Eight Energy Myths Explained

Posted on April 23, 2014

Republicans, Democrats, and environmentalists all have favorite energy myths. Even Peak Oil believers have favorite energy myths. The following are a few common mis-beliefs, coming from a variety of energy perspectives. I will start with a recent myth, and then discuss some longer-standing ones.

Myth 1. The fact that oil producers are talking about wanting to export crude oil means that the US has more than enough crude oil for its own needs.

The real story is that *producers want to sell their crude oil at as high a price as possible*. If they have a choice of refineries A, B, and C in this country to sell their crude oil to, the maximum amount they can receive for their oil is limited by the price these refineries are paying, less the cost of shipping the oil to these refineries.

If it suddenly becomes possible to sell crude oil to refineries elsewhere, the possibility arises that a higher price will be available in another country. Refineries are optimized for a particular type of crude. If, for example, refineries in Europe are short of light, sweet crude because such oil from Libya is mostly still unavailable, a European refinery might be willing to pay a higher price for crude oil from the Bakken (which also produces light sweet, crude) than a refinery in this country. Even with shipping costs, an oil producer might be able to make a bigger profit on its oil sold outside of the US than sold within the US.

The US consumed 18.9 million barrels a day of petroleum products during 2013. In order to meet its oil needs, the US imported 6.2 million barrels of oil a day in 2013 (netting exported oil products against imported crude oil). Thus, the US is, and will likely continue to be, a major oil crude oil importer.

If production and consumption remain at a constant level, adding crude oil exports would require adding crude oil imports as well. These crude oil imports might be of a different kind of oil than that that is exported–quite possibly sour, heavy crude instead of sweet, light crude. Or perhaps US refineries specializing in light, sweet crude will be forced to raise their purchase prices, to match world crude oil prices for that type of product.

The reason exports of crude oil make sense from an oil producer's point of view is that they stand to *make more money* by exporting their crude to overseas refineries that will pay more. How this will work out in the end is unclear. If US refiners of light, sweet crude are forced to raise the prices they pay for oil, and the selling price of US oil products doesn't rise to compensate, then more US refiners of light, sweet crude will go out of business, fixing a likely world oversupply of such refiners. Or perhaps prices of US finished products will rise, reflecting the fact that the US has to some extent in the past received a bargain (related to the gap between European Brent and US WTI oil prices), relative to world prices. In this case US consumers will end up paying more.

The one thing that is very clear is that the desire to ship crude oil abroad does not reflect too much total crude oil being produced in the United States. At most, what it means is an overabundance of refineries, worldwide, adapted to light, sweet crude. This happens because over the years, the world's oil mix has been generally changing to heavier, sourer types of oil. Perhaps if there is more oil from shale formations, the mix will start to change back again. This is a very big "if," however. The media tend to overplay the possibilities of such extraction as well.

Myth 2. The economy doesn't really need very much energy.

We humans need food of the right type, to provide us with the energy we need to carry out our activities. The economy is very similar: it needs energy of the right types to carry out its activities.

One essential activity of the economy is growing and processing food. In developing countries in warm parts of the world, food production, storage, transport, and preparation accounts for the vast majority of economic activity (Pimental and Pimental, 2007). In traditional societies, much of the energy comes from human and animal labor and burning biomass.

If a developing country substitutes modern fuels for traditional energy sources in food production and preparation, the whole nature of the economy changes. We can see this starting to happen on a world-wide basis in the early 1800s, as energy other than biomass use ramped up.

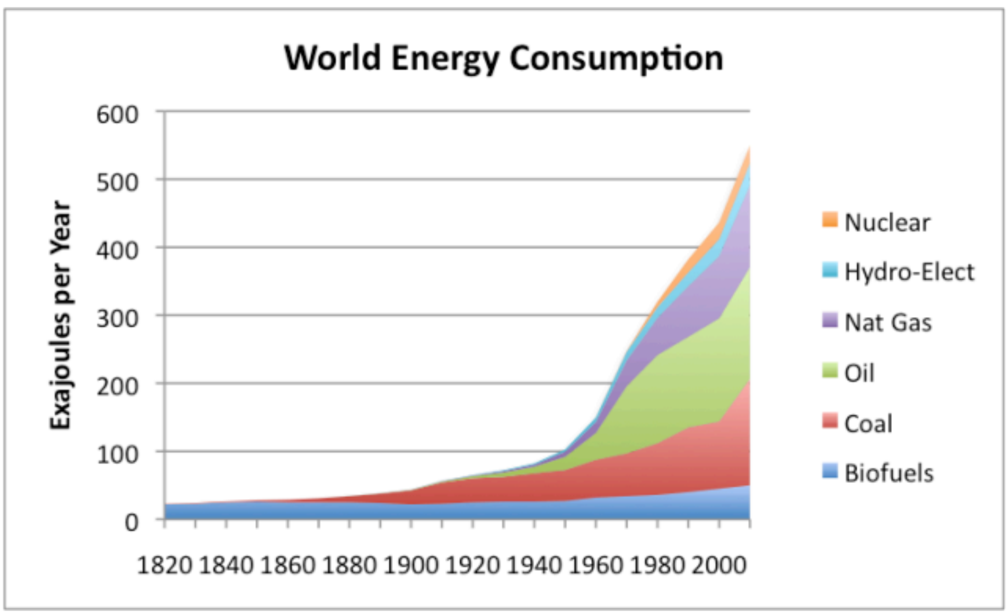


Figure 1. World Energy Consumption by Source, Based on Vaclav Smil estimates from Energy Transitions: History, Requirements and Prospects and together with BP Statistical Data on 1965 and subsequent

The Industrial Revolution began in the late 1700s in Britain. It was enabled by coal usage, which made it possible to make metals, glass, and cement in much greater quantities than in the past. Without coal, deforestation had become a problem, especially near cold urban areas, such as London. With coal, it became possible to use industrial processes that required heat without the problem of deforestation. Processes using high levels of heat also became cheaper, because it was no longer necessary to cut down trees, make charcoal from the wood, and transport the charcoal long distances (because nearby wood had already been depleted).

The availability of coal allowed the use of new technology to be ramped up. For example, according to Wikipedia, the first steam engine was patented in 1608, and the first commercial steam engine was patented in 1712. In 1781, James Watt invented an improved version of the steam engine. But to actually implement the steam engine widely using metal trains running on metal tracks, coal was needed to make relatively inexpensive metal in quantity.

Concrete and metal could be used to make modern hydroelectric power plants, allowing electricity to be made in quantity. Devices such as light bulbs (using glass and metal) could be made in quantity, as well as wires used for transmitting electricity, allowing a longer work-day.

The use of coal also led to agriculture changes as well, cutting back on the need for farmers and ranchers. New devices such as steel plows and reapers and hay rakes were manufactured, which could be pulled by horses, transferring work from humans to animals. Barbed-wire fence allowed the western part of the US to become cropland, instead one large unfenced range. With fewer people needed in agriculture, more people became available to work in cities in factories.

Our economy is now very different from what it was back about 1820, because of increased energy use. We have large cities, with food and raw materials transported from a distance to population centers. Water and sewer treatments greatly reduce the risk of disease transmission of people living in such close proximity. Vehicles powered by oil or electricity eliminate the mess of animal-powered transport. Many more roads can be paved.

If we were to try to leave today's high-energy system and go back to a system that uses biofuels (or only biofuels plus some additional devices that can be made with biofuels), it would require huge changes.

Myth 3. We can easily transition to renewables.

On Figure 1, above, the only renewables are hydroelectric and biofuels. While energy supply has risen rapidly, population has risen rapidly as well.

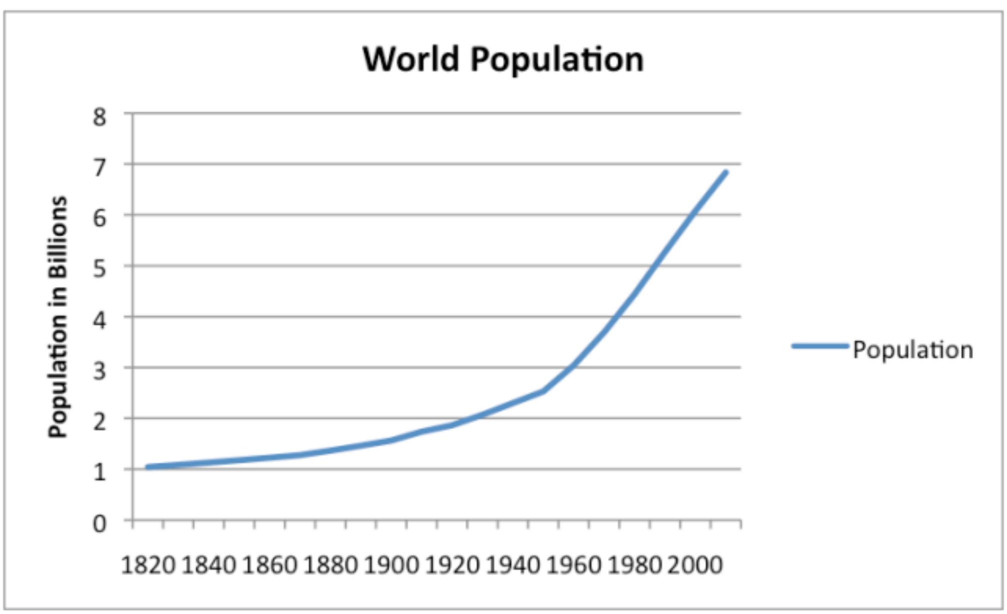


Figure 2. World Population, based on Angus Maddison estimates, interpolated where necessary.

When we look at energy use on a per capita basis, the result is as shown in Figure 3, below.

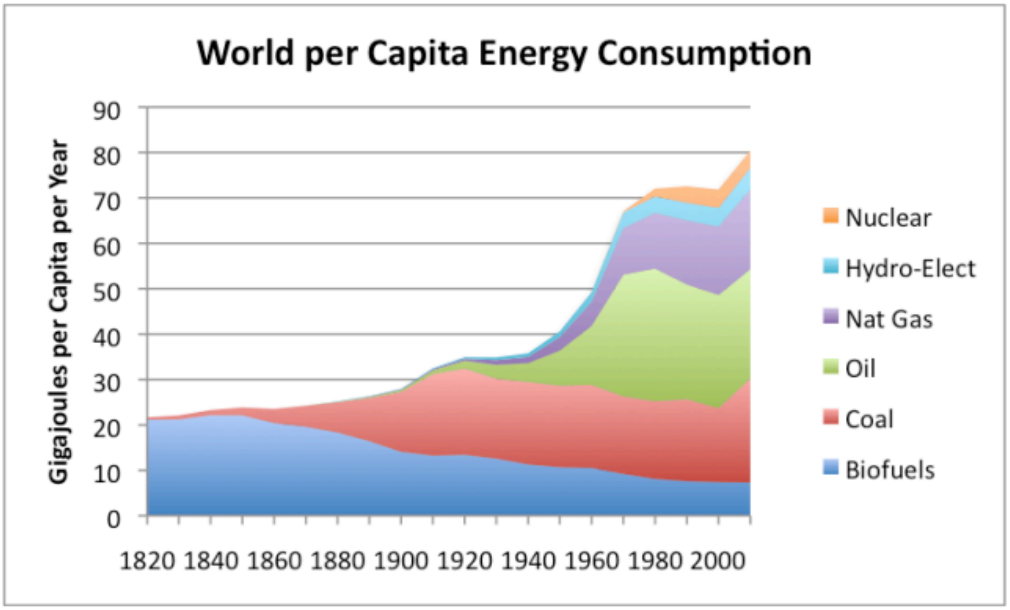


Figure 3. Per capita world energy consumption, calculated by dividing world energy consumption (based on Vaclav Smil estimates from [Energy Transitions: History, Requirements and Prospects] together with BP Statistical Data for 1965 and subsequent) by population estimates, based on [Angus Maddison data].

The energy consumption level in 1820 would be at a basic level–only enough to grow and process food, heat homes, make clothing, and provide for some very basic industries. Based on Figure 3, even this required a little over 20 gigajoules of energy per capita. If we add together per capita biofuels and hydroelectric on Figure 3, they would come out to only about 11 gigajoules of energy per capita. To get to the 1820 level of per capita energy consumption, we would either need to add something else, such as coal, or wait a very, very long time until (perhaps) renewables including hydroelectric could be ramped up enough.

If we want to talk about renewables that can be made without fossil fuels, the amount would be *smaller yet*. As noted previously, modern hydroelectric power is enabled by coal, so we would need to exclude this. We would also need to exclude modern biofuels, such as ethanol made from corn and biodiesel made from rape seed, because they are greatly enabled by today's farming and transportation equipment and indirectly by our ability to make metal in quantity.

I have included wind and solar in the "Biofuels" category for convenience. They are so small in quantity that they wouldn't be visible as a separate categories, wind amounting to only 1.0% of world energy supply in 2012, and solar amounting to 0.2%, according to BP data. We would need to exclude them as well, because they too require fossil fuels to be produced and transported.

In total, the biofuels category without all of these modern additions might be close to the amount available in 1820. Population now is roughly seven times as large, suggesting only one-seventh as much energy per capita. Of course, in 1820 the amount of wood used led to significant deforestation, so even this level of biofuel use was not ideal. And there would be the additional detail of transporting wood to markets. Back in 1820, we had horses for transport, but we would not have enough horses for this purpose today.

Myth 4. Population isn't related to energy availability.

If we compare Figures 2 and 3, we see that the surge in population that took place immediately after World War II coincided with the period that per-capita energy use was ramping up rapidly. The increased affluence of the 1950s (fueled by low oil prices and increased ability to buy goods using oil) allowed parents to have more children. Better sanitation and innovations such as antibiotics (made possible by fossil fuels) also allowed more of these children to live to maturity.

Furthermore, the Green Revolution which took place during this time period is credited with saving over a billion people from starvation. It ramped up the use of irrigation, synthetic fertilizers and pesticides, hybrid seed, and the development of high yield grains. All of these techniques were enabled by availability of oil. Greater use of agricultural equipment, allowing seeds to be sowed closer together, also helped raise production. By this time, electricity reached farming communities, allowing use of equipment such as milking machines.

If we take a longer view of the situation, we find that a "bend" in the world population occurred about the time of Industrial Revolution, and the ramp up of coal use (Figure 4). Increased farming equipment made with metals increased food output, allowing greater world population.

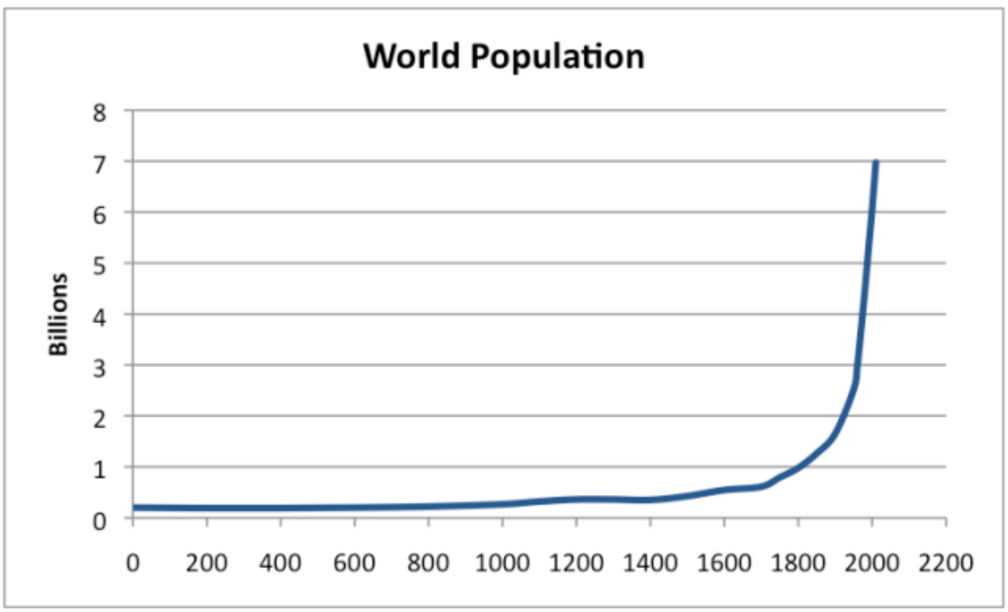


Figure 4. World population based on data from "Atlas of World History," McEvedy and Jones, Penguin Reference Books, 1978
and Wikipedia-World Population.

Furthermore, when we look at countries that have seen large drops in energy consumption, we tend to see population declines. For example, following the collapse of the Soviet Union, there were drops in energy consumption in a number of countries whose energy was affected (Figure 5).

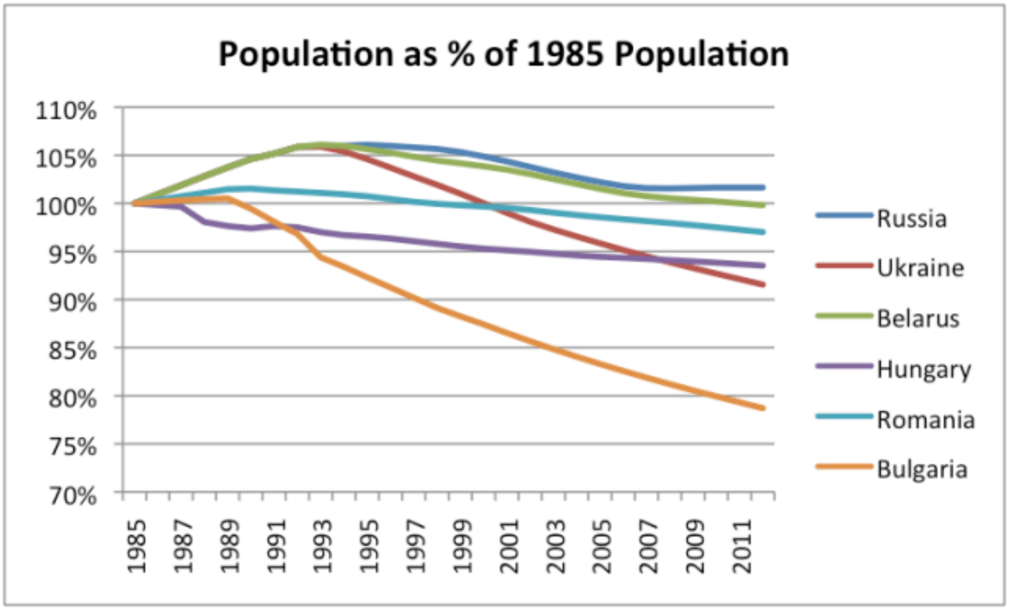


Figure 6. Population as percent of 1985 population, for selected countries, based on EIA data.

Myth 5. It is easy to substitute one type of energy for another.

Any changeover from one type of energy to another is likely to be slow and expensive, if it can be accomplished at all.

One major issue is the fact that different types of energy have very different uses. When oil production was ramped up, during and following World War II, it added new capabilities, compared to coal. With only coal (and hydroelectric, enabled by coal), we could have battery-powered cars, with limited range. Or ethanol-powered cars, but ethanol required a huge amount of land to grow the necessary crops. We could have trains, but these didn't go from door to door. With the availability of oil, we were able to have personal transportation vehicles that went from door to door, and trucks that delivered goods from where they were produced to the consumer, or to any other desired location.

We were also able to build airplanes. With airplanes, we were able to win World War II. Airplanes also made international business feasible on much greater scale, because it became possible for managers to visit operations abroad in a relatively short time-frame, and because it was possible to bring workers from one country to another for training, if needed. Without air transport, it is doubtful that the current number of internationally integrated businesses could be maintained.

The passage of time does not change the inherent differences between different types of fuels. Oil is still the fuel of preference for long-distance travel, because (a) it is energy dense so it fits in a relatively small tank, (b) it is a liquid, so it is easy to dispense at refueling stations, and (c) we are now set up for liquid fuel use, with a huge number of cars and trucks on the road which use oil and refueling stations to serve these vehicles. Also, oil works much better than electricity for air transport.

Changing to electricity for transportation is likely to be a slow and expensive process. One important point is that *the cost of electric vehicles needs to be brought down to where they are affordable for buyers, if we do not* *want the changeover to have a hugely adverse effect on the economy*. This is the case because salaries are not going to rise to pay for high-priced cars, and the government cannot afford large subsidies for everyone. Another issue is that the range of electric vehicles needs to be increased, if vehicle owners are to be able to continue to use their vehicles for long-distance driving.

No matter what type of changeover is made, the changeover needs to implemented slowly, over a period of 25 years or more, so that buyers do not lose the trade in value of their oil-powered vehicles. If the changeover is done too quickly, citizens will lose their trade in value of their oil-powered cars, and because of this, will not be able to afford the new vehicles.

If a changeover to electric *transportation vehicles* is to be made, many vehicles other than cars will need to be made electric, as well. These would include long haul trucks, busses, airplanes, construction equipment, and agricultural equipment, all of which would need to be made electric. Costs would need to be brought down, and necessary refueling equipment would need to be installed, further adding to the slowness of the changeover process.

Another issue is that even apart from energy uses, oil is used in many applications as a raw material. For example, it is used in making herbicides and pesticides, asphalt roads and asphalt shingles for roofs, medicines, cosmetics, building materials, dyes, and flavoring. There is no possibility that electricity could be adapted to these uses. Coal could perhaps be adapted for these uses, because it is also a fossil fuel.

Myth 6. Oil will "run out" because it is limited in supply and non-renewable.

This myth is actually closer to the truth than the other myths. The situation is a little different from "running out," however. The real situation is that oil limits are likely to disrupt the economy in various ways. This *economic disruption* is likely to be what leads to an abrupt drop in oil supply. One likely possibility is that a lack of debt availability and low wages will keep oil prices from rising to the level that oil producers need for extraction. Under this scenario, oil producers will see little point in investing in new production. There is evidence that this scenario is already starting to happen.

There is another version of this myth that is even more incorrect. According to this myth, the situation with oil supply (and other types of fossil fuel supply) is as follows:

Myth 7. Oil supply (and the supply of other fossil fuels) will start depleting when the supply is 50% exhausted. We can therefore expect a long, slow decline in fossil fuel use.

This myth is a favorite of peak oil believers. Indirectly, similar beliefs underly climate change models as well. It is based on what I believe is an incorrect reading of the writings of M. King Hubbert. Hubbert is a geologist and physicist who foretold a decline of US oil production, and eventually world production, in various documents, including Nuclear Energy and the Fossil Fuels, published in 1956. Hubbert observed that under certain circumstances, the production of various fossil fuels tends to follow a rather symmetric curve.

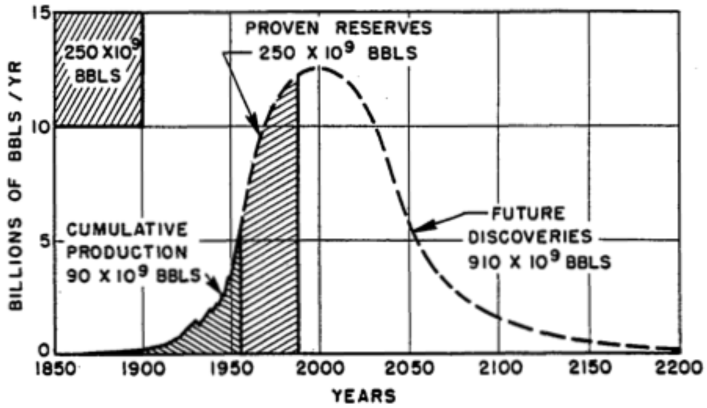
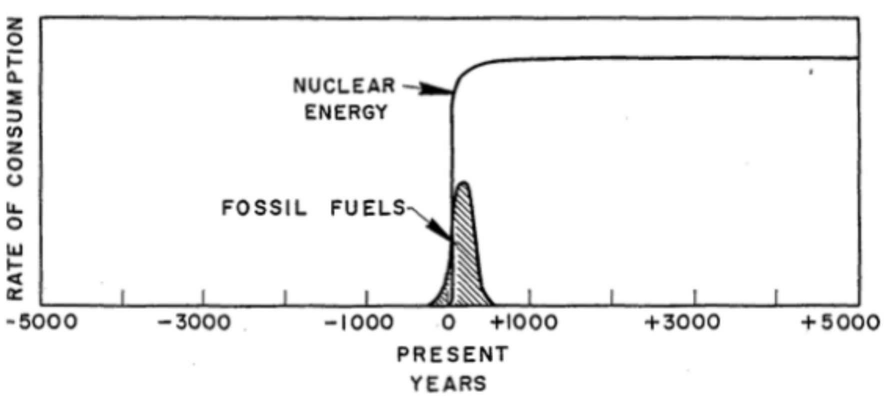


Figure 20 – Ultimate world crude-oil production based upon initial reserves of 1250 billion barrels.

Figure 7. M. King Hubbert's 1956 image of expected world crude oil production, assuming ultimate recoverable oil of 1,250 billion barrels.

A major reason that this type of forecast is wrong is because it is based on a scenario in which some other type of energy supply was able to be ramped up, before oil supply started to decline.



gure 30 – Relative magnitudes of possible fossil-fuel and nuclear-ergy consumption seen in time perspective of minus to plus 5000 years.

Figure 8. Figure from Hubbert's 1956 paper, Nuclear Energy and the Fossil Fuels.

With this ramp up in energy supply, the economy can continue as in the past without a major financial problem arising relating to the reduced oil supply. Without a ramp up in energy supply of some other type, there would be a problem with too high a population in relationship to the declining energy supply. Per-capita energy supply would drop rapidly, making it increasingly difficult to produce enough goods and services. In particular, maintaining government services is likely to become a problem. Needed taxes are likely to rise too high relative to what citizens can afford, leading to major problems, even collapse, based on the research of Turchin and Nefedov (2009).

Myth 8. Renewable energy is available in essentially unlimited supply.

The issue with all types of energy supply, from fossil fuels, to nuclear (based on uranium), to geothermal, to hydroelectric, to wind and solar, is *diminishing returns*. At some point, the cost of producing energy becomes less efficient, and because of this, the cost of production begins to rise. It is the fact wages do not rise to compensate for these higher costs and that cheaper substitutes do not become available that causes financial problems for the economic system.

In the case of oil, rising cost of extraction comes because the cheap-to-extract oil is extracted first, leaving only the expensive-to-extract oil. This is the problem we recently have been experiencing. Similar problems arise with natural gas and coal, but the sharp upturn in costs may come later because they are available in somewhat greater supply relative to demand.

Uranium and other metals experience the same problem with diminishing returns, as the cheapest to extract portions of these minerals is extracted first, and we must eventually move on to lower-grade ores.

Part of the problem with so-called renewables is that they are made of minerals, and these minerals are subject to the same depletion issues as other minerals. This may not be a problem if the minerals are very abundant, such as iron or aluminum. But if minerals are lesser supply, such as rare earth minerals and lithium, depletion may lead to rising costs of extraction, and ultimately higher costs of devices using the minerals.

Another issue is choice of sites. When hydroelectric plants are installed, the best locations tend to be chosen first. Gradually, less desirable locations are added. The same holds for wind turbines. Offshore wind turbines tend to be more expensive than onshore turbines. If abundant onshore locations, close to population centers, had been available for recent European construction, it seems likely that these would have been used instead of offshore turbines.

When it comes to wood, overuse and deforestation has been a constant problem throughout the ages. As population rises, and other energy resources become less available, the situation is likely to become even worse.

Finally, renewables, even if they use less oil, still tend to be *dependent on oil*. Oil is important for operating mining equipment and for transporting devices from the location where they are made to the location where they are to be put in service. Helicopters (requiring oil) are used in maintenance of wind turbines, especially off shore, and in maintenance of electric transmission lines. Even if repairs can be made with trucks, operation of these trucks still generally requires oil. Maintenance of roads also requires oil. Even transporting wood to market requires oil.

If there is a true shortage of oil, there will be a huge drop-off in the production of renewables, and maintenance of existing renewables will become more difficult. Solar panels that are used apart from the electric grid may be long-lasting, but batteries, inverters, long distance electric transmission lines, and many other things we now take for granted are likely to disappear.

Thus, renewables are not available in unlimited supply. If oil supply is severely constrained, we may even discover that many existing renewables are not even very long lasting.

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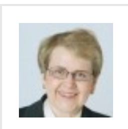

About Gail Tverberg

My name is Gail Tverberg. I am an actuary interested in finite world issues - oil depletion, natural gas depletion, water shortages, and climate change. Oil limits look very different from what most expect, with high prices leading to recession, and low prices leading to inadequate supply.

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561 Responses to *Eight Energy Myths Explained*

OscarThreeKilo *says:*

April 23, 2014 at 12:16 pm

The question that many have is “What can we do?”.

Of course the answer is common to all organisms:

Adapt, Migrate or Die.

I suspect dying will be the most prevalent though unpopular option.

Gail Tverberg *says:*

April 23, 2014 at 8:00 pm

You may be correct, unfortunately.

Paul *says:*

April 24, 2014 at 3:30 am

Most will die — I suspect almost all.

Mansoor H. Khan *says:*

April 24, 2014 at 10:50 pm