

CHAPTER I

A New Apollo Project for Energy

Where there is no vision, the people perish.

—*Proverbs 29:1*

No one ever climbed a mountain they believed could not be climbed. No one ever started a business they believed would fail. And no nation ever undertook a major initiative it believed was destined for dust. When Kennedy said America was going to the moon, he did not believe we would fall short. So too, America will not commit itself to tackle the challenge of global warming or break free from the clutches of Middle Eastern oil until we have confidence that we can build a clean-energy future that will be brighter than the world we are living in today.

Why has America not risen to the challenges of climate change and oil dependence to date?

The problem is not inadequate information or insufficient scientific talent. It is not even the relentless obstructionism of vested interests, though we can't underestimate the tenacity and cleverness of the oil and automotive industries and the politicians indebted to them. Rather, the problem is an overabundance of fear. Fear that we cannot solve the problem. Fear that we cannot change the course we are on.

People have a finely developed ability to ignore problems—like the inevitability of our own death—that we believe we can do nothing about. Yet today, we do not have the luxury of ignorance. Our shift to a deep and abiding hope must be grounded in our ability to guide the forces of change for human betterment, informed by the dangers we face but guided by a belief in our own innovative potential.

As we shall see in the pages of this book, the spirit of innovation is alive today. It is alive at the labs of the Nanosolar Company in California, where a new type of solar cell may bring the world cheap electricity from the sun. It is alive in the wheat fields of Idaho, where the first commercial cellulosic ethanol plant in the world could be built. It is alive at the home of Mike and Meg Town in Washington State, which generates more energy than it consumes. In all fifty states of this union, individual Americans and their companies and communities are ready for the liftoff of a second Apollo project. Now we just need to engage the full scope of our national resources to that end.

Kennedy's original Apollo Project invested \$18 billion per year (in 2005 dollars).¹ The federal government's budget for energy is now just over \$3 billion. Kennedy got us to the moon. The current energy budget will not get us anywhere but to the next high-priced gas station. To put this miserly \$3 billion budget into perspective, the federal government spent \$6 billion last year building a truck to withstand improvised explosive device (IED) detonations in Iraq. This budget is eclipsed by that of just one company, the Microsoft Corporation, which invests twice that sum, or \$7 billion a year, in research.² Just one new biological drug can cost a pharmaceutical company \$1 billion to develop and bring to market. Even more astounding, according to the *Economist* magazine, the U.S. power-generating business, arguably the world's largest polluter, spent a smaller percentage of its revenue on research and development than the U.S. pet food industry did. Clearly, our priorities are in the wrong place.³

We don't need an incremental increase. We need the equivalent of a new space program. As with the original Apollo Project, much of the capital will flow from the private sector, but it will take federal invest-

ment and policy to move that capital toward new technologies that solve these problems.

It is not just money we need. Kennedy did much more than just write a budget. He wrote a new vision statement for the country. He created a national consensus that we were going to do whatever it took to reach that national goal. When young minds of a scientific bent asked “what they could do for their country,” their answer was frequently to go into the space program. Our national leadership must now rekindle that sense of national purpose.

Fortunately, we have leaders today who can articulate the vision of a better future. We are about to meet some Americans who have already set out on that path. This book has been written as a map for the journey. It examines in turn each of the technologies in which we must invest to reach our goal, as well as pioneers of the new energy economy who are leading the way. While these inventors and activists can provide the engines of a new energy economy, it must ultimately be the people and our political leaders who set the course. If we choose wisely, when we reach our destination, we will have transformed the face of our nation. In so doing, we will have addressed the three legs of the new Apollo mission: attack global warming, reestablish our national security, and revitalize our manufacturing economy.

But while Kennedy had a decade to perform his feat, we may have far less time.

Surviving the Bomb, Dying from the Heat

To see the consequences of failing to act, we can look to an island nation once the home of America’s nuclear testing program and now home to 60,000 very worried people. In the middle of the Pacific Ocean, about halfway between Hawaii and Australia, lie the Marshall Islands. In 1948 they were a charming series of 250 coral atolls that had been home to a gentle and friendly group of Micronesian communities for a thousand years. Those people lived an idyllic existence among the palm trees and abundant coral reefs.

Then we tried to blow it up.

We gave it all we had. We exploded twenty-three nuclear bombs on the Bikini atoll between 1946 and 1958 alone, one of which was the largest hydrogen bomb ever detonated by the United States. We hammered that little island with weapons generating temperatures equal to those on the sun itself. Ours was a scorched-earth policy.

But it did not destroy the will of the Marshall Islanders. They moved away from the Bikini atoll to other islands in the group and resumed their long traditions of living close to the land and sea. Their culture remained intact. The Marshall Islands, as a whole, survived.

But they may now be doomed by the more powerful, more pervasive, more insidious threat of global warming. A nation that survived hydrogen bombs may now succumb to H₂O.

With their average height just seven feet above sea level, and the seas rising due to global warming, the Marshall Islands may be a nation that comes to know how the world, or at least their world, ended. As a nation that is literally built upon thousand-foot-tall coral reefs that also serve as critical bulwarks against the surge of the sea, it could drown. What is now an ocean paradise could become an underwater reef. The process has already begun, inch by inch.

The president of the Marshall Islands, a genial leader with a warm smile named Essay Note, knows what it is like to have one's nation nibbled away bit by bit by the power of the sea. "Our situation is already critical. We have seen the sea coming in and destroying our coastal areas. So much of our land is being washed away," he says in a tone that is remarkably calm given that his ship of state is sinking beneath him. "We live close to the ocean here. The sea is both our garden and our neighbor. It is so hard to now see it coming right into our homes. We have had to relocate people already. We have tried building sea walls, but that has limited success on an island that is two feet tall."⁴

When you talk to this president, he will emphasize that the damage to his people has been as much cultural as physical. "Our whole culture is tied to the sea. Our traditional way of preparing food, of teaching our kids, of living in every way is interwoven with the coral reefs that sustain us. But the whole ecosystem around those reefs is now being killed.

Our people have to go farther and farther out to get any fish. The reefs themselves are bleaching, and parts of them are dead. With them goes our culture.”

His reefs are getting a one-two punch. First, water temperatures are rising as the ocean absorbs huge amounts of energy from the warming atmosphere. Second, the ocean is becoming more acidic as it absorbs CO₂ from the air, the carbon dioxide going into solution and changing the pH level of the seas. The combination of warm water and acidic conditions is a deadly cocktail for coral.

If trends continue, there may be no healthy corals anywhere in the world in the next century, because the calcium that builds coral cannot be precipitated out of such acidic conditions. The acidification of the oceans poses a broader threat to our food supply since a substantial number of the tiny creatures that form the foundation for many food chains will also have this problem.

“It’s not just the water level that threatens us,” President Note explains. “Global warming causes more frequent and powerful storms that wash over us and can destroy what little margin we have to keep our noses above water. This is just another reason so many of our people have moved to places like Oregon and Seattle. It’s a real problem.”

The people of the island nation of Tuvalu have already agreed to move to New Zealand when their home becomes uninhabitable. President Note sees the United States as a more likely destination for his island’s climate refugees due to political ties. We put Katrina refugees in the Astrodome. Where will we put the Marshall Islanders?

But President Note’s first instinct is to stay and fight. “The United States is responsible for 25 percent of all the CO₂ emissions in the world. How can it drown my nation and not do something about that? What gives it the right to do nothing as my nation goes under?”

Global Warming beyond a Reasonable Doubt

The science of global warming is well understood. Certain gases, principally CO₂, absorb solar radiation that would otherwise be dissipated back into space. Like a down comforter on your winter bed, they then

radiate that heat back to the earth. The more of these gases in the atmosphere, the more energy radiated back to earth. The higher the percentage of carbon dioxide (CO_2) in the atmosphere, the greater the amount of the sun's energy that is trapped on earth. The basic principles of global warming are as scientifically accepted as gravity.

These gases are called greenhouse gases for good reason. Their presence at the right concentrations is vital to life on earth. Without them, we would be a frozen planet. But we know with a high degree of certainty that over the last two centuries, human activities have increased the concentration of these gases to levels never before seen during human existence and probably not during the last 20 million years.⁵ The levels of CO_2 , for instance, have risen from 280 parts per million (ppm) in preindustrial times to 382 ppm today. And CO_2 stays in the atmosphere for a long time; the carbon we emit now will be part of our atmosphere for another fifty to two hundred years. The question is not whether we are causing global warming, but whether we can avoid almost doubling preindustrial levels of these gases in our atmosphere. Unless dramatic changes are made in our energy economy there will be between 500 and 600 ppm of CO_2 in the atmosphere by 2050, and 800 ppm by 2100. These are more than just numbers.

In other words, by the middle of the century, the gases that trap heat on our planet could be nearly twice as "thick" as they were before we started cutting down our forests and burning oil and coal—if we're lucky. Does it stretch the imagination to think such a titanic global change would have a dramatic impact on our lives? Much worse, should it not alarm us to realize that these projections may understate the problem, since world economic activity based on fossil fuels is accelerating, and these projections are based only on the rate of increase we are suffering today, about 2–2.5 ppm per year?

Among all but a few scientists, it is a given that we have already irreparably altered the course of life on earth. Mean temperatures have risen by 1.4°F and sea surface temperatures by .09–1.8°F over the twentieth century.⁶ Sea levels have risen nearly .2 meter, and the extent of Arctic ice has decreased by 7–15 percent, depending on time of year.

According to both the National Academy of Sciences and the Intergovernmental Panel on Climate Change, the evidence that human activity is causing most of this change is unequivocal.

But this is only the beginning. It is virtually certain that continued buildup of greenhouse gases will cause increased warming, with the potential for sudden changes in major ocean currents, tundra meltoffs, and other unpredictable results presenting additional dangers.

We can expect further increases of between 3.24 and 7.2°F this century if CO₂ emissions continue on their present ominous path.⁷ To put that in perspective, the difference between the last major ice age and our current climate is less than 10°F. Such temperature increases mean longer periods of severe storms as energy in the environment increases. As rising sea levels threaten our shorelines, increased storm surges and extreme wind events become matters of concern. Declining soil moisture will mean lost agricultural productivity and more frequent drought, pests, and forest fires.

All of these statements represent the consensus of an enormously diverse community of scientists from around the world. At a hearing of the U.S. House of Representatives Energy and Commerce Committee in July 2006, organized to challenge the science of global warming, even the witnesses called to question the science ended up agreeing to these basic findings. And of 928 peer-reviewed articles in scientific journals randomly selected from the thousands that have been published in the last decade, not one questioned these fundamental conclusions.⁸

Like the tobacco industry of the 1960s, which declared, “Doubt is our product,” some in industry have nonetheless continued to stress uncertainty to promote inaction; but questioning the basic fact pattern is no longer acceptable in public debate, and many signs of change are emerging. As an example of how far the conversation has moved, even Shell Oil has come out in favor of managing CO₂ to reduce the threat of global warming, and Exxon has dropped some of its support for groups questioning global warming science.⁹

But the scientific news has not gotten better as the picture has become clearer. The damage predicted is more imminent than it was

considered just three years ago when the world's largest scientific panel ever assembled—the Intergovernmental Panel on Climate Change (IPCC), established by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP)—released its Fourth Assessment Report. “All the new information makes it more ominous. Ice caps are melting faster. Greenland is melting faster. Permafrost is melting faster. Beetles are killing millions of acres of forests—since 2000, we have lost an area the size of Illinois to forest fires—and this wasn't even contemplated. Extreme weather events are accelerating in frequency. Feedback mechanisms like methane escaping melting permafrost were not even considered by the IPCC. It's worse than we thought,” says Joe Romm, whose book *Hell and High Water* ought to make the most sanguine concerned.¹⁰

For example, hardly anyone had heard of the problem of ocean acidification three years ago. Some even proposed pumping CO₂ into the ocean to store it. Now the evidence is conclusive that CO₂ from the atmosphere is entering the water and turning it more acidic. Little ecosystem bombshells like this keep going off as our understanding of the climate grows.

When it comes to responsibility for global warming, not all men are created equal. We Americans are the leaders, unfortunately, in global warming. We are only 4 percent of the world's population, but we emit 23 percent of the world's CO₂.¹¹ On a per person basis, the average American is responsible for close to twenty tons of CO₂ each year, nearly ten times what an average Chinese citizen emits.¹² We must do better, and we must do so urgently. It is literally a matter of survival.

Kissing the Arctic Good-bye

It's not just foreign nations that will suffer. To our north lies a threatened place that holds the key to the world's climate, the Arctic.

What is going to happen to the Arctic, home of the polar bear, the Inupiat people, and countless dreams of adventure? “I think it will all be gone in the next century,” says one who is in a position to know,

Dr. Carol Bitz, professor of atmospheric science at the University of Washington. “It is melting rapidly now, and 80 percent of the summer ice will have disappeared by 2040 and the remaining remnants by 2080.”¹³

After extensive research she knows why as well: “The Arctic is suffering two major blows right now. First, it is absorbing huge amounts of solar radiation because as the ice melts, the dark sea absorbs about five times as much energy as would the white ice. Second, we have now found that as the sea ice retreats, it draws warmer ocean water into the Arctic. Maybe the Arctic could survive one blow, but it cannot survive both.”

Dr. Bitz has spent her professional life creating computer models to predict the consequences of the continued rise of CO₂ on the polar ice cap. To do that, she uses the most powerful computers in the world, including the ones also used by the U.S. Department of Defense to model nuclear explosions. Her team’s report in December 2006, incorporating the latest information and predictions about the Arctic, rocked the world. “We found that the polar ice cap will be essentially gone during the month of September by the year 2040,” she says. Forty years later, it will be completely gone.

The context of Dr. Bitz’s research is even more frightening. Her research was triggered by findings in the Greenland ice core showing enormous changes in world temperatures taking place in extremely small time frames during times past. “We saw swings of 10°F in just a decade or so. This means there are mechanisms in the system that can change the whole world climatic system in the blink of an eye. Given that we are expecting 5° changes just in the next century, this is terrifying news. The whole climate could change overnight in a sense.”

“It’s not just the polar bears who are going to suffer,” she says. “When the polar ice cap melts, so will a lot of people’s expectations of what their lives were to be like.” A World Bank map shows that just a one-meter rise in sea level would inundate half of Bangladesh’s rice land. And rising sea levels could create millions of climate refugees in Asia.¹⁴ Such events could make Hurricane Katrina’s warmup act appear as child’s play.

Dr. Bitz's concern has only grown in the last few years. "The new information keeps coming in with bad news," she says. These projections must be disturbing for the very reason that we know how plastic, how dynamic, the world's climate has been. About 25,000 years ago the upper half of the North American continent was covered with an ice sheet 9,000 to 12,000 feet thick. Dr. Bitz does not mince words. "The polar ice cap is a central factor in the world's climate. When it goes, the whole world is going to change."

The small world of one American community has already turned upside down. For thousands of years, Americans known as the Inupiat have lived by hunting seals on Shishmaref, a barren island five miles off the coast of Alaska's Seward Peninsula. Theirs is a survival on the edge of human existence, sustained through the polar night and unbelievable cold, their metabolisms powered by seal blubber. For eons their village has been protected from winter storms by thick buttresses of pack ice. But in the early 1990s the Inupiat began to notice that the ice was thinning, even becoming slushy. The Inupiat's transportation director, Tony Weyiouanna, describes this as "slush puppy" ice, and says its appearance caused great alarm among the Inupiat. The weakening of the ice cut them off from reaching their hunting grounds and stranded hunters on the seas as they pursued the ringed seal, threatening their very way of life. Describing his reaction when he saw it, Weyiouanna says, "Your hair starts sticking up. Your eyes are wide open. You can't even blink."¹⁵ You can trust him to know his ice; his people have been tuned to ice like a maestro to his violin for centuries and have at least three words for it: *sikuliag*, young ice; *sari*, pack ice; and *tuvag*, land-locked ice.

More important to the survival of the village, the thinning of the buttress of ice began to expose the villagers' homes to the ravages of the surging Arctic sea. Storms began to breach the barriers in the mid 1990s. In 1997 a storm washed away 125 feet of the town, taking with it several homes.

With the protection of the ice wall gone, with the tundra melting beneath their feet and seals becoming impossible to reach, the villagers



The first American homes to be destroyed by global warming have already been lost to the sea in Shishmaref, Alaska.

decided it was time to go. In 2002 they voted 161 to 20 to relocate to the mainland and try to find a way to live there. It was not easy. Many elders felt that away from the sea they would be cut off from a life force that had sustained them. As one elder explained, “It is so lonely.” In December 2006 they chose a site, Tin Creek, thirteen miles south of their present location, for their new home. “We don’t know exactly where the \$180 million will come from to move,” says Tony Weyiouanna, “but we don’t have a choice.” Luci Eningowuk, chairperson of the Shishmaref Erosion and Relocation Coalition, knows the transition will be hard for many but can say only: “Our children need a place to go. Our home is gone.”

The Grapes of Global Warming’s Wrath

Americans far to the south are also feeling the ominous brush of global warming.

Cattle and sheep rancher Ogden Driskill is owner of the Camp Stool Ranch near the Devil’s Tower in northeastern Wyoming and as

plainspoken and tough minded as any dirt rancher in America. He says, "Something is way out of whack in our climate right now. I've got hundred-year-old oak trees that are dying, maybe because of the drought or maybe because the seasons are all fouled up. Some are in bud right now when it's in the mid-50s in December."¹⁶

Perhaps it seems strange that a cattle rancher would care at all about oak trees, but to Ogden their condition portends troublesome change: "It seems everything is changing, so we have to make management decisions based on that change. We've been in a prolonged drought that is a major problem. It can be worse than the statistics show, too, because even if we get the same amount of rain a year, it will just be coming down in buckets for a day and then nothing for months. That is not usable irrigation. And, sure, we now can have our cattle getting to the grass for two months more a year because it's so warm, but what is that doing to the soil moisture? My friends out in Nebraska are getting killed by these changes. Who needs another dust bowl?"

These are not the rantings of a farmer down at the coffee shop with too much time on his hands. They represent the dirt-level view of a scientific reality. "We are in the century's third-worst drought so far," says Brad Rippee, agricultural meteorologist for the U.S. Department of Agriculture (USDA). "Fifty-five percent of the counties were in drought conditions in 2006. The somewhat marginal soil moisture areas west of a line between Montana and West Texas are at risk."¹⁷

As Driskill points out, the changes in intensity of weather have had a real impact. "The increased incidence of severe weather events, intense precipitation, [and] high winds have made a real difference. Rain falling at huge rates just cannot be absorbed by the soil, so it doesn't help the farmer. A big variability seems to be imbedded into the climate now, so lots of adverse changes are taking place." Corey Moffet, rangeland specialist for the USDA, cannot say these changes are permanent. That is for another agency. But his conclusion is disturbing: "Maybe it's not permanent. Maybe it's a ripple. But I can tell you this, it's changing the whole face of agriculture."¹⁸

For Ogden Driskill it is not an abstract matter. "We're losing species.



Rancher Ogden Driskill sees the impacts of climate changes on his land in Wyoming.

We're losing soil moisture. We're losing way too much. Something needs to change."

Addicted to Oil and Living in Fear

James Woolsey, former director of the CIA, is a worried man. He worries that the threat we face from our dependence on foreign oil could be as dangerous as the threats we faced in the 1960s during the Cold War. He knows that every year we send billions to the very region that sent us 9/11. He knows that the money that financed 9/11 came from oil proceeds. He knows that the amount of fissile material in the world is increasing. He knows that some of that may one day be for sale, or already is. He is entitled to be worried.

In his 2006 State of the Union address, President George W. Bush declared, "America is addicted to oil." This was news coming from a president who once declared, "There's no such thing as being too closely aligned to the oil business."¹⁹ And his admission of our collective national oil addiction is a testament to the depth of the nation's unease

and our current precarious relationship to energy. Americans of all stripes—liberals, conservatives, and Red Sox fans—are uneasy about our reliance on oil.

The United States uses nearly 21 million barrels of oil a day. That amounts to a staggering 25 percent of total global consumption. Of the oil we use, we import over 65 percent, or 13.5 million barrels, each and every day. That number has risen from 37 percent in the 1970s, at the time of the Arab oil embargo, and 58 percent in 2000. Disturbingly, the trend shows no sign of slowing.²⁰ In 2005 alone, the United States sent nearly \$40 billion to the Persian Gulf region to purchase oil, even as we financed a war on terror.²¹

Woolsey is a defense hawk, and he has dedicated his career to tracking threats to American interests. Today he has become something of an evangelist for clean energy as well. As he puts it, "One of the most powerful things about the fight to break our dependence on oil is that it transcends ideology. Across the whole political spectrum, whatever you think about the war in Iraq and what's gone wrong there, or how hard to push Israel and the Palestinians, it is the height of foolishness to be dependent on this part of the world to keep our economy running." In his words, "Allowing 97 percent of our transportation reliance to be dependent on a substance centered in the Persian Gulf is about as irresponsible as a country can get."²²

Even the mere threat of chaos in the Middle East boosts what we pay for energy. It has been estimated that volatility in the oil market has cost the U.S. economy \$7 trillion over the past thirty years.²³ Oil dependence has direct costs to our military, as around the world U.S. forces are engaged in protecting pipelines and refineries from terrorist or insurgent attacks in Iraq, Colombia, Saudi Arabia, and the Republic of Georgia. The Department of Defense has stepped up its arms deliveries and training to forces in Angola and Nigeria. And the U.S. Navy is patrolling the tanker lanes of the Persian Gulf, the Strait of Hormuz, the South China Sea, and the Strait of Malacca.²⁴

And if you don't think the Iraq war is mainly about oil, ask yourself this: if Saddam Hussein had been the bloodthirsty dictator of Swaziland

instead of Iraq, would we have 140,000 American military personnel in that country? Had he not been sitting atop the second-largest pool of crude oil in the world,²⁵ the strategic assessment and decision to go to war would have been very different calculations for U.S. planners.

One thing that keeps Woolsey up at night is the possibility of terrorists flying an airplane into the unique sulfur-cleaning towers near Ras Tanura in northeastern Saudi Arabia. A single attack could take six to seven million barrels of oil a day off the market and require one to two years to fix, sending crude oil prices well above \$100 a barrel for a year or more. The U.S. economy would come down with the towers.

Since democracies tend to befriend other democracies, we have a stake in creating the conditions in which other societies can develop new democratic traditions. But the dominance of oil has retarded the progress of democracy in the Middle East. Tom Friedman has called it the First Law of Petropolitics that “the price of oil and the pace of freedom always move in opposite directions.”²⁶

Woolsey puts it similarly: “Putting oil money in people’s hands allows for very high economic rents and concentrates power in the central government. If you have a mature democracy, this can be balanced, but with authoritarian regimes, dictators, and tribal kingdoms this concentrated power is very dangerous.” It is not a coincidence that of the ten nations with the largest proven oil reserves (the United States is eleventh), only one (Canada) is a true democracy.²⁷ Governments with an independent source of income like oil face little pressure to invest in the skills and social capital of their people. Oil truly breeds a vicious cycle.

But as bad as the threat is today, it is only growing. The United States has nearly five hundred passenger cars for every thousand people; in China there are ten and in India only seven.²⁸ When those countries demand cars, the new demand for oil will squeeze out any cushion left in the oil market. For example, recent labor unrest in Ecuador, a political incident that formerly would have caused little notice in oil markets, contributed to a jump in prices of \$2 a barrel, causing real pain.²⁹

The projected increase in world demand for crude oil will require an increase in world production capability of about 25 million barrels

per day by 2025, a 30 percent increase.³⁰ That is almost the equivalent of three Saudi Arabias, a demand that will be hard to meet. If we do not act now to break our dependence, we are certainly in for more oil shocks.

At What Cost to America and the World?

The problems of oil are not just questions of climate and security. They go to the heart of our economic welfare as well. In 2005 the United States spent the staggering sum of over \$200,000 a minute on foreign oil.³¹ That represents real resources flowing out of the economy. Think what could be done with \$200,000 a minute in domestic investment in American communities. In fact, oil imports represent the largest single contributor to our spiraling national trade deficit, which set a record in 2005 of over \$791 billion and was expected to climb to well over \$850 billion in 2006.³² Over the two-year period from August 2004 to July 2006, the petroleum-related trade deficit accounted for 80 percent of the deepening overall deficit as oil prices climbed.³³ That is not a recipe for a strong economy, and it costs American jobs, while globally, high oil prices have increased poverty in developing countries, wiping out hard-won gains from debt relief.

Ironically, while oil costs our economy so much in both jobs and treasure, the argument against doing something to curb our addiction to oil or fight climate change is that it would be too costly. Changing the course of our energy use is too often presented as an expensive burden on our economy, rather than an opportunity for innovation. The conventional charge when confronted with curbing oil use or moving to carbon-free renewable energy is that workers and the economy would suffer. In effect, we are being asked to choose between putting food on the table for our children today and protecting the welfare of our children tomorrow.

The road to hell is paved not only with good intentions but also with false choices, and this may be one of the falsest choices ever. In the words of United Steel Workers president Leo Gerard, we cannot choose

between jobs and the environment: “We must have both, or we will have neither.”³⁴

The job concerns of Americans are real. America is not only embroiled in a climate crisis and an oil crisis, but we have been hard hit with a jobs crisis as well. This country has lost over three million manufacturing jobs since the year 2000.³⁵ There is a steady exodus of high-value-added production employment, often in areas where our government has put R&D money into the very technologies that are being moved offshore. At the same time, even in the face of an economic recovery, the benefits are not being shared with working Americans. Inflation-adjusted wages are only just getting back to where they were at the start of the economic recovery in 2001,³⁶ and median household incomes have fallen for five years in a row.³⁷ The spoils of a growing economy have not been reaching average people. Too often this economic insecurity is cynically played on to pit jobs against the environment.

The Apollo Energy Project

A new Apollo Project for energy is really a mission to rebuild our economy. Smart energy policy is, in fact, good economic policy. The two are inextricably intertwined. Done right, solving our crises of climate change and oil dependence can create tremendous opportunity for America and the world, not only by avoiding the severe economic harm of climate disruption, but also by driving new investment into local and metropolitan economies, increasing social justice and reducing economic disparity by creating new career ladders and skilled domestic jobs across the economic spectrum.

What energy strategy, then, can build a clean environment, greater national security, and a transformed and growing economy? We have leaders with answers. These men and women can be considered to be in the vanguard of a national movement that will build the new Apollo energy project, even though it as yet has no formal structure, address, or

registration. One is Leo W. Gerard, an untiring advocate for a clean-energy reindustrialization of America, who began his career as an eighteen-year-old worker in a nickel smelter and is now president of the United Steel Workers. Gerard represents people who make not only nickel and steel but also a host of manufactured goods that go into new energy technologies, from utility workers who power our cities to the makers of glass for energy-saving windows and rubber for the tires of our cars, to the producers of fuel cells, wind turbines, and the concrete for modern buildings. Today Gerard is organizing aggressively around clean-energy job growth for good reason.

Gerard placed his bets early on clean energy, and it's paying off. He worked closely with Pennsylvania governor Ed Rendell to pass the Alternative Energy Portfolio Standard, which created a large market for wind energy and brought the wind energy company Gamesa to Pennsylvania. Today Gamesa is working on building its fourth facility to manufacture components for massive wind turbines in the United States. The first plant is already making windmill blades the size of the wings of a 727. To complete the poetic justice of the enterprise, three Gamesa facilities occupy the sprawling site of a closed Bethlehem Steel plant.

What started as a clean-energy policy for Pennsylvania now means seven hundred new high-skill union manufacturing jobs with family-supporting wages and benefits for workers at Gamesa. For Dave Moore, a union steel worker at the new Fairless Hills plant, it means one very important job—his own—manufacturing wind turbines in the same plant where his father once rolled steel. For Gerard, this is just the beginning. To come are new industrial dynamos and literally millions of jobs in building solar thermal plants to produce electricity, manufacturing hybrid drive trains for a new generation of cars, and developing a whole new “smart” grid system to save energy and enable renewable energy production. This is not about sacrifice; it is about economic growth, productivity, and investment.

The connection between clean-energy systems and a growing economy is a direct one. We can take money that would otherwise flow to foreign emirates and invest those same dollars in local jobs. We can

reduce harms to public health and the global commons by investing in skills, technology, and productive infrastructure.

A clean-energy revolution represents the jobs of the future.

What some in Washington have fought as they beat back efforts to solve the climate crisis or wean ourselves from oil, the investment community has begun to recognize as valuable. In the past three years, renewable energy investments have nearly doubled, and between 1995 and 2005 they increased their value six times, from \$6.4 billion to \$39 billion. Over that ten-year period cumulative investment was nearly \$180 billion.³⁸ In 2006 alone, more than \$7 billion was invested in wind energy and biofuels.³⁹

But this growth is a drop in the bucket compared to our potential, and to our need. U.S. consumers spend over \$500 billion a year on energy, and the figure has been rising each year for decades.⁴⁰

We need a crash national program. Princeton scientists Stephen Pacala and Robert Socolow estimate that to realize the potential of renewables to address our climate challenge, wind energy generation will have to increase to fifty times current levels, and solar installations must rise to sixty times the current rate of deployment. When a project to retool our society to rely on clean and renewable energy is finally developed, the capital flows will be both massive and transformative of our economy and our communities.

The Apollo Alliance, a national coalition of business, environmental, labor, and community groups dedicated to promoting clean-energy jobs, conducted a detailed economic analysis of the potential benefits of a crash program of investment in alternative energy. They found that investing \$30 billion per year for ten years would add more than 3.3 million jobs to the economy, stimulate \$1.4 trillion in new gross domestic product, and add \$953 billion in personal income and \$323.9 billion in retail sales, all while generating \$284 billion in net energy cost savings.⁴¹

Separate studies by the RAND Corporation and the University of Tennessee found that producing 25 percent of all American energy—fuel and electricity—from renewables by the year 2025, the goal of the “25×’25” coalition of farm-based clean-energy advocates, would

produce \$700 billion of new economic activity and five million new jobs, all while reducing carbon emissions by one billion tons.⁴² In 2005, the U.S. ethanol industry alone created nearly 154,000 jobs throughout the U.S. economy and generated \$5.7 billion in new household income.⁴³

The jobs that come from the shift to clean and renewable energy are concentrated in manufacturing, construction, and skilled facilities operations. These are jobs for electricians, carpenters, pipe fitters, laborers, designers, engineers, and refinery and utility workers. They are grounded in communities and hard to outsource. They are good jobs that rely on highly skilled workers and offer family-supporting wages and benefits.

According to a study by the California Public Interest Research Group, renewable energy generates four times the number of jobs per megawatt of installed capacity as natural gas does. This makes sense, because the cost of obtaining electricity from natural gas is largely driven by the cost of fuel, while the cost of renewable energy is driven by the costs of capital investment and skilled labor. The Renewable Energy Policy Project finds similarly that renewables create 40 percent more jobs per dollar of investment compared with coal-fired plants. Energy efficiency likewise redirects capital flows away from energy imports and waste and into high-quality local construction and operations, creating good jobs in the process.

Increasingly, across the country, from Oakland, California, to the South Bronx, community activists are finding that these “green-collar jobs” can have a role in redistributing wealth and opportunity to those who have been passed by in previous economic booms. These efforts are putting in place policies that encourage community hiring and the right to organize, invest in local manufacturing, and encourage new career ladders through links to apprenticeship programs and training for clean-energy jobs like energy-efficiency and weatherization retrofits and solar panel installation. At the same time, major public pension funds like that of the California Public Employees’ Retirement System, with \$190 billion in assets in 2005, and other socially responsible in-

vestors are putting money into clean technology and finding that the new energy economy meets their social and environmental goals even as it makes a profit for their bottom line.

Even if an overhaul of our energy economy didn't throw off these vast economic benefits, it would be worth doing, if only because it can help us avoid the shock to our economic system that climate change will bring.

In the fall of 2006 the head of the UK's Government Economics Service, Sir Nicholas Stern, released a seminal report that put hard numbers to the question of how climate change will affect the economy. Unlike many past studies on the issue, it did not make the baseless assumption that inaction on climate change has no cost. While some have taken issue with the precise analytical methods and how costs were measured, this report finally compared the costs of preventing climate change to the likely negative economic and social impacts of a warming planet and chaotic environment. It did not minimize the difficulty of the path ahead, stating, "Climate change presents a unique challenge for economics. It is the greatest and widest-ranging market failure ever seen."⁴⁴

The startling finding of the Stern report is that far from being a death knell for the economy, compared to the costs of inaction, dealing with climate change will provide substantial benefits to the economy. "Mitigation—taking strong action to reduce emissions—must be viewed as an investment, a cost incurred now and in the coming few decades to avoid the risks of very severe consequences in the future. If these investments are made wisely, the costs will be manageable, and there will be a wide range of opportunities for growth and development along the way," says the report.

The report concludes that a 5 to 20 percent loss of economic output globally could occur due to global warming. These findings are staggering. Yet for an investment of only 1 percent of GDP we can head off those costs. Put simply, we have the opportunity to make low-cost and economically productive investments now in new technology that yields substantial benefits, instead of accepting a much larger reduction

in our overall prosperity through such real costs as lost agricultural productivity and increased harm to human health. The stakes couldn't be higher.

This basic finding has been echoed in recent reports by the Intergovernmental Panel on Climate Change that support the economic value of investing in climate solutions. In the same time period as the Stern report, the International Energy Agency (IEA) released findings of its own that underscored the Stern report findings. The executive director of the IEA, Claude Mandil, states succinctly, "The energy future we are facing today, based on projections of current trends, is dirty, insecure and expensive. But it also shows how new government policies can create an alternative energy future which is clean, clever and competitive. . . ." ⁴⁵ Enough said.

It won't be the first time we've changed the way we power our economy. We once relied heavily on whale oil for light and wood and coal for heat. We moved from gas light to electricity, and in modern times we made the shift to reliance on oil for transportation. A young Winston Churchill famously made the strategic shift from coal to crude oil from Persia to fuel the Royal Navy, and in so doing positioned England to win the First World War by offering greater speed and flexibility. "Mastery itself was the prize of the venture," ⁴⁶ Churchill later said of that idea. Now "Mastery of clean energy" should be our war cry. We can enjoy a rebirth of high-tech manufacturing in clean energy, or we can sit and watch steel mills rust. The choice is ours.

We are about to meet some Americans who opt for action. And one who is still waiting.