CHAPTER 6

Population and Per Capita Oil Consumption

BACKGROUND

This book joins a growing body of evidence that teaches we are at the peak or broad plateau of maximum world oil extraction. **This precarious ephemeral period in the epoch of recorded human history, itself only a tiny fraction of longer archaeolocal time, signals the end of energy-dependent growth.** Oil and the myriad petroleum-based products we have become so dependent on, in just the last century, are critical and fundamental to our modern lifestyle and all other energy sources. These undeniable facts are further exacerbated by a debt-based financial system, also dependent on continued growth and which cannot function without cheap and abundant energy, specifically oil.

This opening statement is ominous enough, but it does not include the concurrent three-fold explosion of world population also in the last century, a little over one human lifetime. It is totally incomplete to focus only on the contemporary peak and imminent decline of geologically-finite oil while human numbers continue to steadily increase**. The purpose of this Chapter is to develop a quantitative view of the second half of the oil age juxtaposed against various scenarios of continued population growth.** The specifics of peak oil are frequently marginalized or ignored by population activists and visa-versa. Both subjects can be lost in the drum beat of environmentalism, and climate change. Obviously, all are related and extremely complex. The main-stream public hears only confusion and non-quantitative panaceas.

POPULATION GROWTH VS. OIL EXTRACTION

Starting back with Figure 7 in Chapter 4, shown are eight different rates of population growth and possible decline by age and fertility rates ranging from three children by each female (3 cpf) to no children (0 cpf). Contrasted, in heavier lines, are three curves of projected world oil extraction. The basic middle curve "H" is the decline expected for the second half of the oil age and typical of any finite-resource

extraction. This phenomenon for oil extraction is well established as Hubbert's Curve. The area under the "H" curve, beginning in 2012, now at or near peak, has been optimistically justified because of higher oil prices and more expensive extraction technologies.We are led to believe there are 1.3 trillion barrels of remaining oil. This prediction can be substantiated by the fact that **we have already used over one trillion barrels in the first half of the oil age** and the world extraction rate of conventional oil, as shown in Figure 3, has hardly increased since plateauing at 75 million barrels per day (or a billion barrels every thirteen days) in 2005. **In just the last twenty years, about one generation, the world extracted and consumed about half the trillion barrels used so far in the total oil age.**

The suggestion of an imminent end to the oil age is so ominous and alarming there is a strong counter-movement underway to debunk these numbers. Obfuscation has increased by the inclusion of non-conventional oil and other liquid fuels. We will never use the last barrel buried somewhere in the earth, but there is no denying that remaining oil is becoming increasingly expensive to extract, both energy-wise and financially.

Oil extraction

Curves (NO) in Figures 4 and 7 show the net oil available for use, **after steadily-increasing oil (or energy equivalent) input of one percent per year yields even less usable oil output than curve "H."** This is called Energy Returned on Energy Invested (EROEI) and shows a more accurate, but dire picture for the timing and availability of remaining oil in just the next 50 years. The third oil curve in Figure 7 (NO +1/2 trillion barrels) and shown by shaded squares, **gives a one-half trillion additional surplus, benefit of the doubt, to the optimists (energy "experts", politicians, and economists) who argue that improved technology and new discoveries will prove Hubbert grossly wrong.** None of the three curves shows any increase in the annual rate of world oil extraction, thus signaling an end to unprecedented oil-based growth as in the last century. The curves shown are for conventional crude oil and not liquid byproducts of natural gas extraction like "condensates" and natural gas liquids (NGL's). Non-conventional liquids like biofuels and tar-sands oil are not included because of their low EROEI and minimal effect on the conclusions.

Population growth
(new, unique, quantitative methodology, not extrapolations)

After spending much time trying to find, and/or not believing population projections that didn't make sense, I developed my own spread sheets to provide numbers I could trust.

Eight combinations of possible future population projections are shown in Figure 7. They were calculated using the following starting point and ground rules:

1. A "snapshot" of time (shown as 2012) defines the beginning point for each series of calculations.
2. Two demographic profiles are used. They differ by percentage of the total population divided into different age groups sometimes called cohorts. Obviously, if we start with a profile with mostly only young people just entering their reproductive age, there will be a much greater population bulge (total number moving forward) than if the starting profile is made up of only middle aged grand parents and seniors just beginning to die off. For my analysis I picked two different starting profiles; one from world, and one from U.S. census data. The younger demographic profile (ydp) is typical of the world as a whole. The older profile or distribution by age (odp) is for the U.S. To Summarize, the percentage of the total population by average age in each age group (cohort) is as follows and shown in the lower left corner of Figure 7:

	Younger Demographic Profile	Older Demographic Profile
Years 0 to 20	40%	32%
Years 21 to 50	43%	47%
Years 51 to 80	17%	21%

3. The average age at reproduction is 25 years old, that is if each female has only one child (1 cpf) that would be when she is 25. If she has 2 children, one might be at 24, and one would be at 26. Of course, in real life, there will be some females having children in their thirties, but this would be averaged by teen childbirth and the math and the conclusions would not change. Child gender distribution is assumed as 50/50.
4. The average age at death is 80 years old. Some may die at 65 and others at 95. The total, average numbers remaining to be fed until 80 would be the same. The luxury of modern health care leading to unprecedented old age

has been labeled "death control." At this point the crux of this entire population discussion will be emphasized one more time: **We can't simultaneously have both traditional fertility rates and modern old age.** A quantitative law jumps out: **It is numerically impossible for any closed society (no immigration or emigration) with a typical age distribution profile, like the world or even the U.S., to reproduce at a rate greater than an average of one child per female (1 cpf) and avoid increasing population in the near term future, if the members expect to live to be grandparents and great grandparents.**

It is true, and conventional wisdom, that a fertility rate of two children per female (2 cpf) will eventually level off at a "replacement" level. **But, as shown in Figure 7, this would take about fifty years and the final, stable, closed-society population would have increased by thirty percent and not decline thereafter.** We can't live to be old with modern healthcare and adequate food and concurrently have more than one child per female (1 cpf). Each of the increasing populace will be competing for a maxed-out food supply. It's been shown, historically, that it is impossible to support increasing numbers without, at the same time, inevitably degrading the agricultural base (carrying capacity).

History teaches of numerous "crashes," "collapses," and "overshoots." **This is already happening today in large parts of the world while, at the same time, we are leaving the artificial, oil-based energy level that made the excess population possible in the first place.** Our short oil age has facilitated old age in many ways; sharply reduced manual labor, dependable year-round nutrition, improved health care, and reduced infant mortality. We would all like this lifestyle to continue.

5. It should be clearly understood that the above ground rules, conclusions, and methodology hold true **regardless of the original, numerical size of the closed society.** I conveniently selected 7 on the digit scale, beginning at zero, on the left-side "y" axis to represent the world, the largest undeniably-closed society which has presently swelled to over seven billion people. All sub-societies as a part of the finite world must together average to equal the world growth or decline numbers. Some local societies may grow more, some less, but each will have to follow the same methodology. Some, like China, may attempt to take control of their population destiny. Others, like sub-Saharan Africa, will just let nature take its course and, without additional energy and food input from somewhere else, must suffer the inevitable consequences of exceeding their regional carrying capacity.

6. Another reason for using single digits on the "Y" axis is to show world oil extraction in tens of millions of barrels per day on the same graph. This shows clearly how population continues to increase while the temporary, two lifetime (eight-generation total) oil age is about to enter into its second half. All societal subgroups will experience the growing tension (gap) between increasing population and decreasing oil. An idealistic, "localized" community of seven-hundred, or an autonomous nation with seventy-million, even if each has bountiful food resources for their present population, must ultimately respect the same numerical limitations of reproduction.

When times are good, like any species, human population increases to the limits of carrying capacity. The excess numbers begin encroaching on their neighbors or suffer Malthusian "misery." All it takes is a climate event or poor land-use to trigger disaster.

The math

This section is included to show the methodology. **To repeat, the conventional wisdom that a "replacement" fertility between 2 and 2.2 will suffice is dangerously false. (Fast forward to the next section to avoid the details.)**

It is simple, but tedious, to do the numbers using the above ground rules. Examples follow so anyone can verify the population curves shown graphically in Figure 7; or use a different demographic starting profile than the two shown.

Referring to the younger demographic profile (ydp), typical of the world, we see 40% of the total population is in the cohort between 0 and 20 years or 2% per each year. Likewise, there are 43% /30 (divided by 30) or 1.43% each year between the ages twenty-one to fifty, and 17%/30 or 0.57% per year between the ages of fifty-one to eighty. At the end of the first year, each female who reaches 25 gives birth to her only child (1 cpf). Because 1.43% of the population is now 25 years old, the female one-half of this age group (1.43%/2) or **0.72% of the total population will be added as new babies.** For instance, if the closed-society population was 1000, 7.2 new babies would be added.

In this same first year, **0.57% of the population, male and female, would die** leaving a gain of 0.72% minus 0.57 % or a net increase of 0.15%. This does not sound like much, but the significant point is that the **population continues to increase even with a fertility rate of only one child per female (1 cpf).** As this birth minus death rate continues for four more years, the net gain in five years would be 5 times

0.15% or 0.75%. Our hypothetical population of 1000 has now grown in five years to 1007.5 people. If we did similar math for a fertility rate of two children per female, our community of 1000 would grow to 1043 mouths to feed in five years, hardly sustainable with a fixed agricultural base. Similarly, in five years, a world population of 7 billion people will grow by 301 million to 7.3 billion people.

When we enter the sixth year of our model, things get more complex because the original twenty year olds are now reaching the average reproductive age of 25, and there are more of them. At the same time the numbers reaching the average age of 80 are the same as the first five years. Using the younger demographic profile (ydp) typical of the world, there are 40%/20 years or two-percent per year of the total population turning 25 years old. Of these, one-half or one-percent are females. If each female has one child and die-off continues at 0.57% per year, the net gain each year is one minus 0.57 or 0.43% per year. This average pace will continue for the next twenty years until the last original female baby, less than a year old when we started twenty-five years ago, reproduces. At this rate in the next twenty years, population would increase another 20 times 0.43% or 8.6%. Our original hypothetical population of 1000 would add another 86 mouths to feed in addition to the 7.5 increase in the first five years, **for a total increase of 93.5 in twenty-five years, with a fertility rate of only one child per female!** With this model, the starting world population of seven billion will increase to 7.654 billion.

In the 26th year, for the first time, the female babies born in the first year become mothers, and our original mothers become grandmothers. Of the 0.72% of the population born in the year one, only one-half (0.72%/2) or 0.36% are females. If each mother continues the one child per female model, there will only be 0.36% of the population added as new babies while, at the same time, the death rate at 80 is still 0.57 % per year. This contrast finally leads to a negative population growth of 0.36% minus 0.57 % or a negative 0.19%. per year. For the next five years this downward pace will result in a total population reduction of 0.95%. Our original community of 1000, that had grown to a peak of 1093 will now begin to decline by the year thirty to 1084 people. For example, a **world population starting at 7 billion would pass maximum population and then decline to 7.588 billion, but it took thirty years even at only one child per female!**

Conclusion

By now, the mathematical methodology presented should be clear. In the graph (Figure 7) the numbers are continued for 80 years, two different starting age profiles, and five different fertility rates. The conclusions are profound and disturbing.

Any closed community, nation, or world, living near the limits of its diminishing finite resources, specifically, energy and fuels, non-renewable minerals, arable land, and water, cannot reproduce more than one child per female, and simultaneously live to old age without exceeding its carrying capacity. To repeat: a society can't have it both ways! This conclusion may, in a nutshell, be a short history of, and future prediction for, the world including all closed-loop, smaller communities. Constant ignorance and violation of these basic mathematics have repeatedly led to starvation, war, genocide, ecological devastation, infanticide, deprivation, misery, and even cannibalism. The entire world is now entering this tipping point. Unrest in many parts of the world including Africa, the Mid-East and American inner cities are clear manifestations of undeniable mathematics.

PER CAPITA WORLD OIL CONSUMPTION

A simpler, conclusive way to combine the contrast and imminent divergence between increasing population and concurrent declining energy is to divide the total world oil consumption by total world population**. Even one barrel of oil per capita would be completely game-changing in the long history of human and animal muscle power.** A single barrel of oil contains 42 gallons of extremely convenient stored energy. This incredible amount is equivalent to 1,384,000 watt hours or 4.7 million BTU. It would take a human working **continuously** eighteen thousand (!!) hours to generate an equivalent amount of energy. Admittedly, there are efficiency losses in converting the oil-energy to mechanical work or heat, but an oil-powered machine does not need to eat or stop for rest.

A pint or two of equivalent liquid fossil fuel energy would have been utopian to pre-industrial humans. Now we take for granted thousands of gallons a year, for each of us; convenient labor-saving energy but at wildly different rates throughout the world**. The per capita curves in Figure 8 demonstratively show the rise and fall of the oil age in a two-lifetime span of 160 years. There was a little oil before this time span and there will be little left afterwards, so for all practical purposes, the total oil-age will be very short.** Chapter 1 and Figure 1 introduce this per capita analysis, especially the highly-skewed contribution of U.S. gasoline.

The demographic methodology for population momentum shown in Chapter 4, Figure 7 shows that the continuation of a **stable,** per capita oil-energy availability with **any fertility rate greater than zero (0 cpf) cannot coexist with the expected decline in oil extraction … no matter how optimistic the decline might be!** In the following Figure 8, the present world average, per capita extraction and

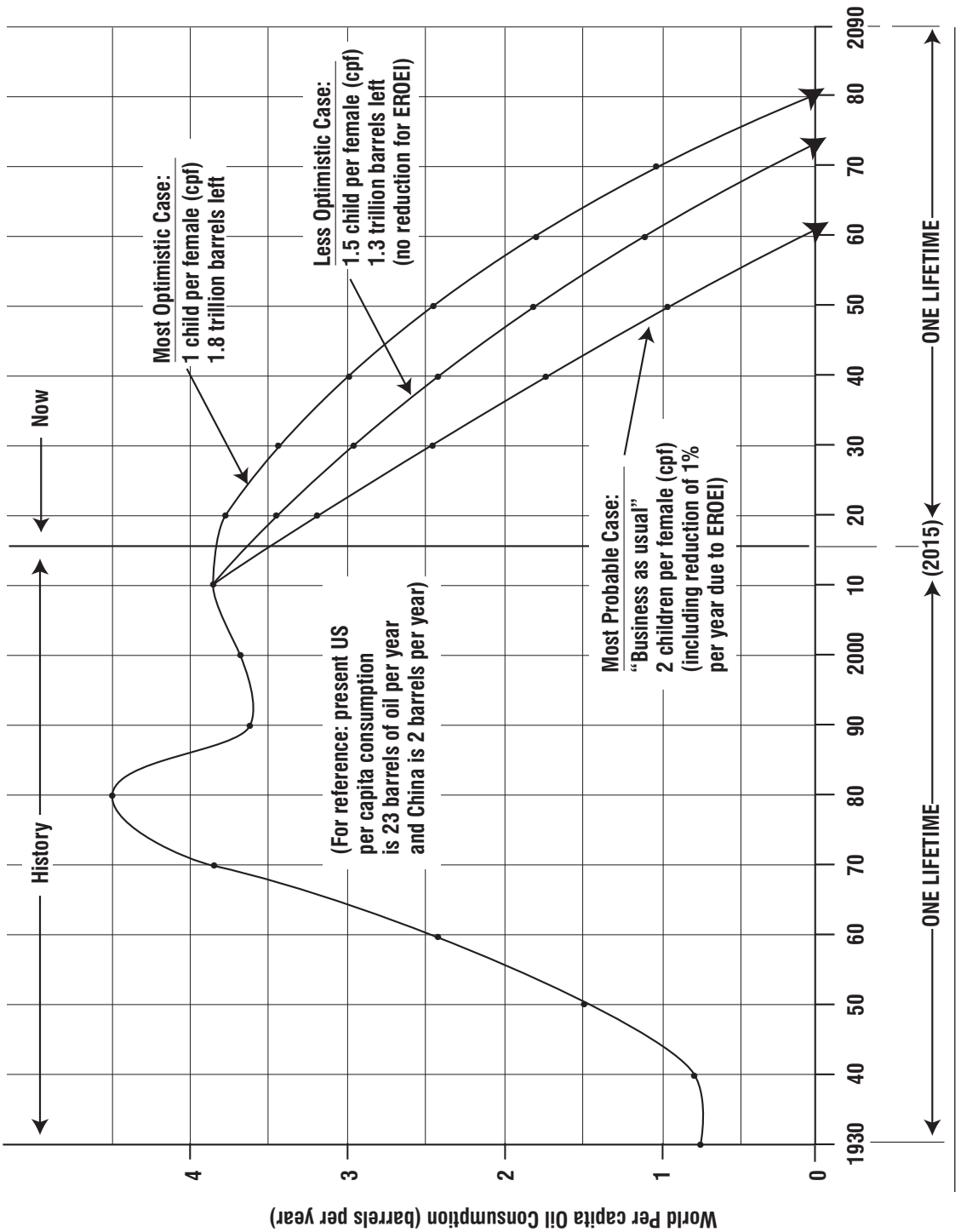

FIGURE 8 Per capita world oil consumption in a two lifetime span

consumption of less than four barrels per year, per human, is beyond peak by over thirty years. Currently the most energy extravagant consumers, led by Americans, each presently use (burn up) over twenty-two barrels of oil per year, six times the world rate. In fact, Americans use about twenty-five percent of the world oil production with only four percent of the population. China is gaining but still uses only twelve percent of world oil with twenty percent of the population for a per capita consumption of two barrels per person per year, about one half the world average shown in Figure 1.

U.S. oil extraction and consumption

Because there is only one world, overall extraction and consumption have to be the same. Therefore the per capita average is simply the ratio between usage and world population. However, as shown in Figure 1, there are gross disparities between different nations that constitute this average. Some parts of the world have achieved exceptional consumption rates typified by the lifestyle we Americans take for granted. The references for the numbers are U.S. census data and the EIA (Energy Information Administration).

The next graph, Figure 9, shows the historic first half and the projected second half of the two-lifetime oil age for the U.S. lower 48 states and Alaska. Also included are U.S. population numbers also reported by the census department prior to 2010 and projected forward using the methodology explained earlier in this chapter. Also, as a subset of the world, we in the U.S. have to deal with immigration and emigration adjustments. The fertility-rate population projections and conclusions would be the same for any autonomous nation**. It makes no difference if the population is immigrant, white, black, religious, rich, poor, republican, or democrat. Everyone has to eat. My analyses are intended to be absolutely apolitical.** There are no reasons why progressive or conservative mathematics are any different. Numbers have no party affiliation.

A most important observation in Figure 9 is that, U.S. extraction did, in fact, peak in 1970 at 3.5 billion barrels per year or 10 million barrels per day. This is about one half the present consumption rate of 19 million barrels per day, down from 20 several years ago. M. King Hubbert was publically derided for predicting the U.S. peak back in the 1950s. But subsequent reality proved the veracity of his techniques which are now the context for prediction of the peak of world oil, and the second half of the oil age with the following provisos:

U.S. oil **extraction has not** exactly followed a mirror-image decline rate as would be simply predicted by a Hubbert's curve. New technology and eight-fold higher

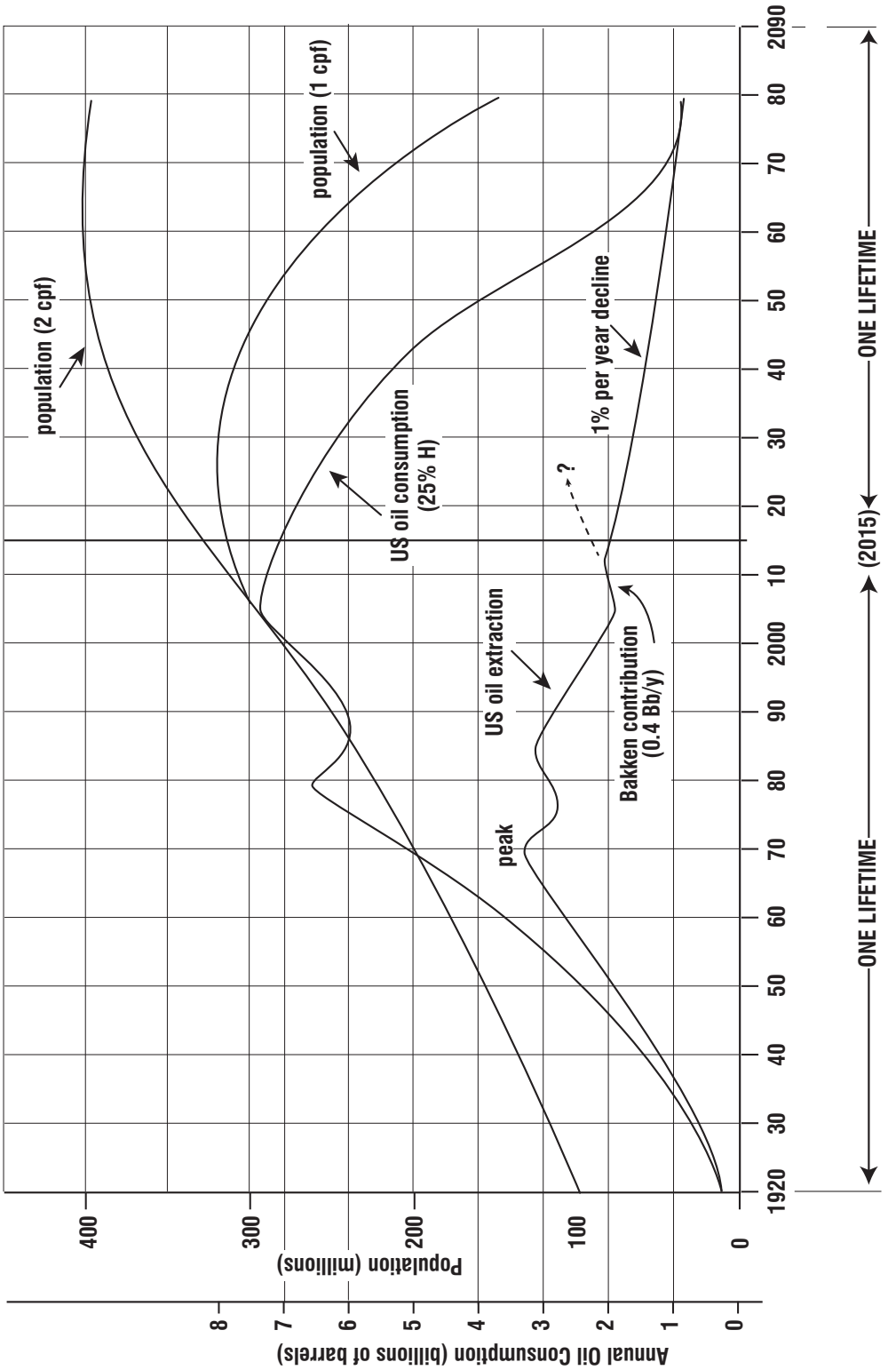

FIGURE 9 United States oil extraction, consumption, and population

prices have eased the decline rate somewhat, but there is no argument that domestic extraction of conventional oil declined by 2005 to half of the 3.3 Bb/y (9 Mb/d) it was at peak. During the rapidly growing period from 1920 to 1970, oil extraction increased by about four-percent per year. After peak in 1970, U.S. oil extraction decreased about one and one-half percent per year. By 2014, U.S. lower 48 states plus Alaska extraction climbed back to 2.5 billion barrels per year or thirty-six percent of our consumption of 7 billion barrels per year.

This is hardly "game changing" or a "revolution" as touted by the "Wizard of Infinite Oil," Daniel Yergen in his February 5, 2013 testimony to the House Energy and Commerce Committee. The legislators and American public do not comprehend the magnitude of these numbers and are led to believe that a resurgence of several million barrels per day will prevent the end of the oil age. In order to give every benefit of the doubt to these optimists, the reduction of future US **extraction** rate is projected (flattened) to one percent per year.

U.S. oil **consumption** (including, but far more than U.S. oil **extraction**) is continued forward in Figure 9 as one-fourth of predicted world consumption. Steadily declining EROEI is not included although oil will continue to become more and more difficult to extract. **Also, in favor of the optimists for non-conventional oil, an additional 300 billion barrels (0.3 trillion) are added beyond that expected in the second half of Hubbert's curve of world extraction.** Continuing forward just 58 years to 2070, U.S. oil consumption would, as one-fourth the world extraction rate, drop below the more-optimistic U.S. extraction decline rate of one percent per year. By that time, total U.S. consumption would have to **decrease by over eighty-five percent** and by then, in less than one lifetime, we either would have taken extreme measures to decrease **both** population and energy consumption or total chaos will have ensued, nationally and world-wide. (See the first four scenarios in Figure 2.)

Figure 9 also shows future U.S. population momentum at one child per female and two children per female using the same methodology (including the eighty-year life span) explained earlier in this chapter. (Present U.S. fertility is 1.86 cpf). **Note again (and again!) that the conventional wisdom of two children per female "replacement rate" further exacerbates our predicament by increasing population thirty percent higher than now, before stabilizing and not dropping.** In the last few years, in rounded numbers, the U.S. annual net increase is four million births **plus** one million immigrants (one-half illegal), **minus** two million deaths, for a net increase of three million per year (4+1-2=3)**. That's 250,000 per month additional jobs and food required just to keep from slipping backwards to more unemployment and economic decline.**

Per capita U.S. consumption

The next graph (Figure 10) combines the extraction, consumption, and population curves developed in Figure 9. At the bottom for reference is the "less optimistic" average world per capita oil consumption for 1.5 children per female. The much higher U.S. consumption of 25% of world oil is projected forward on the same time-line at one and two children per female. Now we can see that 1 child per female gives about a ten year delay before reaching the lower per capita consumption as would be expected with 2 children per female. **The continued attempt to access 25% of world oil ensures we will continue our part in competition for dwindling oil including directly-related foreign presence, geo-politics, territorial conflicts, and deteriorating human-rights.**

We can also see in Figure 10 that if the **U.S. had to depend only on domestic oil (the lower 48 states plus Alaska) for energy, we would already be closer to the four barrels per year current average for the world.** This supports the arguments presented in Part I.

Americans are precariously dependent on foreign oil, including Mexico and Canada, to continue any semblance of our unique energy-intensive lifestyle for a few more years**. A few extra billion barrels from ANWAR, off-shore, or tight "fracked" oil will not change this dire prognosis**. We will soon be forced, whether we like it or not, to sharply reduce our use of oil, especially for non-essential and inefficient transportation. In Chapter 7, the argument is made for coupon gas rationing as the only way to quickly begin an equitable reduction in oil consumption regardless if it comes from domestic or foreign sources.

As the oil age winds down, our food system will be seriously impacted because **it will no longer be possible for one farmer to feed 300 people thousands of miles away.** To repeat the continuing theme of this book, the best we can plan for is that the **U.S. carefully nurtures its remaining oil endowment by drastically reducing consumption, reduce fertility rates, seriously limit immigration, move to local or personal agriculture, and begin immediately to segue to a more expensive (than fossil energy) solar-electric future.** Of course, none of these are likely to happen, let alone all in tandem, without a grass-roots education effort, "It's Up to You." Although the whole subject of transitioning to a post-oil age seems hopeless does not mean it should not be clarified, quantified, and publicized for reference in the near-term future as reality becomes apparent.

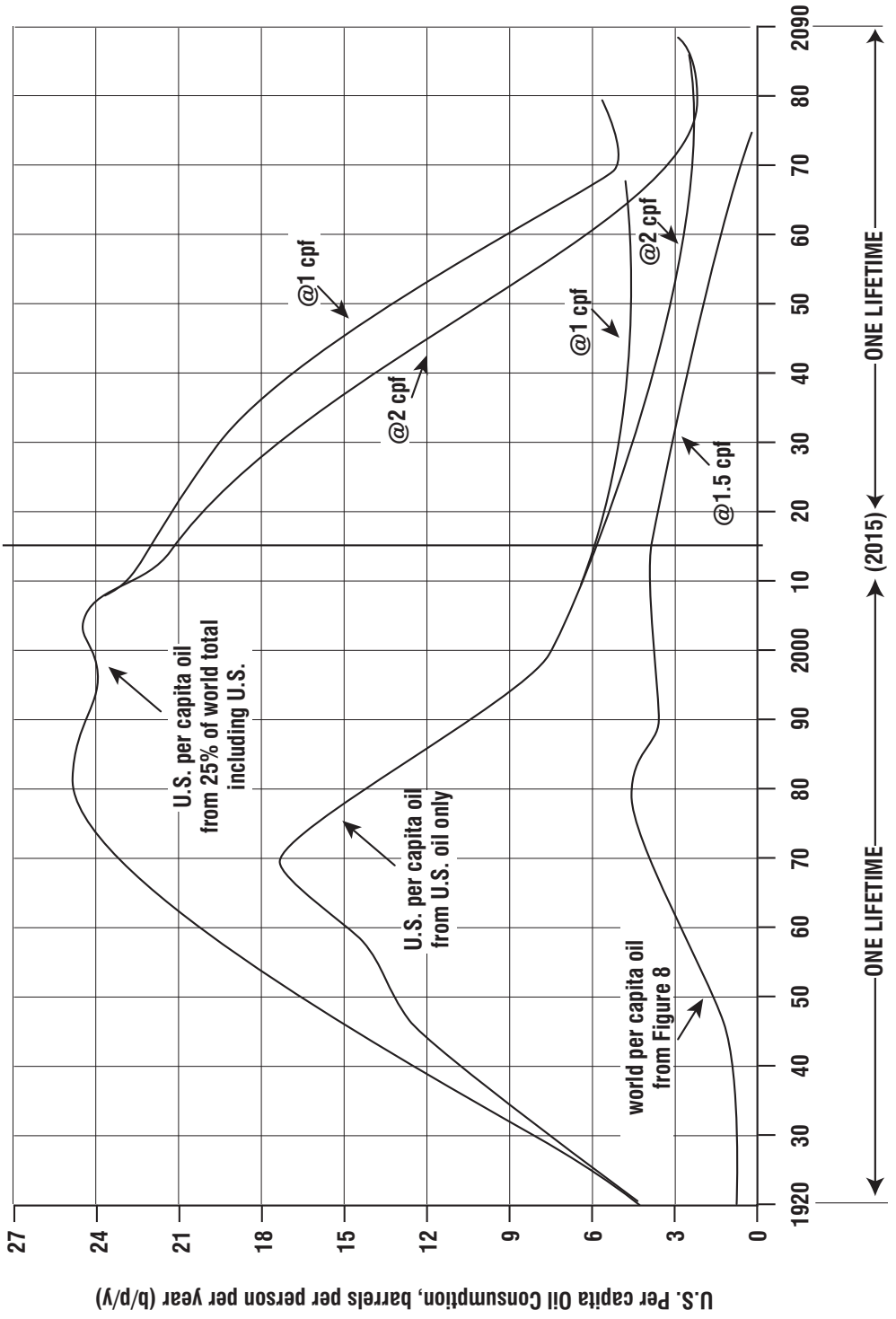

FIGURE 10 United States per capita oil consumption

The only answer

To repeat, it should be clear that the only way Americans could significantly mitigate the end of the oil age beyond one lifetime is to sharply reduce per capita consumption from our present profligate level of twenty-two barrels per person per year to the world average of four as explained in Chapters 1 and 2. This is why the low-energy, solar-electric system described above must quickly extend and overlap waning oil. This is why we must begin to ration oil consumption, starting with gasoline, so everyone has to pitch in. If we were to reduce U.S. per person consumption to the world average of three barrels per person per year, and with our population growth reduced to a fertility rate of 1 child per female, scenarios 5 and 6 in Figure 2 show a U.S. oil age extending between 55 years (still less than the lifetime of a child born today), and possibly much longer. The difference, of course, depends on how much (and at what price) domestic oil remains and how carefully we nurture what's left for our descendants.

THE HISTORY of BIRTH CONTROL and OTHER VOICES

The ultimate societal challenge through the ages has been to control and reduce human reproductive rates to a level commensurate with finite and now-declining energy supplies. This will take massive education, peer pressure, and honest leadership within a closed sovereign national or regional society. Everyone must be involved. Those who are not, only exacerbate the predicament, guaranteeing that all will be dragged down together. For a regional society to succeed in rising above a larger collapsing world civilization, it will also have to be diligent in controlling immigration from envious foreigners.

The bibliography at the end of this book includes many titles specific to population; starting of course, with Thomas Malthus who has been almost forgotten in the last two-hundred years because of new lands, high-tech agriculture, and most significantly, the sudden utilization of fossil fuels.

Modern contemporary authors are Paul Ehrlich who wrote the best seller *The Population Bomb,* and Meadows et. al. *The Limits of Growth*, first published in the seventies. Since then, both these authors were "proven wrong" because the vast potential of the world's finite resources and the technology of the "green revolution" had yet to be fully realized. Now, their voices are ringing true. More recently is the extensive body of work by my good friend and mentor, the late Albert Bartlett summarized in the book *The Essential Exponential.* He has given thousands of lectures throughout the world about the mathematics of population growth. These can be found on youtube.com.

Another contemporary author who integrates both sides of the population-resource equation is Lindsey Grant; *The Collapsing Bubble* and *Too Many People.* He is a contributor to the U.S. non-governmental organization (NGO) Negative Population Growth (npg.org) which focuses directly on the subject. Another U.S. NGO is World Population Balance (worldpopulationbalance.org). I have an older book published in 1980 by M.Bayles *Morality and Population Policy* which raises the obvious question of why we should not have a moral obligation to future generations to leave them a tolerable world-balance of resources and consumers.

From the UK, several of the best references are: *The Rapid Growth of Human Populations* by William Stanton, and *The Growth Illusion* by Richard Douthwaite. Similar work is spearheaded by the Optimum Population Trust (populationmatters.org)

The recently published book *Countdown* by investigative reporter Alan Weisman is an amazingly comprehensive, first-hand, 500 page summary of world population problems.

The only possible way to achieve 1 cpf in a modern free society is with vast education, publicity, and peer pressure. **The public must realize that every child born today will not only compete with everyone else for resources, but their parents will still be here to suffer with them in a world becoming much more difficult.** Isolated bunker mentality will not survive the coming tsunami because of the limitations of localization as discussed in Chapter 9.

Blame the messenger?

I often wonder why I continue this unpleasant mission; but always come back to the conclusion that **our best gift to those already alive is to define how we could extend and possibly supercede the oil age by quantifying the facts and solutions, including fuel rationing and population control.** The weatherman's job is to foretell the future regardless of how unpleasant, so listeners can plan accordingly. We don't blame or ignore the forecaster.

Taboo subjects: sex vs. population?

We are a society saturated with sex. We joke about sex and are constantly bombarded by advertising, clothes, and entertainment in the same mode. **But, we dare not discuss "private", personal decisions that question family planning and more mouths to feed.** The innate desire to mate is one of the most dominant drives of

any species, especially among males. Attracting mates, fleeing from danger, accessing food, and protecting or raiding territories are all genetically "hard-wired" in males for the perpetuation of the species.

Most males have no concern for the numerical outcome or future for the union between thousands of spermatozoa and millions (in the case of fish) female eggs. A few centuries of "modern man" cannot erase eons of successful competitive survival. It takes hundreds of generations for the genetic code to slowly adapt to changing environment, but the basic impetus to mate is always lurking, only recently tempered by the social mores of civilization. This may be why individual or team contact sports from gladiators to football, or violence thrive as entertainment. **They satisfy the basic urge to conquer the other guy and bring home the spoils to a cheering family.** Alternative sports which test individual speed of travel, or compare competence in overcoming natural adversity seem better than beating-up on each other. Modern gun culture may bridge both genetic drives: who is the best individual shooter … inferring the best chance in accessing food, or who can defeat (kill) the other competitor?

We might summarize this line of reasoning with a hypothesis: "higher intelligence" is a prerequisite for population control necessary for a long quality life in a closed society staying within the limits and carrying capacity of its own indigenous fragile resources. The antithesis is "less intelligence"which breeds greater numbers and thus overwhelms the visionaries (and resources) who are striving for long-term sustainability … higher intelligence loses, less intelligence wins, overshoots, and collapses!

In our great wisdom, we neuter our pets and cull our farm animals to restrict population within obvious limits. But now civilization is at the threshold of catastrophe because the decline of fossil-fueled food, and the longer-term context of climate change. There are those who argue that if we all live and eat like marginal third world people, or invent new ways to manipulate agriculture, we will be able to feed the nine billion mouths projected by the UN in 2050. Assuming these alternatives are possible and the crowding is acceptable, what comes after 2050, one half a lifetime from today? Sooner or later, any growing population must respect the limits of earth's finite carrying capacity. If not the result, as Malthus named it, is "misery." We can argue that peak oil, peak food, and *Peak Everything* per Richard Heinberg's book are here, now, but are we ready for "peak sex"?

One child per male

I for one am all for continuing sex, but not population growth. In my opinion, the better way than one child per female (1 cpf) is to switch the gender responsibility for the future of humankind to one child per male (1 cpm). In modern times, the answer is so simple: after his only child, every male gets a (free?) vasectomy. After an hour in the Urologist's office and a couple of days of discomfort, life goes on … without social disruption, abortion, abstinence, frustration, unpredictable birth control, unwanted children, and extra mouths to feed. **In addition, the single child will be the focus of all the love, attention and resources from both of his/her parents in the near-term challenging future.** I bet most forward-thinking females would welcome the idea.

Sounds simple but, like gasoline rationing, the devil is in the details. We still have to respect the traditions of religions as with Amish and Catholics. Will they out populate those making a conscious effort to provide a better life here and now, for us and our descendants? Who is sacrificing what, for whom? Low birth rate is already a fact; nearly down to 1 cpf in some countries like Italy, Japan, and Russia. Can 1 cpm be enforced as by law, peer pressure, or tax credits? The vasectomy can be reversed if the single child dies. At least the topics of 1 cpf and 1 cpm should be openly debated as in China and Japan for thousands of years. The autonomous groups that best resolve the declining-energy, increasing-population paradox will prevail in the coming years.

Scale of implementation

Following are five levels of human living-arrangement from the scale of the entire world of seven billion, down to the individual and/or including the immediate family of, at most, a few dozen people. I've listed my opinions regarding the chance of success for each to survive the population-resource challenges we face:

1. **World (global): There is no hope for the world with more than seven billion humans to reach and enforce any mutual agreements regarding resources and population.** There are far too many differences in religion, culture, proximity to each other, natural resources, language, and wealth... all interacting with the innate tendencies for procreation, survival, and greed. Suggested reference: Dawkins, *The Selfish Gene*. Attempts to prove otherwise like the U.N. are tentative and ineffective. Wars are the results of disagreements and differences. **A world-wide plan for rationing** or *Depletion*

Protocol (see the book by that name by Richard Heinberg) offers little hope for bridging disparate international interests.

2. **NATIONAL: Individual, autonomous nations like the U.S., or several with close cultural, resource, and language ties, are best suited to survive a post-peak-oil future.** The U.S. combined with Mexico and Canada would fit this category. They are large enough to have substantial natural resources, shared national security, food supply, crop diversity, complex manufacturing, and resilience to climate change. Each could ration critical resources with or without broad international cooperation. Singular nations, or close coalitions will have to defend their sovereign borders within common topography to control immigration. They have a better chance to integrate the knowledge, resolve, and support of the majority of their populace behind effective or common leadership. Physically, this intermediate size will be better prepared to survive a low-energy future especially with sharply curtailed travel and long-distance trade.

3. **REGIONAL OR STATE: Smaller segments of a national level have less chance to survive alone.** Although they overlap in history, language, inter-family relationships and closer travel; they are too small to be energy, regional weather, high-tech product, and food independent. Borders cannot be defined or defended. To do so would limit the flow of goods and people, usually with common goals and traditions.

4. **LOCAL: The potential for unique, isolated, long-term survival, or resilience in a localized community of a few thousand people is nil** because the autonomous group is too small to independently maintain a complex modern lifestyle. Although the movement is laudable because of the shared sense of security and temporary buffer against collapse, a localized community cannot stand alone for long and should not shield its members from concern over the larger picture. Ancient tribal patterns were stronger when extended to the limits allowed by topography and travel. This important sub-subject is expanded in Chapter 9.

5. **PERSONAL: This level, including immediate family, infers individual control over one's fate which is totally unrealistic.** Primitive survival required the support of at least a village, with success intimately reflected by the sum and average of individual actions.

CHAPTER FINAL THOUGHTS

The critical subject of population control has been addressed since the beginning of recorded history, and probably before, but not documented. All ancient, autonomous, surviving cultures had to thread a precarious fertility rate path of about three (3 cpf) to ensure continuity, but not grow depending on local, short, hard-life expectancy. Any more would have exceeded the local carrying capacity and lead to collapse. This was before modern health care and longer life spans. Now, we urgently need to reduce fertility to, at most, 1 cpf in order to navigate the end of the oil age … including the ecological devastation we have caused by over populating every niche of the world. There are hundreds of books that venture into every detail of fertility control. I will not go further with this except by suggesting that male vasectomy would be a better choice rather than leaving it to women to be responsible for limiting population within available resources.

This solution seems far more palatable than severe local traditions as described in Arthur Boughey's 1976 book: *Strategy for Survival, an Exploration of the Limits to Further Population and Industrial Growth.* Examples like female infanticide or having to kill another person before marriage helped isolated island societies cope with population control.

Another of the best books in my collection on population is *More* by Robert Engelman, Island Press (2008). It is easy to read and explains older birth control methods like emmenagogues and pessaries (neither word is in my pocket Webster's Dictionary), which were used by women before modern contraceptives were invented. Bill McKibben wrote the book, *Maybe One*. An excellent read is *The Fatal Inheritence* by John Bligh, Athena Press, (2004). For a world-wide web site that advocates zero children see: vhemt.org. Very interesting.

However, in my opinion of comparative time frames, running out of oil is far more urgent than the directly-related crises of longer-term population control and climate change.

To know and not act is to not know.

(Chinese proverb)