

PART I

FOCUS on PER CAPITA OIL

The end of the short, high-energy oil age looms before us in so many ways. Yet we avoid the subject and fail to understand how we Americans are central to this perilous subject.

Instead, we dwell on much longer-term climate change while we motor down the road frantically consuming the liquid finite fossil fuel which will be critical to our and our children's survival. (See Appendix A)

The thoughts presented in this book are not political or vague conjecture. They are based on hard unequivocal math, physics, and evidence.

We start our study by first turning our focus back towards ourselves and our grossly inordinate oil consumption. If there's any chance of shaping our destiny, we must first identify and tackle the root problem.

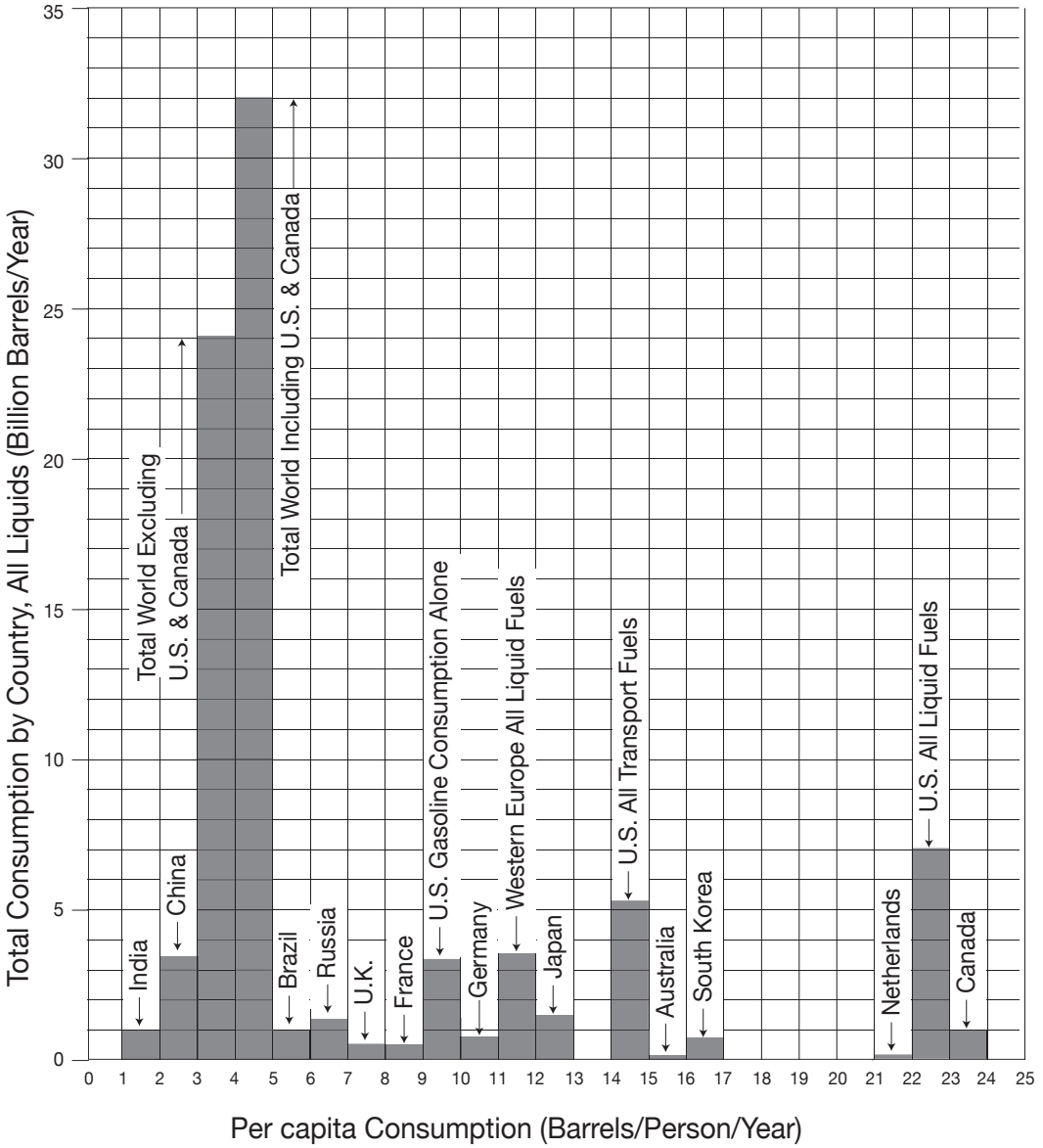


FIGURE 1 World Oil Consumption by Country and Per Capita Consumption

World Liquid Fuel Consumption Highlighting U.S. Gasoline

On the facing page, Figure 1 is a bar-chart showing total and per capita oil consumption for the top twenty oil-consuming **countries** in the world **with the U.S. by far the most dominant. Also included in this bar chart are the total consumption and per capita rates for just U.S. gasoline, and another bar for all U.S. liquid fuels used specifically for transport including diesel and jet fuel.** The numbers used in Figure 1 are duplicated in Table 1 in rounded numbers. Accuracy may vary slightly depending on date and source. Several other countries and Western Europe as a bloc are included for reference: (For reference use google or wikipedia.)

Also included in Figure 1 are:

- Total world consumption of 60 countries (**including the highly-skewed contribution from the U.S. and Canada**), all consuming 32 billion barrels per year (Bb/y) of all petroleum liquids with a population of 7.2 billion. The average world per capita consumption is therefore 4.4 barrels per person per year (b/p/y).
- Total world consumption and per capita consumption **excluding the U.S.** The numbers are then reduced to a total world consumption of 25 Bb/y used by a population of 6.9 billion people with a per capita consumption of 3.62 b/p/y.

Most revealing is the bar in Figure 1 which shows 3.3 billion barrels of oil per year (Bb/y) used in the U.S. by 310 million Americans ... just for gasoline! This would be equivalent to a stand-alone country of 310 million people and a per capita total oil consumption of 10.7 barrels per person per year (b/p/y). In more familiar units, an average of about 400 gallons of gasoline are used in the U.S. each year by every man, woman, and child. Does each American really need one and one-quarter gallons of gas to make it through the day? It could be argued that a small fraction of U.S. gasoline and diesel is exported to Europe and Asia, but that in no way changes the argument and absolves the American motoring bloc from being the third most dominant factor in the world petroleum market. Surely we need to better understand the specifics and implications of this egregious anomaly.

TABLE 1 Numbers used in Figure 1

COUNTRY	CONSUMPTION		POPULATION	PER CAPITA CONSUMPTION
	(Mb/d)	(Bb/y)	(billions)	(b/p/y)
United States total	19.2	7.0	0.31	22.6
U.S. transport only	14.5	5.3	0.31	17.1
China	10	3.6	1.3	2.8
U.S. gasoline only	9	3.3	0.31	10.6
Japan	4.4	1.6	0.13	12.4
India	3.3	1.2	1.26	0.9
Russia	3.2	1.2	0.15	7.9
Brasil	2.6	0.95	0.2	4.75
Saudi Arabia	2.8	1.0	0.03	34.5
South Korea	2.3	0.84	0.05	17.8
Mexico	2.2	0.8	0.12	6.7
Canada	2.4	0.92	0.04	23.0
Singapore	1.4	0.51	0.005	102.0
Indonesia	1.3	0.47	0.25	1.9
Australia	1.0	0.36	0.023	15.6
Iran	1.7	0.62	0.08	8.0
Germany	2.4	0.86	0.08	10.7
France	1.8	0.65	0.07	9.3
UK	1.7	0.43	0.06	7.2
Italy	1.5	0.54	0.06	9.0
Spain	1.4	0.51	0.046	11.0
Netherlands	1.0	0.36	0.016	22.5
Total West. Europe	9.8	3.6	0.33	10.9

Notes:

- Saudi Arabia and Singapore are more egregious cases of per capita consumption than the U.S., but are not included in Figure 1 because their populations and total oil consumption are much lower.
- **U.S. gasoline consumption alone (3.3 Bb/y) is nearly equivalent to the total of all liquid fuel consumption for the six dominant countries in Western Europe. (3.6 Bb/y).**
- U.S. liquid fuel consumption (7 Bb/y) is equal to 65% of the **total** liquid fuel used by all the dominant countries in Asia (10.9 Bb/y); China, Japan, Russia, India, South Korea Iran, Saudi Arabia, Singapore, and Australia.
- U.S. gasoline consumption alone (3.3 Bb/y) is far more than the total liquid fuel used in the three other dominant western hemisphere countries (2.67 Bb/y); Brasil, Mexico, and Canada.

American's profligate use of gasoline represents almost one-half of total U.S. oil consumption and **most of the other half is also used for movement of people or goods**, but with jet fuel or diesel. The next table is an approximate breakdown of all U.S. petroleum consumption including critical uses for agriculture, national defense (about 1 Mb/d), and heating oil (about 0.3 Mb/d):

TABLE 2 U.S. Liquid Fuel Consumption

FUEL TYPE	OIL USED	
	(Mb/d)	(Bb/y)
All gasoline	9	3.3
Distillate (diesel, heating oil)	4	1.5
Jet fuel	1.5	0.5
Natural gas liquids including propane	1.0	0.4
All other uses plus exports and imports	3.6	1.3
TOTAL	19.1	7.0

Combining all forms of petroleum-based transportation (movement) of people or goods provided by gasoline, diesel, and jet fuel, reveals graphically in Figure 1 that the ubiquitous and uniquely-mobile American way of life uses about 5.3 billion barrels of oil per year. This translates to over 14 barrels (602 gallons, 1.67 gallons every day) per year for each and every American for a steadily-depleting energy resource **that can never be replaced or substituted for by any other form of energy; not natural gas, not electricity**. Forget natural gas, hydrogen, biofuels, or electric cars and trucks. Although technically possible, the required time, capital investment, infrastructure, energy input, storage difficulties, and limited range of alternative forms of travel preclude an acceptable future for a nation that is already sinking under a mountain of debt.

ECONOMIC CONSEQUENCES

A quick look at long-term (eia.gov) history shows that U.S. oil consumption has only started to decline in the last decade. This demand-destruction began concurrent with the five-fold increase in the cost of gasoline and oil **and also included a ten-percent increase in population in the same time frame**. As the price of oil increased from the twenty dollar per barrel to the hundred dollar range, the extraction of non-conventional oil sources like deep off-shore and "fracked" tight shale became profitable and justified their immense capital investments. **But the higher cost for all petroleum-related products gradually forced more and more Americans living on social welfare, social security, fixed, or minimum-wage incomes into economic distress because they no longer could afford to pay for other discretionary needs beyond their first priority of fuel and food**. The fracked natural

gas resurgence helped some by reducing the cost of home heating and electricity, But low-cost natural gas does not pay for gasoline and food with forty-seven million Americans now on food stamps. Shelter comes next in priority but is squeezed by what is left for mortgage payments or rent after fuel and food expenses.

Family expense for gasoline

A simpler, personal micro-view of this complex economic interaction is to ponder how each of increasing numbers of marginally-economic Americans, working part time for minimum wages and/or collecting some form of special assistance, can afford to underwrite the soaring macro-costs to drill deeper in more inhospitable places for the earth's remaining oil. The take-home pay of an eight-dollar per hour worker is less than \$15,000 per year. This steadily increasing number of economically disenfranchised consumers cannot afford gasoline costing \$3.50 per gallon or \$5,600 for a family of four each member using 400 gallons per year.

The last thing most Americans want to “throttle-back” is the necessity, freedom, and ingrained love affair with the automobile. But, change they have, which, combined with more efficient cars at all income levels, has somewhat reduced consumption by the most dominant customer in the world. The result is “demand destruction” from the bottom up of the income ladder which, in turn, lowers the price of liquid fuels down closer to balance the much-higher costs necessary for extraction (production) of remaining non-conventional sources. **The clear conclusion is that waning U.S. gasoline demand, the third most significant bloc in the world (after U.S. or China total oil consumption), directly influences and determines the price of world oil rather than the conventional wisdom of the other way around.**

Quantitatively, in round numbers from “google” sources, “peak driving” in the U.S. occurred in 2004/2005 at 24,000 miles per household, 13,000 miles per licensed driver, and 9,000 miles per capita. In the ten years following, all three indicators have declined about ten percent despite a population increase of over thirty million.

In the last months of 2014, Saudi Arabia finally grew tired of losing market share and income beginning back in 2005 when the American motoring public reached peak U.S. gasoline consumption. This Saudi movement has been exacerbated in the last five years by a surging supply of higher-priced, non-conventional sources like hydrofractured (“fracked”) tight shale and Canadian tar sand supplies. **Why should the Saudis support higher-cost U.S. non-conventional extraction only to lose control of their national income?** The Saudi decision to over-supply the world with oil at less than \$50 per barrel, down from the \$100 range, instantly threw the oil markets and short term market speculators into a spin. Gasoline

from \$3.75 down to the \$2.00 per gallon range suddenly released an extra jolt of discretionary per capita purchasing power of over \$500 per year for the average American. Of course, much of this windfall is spent on a resurgence of miles traveled thus reinvigorating the American penchant for burning through precious remaining (U.S. or World) oil as quickly as possible with no concern whatsoever for the not-too-distant future.

TOTAL WEALTH, PER CAPITA WEALTH, AND MEDIAN INCOME

Another way of arguing the premise that the unique combination of **U.S. oil consumption, population size, and residual personal wealth is by far the most dominant force that “drives” the world oil markets**, is to focus on individual consumer spending power and per capita median income for all twenty major oil-consuming nations in U.S. dollars (Table 3). This data is readily available from the internet through google references:

TABLE 3 Spending Power of Oil Consuming Nations

COUNTRY	CONSUMPTION (Bb/y)	POPULATION (billions)	INCOME (per capita)	PERSONAL WEALTH	TOTAL WEALTH (trillions)
United States	7.0	0.31	\$15,480	\$143,000	\$44.3
China	3.6	1.3	\$1,786	\$11,000	\$14.3
Japan	1.6	0.13	\$10,840	\$125,000	\$16.2
India	1.2	1.26	\$616	\$6,500	\$8.2
UK	0.43	0.06	\$12,349	\$130,000	\$7.8
Germany	0.86	0.08	\$14,023	\$90,000	\$7.2
Italy	0.54	0.06	\$6,874	\$121,000	\$7.2
France	0.65	0.07	\$12,443	\$95,000	\$6.6
Spain	0.51	0.046	\$7,284	\$93,000	\$4.2
Brasil	0.95	0.2	\$2,247	\$20,000	\$4.0
Canada	0.92	0.04	\$15,181	\$90,000	\$3.6
Mexico	0.8	0.12	\$2,900	\$23,000	\$2.7
South Korea	0.84	0.05	\$11,350	\$45,000	\$2.2
Russia	1.3	0.15	\$4,129	\$16,500	\$2.4
Australia	0.36	0.023	\$15,026	\$90,000	\$2.1
Indonesia	0.47	0.25	\$541	\$8,000	\$2.0
Netherlands	0.36	0.16	\$14,450	\$121,000	\$1.9
Iran	0.62	0.078	\$3,115	\$16,600	\$1.3
Saudi Arabia	1.0	0.03	\$4,702	\$22,000	\$0.7
Singapore	0.51	0.005	\$7,345	\$113,000	\$0.6

THE CRUX

By combining the above facts regarding personal wealth, income, population, and driving habits, the complex nexus of remaining world oil, consumption rate, price, and the future of our ephemeral, two-lifetime, oil-based society comes sharply into focus and can be accurately predicted.

The only country that has the combination of individual wealth (including debt), population, and per capita income to significantly dominate world oil consumption is the United States at 7 billion barrels per year (Bb/y). This conclusion is exacerbated by rapidly growing wealth disparity. Many Americans still have enough residual wealth and income to afford higher-priced gasoline. The GDP and public confidence are maintained as this wealth flows down through the economic ladder from the “haves” to the “have-nots.” Rich or poor, a significant fraction of American wealth is lost (burned through) as liquid fossil fuels at every level. The remainder of the oil age will be a delicate death-dance between how much longer (and at what price) poorer Americans will still be able to purchase oil (specifically gasoline) and how desperately the remaining producer-nations (including the U.S.) are willing to fuel the American driving addiction in order to continue supporting their own oil-based economies.

China is a distant number-two to the U.S. 7 Bb/y with **total** oil consumption of 3.6 Bb/y. But its five-times larger population dictates that Chinese per capita income, including gasoline consumption is less than 3 b/p/y, and is therefore not the culprit as is the U.S. Other advanced countries like Japan, Canada, Australia, the E.U. countries, and South Korea still have significant per capita income and modern lifestyles, but their much smaller populations, short driving distances, and, in most cases, high gasoline taxes, make them minor players in the world oil scene. Other wealthy countries as in Scandinavia are also not large enough to make the top-twenty list and be major factors in the world oil market. **How much longer the oil age will last will be determined primarily by the balance between decreasing American personal wealth, motoring lifestyle, and the cost of remaining world oil.** We're talking about personal wealth as opposed to national wealth. The U.S. debt is directly approaching twenty trillion dollars, with another seventy-trillion dollars of unfunded long-term liabilities like future social security, medicare, and veteran's benefits. All were premised on the myth of everlasting economic and population growth with no consideration of diminishing resources. See Chapter 10 for further discussion of energy vs. economic growth.

Geopolitics

Most of the world is struggling to exist on an average of three barrels per person per year (b/p/y) which declines steadily as population continues to grow. The result can be seen everywhere, geopolitically, as growing anarchy. Disenfranchised young men and angry mobs revolt to hang onto some form of acceptable existence and western-world lifestyle. The remaining oil exporting countries are often ruled by monarchs or authoritarian leaders who isolate themselves behind grandeur and guards with little left for the masses except devastated countryside. **Meanwhile, much American wealth (and lives) are spent to maintain the flow of oil from the lands of 3 b/p/y marginal consumers to us, the 22 b/p/y happy motoring Americans who still control the oil markets.**

Remember, every drop (gallon, barrel, ...) of oil burned for motive power and heating is gone, forever! Nothing is left to show for this frantic consumption of the world's most vital finite resource except crumbling roads, worn-out cars, pollution, and greenhouse gases. The world production of food for seven billion people is also directly dependent on this downward spiral, but at least there's the extra step of people being fed before millions of years of sunlight energy, conveniently stored in the oil, vanish entropically into the surrounding void.

Since the concept of peak oil first became popular in 2005, another 320 billion barrels of oil have been used in the world. This is about 1/4 of the total oil used since the beginning of the oil age. This was a lost decade we could have used to begin an orderly decline of consumption and transition to an acceptable future. Instead it was wasted as many experts sought to prove that "peak oil is dead."

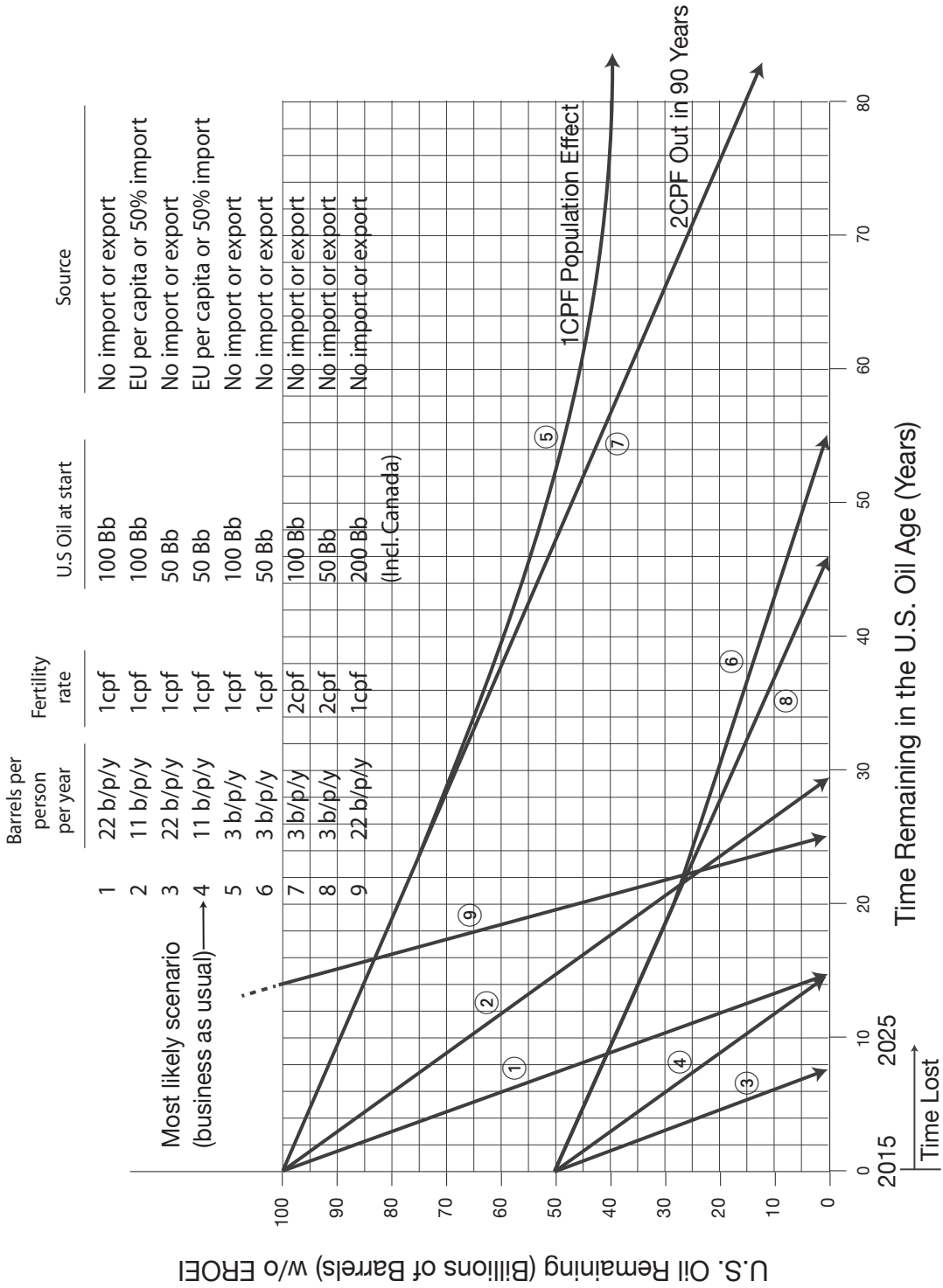


FIGURE 2 Nine Scenarios for the End of the U.S. Oil Age