What Would it Take to Get to a Steady State Economy?

Humans live in equilibrium with other species in a finite world. In such a world, there is never really a Steady State. Instead, there is a constant ebb and flow. For a while, one species may be dominant in an area, and then another. If populations are closely matched in “ability,” then the ups and downs aren’t too severe. If a predator depends on a particular type of prey for its dinner, it can’t eat all of the prey, or it will go hungry.

When the populations of various species are graphed, they rise and fall. We usually think of a close match, such as depicted in this graph:

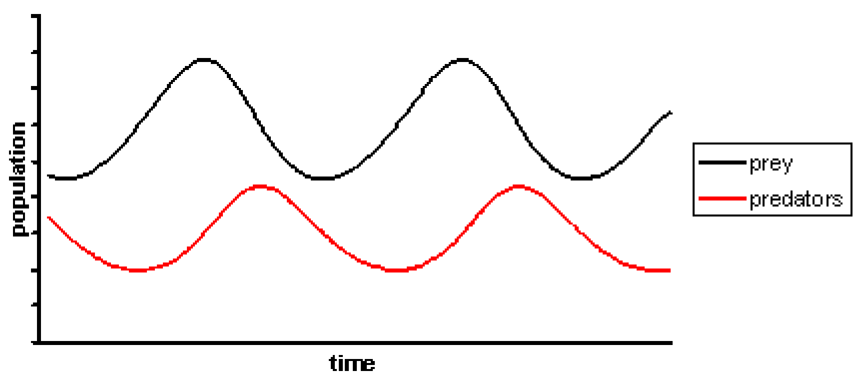

Figure 1. Volterra_Lotka equations used to illustrate situation where population of predators and prey do not vary over too wide a range.Source: Wikipedia.

In fact, the variability of the many species over time tends to be greater than this, as illustrated by the following model that started with 80 baboons and 40 cheetahs:

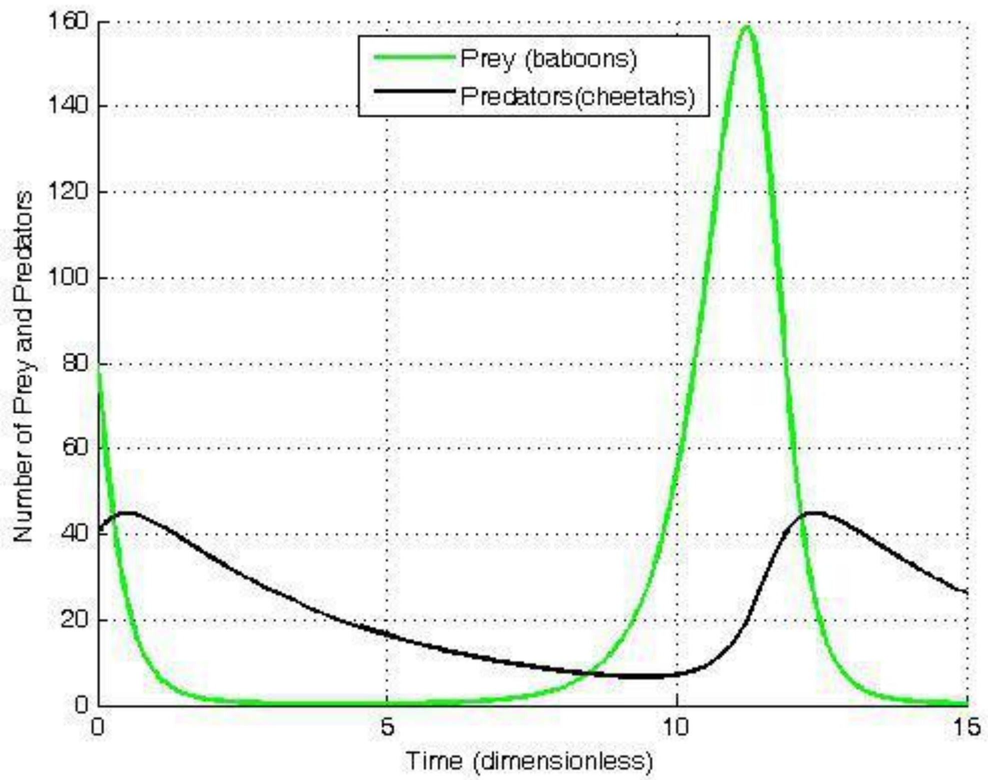

Figure 2. Lotka-Volterra equations used to illustrate situation that begins with 80 baboons and 40 cheetahs. Source: Wikipedia

If species evolve together, a natural balance tends to remain in place. If a species suddenly finds a new, better source of nourishment (really, energy supply, since food supplies energy), its population may increase greatly. For example, yeast may metabolize the sugar in grape juice, converting it to alcohol. The yeast population temporarily rises and then declines, as the food source disappears and alcohol pollution poisons the yeast. Or bacteria may multiply rapidly inside the human body under certain circumstances (including adequate nutrients and a compromised immune system).

An example is sometimes given of reindeer introduced to St. Matthews Island near Alaska, where there was considerable lichen on the rock. The reindeer ate the lichen at a speed faster than the lichen could reproduce. Soon the lichen was gone, and the reindeer population crashed.

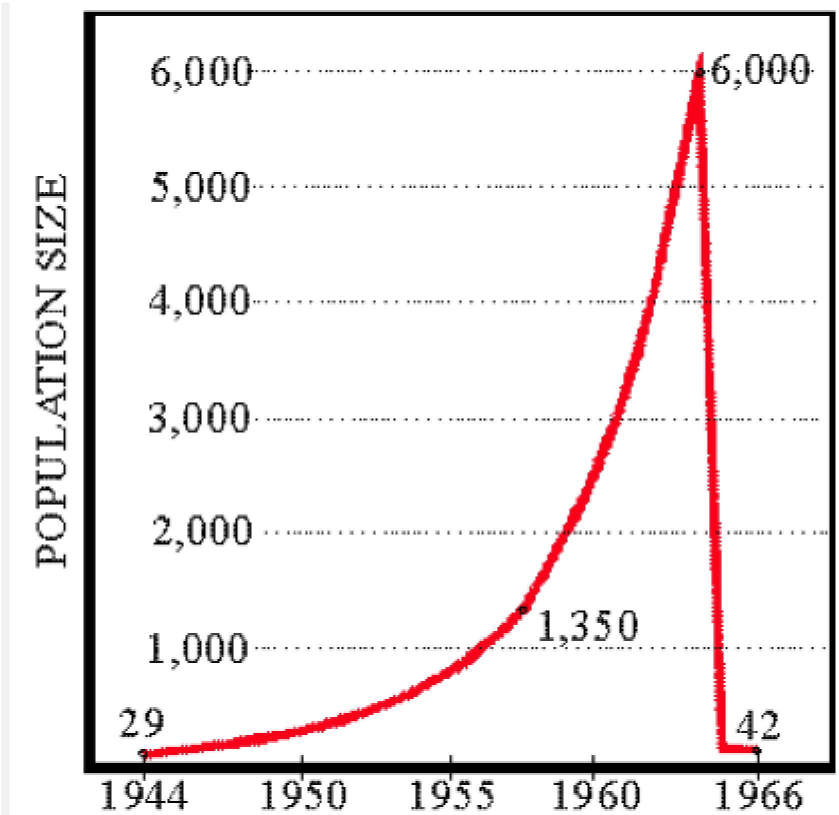

Figure 3. Assumed population of St. Matthew Reindeer herd, with actual counts given. Based on research of David R. Klein of University of Alaska.

The reindeer example is similar to a very severe predator-prey curve. The reindeer ate a renewable resource faster than it could reproduce. There were a few other food sources a reindeer could eat, so a few reindeer remained, but there was a very sharp drop in the number of reindeer.

The population of humans has ramped up greatly in recent times:

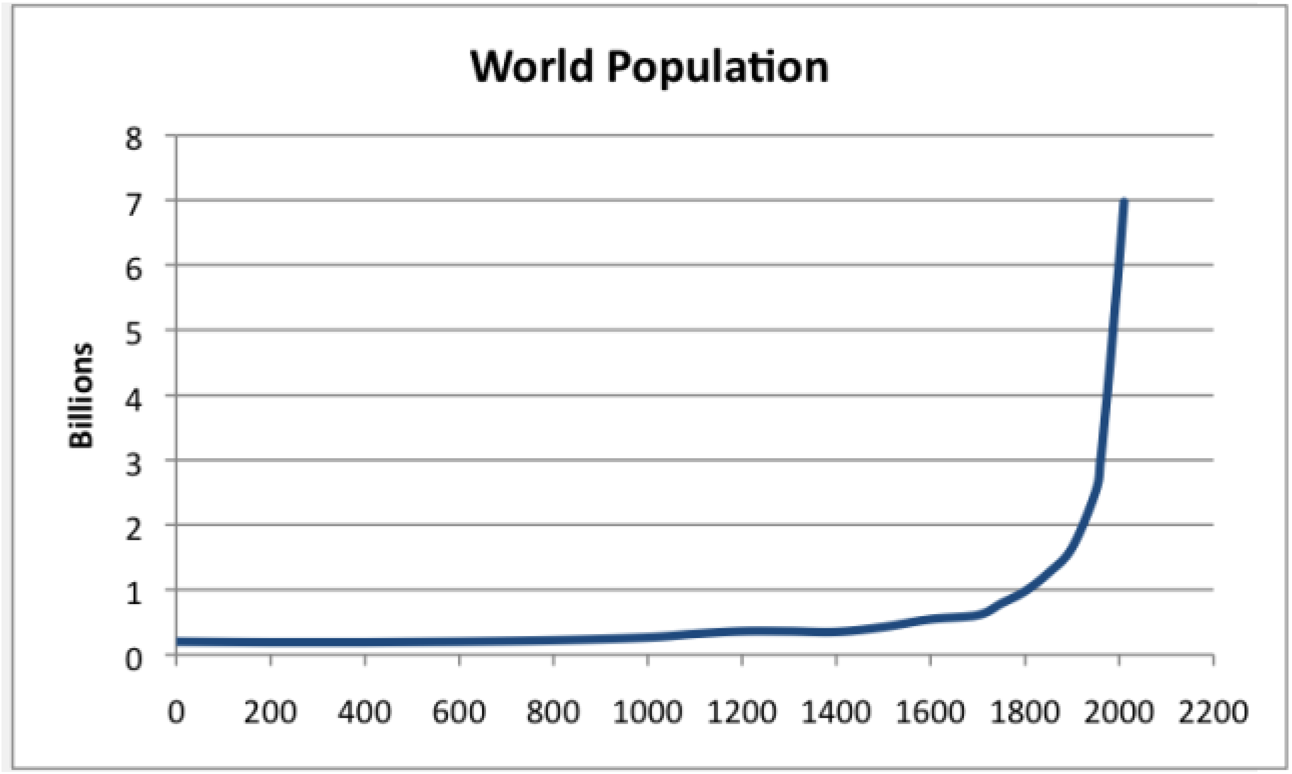

Figure 4. World population based on data from "Atlas of World History," McEvedy and Jones, Penguin Reference Books, 1978 and Wikipedia-World Population.

The most recent growth coincides with the addition of fossil fuels to the energy supplies used by humans, starting about 1800. If we look back, we see though that human population has been ramping up for a very long period. Humans discovered how to control fire over 1,000,000 years ago. Since 75,000 BCE, there has been fairly consistent population growth, if we look at the data on a log/log graph.

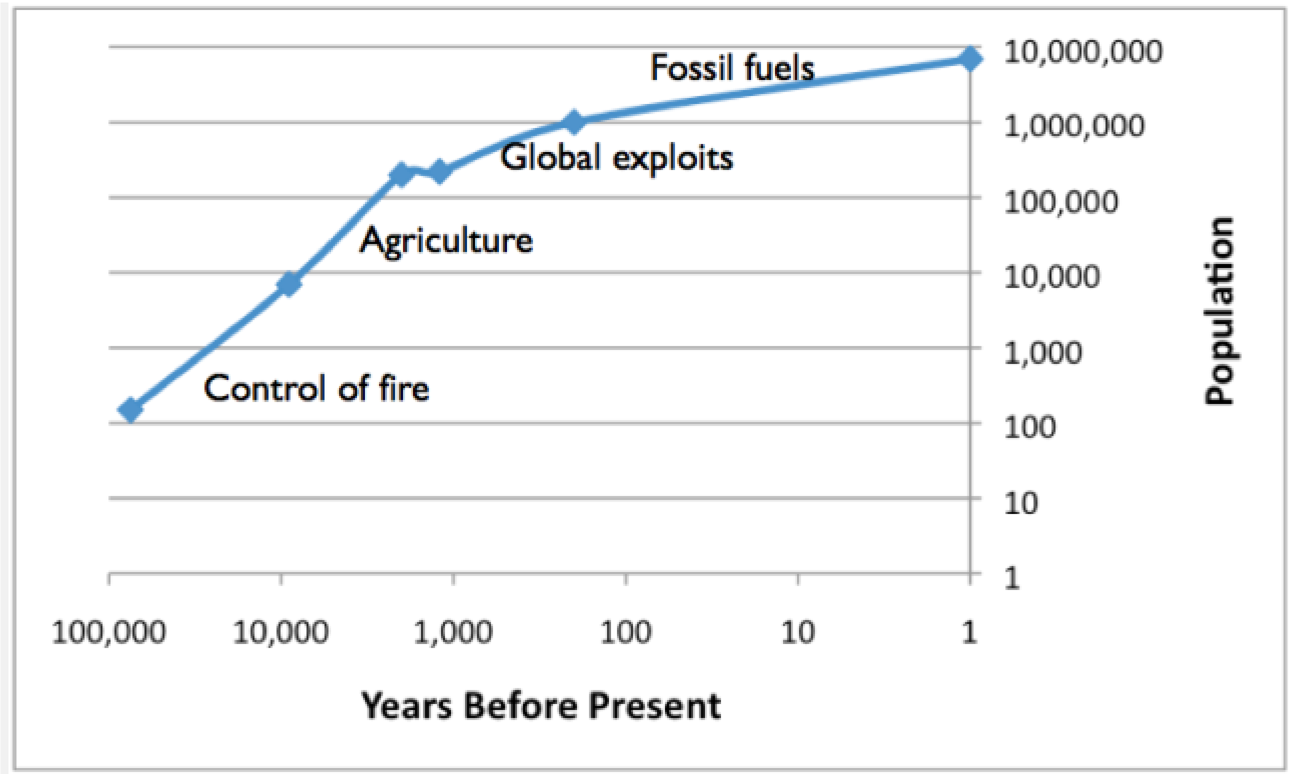

Figure 5. Log/log graph of human population growth, with energy sources giving rise to this growth.

The initial growth of human population occurred with the discovery of how to burn biomass, and how to use it for such purposes as cooking, keeping warm, honing stone tools to a sharper edge, and scaring predator animals away. All of these uses allowed ancestors of modern man to spread over a wider area of the globe, while at the same time wiping out many species of animals, as humans spread to new areas. Biologist and paleontologist Niles Eldridge says that Phase One of the Sixth Mass Extinction began when the first modern humans began to disperse to different parts of the world about 100,000 years ago. Phase Two began about 10,000 years ago when humans turned to agriculture. Even at these early stages, energy use by humans allowed human population to grow at the expense of the population of predator species.

There was a lull in human world population growth between 1 CE and 800 CE (Figure 5). In this period, there were many local collapses, so growth in one area tended to offset collapse in another area. When these collapses happened, they generally looked financial in nature, according to the research of Peter Turchin and Surgey Nefedov in Secular Cycles. Populations had found a new resource that allowed them to have more food supply–for example, they cleared land of trees so that it could be farmed or learned to use irrigation.

But over time, population grew and caught up with available resources. At the same time, the resources started degrading. The soil started eroding, or became less fertile, and or salt built up from irrigation. Wages of the common worker dropped, and it was hard for them to get adequate nourishment. Epidemics became common. The general shape of these collapses was approximately as follows:

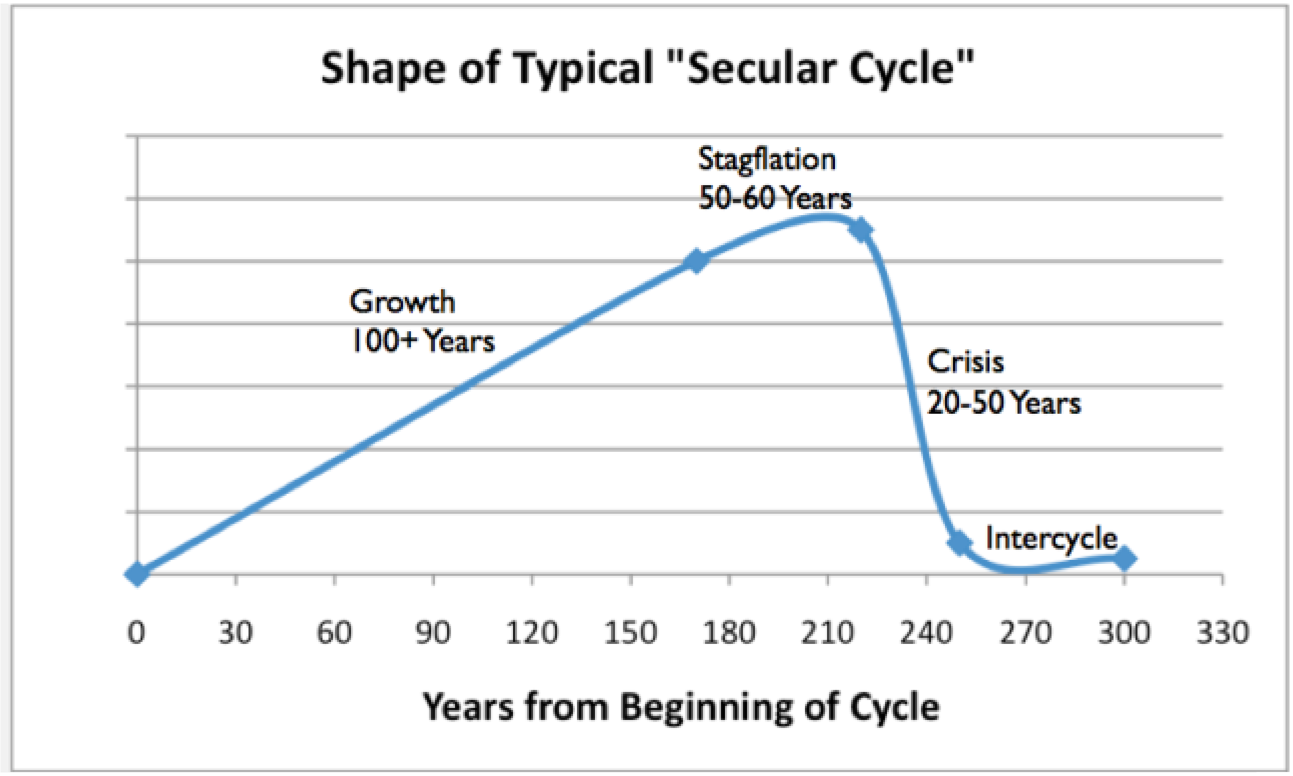

Figure 6. Shape of typical Secular Cycle, based on work of Peter Turkin and Sergey Nefedov.

So even in the Year 1 CE to Year 800 CE period, there was not a Steady State. Instead, there was a combination of overshoot and collapse type waves of the types seen with other species in different parts of the globe, which together averaged out to relatively flat world population growth.

Angus Maddison analyzed GDP growth in the 1 CE to 1000CE period. He concluded that the per capita GDP was slightly lower at the end of the period (453) than at the beginning of the period (476). He doesn't give amounts at the Year 800. But assuming that the change was fairly representative, the period 1CE to 800CE or 1 CE to 1000CE was close to a Steady State economy (with lots of collapses), considering the lack of both population growth and GDP growth per capita.

In more recent times, humans were able to add more energy sources (including peat moss, windmills, and water mills). They also developed better ocean-going ships that allowed them to make colonies, and spread agriculture further, and demand that these colonies extract resources to support the home country. Also, with a more globalized world, agriculture could be improved through a wider choice of domesticated plants and animals, by introducing species from other parts of the world.

Since 1800, the growth in fossil fuels has helped ramp up both population and standards of living.

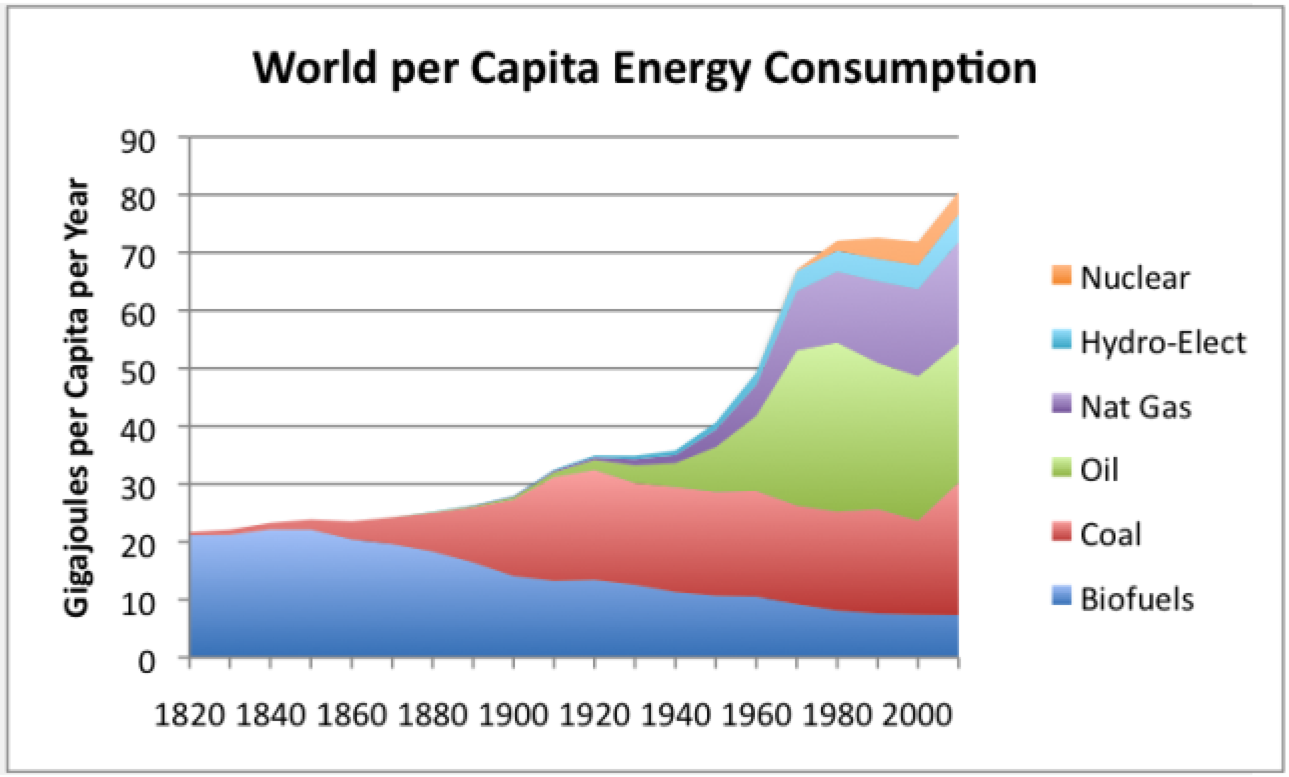

Figure 7. Per capita world energy consumption, calculated by dividing world energy consumption (based on Vaclav Smil estimates from Energy Transitions: History, Requirements and Prospects together with BP Statistical Data for 1965 and subsequent) by population estimates, based on Angus Maddison data.

What Are Humans' Options for Living in a Steady State Economy?

I am not sure there are many good choices:

1. If we went back to the period before the ancestors of humans discovered fire, about 100,000 to 200,000 of us could live in the warm areas of the world, eating raw food, and living much as chimpanzees and baboons do today, based on populations of those

primates today. The population of humans under such a scenario would fluctuate upward and downward, perhaps as in Figure 1.

Because of the availability of cooked foods for many years, the bodies of humans haveadapted to the improvement in diet. It is not clear that our teeth and internal organs could handle a purely raw-food diet, unless we happened to live in a part of the world where a soft diet (berries, fish and worms) was available. The areas where humans could live would also need to be warm, so our lack of fur would not be a problem. To meet these criteria, the population might need to be even lower than 100,000 to 200,000.

2. Having no humans at all is by definition a Steady State. I am doubtful that most people would consider this an acceptable Steady State, however.

3. If we did not have globalization and stopped adding energy supplies, we might continue to have local collapses, as in the 1CE to 800CE or 1000CE period. In this way, we could approximate a Steady State. Of course, now with globalization, a problem in one part of the world quickly spreads to other parts of the world.

4. If we want 7 billion people to be able to continue to live, we will need some basic level of energy supplies for these 7 billion people. If we assume that as a minimum, people today will need at least the 1820 level of energy consumption (based on Figure 7), we will need total energy consumption of at least 22 gigajoules per capita. This would amount to about 7% of the current energy consumption of the United States. It would not be enough to perform what we now consider basic functions such as maintaining roads, electrical systems, water systems, and sewer systems, so would be a major step down for US residents.

At the 1820 level of energy consumption, we would still need to continue a portion of fossil fuel consumption, since there are now so many of us that biofuels would no longer suffice (Figure 7-read across at 1820 level). Also, renewables, including today's modern hydroelectric and solar panels are made and transported with fossil fuels, so in order to have what we now consider renewables, we would need to continue to have some fossil fuel use. Also, electricity from wind and solar PV needs to be backed up with natural gas electricity generation.

In addition to needing energy to maintain a population of 7 billion people, we would also need a way to

(a) keep population down, and

(b) keep people from using available energy supplies (beyond the 22 gigajoules per capita allotted), to improve their lifestyles.

The way we often hear proposed for keeping population down is more education of women together with availability of birth control measures. Unfortunately, this approach is energy dependent. Unless considerable external energy is available, women will have to work in the fields to produce food. This will give them little time for education or the jobs that education would provide.

There are some cultures that have been able to keep population down by less energy-dependent means. For example, China uses strict governmental controls. Cultural and religious practices may also be used, such as delayed marriage and long breastfeeding. In some cases, abortion or infanticide may be used.

Keeping people from using available energy supplies to improve their lifestyles is even trickier. Some central authority can dictate that the US will use only 7% of the energy the population used in the past, meaning that everyone has to give up nearly everything. But enforcing this will be a real trick, unless energy supplies really are constrained.

There seems to be a common belief that cutting down on personal transportation fuel would have a big impact on total energy consumption. In the US, gasoline amounts to about 44% of US oil consumption. If we eliminated all gasoline consumption (even that by police, ambulances, and sales people), it would only reduce US *energy* consumption (all types, not just oil) by 16%. On a worldwide basis, much less oil is used for personal transportation, so eliminating all oil for personal transportation would likely reduce world energy consumption by something like 10% to 12%.

Is There a Reason for Aiming for a Steady State Economy?

At this point, we seem to be headed for collapse, because the number of humans is so far out of line with the population of other species. There are many other limits we are reaching as well, including the cost of oil extraction, the availability of fresh water, and the amount of pollution (including CO2 pollution). Also, governments are in increasingly poor financial condition, because when there are not enough resources to go around, governments tend to "come up short". They can't collect enough taxes relative to the benefits they pay out and all of the government programs they administer.

The only way a Steady State would make sense would be if there were some level of Steady State that humans could fall back to, instead of collapse. Unfortunately, it is hard to see a good place to fall back to. The only period during which human population was relatively constant was the period 1 CE to 800 CE, when frequent collapses kept population down. It is difficult to see any point at which humans have not increased population, or increased resource use, if resources were available, except when frequent civilization collapses overwhelmed the system.

If our civilization does collapse to a lower level, but not all the way back to zero, it seems likely that humans will again repeat the pattern they have experienced, over and over. They will again increase population and resource use, if resources are available. This pattern seems to be an instinct for all species, which is why it is virtually impossible to eliminate. Humans will then again collapse back to a more sustainable level.

Source: http://ourfiniteworld.com/2013/05/15/what-would-it-take-to-get-to-a-steady-state-economy/