five years of the program. This is the highest subscription rate in America. (National Renewable Energy Laboratory)

There are two reasons people don't automatically buy green power. The first is that it costs more, but it's usually less than $10 per month for most households and small businesses. It could

be more for large businesses, but it's tax deductible as a business expense. The second is that people simply are not aware that they have the option. Businesses should buy green power and let their employees know. Go one step further and encourage employees to do likewise. You get to put on a big white hat for doing this and a lot of us bosses need a white hat.

The agricultural industry in America as a whole has an enormous carbon footprint. It takes energy, generally diesel fuel, to plow the ground, to fertilize the ground, to plant the crop, to take care of the crop, to harvest the crop, and then more energy to process, deliver, and merchandise the crop.

The owner of a trucking brokerage told me he had contracts to haul apples from Washington State into San Francisco. He said he hauled three semi-truck loads into the city every day year round.

> *One in four of the trucks we pass on the freeway is carrying food.*

As awareness has grown about the carbon footprint of the food industry, people are endeavoring to buy locally from food co-ops and farmer's markets. Better yet, they are putting in backyard gardens to grow a portion of their vegetables. This may seem a small thing, but it's really not. When we grow our own food, we do it sustainably with old-fashioned methods far different from commercial farming. We are cutting down on food transported to us by trucks, and we're cutting down on our own trips to the grocery store.

Businesses with an environmental mindset can do the same. The Hot Lips Pizza company in my hometown is one example. The owners make a concerted effort to procure ingredients from close by, local sources. They calculate the carbon footprint for the ingredients they use, and they strive continually to lower the number.

We have a great deal of say about the carbon footprint of the food and other products we buy. In fact we have the final word. When I drink water I don't buy water that came all the way from France. As good as they are, I don't buy wines from France either. I'm very thankful that our local water is good. When I drink beer, I drink beer made at one of our fabulous microbreweries in my city. I drink world class Pinot Noir wines from the Oregon wine country. If I lived in St. Louis, I might drink Budweiser. Or, if I lived in Milwaukie, I might drink Miller. Truth be told, I'd have to live in the Northwest to be near my favorite beers. When I'm in Enterprise, Oregon, I drink Terminal Gravity, my favorite Oregon IPA. I may have to move there someday.

A lot of people are buying locally already, perhaps because local is fresher and usually better. Farmer's markets always seem to have bustling crowds, and there's a spirit of celebration for the abundant produce our nearby farmers bring to us.

People all over the country are growing vegetables in their back yards and on their decks and patios. I had my first garden this year. In 200 square feet I grew all the lettuce, tomatoes, peppers, onions, herbs, squash, and zucchini I needed all summer. I gave away a lot of my produce to neighbors and co-workers. I decided to enclose the garden in a greenhouse to extend the growing-season. Gardening is pure joy! People have been telling me that for years. Both my father and grandfather were amazing gardeners. It is great to join in the tradition. My dad was a sharecropper of sorts. He helped three lady friends tend their gardens for a share of the produce. He gave away more than he ate.

Although growing in popularity, the whole idea of community is a new concept to many Americans. We've been conditioned to think of ourselves individually. Yet even the most rugged individualist recognizes he is in fact part of a community, whether or not he participates. Virtually everything we do outside the home: work, school, worship, shopping, all of the elements of daily life, are part

of our community footprint.

For 20 years I lived in the same house, but barely knew my immediate neighbors and really had no meaningful interaction with them. Even though it is awkward for many of us, we are warming up to the concept of being more neighborly.

What would happen if people all over the country organized to plant trees along boulevards and in parkways to serve as carbon sinks and beautify our cities? We should not hesitate to invest our time and energy in our community. If we help make it more appealing where we are, maybe we won't feel the need to get away so often. Don't forget, community activism is responsible for women's right to vote, recycling (which was led by school children), and the abolition of slavery. Any group with a worthy cause can achieve dramatic, even historic, results.

My own energy awareness naturally extends to my community. Although this may seem funny, one of the things I do is send post cards to the owners of businesses I patronize whenever I see waste or inefficiency. If I spot an incandescent light bulb anywhere, they get a card. If the air conditioning is running too cold, they'll get one. Doors not weather-stripped – you bet. Air infiltration wastes more energy than any other single flaw in a building. It costs next to nothing to remedy and is therefore the most cost effective measure that can be taken. It can be water running in the toilet. Moving water around in most cases requires pumping. So even wasting cold water is wasting energy. It does no good to point out to the 19 year-old hostess that energy is being wasted. She's not the owner. If the owner's not on the premises, I ask for his or her name and business address. A brief, handwritten post card that the owner gets through the U.S. mail has considerable clout. Restaurants and hotels live for our business and badly want us to come back.

Just one or two sentences is enough, such as: "Loved your restaurant; noticed the hot water is leaking in the men's room; hope that will be fixed by the next time I visit."

I may go so far as to send a second post card if necessary: "Returned today, the water's still leaking, please call me when it's fixed and I'll come back." Then I pre-print the statement:

"Wasting energy is a great problem in our country. I prefer to patronize businesses that care about the environment and show it by being mindful of their energy usage."

If you get a second card from me, that's it until I get a call telling me the problem is corrected. I have no problem leaving my cell phone number for this purpose.

I visited a gym recently I was considering joining. The showerheads lavishly poured out hot water. My card to them read: "You have a great facility but I was surprised to see you are not using low-flow showerheads. I want to join a gym that is environmentally responsible. Let me know if you change this and I will reconsider joining."

If I ever have to go to Las Vegas I'll put out a few cards. "To the owners of the (*insert name*) Casino. I noticed your marquee, though spectacular, uses an obscene amount of electricity. I called the Nevada Public Utility Commission and learned that on the Vegas Strip, some of the large marquee signs draw two megawatts. That's enough to power 1,000 homes! Are you crazy? Don't you know there's a war on to fight global warming? Your carbon footprint is atrocious. Unless you switch to LED lighting, I will **NOT** be coming back."

As we become more energy aware we can spot energy waste everywhere we look. In sunny warm states like Florida, Arizona, Texas and California, where back yard swimming pools are common, tremendous amounts of energy are used both to heat the pool and to power circulating pumps. Any swimming pool can be heated by solar energy. If trees are a problem, high efficiency heat pumps can be used.

A residential or commercial solar pool heating system can extend the swimming season and save thousands in energy costs.

Health codes require commercial pools for apartment buildings, hotels and motels to circulate the water 24 hours per day. A two-horsepower pump uses 1500 watts continuously. In 24 hours that's 36 kWhs, more than all the electricity used in a typical American home. In California alone 6 power plants are needed just to power swimming pool pumps. If they are coal or other fossil fuel powered plants, millions of tons of CO2 will be "pumped" into the atmosphere. Most of these pumps will be allowed to run until they fail. That can be 20 years or more. However, energy aware pool owners and managers could replace these pumps today with more efficient variable speed pumps that pay for themselves in a few short years.

Pumps for filtration systems on residential pools do not have to operate 24 hours a day. Timers can be used to allow the pump to only operate six or eight hours which is usually sufficient. A combination of a high efficiency pumps and reduced operating time can provide up to 75% energy savings and a corresponding reduction in CO2. (U.S. Department of Energy)

As I travel, I am particularly keen on what I see in other parts of the country. Often I find people aren't as concerned about the environment as they are in the Northwest where I often see signs at hotels reading:

SAVE WATER AND ENERGY
RE-USE TOWELS WHEN POSSIBLE

At the Boardwalk Resort Hotel at Disney World was a placard that read:

EVERY LITTLE BIT MAKES A DIFFERENCE
Every day tons of detergents and millions of gallons of water are used to wash towels that have only been used one time.
PLEASE DECIDE FOR YOURSELF
If you would like to reuse your towel, please hang it over the shower rod.

I would have even liked it better if it mentioned CO_2 as a product for the washing and drying of towels. If I owned a hotel, my sign would say something like this:

EVERY LITTLE BIT MAKES A DIFFERENCE
Every day tons of carbon dioxide are generated and millions of gallons of water are used to wash towels that have only been used one time.
Help us save energy and reduce our carbon footprint. If you would like to reuse your towel, please hang it over the shower rod. When it comes to energy, we're all in this together.

Hotels and motels, like any other business, seek customer loyalty. Those who want my business get it with energy saving placards and demonstrating good energy practices. I look for

compact florescent lights, efficient heating systems, low-flow showerheads, and solar panels on the building.

The bottom line is that many of us very much appreciate businesses that try to do the right thing with respect to the environment. I will continue to patronize these businesses and feel good about it when I do. Letting these businesses know, with a comment or a card, that we appreciate their efforts will help to reinforce what they're doing.

I find it funny to have to convince anyone of the merits of saving energy. For a homeowner who pays energy bills in after-tax dollars – that is to say, utility bills are not tax deductible for most homeowners – a dollar saved is a dollar earned tax free. Since so much can be saved with very little out of pocket cost, it usually equates to a fantastic return on investment. Even a solar energy system that has a ten-year payback is in reality an investment earning 10% tax free. Investors and commercial property owners grasp the value more readily but often hesitate to be serious about conserving energy or making capital improvements that save energy. Some have arbitrary return on investment criteria. Energy conservation and efficiency will always meet even the strictest criteria. If a larger capital energy improvement has a four year payback but your company won't consider anything over three, does it make sense to pass on it when in four years you will have paid for it anyway? An investor client of mine wrote:

> The solar pool heating system you installed on our Wood Village Apartments is one of the best investments we've ever made! Not only has the system paid for itself in just three years, apartment buildings of this kind are valued by a factor of the net operating income. Based on current market values, the value of the property has increased by more than the cost of the system.
>
> – Dr. Davis, Gresham, Oregon

CHAPTER 14

Reducing Your Country's Carbon Footprint

If John F. Kennedy were alive today and had been briefed by Dr. James Hansen about global warming, he might say, "Ask not what your country can do to reduce your carbon footprint, ask what you can do for your country's." Our country puts a little over 6 billion tons of CO_2 into the atmosphere each year, and there are a little over 300 million of us. This puts our per capita CO_2 emissions at 20 tons per person per year.

In America we use a lot of energy and we will continue to do so in the future. We are not going back to plowing behind the mule, but we will have to do without the six billion tons of CO_2 per year. Beyond the global warming concerns, there are health implications. On Thanksgiving Day 2009 in a story by Seth Borenstein of the Associated Press reported what a consensus of doctors believe: "Slashing carbon dioxide emissions could save millions of lives, mostly by reducing preventable deaths from heart and lung diseases." (Borenstein)

As of 2007, transportation in America accounts for 33.6% of our country's carbon emissions. Moving people around and moving goods from place to place is an enormous commerce propelled almost entirely by fossil fuels. (Center for Transportation Analysis)

Still, by far, buildings in the United States use the most energy. Our buildings should be designed to optimize the use of solar energy through simple building orientation and rooftops with solar collectors. Depending on geographical location a building

with 50% of its windows placed on the south wall can become a passive solar energy collector, meeting 25 to 95 percent of its space heating needs.

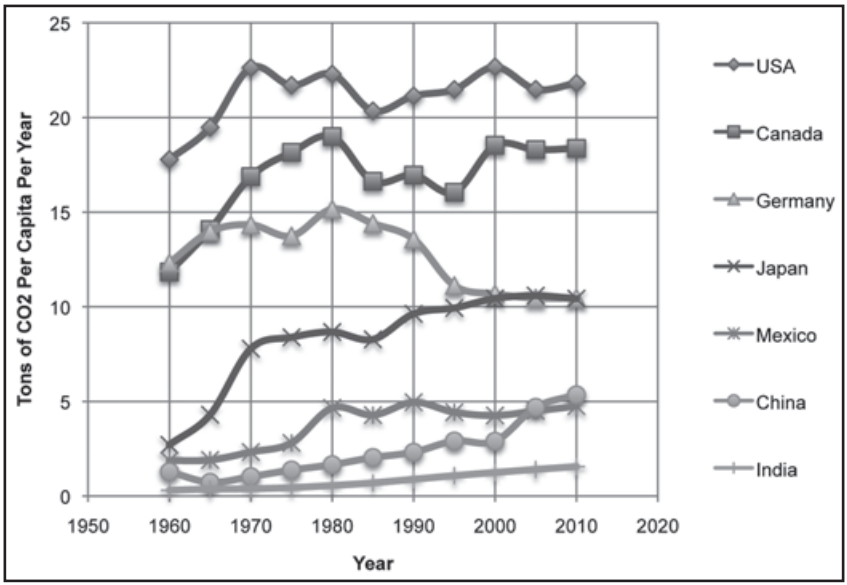
Staggered stud wall construction and structural insulated panels (SIP's) should replace framing systems of the past. Insulation with high R-values and sealed ducts should become standard. Wherever possible heat from ground source heat pumps delivered with radiant heating systems should be utilized. The earth's surface is the average annual temperature of the air; therefore it is a relatively constant, inexhaustible source of heat and cooling. Less expensive air-source heat pumps can approach the same efficiency in moderate climates. Building codes should be instituted that really make a difference in CO2. Tax credits or other incentives should be available for the most energy efficient homes.

New York City, already America's lowest carbon footprint city per capita, wants to do more. In addition to Yellow-Cab Priuses, the city government voted on a package of building conservation measures that will lower the carbon footprint of the buildings in New York by 30% over the next two decades. (Sustainable Business.com)

Planting trees can be really helpful in some places. Residents in Portland, Oregon can receive $50 credit on their sewer and water bill under the city's "Treebate" program. (Portland Bureau of Environmental Services)

Much has been done on the local level, but on the Federal level there has been very little to encourage Americans to conserve and use renewable energy. Federal tax credits for solar energy disappeared for 20 years between the Reagan and the second Bush presidencies. At the Solar Power Conference 2008 in San Diego, I attended a seminar entitled, "A Growing Worldwide Market, Solar Thermal." I was surprised to hear one of the presenters report by country the number of solar water heaters per capita. Solar hot

water, a mature technology, is affordable for a lot of people and can save 3,000 kWhs per year (6,000 pounds of CO2). The countries of Cypress and Israel were number one and two. One in six people in China have solar hot water. Germany, Spain, Italy, and Greece were all countries with progressive national leadership. There are 20,000 people working in the solar thermal industry in Germany, a country that gets less sunshine than the cloudiest parts of the Pacific Northwest. The U.S. was dead last in per capita solar hot water.



Tons of CO2 per capita by country.

There are some encouraging signs that the Federal government will finally come around, prompted by the initiatives in many states. California is an outstanding example. The first mandate for TV manufacturers to produce energy saving televisions was passed in California. Aimed at the high definition TV market, the more stringent standards would cut energy use by 50%. There are 35 million TV's in California. James Boyd, an economist and former chief executive of the California Air Resources Board, says:

"Efficiency is the cheapest and simplest way to save our citizens money...and to drive our economy." (Lifsher) I'm sure Mr. Boyd would agree it's the simplest way to save the planet as well. What the California Energy Commission (CEC) has done in this instance is an outstanding example of policy changes which favorably impact the climate crisis. Most buyers don't walk into appliance stores with their watt-meters. I do; but not everyone's like me. This is a clear way in which policy can lead.

The California initiative will result in enough energy savings to power 864,000 single-family homes which would otherwise require the power output of a 615 mW power plant, which, if it were coal, would spew 6 million tons of CO2 into the atmosphere each year.

It's hard to believe a coal plant would be needed just to power televisions in California. I went into a Best Buy appliance store with my watt-meter to see how much power the big TVs use. I was flabbergasted. One 58" plasma set used 600 watts! Imagine having six one hundred watt light bulbs shining back at you the entire time you had the TV on. Three people would have to peddle bicycles to power that bad boy. A 50" model used 400 watts. 52" to 55" LCD and LED television monitors by stark contrast only used 143 to 196 watts. A coal plant for TVs is not so hard to believe when we realize the average American spends 5 hours per day watching TV. That's effectively 17 years of a person's life. The best of the big models I tested was the 40" Sony VE Green Friendly Edition which uses 95 watts. It's so well designed, it turns itself off after a period when no motion is detected in the room. It would be perfect for the viewer who falls asleep. If Sony can do it, the technology obviously exists. Bravo to the California Energy Commission for their initiative!

On June 1, 2005, Governor Arnold Schwarzenegger signed Executive Order # S-3-05, which established the following greenhouse gas targets:

By 2010, Reduce to 2000 emission levels
By 2020, Reduce to 1990 emission levels
By 2050, Reduce to 80 percent below 1990 levels

Now these are real goals, meaningful goals, that would actually make a difference in global warming. It appears the "governator" is a "terminator" of greenhouse gas emissions in his state. The only thing I would change would be moving the 2050 goal to 2030.

At the Solar Power Conference 2008 I also learned that California uses less energy per capita than any other state. Since 1974, while the rest to the U.S. increased energy use 50% per capita, California experienced 0% increase in energy use per capita. With the influx of 600,000 new residents per year, California continues to prosper as the world's 6th largest economy, without growing the state's carbon footprint.

The neighboring state of Oregon is another outstanding example. Over a period of 30 years the state has offered tax credits for solar energy. As a result, tens of thousands of solar projects have been installed producing millions of kilowatt-hours a year of clean, renewable energy. They have encouraged renewable energy businesses to come to the state and begin operations. Oregon is one of the leading states for wind development. Legislation was passed to create the Energy Trust of Oregon, which collects 3% from ratepayers of the two largest utilities in the state, then distributes incentives for conservation and renewable energy projects.

Since our country will always use a lot of energy, we must use it efficiently. We cannot thoughtlessly waste energy as we have for well over 50 years. At the same time we as a society must transition to a non-fossil fuel economy. There is a debate underway on the national level about the role of nuclear power.

On June 30, 2008 the Wall Street Journal featured an entire section on renewable energy versus nuclear as the only viable options that don't contribute to global warming. The caption read,

"Is nuclear power the answer for a warming planet? Or is it too expensive and dangerous to satisfy future energy needs?" Writer Michael Totty acknowledged that scientists agree that greenhouse gases, mainly CO2, are building up in the atmosphere and contributing to a gradual increase in average global temperature. He stated that generating electricity accounts for about a third of U.S. greenhouse emissions, mostly from burning fossil fuels to produce power.

Totty gave a fair argument of both the pros and cons of nuclear energy production, concluding that "the sheer number of nuclear plants needed to make a major dent in greenhouse emissions means the industry hasn't a prayer of turning nuclear power into the solution to global warming."

With regard to the safety question with nuclear, Totty points out that "coal mining world-wide results in several thousand deaths every year…and burning coal is a leading source of mercury in the atmosphere." Looking at safety more broadly, he says, "Death and destruction stemming from global warming far exceed what is likely to happen if there is a nuclear accident."

In the final analysis, he writes, "Even if a high price of carbon makes nuclear economic, the costs of renewable energy such as wind and solar power are cheaper, and getting cheaper all the time. By contrast, nuclear is more expensive, and getting more expensive all the time." Practically speaking, there simply isn't time to bring enough nuclear plants on line. There are always delays due to public protest, and ultimately the already astronomically high cost becomes even higher. (Totty)

He, like nearly all the experts, sees conservation as the first and most cost-effective step. Natural gas he likes as a bridge fuel. It is the most benign of the fossil fuels. He advocates the continued use of the 104 gas-fired power plants currently in the U.S. generating about 20% of the nation's electricity. The value of nuclear and natural gas electrical generation is that they can be

used anytime during the 24 hour day, whereas solar and wind are intermittent. Since load nationwide is about twice as much during daylight hours, solar and renewable energy could ultimately be primary, with nuclear, gas, and hydro balancing out the 24-hour load profile.

Many energy related businesses placed advertisements accompanying the article. One was United Technologies which is helping to develop a more efficient jet engine capable of delivering "double digit reductions in fuel burn…by 2013." The new engine will "reduce carbon equivalent footprints by 3.1 million tons."

Chevron took out a full-page ad. It starts, "With our planet's population continuing to increase, and the quality of life for millions in the developing world improving daily, our demand for energy is also growing…to meet everyone's needs 25 years from now may take 50% more energy than we use today. Finding and developing all the fuel and power we need…could be one of the greatest challenges our generation will face."

I like the ad. The only thing I would change is that the energy challenge they see *IS* the greatest challenge our generation will face. Oh, and by the way, petroleum, Chevron's principal product, will need to not be a part of the solution.

Not to be outdone, Vestas, the wind turbine manufacturer, also took a full-page ad. "The United State has some of the best wind resources in the world and it is time to let modern energy power us."

Intel took a half page add touting their environmental initiative: "We must prioritize our use of fossil fuels. We can't build a photovoltaic module or a wind turbine without fossil fuels."

The Wall Street Journal is a business publication. It is written for the business community. Shortly after reading the article and seeing the presidential candidates debate nuclear energy, I decided to go online and see what Amory Lovins had to say. I came upon an interview in which Lovins was asked direct questions.

To the question about nuclear energy he said:

> What nuclear would do is displace coal, our most abundant domestic fuel. And this sounds good for climate, but actually, expanding nuclear makes climate change worse, for a very simple reason. Nuclear is incredibly expensive. The costs have just stood up on end lately… It costs, for example, about three times as much as wind power, which is booming…it's grossly uneconomic, which means the nuclear revival that we often hear about is not actually happening. It's a very carefully fabricated illusion. And the reason it isn't happening is there are no buyers. That is, Wall Street is not putting a penny of private capital into the industry, despite 100-plus percent subsidies...I really take markets seriously. 2006, the last full year of data we have, nuclear worldwide added a little bit of capacity, more than all of it from upgrading old plants, because the new ones they built were smaller than the retirements of old plants. So they added 1.4 billion watts. Sounds like a lot. Well, it's about one big plant's worth worldwide. That was less than photovoltaic solar cells added in capacity. It was a tenth what wind power added. It was a thirtieth to a fortieth of what micropower added. (Lovins)

Amory Lovins has written or co-authored 26 books. A common theme is that we need to get the cleanest energy we can for our energy dollars, and that conservation and efficiency can substantially reduce our energy usage to a fraction of the current extravagant norms in the U.S.

There are many who feel we must replace coal-generated electricity with nuclear. Dr. James Hansen, possibly the only person on the planet who hates coal more than I do, is an avid

proponent for this strategy. He especially believes China and India must replace coal with nuclear, employing a new generation of "fast-reactor" power plants.

After reading Totty and Lovins and studying the matter further, I concluded that it's more likely we could cover a portion of the desert of Nevada with solar modules to meet the country's needs than it would be to build dozens of nuclear plants and bury their radioactive waste in Nevada's Yucca Mountain.

Switching to nuclear may be more doable in China and India where governments have more control of their people. In the U.S. it would take ten years or more for the first nuclear plants to be built. We can put up a lot of solar panels and wind turbines in ten years.

There are practical considerations that affect the grid's ability to incorporate "green" electrons from wind and solar. Utility companies must see that load is met at all times of the day and night no matter what. They have historically liked coal and nuclear because they are easily controlled and the fuels can be "burned" 24 hours a day. Natural gas has the advantage of being able to be throttled up or down whereas coal and nuclear need to operate continuously. There's no fast start up or slow down for coal and nuclear.

In February 2010 President Obama announced guarantees for new nuclear power plants. A single nuclear power plant capable of generating 1,000 megawatts is estimated to cost $10 billion. Operating 24 hours a day, this would generate 24,000 megawatt-hours (or 24 million kilowatt-hours) per day.

What would it take to generate the same 24 million kWh per day from solar? If we located a solar farm in the sunnier parts of the country it would take a 4 million kW solar array, or a 4-gigawatt array (24,000,000 kWh divided by 6 peak sun hours = 4-gW solar array). The cost would be $16 billion for the solar farm, a little more half again what the nuclear plant costs.

Nuclear vs. Solar: One on One

1. Both have the advantage of being non-fossil fuel power generation resources – what the world must transition to quickly. (Tie)
2. Solar has the advantage of being able to be done immediately. The nuclear plant will take years to bring on line. Ten years of carbon from a 1,000 mW coal plant that must remain on line until the nuclear plant is built is a grossly unacceptable 85 million tons of CO2. (Big advantage solar)
3. The price of solar is going down all the time and the price of nuclear is going up. If it takes 10 years to bring nuclear on line, price parity could well occur within that time making solar and nuclear the same cost. (Tie)
4. Choosing to install solar will help bring down the price of solar, causing parity to occur sooner, and resulting in solar being more viable for individuals wanting to install solar on their homes and businesses. No homeowner will ever install nuclear power. (Advantage Solar)

5. Nuclear has the advantage of meeting base load 24 hours a day, whereas solar only meets load during daylight hours. However, peak usage of electricity in the country occurs during the day. Solar can meet daytime loads whereas other resources including hydro, wind, geothermal and existing nuclear can meet nighttime loads. Natural gas can continue to be used for base load fill. (Advantage nuclear)
6. Solar takes up a lot more real estate, over six square miles, but there's plenty of unused Federal lands in the sunny southwest. (Slight advantage nuclear)
7. There is no terrorist threat with a solar farm whereas there is with nuclear. (Advantage solar)
8. There is no radioactive nuclear waste with solar. (Big advantage solar)
9. There is no Chernobyl or Three Mile Island meltdown potential. (Advantage solar)
10. The people want solar. The people don't want nuclear. (Advantage solar)

FINAL SCORE: SOLAR WINS BY A MARGIN OF 3 TO 1!

Often we hear that solar and wind can't work, or can only be used in a token fashion, because they are intermittent. This is not at all true. The grid does not have to be powered 100% by generation capable of operating 24 hours per day. At least 20% of the grid could be powered by wind alone with no significant energy management issue, and solar could provide that much or more. A scenario where solar and wind are used to provide 40-50% of the country's power while hydro and natural gas fill in intermittently is a very workable dynamic. Conservation and managing with a "Smart Grid" make this completely doable.

Solar electrons can be brought on line in two very different ways. The first is with photovoltaic modules that directly convert sunlight into electricity during the daylight hours. The second is through concentrating solar thermal energy, also called CSP (Concentrating Solar Power). This method utilizes mirrors (acres of them) to concentrate sunlight to produce heat capable of boiling water to run a steam turbine in much the same way as coal is used to boil water to generate electricity. Latent heat in the system can keep water boiling for a few hours after sunset, giving additional energy to meet late afternoon and evening loads. In 1985 I visited Solar One in California's Mohave Desert, America's first large CSP facility. It was amazing to watch thousands of mirrors programmed to precisely track the sun and focus millions of BTUs to a central tower. Spain is also deploying this technology aggressively.

Geothermal

America is the land of the entrepreneur. We are known to the rest of the world for our "Yankee ingenuity," as the country with the "can do" spirit. We can transition to a renewable economy as fast or faster than anyone. In short order and on a large scale we could develop underground high temperature geothermal energy. We can put "Old Faithful" to work.

According to the Environment News Service, as of 2008 there

were 86 new geothermal power projects underway in 12 states that would virtually double the amount of utility scale power generation from geothermal energy. 90% of these "hi-octane" geothermal resources are on Federal lands. By 2015, there will be enough geothermal power generation on line to power over 5 million homes, and 12 million by 2025. (Environmental News Service)

This is good, but we have to do better. It is estimated that there are 160 million homes in America. So 12 million would be less than 10%. But if American homes were to use half as much energy as a result of a serious conservation campaign, the geothermal power generation would be enough to provide for 16% of America's homes. If incentives and investment opportunity were enough to double the geothermal development projections *AND* American homes use half as much energy, then the number would be 32%. Form 4% to 32% in a decade or so would be impressive. It's doable. It's what we need to save our planet.

Wind

While others carry on the debate about nuclear power, T. Boone Pickens of Texas, a great American entrepreneur in the energy field, has come up with a plan. Pickens plans to help America reduce its reliance on foreign oil by significantly utilizing America's enormous wind resource. The Great Plains, extending from Texas to the Canadian border, is nothing short of a 500-mile-wide wind corridor. Wind is most usable when it blows steadily, without turbulence caused by trees and buildings. The Great Plains offer an ideal and vast wind resource.

On a global wind map, the U.S. has the greatest wind resource of any country, and the Great Plains are ideally located in the middle where it can potentially be transmitted east and west to the largest population regions of the country.

The Pickens Plan, which can be viewed on his website (www.pickensplan.com/act/), starts with the recognition of how

electricity is produced in the United States. His chart shows 50% from the burning of coal and 22% from the burning of natural gas. His strategic plan is to use wind to replace the portion of the country's electric load currently being met with burning natural gas. There is certainly enough wind to do this, and the grid is already carrying that much natural gas-generated power. Natural gas would then be used for transportation. The effect of this would be to reduce American dependence on foreign oil from 700 billion dollars of oil to 300 billion dollars, a 38% reduction. (Pickens)

Pickens describes his plan as a bridge plan; it buys us 20-30 years to develop electric cars. From a global warming standpoint, at face value the plan has merit. Injecting a massive wind resource into an equation, which ultimately reduces the U.S. oil consumption by 38% is, to say the least, a good idea. Burning natural gas, a less potent greenhouse gas, instead of oil reduces carbon emissions by nearly half. The CO2 reduction of the Pickens Plan would be on the order of 600 million tons per year. In a single step it would reduce America's footprint by 10%. To use natural gas as a transition fuel makes sense.

It could be the most heroic single step taken to reduce America's carbon footprint. As big as it is, it is small compared to what the country can do by simple energy conservation. The most conservative estimates place the country's potential at 20% – twice the savings of the Pickens Plan. 304 million Americans driving less, using efficient lighting and appliances, and choosing to buy green power can yield far more savings than any fuel-switching scheme. Personal conservation teamed with the Pickens Plan can only realistically get the country half way to where we need to be by 2020. I don't know what will come of Mr. Pickens and his plan, but I applaud his creative thinking and hope other entrepreneurs will follow.

There are other entrepreneurs thinking beyond natural gas for powering cars by going immediately to the electric vehicle.

Electric vehicles would be recharged mostly at night. These are the non-peak hours so utilities can readily meet load. More than that, the wind blows a lot at night. Hooking wind energy directly to power electric vehicles leap frogs over the need for natural gas as a transition fuel for transportation and results in zero carbon. Why not use natural gas to replace coal for electrical power generation? This would leave both coal and oil in the ground.

Solar

A few more bold strokes are in order. If the Midwest has the wind resource, the Southwest has the solar resource. The entire world can be categorized by peak sun hours. Peak sun is a measurement of the sun at its brightest – very close to 1,000 watts per square meter. In other words, the sun shining at its brightest on an area of 39 inches by 39 inches (one square meter) would be equal to ten-100 watt light bulbs, or 1000 watts. The peak sun hour has become a standard of measurement just like the inch, the mile, or pounds and ounces. The sunniest places on earth get the equivalent of 7 peak hours of sun per day. Most of the Southwest (Nevada, Arizona, New Mexico, West Texas, and Southern California) gets 6 peak hours of sun or more per day. Most locations in the world receive at least 3 to 4 peak hours of sun per day.

Solar modules were first developed by the space program to convert sunlight to electricity. Many modules can be wired together to make up a large photovoltaic array. If an array of photovoltaic modules totaling one thousand watts (1 kilowatt) is installed in the sunniest place in America (Las Cruces, New Mexico), it can produce 7 kilowatt-hours per day. The same array in Astoria, Oregon, one of the least sunny places in America, will produce barely 3 kilowatt-hours. Individual homeowners and businesses all over America are installing solar photovoltaic arrays and generally getting 4 or more kilowatt-hours per day per kilowatt of photovoltaic array. Certainly it's good for Americans to continue installing individual

systems because there are many benefits to this kind of distributed generation. However, as a national strategy, it would be wise to place large photovoltaic arrays capable of delivering a high percentage of the country's electrical needs in the sunny southwest where at least 6 kilowatt-hours per day can be realized from each 1,000-watt array.

Since the United States uses about 30 billion kilowatt-hours per day, we can divide that number by 6 (the peak sun hours in the southwest) to get the size of the photovoltaic array we would need to power the country. 30 billion kWh divided by 6 peak sun hours = 5 billion kWs of PV. Therefore, 5 billion kWs of photovoltaic modules located in the Southwest would power the entire country. It could take up a square area in the desert of Nevada 115 miles on each side. What would it cost? Well, it would cost about 30 trillion dollars.

In actuality, we would never need that big a solar array to power the country. We already have nuclear power plants producing about 20% of our electricity, and hydro power plants producing another 10%. We might as well leave those in place for the time being, and let anti-nuclear protestors and fishermen dream of future days when nuclear plants are decommissioned and the dams are breached.

If we kept existing nuclear and hydro power, our nation's solar array would be one-third smaller, cost only $20 trillion, and cover an area in Nevada 95 miles on each side. Rather than a big square array in the middle of Nevada, perhaps we could have a long thin national solar array stretching along Interstate 10 from Jacksonville Florida to Los Angeles. This array would need to be only 4 miles in width. This would help with distribution: as the sun moved across the country, the electrons would flow proportionally in each time zone. Of course there could be lots of system configurations. The Florida or east coast array could be located anywhere in the state that made the most sense. Texas has lots of room. There

are vast expanses of dry land west of Texas that get nothing but sun. In the meantime we should fully utilize wind, geothermal, concentrating solar thermal, smaller scale solar photovoltaic for individual homes and businesses, and any other viable non-fossil fuel-burning resource that makes sense.

According to the National Renewable Energy Laboratory, current efficiencies of solar photovoltaic modules are 24 times greater than the first ones built for the space program. Efficiencies of this magnificent technology are growing gradually; but more importantly, prices have gone down considerably since the year 2000.

If America wants to become carbon neutral, we will almost certainly have to develop large photovoltaic energy "farms." If we were to do a good job as a nation with conservation and efficiency, as well as developing other cost effective sources such as wind and geothermal, perhaps our nation's PV array could be one tenth the size. It might even fit in the median of I-10 and cost $2 trillion, about half a year's national budget.

Where would even the great and mighty United States of America get that kind of money? Well, the IRS collects more than that amount from its citizens every year. The U.S. military spends that amount in just a few short years. Americans earn that amount in a few months of each year. The U.S. government has the ability to issue bonds in this amount, and the American people have the assets to buy the bonds. The simple answer is: the money's there. Some formula consisting of private investment, government tax credits, and bonding certainly could capitalize an endeavor even of this magnitude if it were the best alternative.

An income tax credit is a marvelous mechanism. It is nothing short of the government saying, "We will give you a choice about where your tax dollar goes. If you don't like the war in Iraq, and would rather put some of those tax dollars into renewable energy devices for your home or business, we'll allow you to do that."

That's the kind of thing that makes me actually feel like I'm a part of a country that has government of the people and for the people.

Oregon has generous tax credit incentives. Most people invest more of their own money than the state provides. Even so, some people object to these credits. Their argument is that even though taxpayers are specifically designating their tax dollars for renewable energy, in addition to their own out-of-pocket matching funds, this leaves more of the state budget that has to be paid by those who don't invest in renewable energy.

This is a cogent argument, but when a government sees the bigger picture and attempts to do something constructive, it is a good thing. Society pays a price for using polluting energy. Actually new tax revenues from employee and employer taxes and taxable sales of business-to-business products and equipment supplement the tax credits.

Astutely some would say, "That just buys the solar modules. What about the infrastructure to enable the grid to carry all this power from the southwest region to the population centers hundreds of miles away?" The wind developers are already asking that question and government initiatives are being planned to modernize the nation's grid to transmit "green" electrons. The estimates I've heard are $150 billion for infrastructure improvements for the renewable energy super-highway. (Climate Change Investment Research) Relatively speaking, $150 billion is a pittance compared to other government spending, which in many cases does not carry with it the important economic and security benefits that converting to a renewable energy economy brings. $150 billion is about one fifth of the $700 billion spent on the 2008 financial bail out. It's the amount spent each year on the Iraq war.

Strategically solar "farms" should be developed in relative proximity to population centers to minimize transmission

losses. Las Vegas could have a solar farm very close by. Other major population centers such as Phoenix, Los Angeles, Dallas, and Houston could easily be served by solar farms less than 100 miles away. By 2015 our European neighbors will be served by solar power from the North Africa desert transmitted 500 to 1,000 miles. Eventually, as electric cars replace gasoline powered commuter vehicles, the grid will be the source for recharging. The infrastructure investment needs to be made now. This country's wind and geothermal resources need to be fully utilized, and solar should be deployed as well. (Seager)

Regulations governing utility grid interconnection will have to be made solar and wind friendly. I attended a few sessions of a national Public Utility Commissioner's conference in Portland, Oregon in July of 2008. A long time friend of mine, Sam Thompson, is a commissioner in Nevada. He toured my business facility and saw the large photovoltaic array. I asked Sam and Oregon's PUC Commissioner, Lee Byer, why I couldn't put in a photovoltaic system in Nevada where it would generate almost twice as many kilowatt-hours as in Portland. Their answer was "Well, the system isn't set up to do that."

In the poignant words of Bobby Kennedy, I have to ask, "Why not?"

As I pressed the question later with Sam, he said the grid isn't best used to transmit electricity great distances because of transmission losses. Most utilities buy resources as close to home as possible.

What would it take to bring my idea about? If I am willing to invest thousands of my own money in a photovoltaic array, and I'm willing to let it be installed in the sunniest place possible, and if the Federal government is willing to give me a tax credit regardless of where the system is installed, what remains? The utility incentive is only available from certain utilities. Should it really matter where the system is located? Why can't my utility and other utilities have

reciprocal agreements to move the electrons around?

Years ago my family was part of a fundraising effort to buy a brick in the courtyard of a downtown city park called Pioneer Courthouse Square. A single brick was engraved with our name on it. I would love to see a similar thing with solar modules in the southwest. I can visualize satellite photos from space that zoom in on my solar array in the Nevada desert. Ted Turner could have a great big array, and I have a little one. There could be a placard marking my array. If I personally invested one third, the government and utility each invested one third, why couldn't this happen?"

If solar power farms are, for whatever reason, unfeasible in Nevada, why not develop them in eastern Oregon, which is nearly as sunny? It seems to me that if utilities co-operated to pass through the electrons, or give credit to the ratepayer who placed the grid-tied system on their sunnier part of the grid, that this should be a simple enough transaction. Every part of the United States is within a thousand miles of I-10. If the Europeans can figure out how to bring solar energy 1000 miles from the Sahara, why in the world can't we?

While I and others dream about solutions, the chief power brokers of our country – those who create laws that form our energy policies – are our elected leaders and their appointees. In the summer of 2008 I was invited to a forum hosted by U.S. Senator Ron Wyden. The topic was "How can America be more energy independent?" I was told I would have two minutes to tell one of the most powerful people in the country what I had to say. This was what I said:

> I'm John Patterson, President of the Oregon Solar Energy Industries Association. OSEIA's 100 member businesses throughout the state are doing more and bigger solar energy projects than ever before.

30,000 Oregonians have invested in solar energy in the 28 years of my career. During 20 of these years there were no Federal incentives whatsoever. However, during the Carter administration, and in the last 2 years when Federal tax credits have been in place, the market responded enthusiastically. Therefore, the first priority for the Federal government must be the extension of the solar tax credit.

Americans, more than any other people, enjoy the privileges afforded by a fossil fuel economy. As a result we are responsible for a glaringly disproportional amount of CO2 emissions. Our Federal government could not bring itself to sign the Kyoto Accord, yet a growing number of cities, states, and entire regions are voluntarily embracing the CO2 reduction goals of Kyoto. Our Federal government should take the same initiatives as the state of Oregon and the City of Portland. We must join the other developed countries which have arrived in the 21st century in admitting that we have a serious problem and make a plan to deal with it.

We are the world's consumers. Much of the CO2 generated by worldwide manufacturing is to produce goods for us. Our people, our economy and our military are addicted to oil; so much so that we will do anything to guarantee an uninterrupted supply, including going to war under false pretences.

America is the most imitated country in the world. Everyone wants to live like we do. It has been determined that if the people of China consumed as much global resources as the average American, we would need six planet earths. Well, we only have one. If China and India want prosperity for their people like we have, we'd better show them how it can be achieved using renewable

energy, and we better show them quickly.

Dr. Frank Vignola, a physicist and solar energy researcher at the University of Oregon, wrote the following letter to the Senator:

> Jim Hanson of NASA recently testified before Congress that unless we reduce the atmospheric content of CO2 to levels of 350 parts per million (ppm) we will face dire climate change effects (for example, sea level increase of 20 to 30 feet).
>
> The difference between an ice age and the interglacial periods is about 100 ppm of CO2, from 200 to 300 ppm. We are already 85 ppm above the interglacial period level at 385 ppm of CO2 in our atmosphere, and this level is increasing. The earth takes time to adjust, but if we don't act soon and decisively, our children and grandchildren will face a more chaotic and challenging environment.
>
> Solar energy is a significant part of the answer, but we need all the renewable technologies to address this problem. Since 1977, I have been working at the University of Oregon Solar Radiation Monitoring Laboratory to help build part of the infrastructure needed for a successful deployment and utilization of solar energy technologies.
>
> The framework is there and there are other groups within the Oregon University System with their expertise that can help build the needed infrastructure. Oregon has a good potential for all renewable technologies and in fact, two-thirds of the Pacific Northwest has as much or more solar energy than Florida. In addition, even Astoria has a solar potential equal to the best locations in Germany.
>
> There are still problems and barriers that need to be overcome. We need federal funding to develop the infrastructure and support for the the solar industry.

> The solar industry needs stable and reliable federal tax credits to build the factories and develop the financing and marketing. The uncertainties of the federal tax credits severely curtailed the development and deployment of solar generating facilities in the 1980s and will likely do so again if the government cannot decide to take consistent action.

A representative from the International Brotherhood of Electrical Workers (IBEW) told the Senator he had hundreds of electricians trained to do photovoltaic installations but he doubted that more than 30 were working on solar electric projects that day.

Others came to the microphone to give their recommendations. The Senator listened well: within six months the Federal tax credit for solar was extended. Senators from other states must have listened too.

One of the ideas kicked around in national government circles is the concept of Cap and Trade. I have never been a fan of the scheme where low carbon producers are allowed to sell carbon credits to heavy users. The hope is that the major carbon polluters will ask themselves, "Why are we buying credits from someone else, why don't we figure out how to save the carbon ourselves?" This becomes the motivation for them to reduce their own carbon output. Al Gore says it works. It seems counter to the more pure ideal of everyone everywhere doing all they can voluntarily to reduce carbon emissions. Buying and selling the right to put carbon in the atmosphere doesn't ring true to my way of thinking. A carbon tax for everyone in proportion to what is used seems to me a better idea.

Cap and trade ultimately makes carbon dioxide a commodity. Wall Street is chomping at the bit for this. Making cap and trade commissions on large, rich carbon polluters who can easily afford

$20 a ton for their CO2 emissions may be appealing to Wall Street, but it doesn't serve humanity well.

A carbon tax (a/k/a "fee and dividend") is a much better idea, where the carbon-based fuel is taxed at the source. For instance, we know how much CO2 is in coal and oil and natural gas once it is burned. A tax or fee would be imposed by the Federal government upon the developers or suppliers at the front end of the supply chain. That cost gets passed down the chain to the end user in the form of higher prices. The up-front fee the government collects could be used in any number of ways. It could be used to capitalize the cost of improving the grid, or used to buy solar modules for a national solar array, or as a dividend to those who use less fossil fuels, or as incentives that the government could use to partner with geothermal or wave energy developers. If this were the case, as more and more renewable energy comes on line, there would be less and less fossil fuels needed to be extracted. At some point in the not too distant future, the fossil fuels would remain in the ground, which is exactly where we need them.

The electrical generation grid must be updated to transmit wind energy from the middle of the country to load centers toward the east and west coasts. Solar power from sunny regions must be transmittable to the closest population centers where solar electrons can be used. Buildings of all kinds need to be designed to utilize solar energy on site. Their backup heating and cooling systems need to use heat pumps, and in the colder regions of the country ground source heat pumps, with their electricity coming from a grid that is powered by renewable energy.

Fee and dividend, or carbon tax, is the most efficient and direct way of achieving the goal of carbon reduction. It also requires the least bureaucracy. In British Columbia, Canada, a fee and dividend

scheme was instituted using the carbon tax to offset payroll taxes. That's something employers and employees could get excited about. The cap and trade crowd will be disappointed, but it won't hurt my feelings to see Wall Street left out of the loop for once. Ultimately the burning of fossil fuels for generating electricity must be permanently supplanted by wind, solar, geothermal, or any other non-carbon producing method, and it must be done as quickly as humanly possible.

Transportation must transition to rail and electric vehicles and perhaps hydrogen in future decades, but for the next decade the only viable option is electric vehicles recharged by a grid fueled by renewable energy.

Joe gets an electric vehicle, re-charged with wind energy, and a rooftop solar water heater, reducing his carbon footprint in half again to 25 pounds per day.

Fossil fuels must be reserved for critical loads that only they can realistically meet. Military operations, commercial aviation, giant earthmovers, and diesel locomotives will likely still use fossil fuels for a few more decades. Even so, we should seek a true world

peace that requires less and less military force, and renewable fuels like hydrogen that can ultimately power our biggest, most powerful machinery.

Howard Reichmuth, a physicist and solar expert, was touring some of my solar water heating systems and monitoring them for performance. As we left one home, he said to me, "I wonder if your customers realize that the heat that is in their solar storage tank was in the sun just a few minutes earlier?" His words were an epiphany to me. I knew it was true, of course, but his simple statement gripped me to the core. I could visualize the sun's rays traveling through space and landing on the solar collector. Although I've installed thousands of them, I appreciated the solar water heater in a new way.

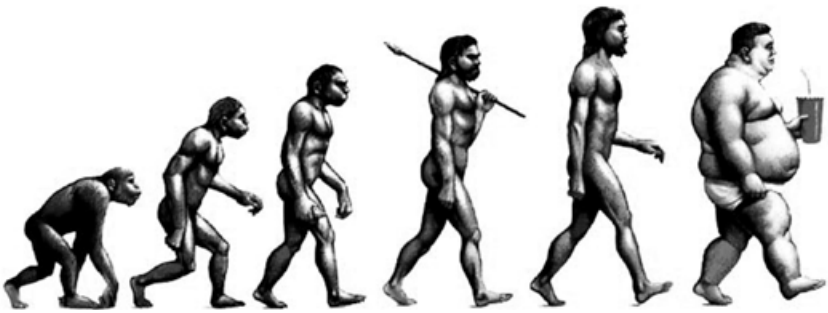
Solar water heating and photovoltaics on a Portland residence.

When my son Jonathan was 5 years old, he was hanging out with me at my shop. I was soldering when the squirt bottle I used to cool the solder joints ran out of water, and I didn't have a way to refill it. I started grumbling about having to wait for the joints to cool when Jonathan nonchalantly walked over with the compressed air hose and cooled the joint for me with air. I was only thinking about not being able to cool the solder joint in the way I had always done it. He saw a totally new way.

What we need is a new way of thinking that ushers in a global energy renaissance. Just like the first Renaissance in Europe brought a whole new way of looking and thinking about life, religion, and art, so we need to look at energy in a whole new way. We need to think of energy not by how much it cost (the old way of thinking), but where it comes from and what it does to the environment.

Certainly we need this new way of thinking about energy in the United States; but also we need it on a global scale. We must look at energy from a whole new perspective to solve the problem of global warming. Tweaking the system a little here and there while for the most part continuing to do things the old way won't do.

America used to be the world leader in innovation and technology, and an example for others of hard-working self-reliance. Now we seem to be more focused on comfort and indulging our pleasures and appetites. We show off our wealth in oversized homes and cars that waste valuable resources. I heard that the average American eats twice their weight in meat and drinks three times their weight in soft drinks per year. "Progress is our most important product."



Is this progress?

We need a new generation of entrepreneurs like Thomas Edison and Alexander Graham Bell to lead us into a new energy future. It doesn't have to be just geothermal, wind and solar, it can be anything that doesn't produce methane or CO_2. Entrepreneurs

young and old can surprise us with the impossible! There is so much innovation that can be applied to the field of energy it boggles the mind. I've seen all sorts of inventions and ideas that people are doing or about to do. Benjamin Franklin would have a hay day if he were alive today and saw the possibilities with renewable energy. What will it take to ignite a new energy renaissance?

Picture us in a global stock car race and a crash has just occurred. A yellow caution flag comes out, all the racers slow down and hold position. In the global economy, the race is for economic advantage – in a word: money. The U.S. has held the lead for quite a few laps (decades). Other countries are closing fast. But there's been a crash, and things have changed. We can't go on with business as usual, racing at such a frantic speed, or there will be a 200-nation pile up and we'll all die in a blazing inferno.

Let's carry this illustration further. Let's say there are 200 drivers of racecars, one for each nation. We, the people of all these nations, are sitting in a giant grandstand that holds 7 billion people. We're watching the race. We see the problem. The caution flag has been raised by the United Nations, the scientific community, Kyoto, and Copenhagen. In spite of the yellow flag, the U.S. and the Chinese racecars keep accelerating as fast as they can. Some of the racecars (those driven by leaders who signed the Kyoto accord) slow down as they're supposed to. People in the stands start shouting, "Hey, what are those two cars doing? Boo, hiss, they should be disqualified!"

There's the rub: who's going to disqualify them? These are the two most important countries in the global economy. The rest of the drivers can't stop them; they simply aren't powerful enough; and they are seat belted into their own cars. Everyone on earth is present; can no one stop them? People in the stands are looking around at each other. Where's Superman when you need him?

Then it dawns on us: we can stop them – we in the stands. If we declare we want all of our energy to come from non-polluting

sources, guess what? That's what will happen. They're going to remind us they burn all that coal for our sakes, but all we have to do is answer, "No thank you. There are other alternatives."

Solar water heating and photovoltaics on a condominium project near Hood River, Oregon provide 1/3 of all energy needed.

Biomass

Biomass, a renewable energy source, is biological material derived from living, or recently living organisms, such as plants, wood, waste, and alcohol fuels.

We need to get serious and we need to get smart about biomass. There is heat energy in the decomposition of organic waste. I know of a tree trimming business that takes the wood chips and leaves from the day's activities and spreads them over a network of pipes that provide hot water for their facility. Waste treatment plants are investigating recovering heat from this source through low-grade heat exchangers.

Corn was the first ethanol fuel we commercially tried in the United States. Corn gives 250 gallons of ethanol per acre. In the U.S. there are 71 million acres in corn. People eat corn, so using corn for fuel has become controversial. Cattails, on the other hand, yield 7,500 gallons of ethanol per acre and grow back year after

year. That's 30 times the yield of corn and there's no competition for food. In Brazil native sugar cane is used. Another promising raw material is algae, which has more energy value than corn, without competing as a food source. (Blume) Whether it's composting in our backyard gardens or larger commercial projects, we need to do what we can at all levels to use biomass, an often overlooked renewable energy source.

In a stirring and provocative lecture given at the 2008 Solar Energy Festival (Sol-Fest) in Northern California, Daniel Solnit outlined the most cogent plan I've heard for what America must do to solve the climate crisis in the immediate future. In his talk, entitled, "Why You Can't Have a Solar-Hydrogen Hummer: Real Solutions & Strategies for a Post-Carbon Society," he made no bones about what the priorities have to be and what ideas, even if they're good ones, must be set aside in order to do the most important things first. He was very clear about the priorities for the decade ahead and listed them according to their feasibility:

DEAD ENDS – Clean coal, hydrogen cars (a dead end for the short term), corn ethanol, nuclear, cap and trade (which he calls corporate welfare), shale oil, and tar sands.
MAYBE – Certain methods of carbon sequestration, stationary hydrogen, and cellulosic ethanol.
TRANSITIONAL – Strategies using plug in hybrid cars, natural gas, carbon tax, and green consumerism.
SUSTAINABLE – Technologies he believed needed to be embraced wholeheartedly. These were solar, wind, mass transit, bicycling, permaculture, biomass, zero waste, geothermal, and small-scale hydro.
SOLUTION – Transitioning to a green economy, sustainable public policies, and a grassroots movement that carries out a culture shift.

What happens with the compounding effect of switching to renewable energy?

The synergy of combining new technologies such as solar, wind, geothermal, and biomass, and coupling each of these with serious, deliberate, and intelligent conservation and energy efficiency – the low hanging fruit – can have the amplified results that are needed to de-fuse the tipping point. The old energy culture of people being energy oblivious has to be replaced with a new energy culture that all but eliminates CO2 on a personal, community, national, and global level. This vision is as exciting and promising as the tipping point is scary and daunting. The goal of a renewable energy present and future is achievable and worthy of the commitment of every American.

The result is an exponential energy confluence that arrests global warming and ushers in a clean energy economy.

One bright spot on the national horizon is the National Science Foundation (NSF)'s goal of building an infrastructure for renewable energy technicians nationwide. NSF awarded a grant to the Advanced Technology Environmental and Energy Center to help community colleges develop training and certification in the fields of energy assessment, energy efficient building, wind energy, and solar energy. ATEEC is conducting workshops throughout the country to facilitate the program. I attended one of these all day workshops and was most impressed.

So, as a citizen of the United States, this is what I would I do to reduce my country's carbon footprint. First, I would call on the entrepreneurs to get out there and develop all the wind, geothermal, and solar they possibly can and as quickly as possibly. I was asked to speak to 80 engineers at Hewlett-Packard on the day HP announced 200 would be laid off. I told them to consider the fields of energy conservation, energy management, and renewable

energy. I told them if no one hired them, start their own company. Offer their services to the end user. There is economy in saving energy.

To the U.S. Government I would say, "You are a partner in every business in America because you get part of the profit. Be a good partner! Invest in the country's patchwork electricity grid, make it a Super Grid, a Green Superhighway to bring online all the renewable energy our country has. Make it attractive for the American entrepreneur to do what needs to be done. Allow our Federal lands to be used for geothermal plants and solar farms. At the very least, get out of the way."

To the thousands of utility companies in America I would say, "Invest in your piece of the utility grid by making it a Smart Grid integrating advanced sensing technologies, control methods, and communications that will manage resources more efficiently on both sides of the meter. A Smart Grid allows for better peak load management and outage management. It eliminates the cost and carbon footprint for meter readers. Simply managing resources better can avoid the need for new conventional power generation facilities. There's so much waste in existing grids that the Smart Grid pays for itself in short order. Communities like Boulder, Colorado are already enjoying the benefits of a Smart Grid. Even large utilities like PGE are switching all 850,000 of their customer meters to 'Smart Meters.' Energy used more wisely ultimately translates to CO2 reduction on a large national scale."

A new course description offered by Portland State University on the Smart Grid reads:

> "…this emerging 'internet for energy' will enable individuals and businesses alike to participate in both the quality and quantity of energy they use to live and work, generating and storing energy from multiple sources, and managing the amount and timing of their use of

> that energy. The Smart Grid will integrate generation from both directions - home/business and central station plant - and move it as needed to meet load while incorporating solar panels, wind farms, fuel cells, plug-in hybrid electric vehicles, and other energy sources. This intelligent electric network will manage load shape and will achieve greater utilization than today. Its full value will be achieved when it is combined with an emerging participatory network model that enables consumers to actively manage their electricity consumption and sell back to the grid the surplus power they generate." (Portland State University)

To code officials and energy policy makers I would say, "Mandate the highest reasonable energy codes possible. Give provision for zero net energy homes in the form of reduced permit fees or offer some other incentive. Streamline your permitting process so that renewable energy projects move forward quickly. Insist on safe, reliable installations, but don't forget to be reasonable and timely."

To community colleges and trade schools, "Gear up for a renewable energy economy. Start offering curriculums like the Energy Management Program and Renewable Energy Program at Lane Community College. Their graduates find jobs, good jobs, and the end product is energy savings for their clients and less carbon for our atmosphere."

To architects I would say, "Think of energy first for new construction and remodeling. Go for LEED Platinum or Gold or at least Silver. Do it every time. Don't let your client bully you. Hold to your guns. Save money somewhere else, put in cheaper carpet if you have to, but don't compromise on energy."

I have to admit to one fear I have about our country completely

changing direction. It's the fear of approaching this problem halfway, without full zeal and commitment. In America we have to go all out on this. The moderate proposals being offered up to gradually cut greenhouse gas emissions over 30 or 50 years won't make it. We will have gone past the tipping point by then. The consensus of the scientific community is that we have 10 years to turn this thing around.

Having been a moderate all my life, I know what the pragmatist is thinking. Conserving first then switching to renewable energy is a great idea, and should be done, but it's just not going to happen in a single decade. Our government and big business leaders simply can't respond that quickly. Aristotle, one of the fathers of democracy, had this to say about that:

> "In a democracy the poor will have more power than the rich, because there are more of them, and the will of the majority is supreme."

We may think that the evolution of democracy in the U.S. has eroded this fundamental principal. In reality, it is still very much in place because the common person still has the power – he has the vote and, more importantly, he has energy choice. In democracies government exists by the permission and favorable will of the people.

The will of the majority is supreme.

Richard Nixon, never admitting he did wrong, resigned because he said he was unable to lead. After Watergate he no longer had the faith of the people and this made it impossible for him to function as president. In one sense leaders can operate for a while under the radar of popular approval, getting away with whatever they can because of the apathy of their constituents; however, once we

say, "This is the way it's going to be," they must comply. If we say "We don't want coal, clean or otherwise," they must listen.

At Copenhagen many developing countries sought aid from developed countries for the costs they are incurring to combat the effects of climate change. Their argument is that since the industrial countries overwhelmingly caused the problem they have the responsibility to pay for it. This is a sound position, but as a member of an industrial country I would say in our defense, "We didn't know." However, we do know now. If we continue without drastically reducing carbon emissions, in my opinion, we have no defense.

There were high expectations for Copenhagen. It's not often that all the heads of state come together to address a global problem. Many had hoped a concrete plan would be the outcome. However, the text of the Copenhagen Accord stuck to previous goals, including one of limiting world temperature rises to a maximum rise of 2 degrees Celsius (about 3 1/2 degrees F) above pre-industrial times to avert impacts such as floods, heat waves, species extinctions and rising ocean levels:

> To achieve the ultimate objective of the Convention to stabilize greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, we shall, recognizing the scientific view that the increase in global temperature below 2 degrees, on the basis of equity and in the context of sustainable development, enhance our long-term cooperative action to combat climate change. We recognize the critical impacts of climate change and the potential impacts of response measures on countries particularly vulnerable to its adverse effects and stress the need to establish a comprehensive adaptation programme including international support. (Biello)

Pretty general. A statement that they will try and work together is about all we could expect from the world's political leaders.

Sometimes we wish someone would just take the bull by the horns and do what needs to be done. Perhaps all of us have imagined what we would do if we were in charge. Here's my short list of what I would do:

1. I would hand out free clotheslines for people to hang out their clothes to dry, and if any neighborhood associations challenged hanging clothes out, I would take the case to the Supreme Court and defend it on the grounds of global warming.
2. Just as FDR promised "a chicken for every pot," I wouldn't rest until there was a solar hot water heater for every home.
3. I would institute San Diego County's initiative that required every new swimming pool to be heated with relatively low cost solar thermal collectors.
4. I would work to make it a Constitutional right of all Americans to have access to Green Power – that every utility in the country would have to offer a green power purchase option.
5. I would ask Congress to appropriate the funds for implementing a nationwide "Super Grid" even if it meant taking the money from the military budget. I'd rather take my chances that the world would honor a temporary truce than go past the tipping point.
6. I would outlaw the sale of incandescent light bulbs except in extreme cases.

All of us want to do what is right in our daily lives with respect to energy, but how do we know if we're on the right path? When we see the bar graph showing our energy usage stair stepping downward, we're doing something right.

We're doing something right when we move closer to work so

our commute is less and might even make it be possible to ride our bicycle. We're doing the right thing when we find ourselves reading more and watching less TV. You know you've done something right when your teenager, on his own, hangs out his laundry to dry for the first time.

As a company you're doing something right when there are more bicycles in the employee parking area than cars because you offered incentives to those who bike or take public transportation to work. I did the right thing today when I noticed I had only one mid-day appointment that could easily be switched to tomorrow when I have a full day. I saved one 15 mile round trip and 6 pounds of CO_2. I worked instead from home. It was the right thing to do. I was so happy I wrote this poem:

I did not have to drive today,
Hooray, hooray, hooray, hooray.

Did all my business right from home,
By email, lap top, and cell phone.

The errands that compelled me out,
Were done by bike as I rode about.

My shower came right from the sun,
I cooked my dinner in a solar oven.

The gas company I need not hassle,
Because I'm living in a solar castle.

CHAPTER 15

Reason to Hope

I visited a children's website which talked about global warming. The analogy was given of 100 million elephants, the approximate weight of all the CO_2 humans put into the atmosphere each year. (Gardner)

It might be hard to believe that there is any hope of good news knowing that 100 million elephants have been stampeding each year for decades, and even if we were to systematically cut back

to 50 million by 2050, the dust from the billions that stampeded before will not settle until well into the 22nd century.

Still there is good reason to hope. Within a few months of the end of his Presidency, George Bush took some very good steps. First, he signed into law legislation that restored Federal tax credits for solar energy systems. Not since President Jimmy Carter has there been this kind of support for the renewable energy industry. Next he embraced the G-8 proposal that committed developed countries like the US to reduce their carbon footprint by 50% by the year 2050. Critics argued this was too little too late, that we'll all cook by 2050. Still this is quite a turnaround for a president who debated Al Gore eight years earlier saying the science about global warming wasn't certain. The G-8 countries of the United States, Canada, UK, Japan, Russia, France, Italy, and Germany signed a pact stating: "We are committed to avoiding the most serious consequences of climate change…and move toward a low carbon society. (Encyclopedia Britannica)

Every single day there is news about more wind turbines going in. Cities, counties, states and countries are making concrete plans to reduce carbon emissions. Sharp Corp, one of the world's biggest photovoltaic manufacturers, announced plans for a $9 billion factory the size of 32 baseball stadiums to make liquid-crystal-display panels and photovoltaic modules. The plant begins operation in 2010.

Everywhere I turn I see signs of change. There are a lot more Priuses on the road these days. A man in my neighborhood is building battery powered three-wheel vehicles that can go 30 mph and make a 20 mile round trip. They can be plugged into an outlet and re-charged overnight by electric power that generally comes from wind turbines if the owner has elected the green purchase option from the power company. He let me take it for a spin. I went 25 miles on one kilowatt-hour's worth of energy. I offered him a dime – the cost of the energy – but he laughingly refused.

For those driving a car getting 25 miles per gallon, the cost of the same trip would be 30 to 40 times as much depending on the price of gasoline, and 20 pounds of CO_2 would have been left in the air.

There is great excitement in the transportation industry. One and two passenger electric vehicles will be popular second cars in the very near future. With a range of 60 miles or more, these will be suitable for 80% of Americans who commute less than 20 miles round trip to work each day. Detroit may well not be the center for this industry. The Pulse is made in Eugene, Oregon; the Tango in Spokane, Washington; and the Persu in Los Angeles. Many EVs are narrower, some fitting a second passenger in tandem, affording the oportunity for more lanes on existing highways. (Weymouth)

An electric car powered with green energy has no carbon footprint.

For those able to pedal their bicycles, there are pull carts being sold all over the world to carry groceries and other goods. It's a booming business in many places.

For 30 years my principal business has been to help people find practical ways to use solar energy to meet a significant part of their energy needs. For most of that time my customers have been early adopters or those who could find a reasonable payback. In recent times, however, people are far more motivated by environmental concerns than any other reason. This is very encouraging to me.

It is inspiring to me that people I know have made decisions to reduce their carbon footprint. Brian and Julie Kruse, who own a veterinary clinic in Lake Oswego, Oregon, covered the clinic's rooftop with all the solar modules they could possibly fit. They

generate a third of the building's electrical energy. The modules aren't even visible from the street.

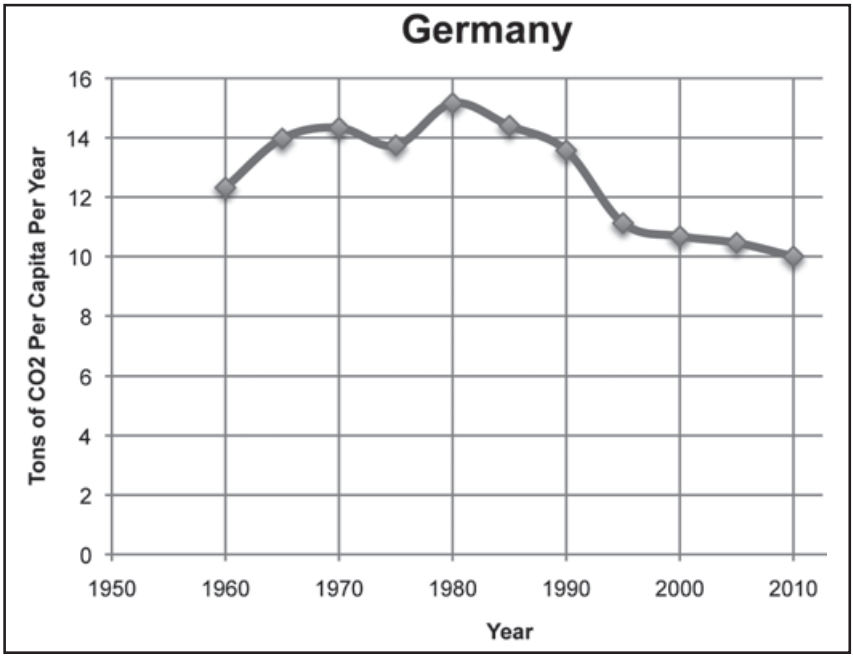
The sisters of St. Gertrude Monastery in Cottonwood, Idaho, raised $100,000 to put solar water heating and a photovoltaic system on their retreat center to provide 25,000 kWh of the building's energy load each year. Since they are a non-profit organization, they did it with none of the financial incentives most homeowners and investors get. They did it because they believed it to be the right thing to do.

Pope Benedict put solar panels on the Vatican and preaches the moral imperative of reducing carbon emissions and utilizing renewable energy. Roman Catholics worldwide should heed the example of the Pope.

One country that seems to have a good strategic plan is

Joe installs a heat pump, enabling him to disconnect his final fossil fuel source, natural gas. With green energy, an EV and solar on his roof, Joe achieves zero net energy for home and personal transportation.

Germany. If reducing CO2 emissions were an Olympic event, Germany would win the gold medal. With one of the world's most robust economies, Germany has reduced greenhouse gas emissions by 17.2% between 1990 and 2004. At certain times of the year, Germany gets 20% of it's power from wind and solar, which is truly inspiring since the sun shines less in Germany than nearly any place in the United States. Germany has ambitious goals of getting 30% of its electricity from renewables by 2020 and 50% by 2030. (Burgermeister)



Germany's CO2 levels have been steadily dropping.

In 1973, while America and other oil dependent countries were waiting in line for gasoline, Denmark confronted the issue. There was a major national debate about nuclear energy that ultimately resulted in the decision not to go nuclear. Instead they chose the path of energy conservation and renewables. As a result of that

Germany has more solar per capita than any other country.

decision, the economy grew. A whole new renewable energy industry sprang into existence. Vestas, the Danish wind turbine manufacturer, exports turbines all over the world. Unemployment in Denmark is far lower than most countries. Whole communities are served by central solar water heating. Nearly 20% of all energy in Denmark is produced from renewable sources like wind and solar. The carbon footprint for Denmark has stayed the same for 35 years.

Honorable mention goes to the entire European Union, especially Spain, which is reducing CO2 emissions from previous levels.

The Spanish government announced that it will target reaching 12 percent of its energy from renewable energy by 2010. A popular method is using mirrors to concentrate solar thermal energy. Towers rise in the Spanish countryside nearly 380 feet tall, flanked by acres of mirrors concentrating sunlight to the top of the tower, where a steam turbine is located. 66,000 kilowatt-hours per day can be generated from such a solar thermal system, enough to power 3,000 Spanish homes from the sunlight falling on roughly 20 acres. Building code laws in Spain require solar hot water for new and remodeled homes, and some photovoltaics to help offset energy needs for new and remodeled commercial buildings, as

well as improved insulation and use of natural lighting.

Europe as a whole is doing great things. In October 2008 the European Commission energy newsletter, ManagEnergy, announced the SolTherm European Initiative for "A solar water heater for every European." Citing that solar water heaters in northern Europe can provide 50% of the annual energy while those in southern Europe can provide 80%. "Solar water heating can make a significant contribution to meeting the EU's Kyoto targets for CO2-emission reduction." (ManagEnergy Newsletter)

China is doing well in solar water heating. In 2006, 200 million Chinese, $1/6^{th}$ of the population, were served by solar water heating. According to ChinaDaily, by 2010 another 100 million will be served. That would equal the population of the United States. Recent reports indicate nearly everyone in China will soon have solar hot water.

Schools in Bahrain are entering into a countrywide assessment of determining how much CO2 is used in each school, and finding ways to reduce it.

France shut down its last coal plant in 2004.

In Europe the "EcoJet," a short range jet, is being developed that would have half the CO2 emissions per passenger mile by 2015. The CO2 emissions per person on the plane would equal that of a Prius being driven by one person. (Kjelgaard)

When I hear about all the progressive measures other countries are taking I sometimes get disillusioned with my own country. We are the sleeping giant in a world that has come awake ahead of us. Nonetheless the U.S. Environmental Protection Agency isn't asleep. In 2009 they enacted a binding rule that requires CO2 reductions whether legislation passes or not. (Welch)

The United States has hit the snooze alarm several times over the last two decades, but now it's time to get up and go to work.

Some of the most progressive programs in America are coming from our cities and states that have already been at work. In 2007, eight Northeastern U.S. states (Maine, New Hampshire, Vermont, Connecticut, New York, New Yersey, Delaware, Massachusetts, and Maryland) signed the Regional Greenhouse Gas Initiative, showing that reductions can be achieved without being a signatory of the Kyoto Protocol.

By the close of 2007, 740 U.S. cities from all 50 states and Puerto Rico had volunteered to support Kyoto guidelines after Mayor Greg Nickels of Seattle started a nationwide effort to get cities to agree to the protocol. In October 2007, it was reported that Seattle met their target reduction in 2005, reducing their greenhouse gas emissions by 8 percent since 1990, the required provision for the U.S. in the Kyoto Protocol.

In December 2009, Washington Govenor Chris Gregoire went to Copenhagen, along with Wisconsin Governor Jim Doyle and Arnold Schwarzenegger, and came back fired up. She wants Washington's state government to be carbon-neutral by 2020.

The fact that we can use energy more wisely and make a significant difference is finally being embraced by the people

Wind is the fastest growing energy source in America.

and our leaders. Just by using the "off the shelf" energy-efficient technologies available today, we could cut the cost of heating, cooling, and lighting our homes and workplaces by up to 80%.

Wind power is the fastest-growing energy source in the United States and in the world. Traveling in Eastern Oregon, for years I would often see long trains with every car filled with coal traveling westward toward Boardman Coal Plant. Recently I saw a long train of flatbed cars whose only cargo was wind turbines – spectacular one hundred forty foot-long blades, 10 to 12 feet tall at their highest point – resting on a single flatbed railroad car. There were dozens of them, along with the accompanying tower sections. This train was heading east from Portland toward the windy areas of the state. There was a poetic significance to what I was seeing. I knew someday in the not so distant future, the coal train would disappear from the landscape whereas the wind turbines would stand, tall and proud. When the trainload of coal is burned, it's gone, but the wind will always blow.

On January 19, 2010 Oregon Public Broadcasting had guests

The author admires a single wind turbine blade on a train.

from environmental groups, Portland General Electric, and others during its "Think Out Loud" broadcast entitled "Boardman to Close in 2020?" Boardman is the only coal plant in Oregon. I listened to the broadcast intently. There are real indications American utilities are finally getting the message about coal. Bruce Nilles of the Sierra Club reported that North Carolina has plans to shut 11 coal plants by 2014. Also, Duke Power has plans to close two coal plants in Indiana. And with looming regulations from the U.S. Environmental Protection Agency (EPA), it will be difficult for coal plant operations to justify the cost to clean up the worst emissions of coal, much else any form of carbon tax that may be prohibitive. Switching to natural gas is viable in most cases because the power generation infrastructure, including distribution lines, are already in place. Whereas coal plants take 24 hours to bring up to operation and 24 hours to shut down, natural gas is immediately responsive to load. Therefore, gas can more readily be used to "fill in" as needed when solar, wind, hydro and other renewable resources might not be available to fully meet load. Gas is far cleaner than coal, more efficient, and far less carbon intensive. (Miller) The cost of natural gas historically has been volatile. However, large utilities can often get price commitments for ten year contracts. A PGE spokesman indicated that another option being considered was switching Boardman from coal to biomass. Preliminary studies indicate that carbon neutral high energy yield grass and cane biofuels from eastern Oregon farms could replace coal.

Americans have invested in solar energy in recent years to an extent never before seen in this country, and they've done it primarily because of their concern for the environment. It's true that only 250,000 out of America's 100 million homes have solar panels. That's ¼ of 1%. However, the number of installations per year has doubled and even tripled in many parts of the country where state and local incentives encourage the use of solar energy. The U.S. has risen to 4th of all nations in the world for solar energy

installations behind Germany, Japan, and Spain. (Solar Energy Industries Association)

There are thousands of electric vehicles operating throughout the United States (with the largest number in California and the western United States). In a few short years there will be millions.

Tens of millions of Americans have installed compact florescent lighting in their homes and businesses that uses ¼ the energy of incandescent bulbs. LED lighting which uses even less energy is growing by leaps and bounds.

20,000 solar pool heating systems are installed each year in the U.S. The amount of CO2 offset by each of these is an average of 5 tons; that's 100,000 tons of CO2 per year from one small industry segment.

In California new requirements for pool pumps are being instituted. Low speed and variable speed pumps that use a fraction of the energy of the typical one horsepower pumps will be required. Florida is poised to adopt similar requirements. Most certainly other states will follow.

Energy Star appliances are becoming the 1st choice for most Americans replacing older, less efficient appliances.

A recent news story from North Carolina reported that, "Central Piedmont Community College recently announced that it will receive $525,000 in congressional funding to help establish the Carolina's Energy Training Center." The training center is a facility that will train high school graduates and displaced workers for energy sector jobs. (NC Magazine)

As energy awareness increases, American ingenuity may well lead the way to develop energy efficient products and ideas of all kinds. As the seeds of entrepreneurship take root in the renewable energy sector, incredibly fantastic things can happen.

There are many exciting new ideas in the developmental stage that, if successful, can help bring our planet back into energy

equilibrium. One is the artificial tree being developed by Professor Klaus Lackner of Columbia University who is also co-founder of Global Research Technologies (GRT) in Tucson, Arizona. Potentially these trees could absorb hundreds of times more CO2 per day than the trees of nature and place sequestered carbon back into porous limestone in the earth. Sixty million of these trees could handle the world's CO2 emissions and help bring us back to pre-industrial revolution levels. (Discovery Channel)

While scientists and others are working on experimental solutions, the world's peoples must do everything we can possibly do right now to slow down the process of global warming in order to buy time for breakthroughs to occur.

A call to simplify

Henry David Thoreau wrote in his book, *Walden*, that, "Our life is frittered away by detail... Simplify, simplify, simplify! ... Simplicity of life and elevation of purpose." (Thoreau)

Even in the mid 1850s Thoreau and his friend and writer, Ralph Waldo Emerson, realized there is great beauty in living simply. The complexities of life are tiring, frustrating, and wearing. The simpler life gets, the easier it gets, and the richer it gets.

The simple lifestyle is worthy of our pursuit, especially in the context of global warming. The smaller your home - the smaller your mortgage, utility bills, taxes, upkeep, and worry. We must not get trapped into an ever-expanding lifestyle that requires more and more money, resources, energy, and, consequently, carbon emissions.

I was buying a home a few years ago and my realtor calculated the maximum price I could pay. She was stunned when I chose a home considerably below my price range. I told her just because I could afford a larger home didn't mean I had to buy one. She told me how rare my decision was. "Usually," she said, "people try to get the most expensive home they can qualify for. They look at

homes beyond what they can afford and make lower offers. What you're doing almost never happens."

I like the slogan: "Live simply so others can simply live." One of my favorite quotes by Emerson is: "The purpose of life is not to be happy. It is to be useful, to be honorable, to be compassionate, to have it make some difference that you have lived and lived well."

In the end, the question often asked is, "Who cares?" Most people care about something. Some care about the environment and wouldn't think of not recycling. Some people care about sports, or music, or hedonistic pleasure. Everyone seems to care about themselves and about their families. The problem is that if only a handful of people care about global warming, it is unlikely to get the kind of positive result we need. I remember my grandparents telling me the whole country was behind the World War II effort. People wouldn't buy frivolously, and if someone did, a common reaction was, "Don't you know there's a war on?" It's that kind of unified effort that enabled America to win a war on two fronts.

Civilian involvement during the war was in the area of recycling. Many everyday commodities were vital to the war effort, and drives were organized to recycle such things as rubber, tin, waste kitchen fats (the predominant raw material of explosives and many pharmaceuticals) paper, lumber, steel, and many others. Popular phrases promoted by the government at the time were, "Get into the scrap!" and "Get some cash for your trash." A nominal sum was paid to the donor for many kinds of scrap items.

I am amazed when I see incandescent light bulbs for sale in the store and still operating in homes and businesses. I suppose, since the initial cost is cheaper, the market will always be there. They really are not cheaper in the long run because of the monthly cost of the power to operate them. They require 4 times the electricity as compact fluorescents, and therefore put out 4 times the CO_2.

In 1992, I built a solar home in which I installed all compact

florescent lighting. A single compact fluorescent light cost $20 back then. They've dropped in price tenfold. Still they were a great investment. Operating for 20 years at 1/4th the cost of incandescent bulbs puts me money ahead. Many people have replaced some of their incandescent bulbs with CF's, but not all. If your body had 10 melanomas, why would you cut off five of them and leave the other five to kill you?

Thomas Jefferson is my favorite of the founding fathers. He was an innovative thinker and a wise energy user. His Virginia home used the earth's constant temperature to help keep it cool in the summer. He designed a system to allow cool air from the below-ground basement to be drawn up through the living space and exit via the attractive cupola extending above the peak of the roof. Today's earth-bermed homes employ the same principal. Even a partially earth-bermed home can cut heating and cooling loads considerably. If I lived in Arizona I would build into the side of a hill, like the Pueblos did, rather than running a 5-ton air conditioner.

Jefferson grew most of his own food in a comprehensive, well-organized gardening system, sustaining himself and his numerous household workers. Many of these workers were slaves, which he voluntarily freed toward the end of his life. Any visitor to Monticello marvels at the sustainability that was practiced there.

Today super-efficient and super-insulated homes, fashioned after the German model, can practically heat themselves with the waste heat from lights, computers, and other household appliances. A small back-up heating system is only occasionally required in the coldest weather. I believe Thomas Jefferson would be an early adopter of such a home. He would see it as a patriotic thing to do.

Ace In the hole

We the people living at this time in history being confronted with the climate crisis may rightfully feel we have been dealt a

tough hand; but we have an ace in the hole: the sun.

If we were to have a candid interview with the sun it might go like this:

Human: Can you meet the energy needs of all humans on earth?

Sun: I already do.

Human: No, I'm talking about the energy needs to run the world. You see we are currently meeting most of these needs with fossil fuels, which are causing us problems. We're talking big energy needs from all sources that equate to 300 million kilowatt-hours per day.

Sun: 300 million kilowatt-hours per day, no problem.

Human: But Mr. Sun, you don't understand, China and India are coming on fast. Our energy needs could practically double overnight.

Sun: (somewhat amused): 600 million kilowatt-hours per day, no problem.

Human: I hate to tell you this, but the number could get a lot bigger by the end of the 21st Century. There could be twice as many of us using 10 times as much energy as we use today.

Sun: I see, so then you would be talking 12 billion kilowatt-hours per day. That's a piece of cake!

Human: Really? Then what is your capacity? How much energy could you provide, and of course still be able to do photosynthesis and everything else you have to do to keep our planet habitable?

Sun: Well, if you ever need two or three trillion kilowatt-hours per day, then I would start to worry a little. Everybody has their limits, even bodies in space like us stars, but I could provide a trillion kWh per day to you people down there and not even break a sweat.

The sun: our ace in the hole.

Human: Does that mean we could eventually de-commission the nuclear power plants and breach the dams?

Sun: (as if stating the obvious): That would be affirmative.

Human: Then all we have to do really is switch from fossil fuels to renewable energy and we will never have to worry again?

Sun: Duh. It's about time you realized that. I've been here all along. Talk about being ignored and feeling neglected.

Human: Sorry. Better late than never?

Sun: Let's hope so. Now run along. You figure out what you need to do. I'm always here for you, 24/7. It's my job.

The sun delivers about 7000 times more energy than we currently consume globally. If we used only 1% of unused land area

we could produce nearly 4 times more electricity than we produce using fossil fuels and nuclear power combined, according to Dr. Ron Nielsen in his 2005 article about Solar Radiation. (Nielsen)

When we use solar energy in particular we are getting double duty from the sun. Instead of the sun's powerful rays falling wastefully on the ground and continuing to warm the planet, we intercept them and use the same rays to heat hot water or make electricity for us. These rays are taken out of the global warming equation. Likewise the CO2 that would have been added to provide that same energy with fossil fuels would be removed from the equation. In simple math, a single solar water heater delivering 3,000 kWh per year directly from the sun offsets the 6,000 pounds of CO2 that would have been produced if the water had been heated by electricity generated from a coal plant. The net effect from this single energy transaction is: no solar heat build up, no carbon dioxide, and hot water for the household. For any solar technology used, solar thermal or solar electric, we, and our planet, receive a duel benefit. If ever there was a time to go solar, now is that time, and the sooner the better.

When we use a heat pump to heat our homes we also get double duty. The heat from the sun (residing in the air or in the earth) is taken from the equation, as well as the corresponding CO2. We are in essence cooling the earth while we heat our homes. In the context of global warming, using solar energy makes us allies with the sun. Using fossil fuels makes the sun our worst enemy.

Obviously the sun is more than adequate to provide all of earth's energy needs – even rapidly growing needs – and we all know that eventually our world will be powered completely by renewable energy. The question is: Will we do what is necessary to make the shift in time? Many believe that human nature is such that we won't. We are selfish, lazy, shortsighted, self-indulgent, spoiled brats. Others who think about the human quest for excellence believe we can reach for the stars. Still the question remains: Can

we save our planet? Of course we can. We have the ability to do so, but will we or are we doomed by our more dominant shortsighted nature?

Are we doomed?

Of all the opinions I gathered on this question, the one I like best comes from the noted Australian nuclear physicist Dr. Ron Nielsen. Dr. Nielsen, author of *The Little Green Handbook* and several other works, is listed among the 2000 Outstanding Scientists of the 21st Century, 2000 Outstanding Intellectuals of the 21st Century, and Who's Who in the World. He has had a marvelous career in various scientific disciplines that have helped him form a well-rounded opinion. He also possesses that down to earth common sense we love about Australians. In a paper written in 2005 to the question, "Are We Doomed?" he answers:

> The general consensus is that we do not have much time left to change the course of the critical global events and that if we don't do what's right we shall miss the opportunity to solve the critical global issues. Indeed, there's a justified fear that we might cause our self-extinction or that we might create unbearable living conditions on our planet possibly within only a few decades…we can cause a doomsday if we continue to behave foolishly. So the choice belongs to us and if we chose to neglect our opportunity to do what's right we shall only have ourselves to blame. (Nielsen)

I think that says it all.

Although the purpose of this exposition is to help the reader make energy choices that reduce CO2 emissions, no discourse on the subject would be complete without mentioning the problem of

methane. Methane is a powerful greenhouse gas, 20 times more powerful at trapping solar energy than carbon dioxide. Even though carbon dioxide from the burning of fossil fuels is responsible for 43% of global warming, methane ranks second at 26.7%. Black carbon (soot) is responsible for 11.9%, nitrous oxide and two other gases account for the balance. (Gore 47)

Most of the methane that enters the atmosphere comes from livestock. There are 1.3 billion cows in the world. When adding the effects of methane and other greenhouse gases to the 90 million tons per day of CO2, we get 134 million tons per day of CO2 equivalent. (Walker 126) CO2 equivalents is a term used to combine the heat trapping characteristics of other greenhouse gasses and express them in terms of equivalent amounts of carbon dioxide.

Some think that we should just ask the people of the world to stop eating red meat rather than completely overhauling the energy system. If not for the cultural and social obstacles, solving the methane problem could be easier. Whereas CO2 can remain in the atmosphere for centuries, methane is relatively short-lived. I did a very quick, very informal survey among a few people I knew. They thought it would be easier for Americas to convert to non-fossil fuel energy than give up meat. Maybe McDonalds and Burger King just wouldn't be the same if they didn't sell hamburgers. Experiments are being conducted to reduce the amount of methane generated by the digestive process of livestock. If these efforts are successful, perhaps we can have our steak and eat it too.

I'll leave it to others to deal with burping cows. In the meantime, many Americans, including myself, have chosen to reduce our consumption of beef and other dairy products. There are many other good reasons not to eat red meat. One argument is that if the land necessary to support livestock were planted in grains and vegetables instead, there would be more food available worldwide.

I once served a big steak to a dinner guest who was a cardiologist. He nearly had a cow. In a polite and refined manner he let me know this wasn't the healthiest food we could be putting into our bodies. Knowing the significant contribution methane makes to global warming, it doesn't take a cardiologist to convince me I should eat less beef. Enough said.

Another item that must be mentioned is the problem of deforestation worldwide. Al Gore says 20% of global warming is from the enormous amount of trees that are removed each year in Brazil, Indonesia, and other places. In his fabulous book, *Our Choice: A Plan to Solve the Climate Crisis*, the former Vice-President explains the problem and offers solutions. By the end of 2009 the Brazilian government had taken measures to protect 40% of the rain forest from wholesale cutting. I would also commend Mr. Gore's section on sustainable farming.

Moving ahead there will certainly be obstacles, but none of them are insurmountable. The problems of inertia and energy oblivion that got us into this mess will persist for a long time. Some of the entrenched powers of what will soon be the old fossil fuel industry will go down with their ship kicking and screaming until the bitter end. The smart ones will get into renewable energy and make their millions there. One of the richest men in China manufactures solar photovoltaic modules.

For Americans the question always comes up: What will China do? Even if the U.S. were to drastically reduce its carbon emissions, would it matter much if China and eventually India continue to use growing amounts of fossil fuels to power their economies? Certainly it is true that, "unless China finds a way to develop without massively increasing its greenhouse emissions, the efforts of the rest of the world will count for very little." (Hot Topic, 181) However, the governments of both China and India are better able to effect rapid change in their countries than we are here. Both are capable of transitioning to renewable energy faster

than the United States. Furthermore, the United States would be able to exert great pressure for these countries to follow suit. It is fully expected, however, that they will transition away from fossil fuels faster than the U.S. regardless of what we do. Our transition can only expedite theirs.

I asked my nephew, Leif Rogers, a very astute international businessman who has lived in China for several years, what he thinks. This is what he had to say:

> China is going full tilt on solar and wind, Uncle John. You see it constantly. On my way out to the South Train Station they just installed street lights all the way out there, over a 1,000 of them at least. They all look like normal street lights, except the panel above is a solar panel, because they're all run completely on solar. All our new traffic lights in the development zone and South Jinzhou are all solar. Almost all water heaters everywhere in China are solar. Mine is and we live in the nicest apartment complex in the city, but you can drive out 1,000km to little mud hut villages and farms and everyone of them will have a solar panel for their water. It's everywhere. I bet there's at least 200,000 people with electric motorcyles. My city is a third tier city in China. So this would have the same status as a city like Salem [Oregon] in America, but we have over a million people in the city and close to 2 million including the suburbs. Sure China is a huge polluter but it's simply a numbers thing.
>
> You ask any American what their take on Chinese energy is and all you hear about is the coal, the pollution, the industrial revolution, an 1800's type of scenario, when it's not true at all. Sure they have major problems, I don't think people grasp just how much industry there

> is here and the heating is all with coal, but from the government all the way down to the poor farmer they have taken solar on 1,000,000 times more than you ever see in America. America needs to wake up.

I could not possibly agree more. If America were to fully wake up, if China and India were to continue to grow their economies with renewable energy, if Europe and the rest of the world were to continue in the right direction, if deforestation were to cease and a global energy renaissance were to occur, imagine what that would look like.

Imagine a short-term scenario in which CO2 levels which have been gaining at three parts per million per year in recent years suddenly are reduced to two; then one; then none. Then imagine the CO2 levels retreating in the same fashion. The world would celebrate like it's never celebrated before. Experts tell us that peak CO2 (the point at which CO2 parts per million tops out) needs to happen by 2015. Imagine the jubilation when it does happen! The global CO2 level is something we can all watch, something we can all influence, and something we can all celebrate.

In the summer of 2007 I completed an off-grid photovoltaic installation on a 5-acre lot 10 miles or so inland from the Oregon coast. It was a special site. There was a year round spring and a beautiful building site on a small hill 20' or so above the spring and a few hundred feet away. The densely wooded area was full of animals. I could hear birds throughout the day and saw several deer over the course of time I was doing the project. I caught glimpses of smaller animals such as rabbits and squirrels.

I was hand-digging a trench for electrical lines right beside the new, single-room cabin. I was about 3 feet down into well-compacted dirt which nature had pressed firm for hundreds of years. Suddenly I dug into what looked like an old campfire. There

were multiple pieces of charred firewood and cinders. It gave me goose bumps to think I'd happened upon an old Native American campfire.

I called a geologist friend of mine who told me it was very likely I had uncovered an ancient campfire. At that depth, he said, it could be at least 1,000 years old. "Charred wood doesn't decompose, it will last a really long time. It takes a hundred years for the earth to gain an inch or two from leaves and other organic decomposition," he said.

I could easily imagine a family living there long ago. There were all the elements to sustain life: firewood, water, game. I was there providing a renewable energy system to a new 21st century resident. The cabin's owner would use solar energy to pump water and provide electricity. The only difference between living there now and 1,000 years ago is the present occupant's ability to live with greater ease. She has a cozy shelter; and no one has to haul water up the hill. Those of us living in developed countries have the amazing luxury of electricity. We bathe in hot water just by opening the tap. We cook without building a fire and employ dishwashers to clean up after us. Our homes are well insulated so that a little bit of energy goes a long way. A fire in the wood stove gives warmth without smoking up the teepee.

The day I uncovered the fire pit, I was driving slowly away in my quiet Prius and came upon a deer grazing right next to the road into the property. I stopped the car. The window was already down. Ten feet away the deer stopped grazing and looked up at me. We had a moment together. I said in a soft, careful voice, "Hi, I'm a human. I'm one of God's creatures just like you. You look like you're enjoying the sun and the grass." There was no response, just an uninterrupted gaze. Our eyes were locked together. Maybe we were both wondering which of us would break the connection. Finally, after a good 2 or 3 minutes, I said, "Well, it's been lovely meeting you, but I have to go." I slowly drove away. At my first

movement, the doe darted into the brush. No doubt she was thinking, "What was that all about?"

It occurred to me as I drove away, thinking about the deer, the fire pit, the spring, and life a thousand years ago, that there was a connection between the people then and those of us living now. I realized it was incumbent upon us living now to continue the connection to those coming a thousand years from now. We don't have to live in a small cabin in the woods to save the planet, but we need to do our part wherever we live and however we live.

I think about the campfire I unearthed, and the deer, and realize that hundreds of years from now someone may be digging around in the area. Will animals still be there, rabbits and squirrels and deer? My hope is that they will be there, in abundance. If that person were to be digging and happened to find the fragments of electric wires and conduit in my trench, perhaps he might wonder what kind of challenges we solar pioneers must have had in convincing our societies to move from fossil fuels to renewable energy. I hope he looks up at a crystal clear sky and breathes a deep breath of clean, healthy air, and feels a kindred spirit with his primitive ancestors from the 21st century.

QUESTIONS AND ANSWERS

Q. The sub-title of the book "A Funny Thing Happened on the Way to Extinction" seems out of place. There's nothing funny about going extinct. What do you mean?

A. The word "funny" is used in the sense that means strange, difficult to explain or understand; as in "I had a funny feeling you'd call." It does indeed seem strange or odd to me that we would carry on life as usual knowing it could lead to our very extinction.

Q. How does anyone know how much CO2 is generated by a given country in a given year? How can we know this and regard these figures as facts?

A. There are no CO2 meters coming our of our car exhaust pipes or from the smokestacks of power plants. However, we do know how much carbon based fuels are sold in the country, and we know how much CO2 will result from the burning of each of these fuels. The statistics, therefore, are compiled based on the amount of coal produced, the amount of petroleum imported, and the amount of natural gas metered.

Q. Throughout the book you count every kilowatt-hour of electricity generated by power companies as if it had come from burning coal, which is the highest CO2 fuel per unit of energy. Many utilities use coal as only a part of their energy mix. Is this fair?

A. Recognizing that natural gas and other fossil fuels result in less CO2 per kWh than coal, I think it is fair to continue to use 2 pounds of CO2 per kWh (coal's approximate CO2 output per kWh)

until the U.S. closes its last coal plant as France did in 2004. Once we've closed all the coal plants, I think it would be fair to use 1.9 pounds of CO2 per kWh, the value for oil-fired power plants. Once we've closed all of those, it would be fair to use 1.3 pounds for natural gas.

Q. You encourage buying green energy and allowing those who do to put a "Zero" for the CO2 for their electricity. This is only theoretically true, since power companies must provide uninterrupted power so there will be times when the wind isn't blowing, the sun isn't shining, and the dams aren't releasing water. Fossil fuel energy has to be supplied then.

A. This is accurate. However, utilities are required to match the annual load of customers who choose green power with a corresponding amount of renewable energy from their portfolio. Therefore, as customers choose to buy green power, they must add renewable energy in matching amounts. Even though this may not balance from day to day it must balance over the course of a year. It's the law.

Q. What if I am served by a utility that doesn't offer a green power purchase option?

A. Call your utility and tell them you want them to provide green power. Keep calling them. Write a note on every utility bill you pay. Call your State legislative representatives and Congressional representatives and tell them you want green power. Keep asking until they do something. As Winston Churchill said, "Never, never, never give up."

Q. If coal were taken out of our energy mix, 100,000 people would lose their jobs. What's to be done about that?

A. Retrain them in the renewable energy sector. They can construct and maintain wind turbines. They can drill for geothermal

energy and work in geothermal plants. Germany, with about one-fourth the population of the U.S., has 20,000 workers in renewable energy. In like proportion, the U.S. could absorb three-fourths of coal industry workers. They can transition to other sectors as well. I don't know how many people would have to be retrained if the tobacco industry were to be shut down, but it would be worth it. Doing the right thing should always come first. Everything else can be figured out. I grew up in Appalachia. I know coal miners would rejoice to come out of coal mines and onto roof tops installing solar panels.

Q. To the question of solar vs. nuclear, proponents of nuclear talk of the jobs created from building new plants. Is this a fair justification?

A. Job creation is often attached because it helps win allegiance to a particular cause. The coal industry does it, as does LNG, nuclear, and even solar for that matter. This cannot be justification. We could justify anything if it were to bring on new jobs. Manufacturing asbestos provided many new jobs, but it was bad for society. Of all energy technologies, renewable energy can bring on just as many jobs as the others - jobs workers can feel good about doing.

Q. If I were to have to cut down trees to put solar panels on my house, what should I do?

A. Leave the trees. Mature trees are too important. We need to put the solar panels where the trees aren't.

Q. Should I wait for technology to improve to go solar?

A. No. There is no advantage whatsoever in waiting. Solar water heating is a mature technology that is on the order of 80% efficient. Solar photovoltaic is gaining in efficiency all the time. Solar PV is modular in nature. Do what you can now and add to your system later.

Q. Shouldn't I wait until the prices come down to go solar?
A. No. The prices have come down dramatically. In 1990 I paid $8 per watt for PV. In 2010 I can buy, in quantities, at $2 per watt. If manufacturers or the government were to give solar modules away one couldn't do much better.

Q. What are the priorities for reducing my carbon footprint?
A. Conserve first. Do a comprehensive review of your entire energy usage and put your money where you gain the most energy-saving benefit. Don't waste energy. Buy green power. Drive less and use other means of transportation like mass transit and bicycling whenever possible. Always travel by the means that uses the least fossil fuel, and know how to determine which that is. Promote energy awareness and conservation in your community. Go solar. Plant trees.

Q. It sounds like you are very much against air travel. Are you?
A. I am not necessarily against air travel as much as I am in favor of only traveling when necessary and doing it in the least carbon intensive way possible. In most cases other means are better than air. However, when traveling overseas in a full 747 getting 70 passenger miles per gallon, this would in fact be the least carbon intensive means and perhaps the only practical one. There are compelling reasons to fly, even domestically. Instead of 90,000 flights worldwide each day, I would like to see a much smaller number, with planes nearly always full of travelers that have to fly.

Q. If within 10 years time there's a radical change in the way we use energy, wouldn't this totally disrupt the economy?
A. I'm not an economist, but if I were I would be looking at the problem and figuring out what to do because the way we use

energy has to change and it has to change fast. In one sense people using less energy and cleaner energy in the next decade could very well help the economy in many ways. When we brought water pollution under control and started recycling, the long term economic effects were very positive.

Q. What forms of renewable energy can I use at my own home?

A. Tubular skylights and solar attic fans are affordable and can make a big difference, and you can install them yourself. Solar water heating and solar electric modules are good for anyone who has good solar access, which is generally considered 75% of full sun or more. Small-scale wind is viable if you live in an area that gets good wind. There are wind resource maps for the entire world. Most of us don't live where the best wind blows. Consistent, steady winds over 20 miles per hour constitute good commercial sites. Geothermal energy from ground source or air source heat pumps are well worth considering. There are many new exciting heat pumps available that are twice as efficient as anything we've seen before. Some even use liquid CO2 as the heat transfer fluid.

Q. I am just one person. Can what I do make a difference?

A. Absolutely! The amount of anthropogenic (human caused) CO2 in the atmosphere is exactly the sum of all the fossil fuel burning for every person on earth. One person reducing his or her carbon footprint is accounted for in the atmosphere.

Q. You advocate green power, closing coal plants, a carbon tax and building a Smart Grid. All of these could raise utility rates and fuel costs. How will customers, especially lower income families, deal with the increased costs?

A. Less energy use and more efficient energy use can reduce

energy consumption for most Americans by half. If energy costs doubled, but consumption dropped in half, there would be no difference in cost. All indications are that the carbon reduction measures needed to curb global warming will increase carbon-based energy costs less than 50%, in which case most people, if they conserve, will be ahead.

Q. You talk about putting up gigantic 4 gigawatt solar farms that would produce as much power as a nuclear power plant. This is many times bigger than anything that's been built anywhere in the world. Are you serious?

A. Absolutely! This is America; we can do big things. We have the land and we have the sun. Solar photovoltaic is totally modular, so we can build 40-megawatt solar farms (which have already been done in Germany, Spain, and even Portugal), or 400-megawatt (10 times larger), and if you have the land, 4-gigawatts (10 times larger still). In 2009, people in effect built two-nuclear-power-plant-sized solar arrays – distributed on rooftops all over the world.

Q. I've heard that having white roofs that can reflect sunlight will help with global warming. Is this a good idea?

A. Yes, especially with commercial buildings which often have acres of black roofing. These should be coated white or replaced with white membrane roofs. Light colored roofing for homes and businesses helps do the job of the polar ice caps by reflecting incoming solar energy back to space.

Q. On a global scale I don't see how we can possibly do what is needed in time. It would take a miracle, don't you agree?

A. The people of the world would need to join together to voluntarily reduce CO2 to manageable levels in time. It is hope for this miracle that moved me to write this book.

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DEDICATION

I dedicate this book to my granddaughter, Bella, that the world you grow up in will be as beautiful and magnificent as the one I inherited; and to Almighty God, that you will give us a miracle along with the courage and conviction to be good stewards of your earth.

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	Carbon Footprint Calculator Date: _____	
Energy	Formula	Pounds of CO2/Year
Gasoline	Miles per year _____ divided by (÷) ___ miles per gallon = _____ gallons x 20 lbs =	
Electricity	Annual kWh _____÷ # in household ____ = _____x 2 lbs./CO2 per kWh = If you participate in a Green Power purchase option, purchasing 100% of your electricity from wind and other renewable energy sources, enter "0."	
Natural Gas	Therms per year _____ ÷ # in household ___ = _____x 12 lbs of CO2 per therm =	
Air Travel	Miles flown per year _____ x .9 pounds of CO2 per mile =	
Fuel Oil	Gallons per year _____ ÷ ___ # of people in household =_____ x 22 =	
Propane	Gallons per year _____ ÷ ___# in household = ____ x 13 pounds of CO2/gallon =	
Mass Transit	Miles per year traveled _____ x .5 lbs. CO2 per mile =	
Waste Per Person	Average is 1,000 pounds per year. (If you recycle newspapers, glass, cans, and plastic, use 500 pounds) =	
	TOTAL CO2 PRODUCTION or ANNUAL CARBON FOOTPRINT:	

	Carbon Footprint Calculator Date: _____	
Energy	Formula	Pounds of CO2/Year
Gasoline	Miles per year _____ divided by (÷) ___ miles per gallon = _____ gallons x 20 lbs =	
Electricity	Annual kWh _____÷ # in household _____ = _____x 2 lbs./CO2 per kWh = If you participate in a Green Power purchase option, purchasing 100% of your electricity from wind and other renewable energy sources, enter "0."	
Natural Gas	Therms per year _____ ÷ # in household ___ = _____x 12 lbs of CO2 per therm =	
Air Travel	Miles flown per year _____ x .9 pounds of CO2 per mile =	
Fuel Oil	Gallons per year _____ ÷ ___ # of people in household =_____ x 22 =	
Propane	Gallons per year _____ ÷ ___# in household = _____ x 13 pounds of CO2/gallon =	
Mass Transit	Miles per year traveled _____ x .5 lbs. CO2 per mile =	
Waste Per Person	Average is 1,000 pounds per year. (If you recycle newspapers, glass, cans, and plastic, use 500 pounds) =	
	TOTAL CO2 PRODUCTION or ANNUAL CARBON FOOTPRINT:	

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Energy	Formula	Pounds of CO2/Year
Gasoline	Miles per year _____ divided by (÷) ___ miles per gallon = _____ gallons x 20 lbs =	
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Propane	Gallons per year _____ ÷ ___# in household = ____ x 13 pounds of CO2/gallon =	
Mass Transit	Miles per year traveled _____ x .5 lbs. CO2 per mile =	
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	Carbon Footprint Calculator Date: _____	
Energy	Formula	Pounds of CO2/Year
Gasoline	Miles per year _____ divided by (÷) ___ miles per gallon = _____ gallons x 20 lbs =	
Electricity	Annual kWh _____÷ # in household ____ = _____x 2 lbs./CO2 per kWh = If you participate in a Green Power purchase option, purchasing 100% of your electricity from wind and other renewable energy sources, enter "0."	
Natural Gas	Therms per year _____ ÷ # in household ___ = _____x 12 lbs of CO2 per therm =	
Air Travel	Miles flown per year _____ x .9 pounds of CO2 per mile =	
Fuel Oil	Gallons per year _____ ÷ ___ # of people in household =_____ x 22 =	
Propane	Gallons per year _____ ÷ ___# in household = ____ x 13 pounds of CO2/gallon =	
Mass Transit	Miles per year traveled _____ x .5 lbs. CO2 per mile =	
Waste Per Person	Average is 1,000 pounds per year. (If you recycle newspapers, glass, cans, and plastic, use 500 pounds) =	
	TOTAL CO2 PRODUCTION or ANNUAL CARBON FOOTPRINT:	

Notes

Why are the world's top scientists concerned about climate change? Is there anything I can do?

Footprint provides:
-a clear understanding of global warming and its cause
-an easy to use carbon footprint calculator
-ways to reduce your footprint without changing your lifestyle
-dozens of energy savings tips that cost little or no money
-a call to action for a renewable energy future

"Students, parents, community leaders and corporate presidents will enjoy the personal perspective of John Patterson in FOOTPRINT. It's an easy-to-read guide to global warming and what you can do to stop climate change before it's too late." - *Dr. James Hansen, NASA Climatologist, regarded as one of the world's foremost experts on climate change. He has advised U.S. Presidents and world leaders for over 20 years.*

Photo by Suzanne Olsen

Since 1980 John Patterson has helped thousands of clients achieve dramatic energy savings and carbon footprint reductions. Founder of Mr. Sun Solar and inventor of the Sol-Reliant™ solar water heating system, John has served as Chairman of the Citizens Utility Board (CUB) and as President of the Oregon Solar Energy Industries Association. He teaches solar energy courses for Portland Community College and has numerous renewable energy articles published in Home Power and Solar Pro Magazines. John also conducts hundreds of workshops and seminars for energy professionals, architects, engineers, as well as commercial and industrial customers of major utilities like PGE. He has been a guest workshop speaker for Solar Energy International (SEI) and keynote speaker at Sol-West. (www.JohnHPatterson.com)

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