

Oil Depletion and the Fate of the World

A Synopsis of Richard Heinberg's
book: *The Party's Over: Oil, War
and the Fate of Industrial Societies*

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1. INTRODUCTION

The world is about to change dramatically and forever as the result of oil depletion. Within the next few years global production of oil will peak. Thereafter, even with a switch to alternative energy sources, industrial societies will increasingly have less energy available to do all the things necessary for our existence.

When Mike Bowlin, chairman of ARCO, said in 1999 that, “We’ve embarked on the beginning of the last days of the age of oil,” he was voicing a truth that many others in the petroleum industry knew but dared not utter. Among experts in the field there is no question that the era of petroleum-based industrial society will be coming to an end within the lifetimes of most people now alive.

The ramifications of this fact are simply staggering. Oil not only powers our cars, trucks, trains and airplanes, it is essential to virtually every aspect of our material existence in the Western world. Fossil fuels, including natural gas and coal (which will also be harder to extract as time goes on), are by far the main source of energy for the factories which produce all the material goods we use every day, for the electricity that powers our cities and homes, for the heat we need to survive the winters, and for our current system of corporate agriculture that puts food on our tables—in short, for everything that sustains our modern world.

The transition to a post-petroleum world will be more or less catastrophic depending on our society’s decisions over the next few decades. What those decisions should be is one of the main topics of *The Party's Over: Oil, War and the Fate of Industrial Societies* by Richard Heinberg, faculty member of New College of California in Santa Rosa, CA. Every statement in this booklet (and much more) is explained, amplified and documented in *The Party's Over*, available from New Society Publishers at www.newsociety.com, through your local bookstore, or by writing New Society Publishers, P.O. Box 189, Gabriola Island, BC, Canada V0R 1X0. To support Post Carbon Institute, buy *The Party's Over* at <http://store.postcarbon.org>.

2. SOME BACKGROUND

Oil has been the cheapest and most convenient energy resource ever discovered by humans. During the past two centuries, people in industrial nations accustomed themselves to having more fossil-fuel energy available each year. During this same two hundred year period, our global population soared from 1 billion to over 6 billion people, largely as a consequence of this energy windfall and (among other things) the increased food production it allowed.

Industrial nations also came to rely on an economic system built on the assumption that growth is normal and necessary and that it can go on forever. In the decades following the peak of world oil production, however, that assumption will come crashing down.

We are about to enter a new era in which each year less net energy will be available to humankind, regardless of our efforts or choices. The only significant choice we will have will be how to reduce energy useage and make the transition to renewable alternatives.

Are we preparing for this historic transition? Of course not, largely because politicians won't jeopardise their careers (and corporate leaders won't jeopardise their companies' stock prices) by confronting this issue head on. Without pressure from us, the people of the world, the odds of averting catastrophe are not good. This booklet, and Richard Heinberg's book, will give you the tools you need to become an advocate for a rational transition to a post-petroleum world.

3. HOW DO WE KNOW THAT OIL WILL PEAK SOON?

In the lower 48 states, U.S. oil *discoveries* peaked in the 1930s. The trend since then is that less and less new oil is discovered each decade. Forty years later, U.S. oil *production* peaked in 1970 and we have had to import more and more oil almost every year since then.

World oil discoveries peaked in the 1960s. We now consume four barrels of oil for every new barrel that is discovered. Logically that would lead to the conclusion that world oil production is probably due to peak within the next few years, i.e. 40 years after the peak in oil discoveries.

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Even Exxon-Mobil recently stated that, due to depletion, it will be necessary to replace 80% of current production with new fields by 2015. In other words, we need to find four new Saudi Arabias in the next 11 years just in order to keep oil production flat. And, as you can see below, the discovery trend of new oil fields is down, down, down.

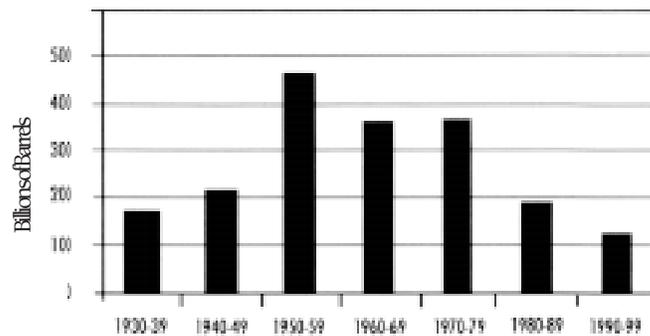


Figure 13. Oil discoveries by decade, in billions of barrels. (Source: C.J. Campbell)

On the next page we see a graph of world oil production with the worst, best, and mean-case scenarios for the next few decades. As you can tell, the era of cheap energy from oil is coming to an end—it's only a question of *when* that will happen, not *if* it will happen.

(Please see *The Party's Over*, pages 81-121, for a thorough discussion of the evidence available on this crucial question, including an effective debunking of the claim that world oil reserves dramatically increased in the 1980s.)

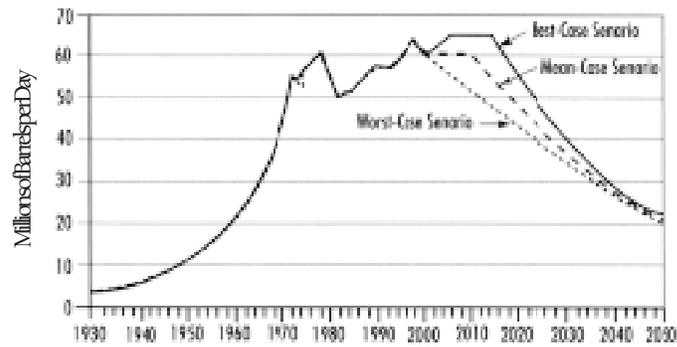


Figure 7. World oil production 1930-2050; best, worst, and mean cases scenarios, in millions of barrels per day. (Source: C.J. Campbell)

4. CAN THE PARTY CONTINUE?

Clearly, we will need to find substitutes for oil. Below are short discussions of the main alternatives that are available. For a much more thorough discussion of each of these options, please see Chapter Four of Richard Heinberg's *The Party's Over*.

Nuclear Power - Since its inception, nuclear power has been dogged by the unsolved problem of radioactive waste disposal. It is also by far the most expensive conventional energy source—if you take into account all the costs of uranium mining, plant construction and maintenance, plant decommissioning, and waste storage. In addition to the cost, the ratio of the total amount of energy returned on energy invested (EROEI) is fairly low—nothing like the 100 to 1 ratio of petroleum in its heyday.

Scaling up the production of electricity from nuclear power would be slow and costly. Just to replace current electricity

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generated by oil and natural gas in the U.S. would take about 50 new nuclear power plants, and this would do nothing to replace losses of energy to transportation and agriculture as oil becomes scarcer. In short, nuclear power is not a good bet to make up for the declining quantity of energy from fossil fuels in the coming decades.

Natural Gas - Conventional natural gas depletion can follow the same sort of curve that we've seen for petroleum, with the peak of North American extraction already in the past.

In the decade from 1977 to 1987, 9000 new gas fields were discovered, but the following decade from 1987 to 1997 yielded only 2500 new fields. This general downward trend is continuing, despite strenuous efforts on the part of the industry. New fields are themselves being depleted much faster than oil fields. World natural gas production may also peak within about twenty years; however, natural gas is difficult and expensive to ship long distances, so we North Americans will not be able to rely much on gas from overseas sources.

For a through discussion of the natural gas issue, please read Julian Darley's book, *High Noon For Natural Gas: The Next Energy Crisis* (Chelsea Green).

Coal - There is still a lot of coal remaining in the U.S., but its inefficiency, pollution, and declining net energy yield casts a pall on prospects for the increased use of coal to replace dwindling oil supplies. Likewise for synthetic liquid fuels derived from coal, whose net energy yields are already extremely low and will only decline further when the net energy from coal itself decreases as extraction becomes more difficult over time.

This is because the easy-to-get coal is mostly gone. Going back to traditional underground coal mining (as opposed to current open-pit mining) to supply America's energy needs would mean greatly increased pollution, acid rain, dangerous and unpleasant work for a growing army of coal miners, and dwindling net energy gained in the process as time goes on.

Hydrogen - Useable hydrogen has to be manufactured from hydrocarbon sources, such as natural gas or coal, or else extracted from water through electrolysis. The big problem is that the process of hydrogen production always uses more energy than the resulting hydrogen will yield. Hydrogen is thus not an energy source at all, but rather an energy carrier.

In that capacity, it may very well be used in the future to run a small proportion of our automobile fleet, but it will not solve the underlying problem of fossil-fuel depletion.

Ethanol - Cornell University professor David Pimentel performed a thorough net-energy analysis of ethanol and found that an acre of corn ultimately yields, on average, 328 gallons of ethanol. It currently takes 130 gallons of fossil fuels to plant, grow, and harvest this quantity of corn; with processing factored in, the exercise results in a 41% net loss of energy.

A recent USDA study came to a more optimistic conclusion: it claims that ethanol gives a 34% energy profit. But, in either case, if the entire U.S. automobile fleet were to run on pure ethanol, nearly all of the continental U.S. would be required to grow the feedstock. There would be no land left over even to house the American population, let alone feed it.

Oil Shale and Tar Sands - Efforts to develop an oil shale industry date back nearly 90 years, and so far all attempts have failed. Walter Youngquist sums up the situation well: "Adding up the water supply problem, the enormous scale of the mining which would be needed, the low, at best, net energy return, and the huge waste disposal problem, it is evident that oil shale is unlikely to yield any very significant amount of oil, as compared with the huge amounts of conventional oil now being used."

Canada's tar sands are a better bet, but again the energy profit ratio is low, the environmental costs are high, and the production process cannot be scaled up arbitrarily.

Wind Power - Wind power is a limited, but renewable energy resource. Currently about one percent of U.S. electricity is generated by wind-driven turbines. Wind-turbine technology is rapidly advancing, leading to lower costs per kilowatt-hour, which are now competitive with fossil fuel sources, and will be even more so in the future as fossil fuels become more expensive, due to dwindling reserves.

The National Renewable Energy Laboratory estimated in 1993 that the U.S. could produce 15% of its energy needs from wind power. Recent technological advances since then could raise that number to as high as 60%. However, the realization of that potential will require huge investments for both turbines and new transmission lines. Our policymakers

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need to be pressured to oversee a significant reallocation of economic resources towards this clean and renewable source of electrical energy.

Please keep in mind, however, that electricity generation is not well-suited to the powering of our current transportation and agricultural infrastructure, and the rebuilding of that infrastructure is itself a gargantuan task in both economic and energy terms.

Solar Power - Solar power too is clean, renewable, and essential to our energy future; but at a cost of \$.11-.15 per kilowatt-hour, photovoltaic electricity is still expensive. Due to increased economies of scale and new solar technology, however, the cost of solar power will go down in the future-at the same time as the cost of fossil fuel electricity will go up. It must also be noted that pollution is caused during the production and disposal of the solar cells.

Conservation - Two more sources of softening the impact of fossil-fuel depletion are *curtailment* (simply using less energy resources) and energy *efficiency*—both coming under the general term conservation. Here we, as individuals, have some power to make a difference. Turning off lights and electronic devices when not in use, buying energy-efficient cars and appliances, and supporting environmentally-conscious companies are just a few of the things we can all do.

Increasing the efficiency of current home energy use and industrial processes is a good thing, but it is subject to the law of diminishing returns and is no overall panacea. Our guess is that eventually the curtailment of a substantial portion of our current non-essential economic activity will probably be necessary.

5. WHAT THE FUTURE HOLDS

What are the predictable consequences of the coming end of "the age of oil" if this long-range problem continues to be ignored?

The Economy - The most likely consequence of ignoring the finite nature of our energy base will be that everything will get increasingly expensive as the energy to create it gets scarcer. Thus, the poor will feel the initial pains of the coming

transition first and hardest. This will be true both nationally and internationally. And the ranks of the poor will swell as the contraction of economic activity will force more and more people out of work.

Transportation - As the economy shrinks, car ownership and air travel will increasingly become luxuries, and road building and repair will slow down and eventually cease altogether. Countries with good public transportation will be much better poised than the U.S. to weather the energy transition. The construction of mass-transit systems itself requires a sizeable energy investment and there is currently no sign of that occurring here in the U.S.

Even more serious consequences of reduced transportation will be felt in disruptions in the distribution of goods. As fuel for transportation gets scarcer and more expensive, we will see an inevitable return to local production for local consumption. But this process of Global Relocalization will not be without difficulty, since local manufacturing has often been destroyed by the building of the global economy. For example, no large shoe companies continue to manufacture their products in the U.S. Unfortunately, the rebuilding of local manufacturing infrastructure will be problematic with less energy available.

Food and Agriculture - Throughout the 20th century, food production expanded dramatically in country after country, and virtually all of this increase was directly or indirectly attributable to energy inputs. Overall, global food production approximately tripled during the last one hundred years, which has allowed an equal increase in world population.

Traditional forms of agriculture produced a small solar energy surplus: each pound of food contained somewhat more stored energy from sunlight than humans and their animals had to expend in growing it.

Today, between four and several hundred times the energy stored in the food is typically expended in growing, packaging, and transporting it. This is because modern industrial agriculture is very energy intensive—from the diesel fuel consumed by large agribusiness machinery; to the industrial production of nitrogen fertilizers, pesticides and herbicides; to the 1300 miles in transportation that the average food item travels to get to your dinner table; to the energy invested in packaging and then cooking the meal. This energy deficit can only be maintained because of the availability of cheap fossil fuels, a temporary gift from the Earth's geologic past. The ramifications of this fact are enormous and well worth pondering.

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Population - The greatly increased population of the planet in the last 150 years (from 1 billion to over 6 billion people) has been possible, in large part, because of our fossil-fuels based industrial system—a system which has greatly increased world food production, provided modern health care to most of the world, and allowed the transportation of goods needed to support that increased population.

Once that “free ride” has ended, the odds of the carrying capacity of the Earth remaining at its current level are not good. If the needed reduction in population does not take place through voluntary programs of birth control, then it will probably come about as a result of famine, plagues and wars—the traditional means by which human populations have been culled when they temporarily exceeded the carrying capacity of their environments.

Overview - As Richard Heinberg writes in the Foreword to Julian Darley's book, *High Noon For Natural Gas*, “Simply searching for substitute energy sources will not be sufficient. We are too many people extracting too many resources, too quickly, from a finite planet. We must learn to use much less of virtually everything. Yes, we should find alternative energy sources—ones that are renewable and as environmentally benign as possible. But if we assume that we can do so and then continue on as we are now, we are in for a series of rude surprises. Today the declining resources are oil and natural gas; tomorrow they will be fresh water, copper, lead, phosphates, fish, and topsoil. Fossil fuel depletion is merely one of nature's first wake-up bells, letting us know that industrialism as we have been pursuing it is fundamentally unsustainable.”

This sentiment is echoed by Cal Tech physics professor David Goodstein in his recent book *Out Of Gas*, “Civilization as we know it will come to an end sometime in this century unless we can find a way to live without fossil fuels.”

6. TWO PATHS TO THE FUTURE

As Jimmy Carter wrote during his presidency, “We must face the prospect of changing our basic ways of living. This change will either be made on our own initiative in a planned way or forced on us with chaos and suffering by the inexorable laws of nature.”

Thus, there are two basic paths our society could take in response to the coming energy crisis. One, the path of denial,

is currently practiced by our political and corporate leaders here in the U.S. As energy from fossil fuels starts to decline, the people in control of our political and economic systems will take increasingly desperate measures to keep their hold on power and to keep the privileged lifestyle of their social class intact.

They will step up repression of dissent and will wage war on any country that might have resources they want. They will blame “terrorists,” “foreign enemies,” and “liberals” for our mounting problems and will increasingly erode our constitutional rights, a process that is already underway. They will call for an increased reliance on nuclear power, coal, and other non-renewable energy sources to keep society running—with the predictable consequences of nuclear accidents, greatly increased pollution, endless military adventures, global warming disasters, and the wasting of an immense amount of capital on non-solutions like the hydrogen economy.

They will try to convince you that our American lifestyle is non-negotiable, when the reality is that it is non-sustainable. Theirs is the path of war, environmental degradation, and ultimately the collapse of our industrial society.

A second way, the rational path, is also possible but it will entail educating our fellow citizens to the dangers that lie ahead, and getting rid of our current corporate-controlled politicians in favor of environmentally-conscious leaders who will work in the best interests of society as a whole. Thus, political organizing and education remain the keys to a viable future.

If there is any solution to industrial societies’ approaching energy crisis, renewables plus conservation will provide it. The rational path would require shifting investment from non-essential sectors of the economy (such as the military) toward energy research, conservation, and massive investments in renewable energy alternatives.

Those alternatives, however, will be unable to support our current profligate lifestyle here in the U.S. and would require the wholesale revamping of our housing, transportation, and food production systems. The end result would have to be an energy-conserving society that is less mobile, more localized, and more materially modest.

At the same time, our society could become more humane, more community-oriented, less frenzied, and with more concern for the common good than is now the norm. We feel that the coming energy crises may actually present us with a chance to bring out the best in who we are, instead of the “me first” attitude that is fostered in our increasingly dog-eat-dog world.

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7. WHAT WE CAN DO

As we lead the way forward on the path of reason, there is much that can be done to mitigate the worst of the likely impacts of the coming energy crunch.

You, Your Home and Your Family - As an individual, there is much you can do to prepare for the coming energy transition:

- Begin by assessing your current energy usage, then decide what are essential and what is not. Gradually and deliberately reduce your non-essential usage.
- Consider equipping your home and/or business with a renewable energy source. There are federal subsidies for businesses and some states have considerable subsidies for installing solar panels.
- If you are thinking of building a new home or remodeling your existing one, consider using ecological design principles and natural or recycled materials.
- Reduce your debt. Don’t buy what you don’t absolutely need. Learn basic maintenance and repair skills.
- Grow as much of your own food as you can. Buy directly from farmers whenever possible, e.g. by shopping at your local farmer’s market, if one exists.
- Eat lower down the food chain, as close to vegetarian as possible.
- Consider the possibility of becoming car-free. Drive only when necessary and walk, use mass transit, carpool or ride a bicycle whenever feasible.
- Consider organizing or hosting a screening of the new film *The End of Suburbia*, <http://eos.postcarbon.org>
- Start a community group focused on these issues.

Your Community - During the energy downslope, true individual and family security will come only with community solidarity and interdependence. Community gardens, supporting local businesses instead of “big box” corporations, creating public power systems where the consumers control energy decisions, encouraging local public transportation, creating intentional communities, becoming involved with local politics, and working towards the goal of energy and food independence for your community—these are all avenues for positive action at a local level.

The Nation - However, most of the legal and economic structures that will prevent industrial societies from adjusting to the coming energy decline exist at the national level.

Policymakers cannot simply wait for the price of nonrenewable energy sources to rise and that of renewables to fall, so that the market itself automatically effects the transition. It will take decades to rebuild the national energy infrastructure, and price signals from the dwindling of fossil fuels will appear far too late to be of much help. But even at this late date, a truly heroic national effort towards developing renewables could succeed in substantially reducing social chaos and human suffering in the decades ahead.

The U.S. government should provide generous tax breaks for investment in wind and solar, and subsidies for utilities that switch to renewables. Carbon taxes should be instituted and gradually raised to pay for these transition measures. Big Oil's "depletion allowances" should be ended. Conservation and car efficiency standards should be mandated on a national level.

We need a national food policy that encourages regional self-sufficiency, diversity rather than monocropping, small family farms rather than agribusiness cartels, and organic farming rather than biotech- and petrochemical-based farming. Our government should immediately cease subsidizing highways and airlines and begin investing in more fuel-efficient railway systems.

Numerous other policies should be adopted on a national level, but nothing will happen without pressure from an informed citizenry and the replacement of our current political leaders with people of vision, courage and commitment to the welfare of all.

The World - During the extraordinary period of the peaking and decline of fossil-fuel based industrialism which we are now entering, there must be global regulation mechanisms for a) resource conservation, b) large-scale pollution control, and c) the resolution of conflicts between nations.

The nations of the world should negotiate more global agreements modeled on the Kyoto accord which were designed to reduce greenhouse gases (an accord which the U.S. has refused to ratify, to our shame).

The International Energy Agency could be expanded and empowered to survey, conserve, and allocate energy

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resources in such a way that all nations would have assured (though diminishing) access to them, and that profits from resource exploitation would go toward helping societies with the transition, rather than merely further enriching corporations.

A Positive View of the Future - These suggestions describe a fundamental change of direction for industrial societies—from the larger, faster, and more centralized, to the smaller, slower, and more locally-based; from competition to cooperation; and from boundless growth to self-limitation.

If the rational path is followed, it would lead to a world a century from now with fewer people, using less energy per capita, all of it from renewable sources, while enjoying a quality of life perhaps enviable by the typical industrial urbanite of today. Human inventiveness could be put to the task of expanding artistic satisfaction, creating a more just society, and deepening the spiritual experience of being human—as opposed to the current obsession of our society with material acquisition above all else.

Is such a path just "pie in the sky"? Not necessarily. There are many examples of societies that have adapted well to changing circumstances. After Cuba's oil subsidies from the Soviet Union ceased in 1990, that country's petroleum-based agricultural system became untenable. Cubans went to work and converted their food production to an all-organic, locally-based system and now they feed their people sufficiently without much fossil fuel use at all.

The state of Kerala in India has developed a low-energy, virtually self-sufficient, sustainable economy that does not depend on economic growth. As a consequence, it has a much higher level of well-being, longer life expectancy, and a lower birth-rate than the rest of India. As a result, Keralans will likely be able to weather the downslope of the world energy crisis better than people in the U.S. or Europe.

The U.S. showed some adaptability after the OPEC oil embargo of 1973. The federal government adopted lower highway speed limits, encouraged smaller cars, and increased efficiency standards. As a result, oil consumption actually declined for a few years. Faced with the coming energy crisis, our people are certainly capable of following the rational path, if we have leadership that presents it as a necessity.

What You Can Do Now - The path of reason, however, is not likely to be taken unless there is a concerted effort by informed people of good will. So what can we do to start heading our country in the right direction?

- 1) If you found this booklet to be enlightening, then spread the word to your family and friends. Copies of it are available for \$1.00 each (to cover our printing and postage costs) by sending a donation to Post Carbon Institute, 5807 Fremont St., Oakland, CA 94608. You can also make a donation with a credit card directly through the secure server at <http://store.postcarbon.org>. A PDF version of this booklet can also be found on our website. For more information, please contact celine@postcarbon.org. Please indicate that you would like copies of the booklet along with your donation, and they will be sent to you.
- 2) Buy and read *The Party's Over: Oil, War and the Fate of Industrial Societies* by Richard Heinberg. Subscribe to his monthly Museletter at www.museletter.com.
- 3) Send copies of this booklet to your elected officials at the local, state and national levels. Arrange meetings with your City Council members, State representatives and your members of Congress and Senators. Ask them to read the booklet and address the issues brought up here.
- 4) Send copies of this booklet to your local and national media outlets and then follow up with phone calls asking our news sources to cover this crucial issue.
- 5) Consider joining Post Carbon Institute or other local Sustainability groups. In unity there is strength.
- 6) Read the full text of *The Party's Over and High Noon for Natural Gas*. Ask your local librarian for the books. They can also be purchased at www.postcarbon.org, click on the Bookstore.
- 7) Be kind and work hard for a better world. We need you. Peace.

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THE PARTY'S OVER

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Every statement in this booklet (and much more) is explained, amplified and documented in *The Party's Over*, available from New Society Publishers at www.newsociety.com, through your local bookstore, or by writing New Society Publishers, P.O. Box 189, Gabriola Island, BC, Canada V0R 1X0. Tel: (250) 247-9737.

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