What is ahead for 2016? Most people don’t realize how tightly the following are linked:

1. Growth in debt
2. Growth in the economy
3. Growth in cheap-to-extract energy supplies
4. Inflation in the cost of producing commodities
5. Growth in asset prices, such as the price of shares of stock and of farmland
6. Growth in wages of non-elite workers
7. Population growth

It looks to me as though this linkage is about to cause a very substantial disruption to the economy, as oil limits, as well as other energy limits, cause a rapid shift from the benevolent version of the economic supercycle to the portion of the economic supercycle reflecting contraction. Many people have talked about Peak Oil, the Limits to Growth, and the Debt Supercycle without realizing that the underlying problem is really the same—the fact that we are reaching the limits of a finite world.

There are actually a number of different kinds of limits to a finite world, all leading toward the rising cost of commodity production. I will discuss these in more detail later. In the past, the contraction phase of the supercycle seems to have been caused primarily by too high population relative to resources. This time, depleting fossil fuels—particularly oil—plays a major role. Other limits contributing to the end of the current debt supercycle include rising pollution and depletion of resources other than fossil fuels.

The problem of reaching limits in a finite world manifests itself in an unexpected way: slowing wage growth for non-elite workers. Lower wages mean that these workers become less able to afford the output of the system. These problems first lead to commodity oversupply and very low commodity prices. Eventually these problems lead to falling asset prices and widespread debt defaults. These problems are the opposite of what many expect, namely oil shortages and high prices. This strange situation exists because the economy is a networked system. Feedback loops in a networked system don’t necessarily work in the way people expect.

I expect that the particular problem we are likely to reach in 2016 is limits to oil storage. This may happen at different times for crude oil and the various types of refined products. As storage fills, prices can be expected to drop to a very low level—less than $10 per barrel for crude oil, and correspondingly low prices for the various types of oil products, such as gasoline, diesel, and asphalt. We can then expect to face a problem
with debt defaults, failing banks, and failing governments (especially of oil exporters).

The idea of a bounce back to new higher oil prices seems exceedingly unlikely, in part because of the huge overhang of supply in storage, which owners will want to sell, keeping supply high for a long time. Furthermore, the underlying cause of the problem is the failure of wages of non-elite workers to rise rapidly enough to keep up with the rising cost of commodity production, particularly oil production. Because of falling inflation-adjusted wages, non-elite workers are becoming increasingly unable to afford the output of the economic system. As non-elite workers cut back on their purchases of goods, the economy tends to contract rather than expand. Efficiencies of scale are lost, and debt becomes increasingly difficult to repay with interest. The whole system tends to collapse.

How the Economic Growth Supercycle Works, in an Ideal Situation

In an ideal situation, growth in debt tends to stimulate the economy. The availability of debt makes the purchase of high-priced goods such as factories, homes, cars, and trucks more affordable. All of these high-priced goods require the use of commodities, including energy products and metals. Thus, growing debt tends to add to the demand for commodities, and helps keep their prices higher than the cost of production, making it profitable to produce these commodities. The availability of profits encourages the extraction of an ever-greater quantity of energy supplies and other commodities.

The growing quantity of energy supplies made possible by this profitability can be used to leverage human labor to an ever-greater extent, so that workers become increasingly productive. For example, energy supplies help build roads, trucks, and machines used in factories, making workers more productive. As a result, wages tend to rise, reflecting the greater productivity of workers in the context of these new investments. Businesses find that demand for their goods and services grows because of the growing wages of workers, and governments find that they can collect increasing tax revenue. The arrangement of repaying debt with interest tends to work well in this situation. GDP grows sufficiently rapidly that the ratio of debt to GDP stays relatively flat.

Over time, the cost of commodity production tends to rise for several reasons:

1. Population tends to grow over time, so the quantity of agricultural land available per person tends to fall. Higher-priced techniques (such as irrigation, better seeds, fertilizer, pesticides, herbicides) are required to increase production per acre. Similarly, rising population gives rise to a need to produce fresh water using increasingly high-priced techniques, such as desalination.

2. Businesses tend to extract the least expensive fuels such as oil, coal, natural gas, and uranium first. They later move on to more expensive to extract fuels, when the less-expensive fuels are depleted. For example, Figure 1 shows the sharp increase in the cost of oil extraction that took place about 1999.
3. Pollution tends to become an increasing problem because the least polluting commodity sources are used first. When mitigations such as substituting renewables for fossil fuels are used, they tend to be more expensive than the products they are replacing. The leads to the higher cost of final products.

4. Overuse of resources other than fuels becomes a problem, leading to problems such as the higher cost of producing metals, deforestation, depleted fish stocks, and eroded topsoil. Some workarounds are available, but these tend to add costs as well.

As long as the cost of commodity production is rising only *slowly*, its increasing cost is benevolent. This increase in cost adds to inflation in the price of goods and helps inflate away prior debt, so that debt is easier to pay. It also leads to asset inflation, making the use of debt seem to be a worthwhile approach to finance future economic growth, including the growth of energy supplies. The whole system seems to work as an economic growth pump, with the rising wages of non-elite workers pushing the growth pump along.

**The Big “Oops” Comes when the Price of Commodities Starts Rising *Faster* than Wages of Non-Elite Workers**

Clearly the wages of non-elite workers need to be rising faster than commodity prices in order to push the economic growth pump along. The economic pump effect is lost when the wages of non-elite workers start falling, relative to the price of commodities. This tends to happen when the cost of commodity production begins rising *rapidly*, as it did for oil after 1999 (Figure 1).

The loss of the economic pump effect occurs because the rising cost of oil (or electricity, or food, or other energy products) forces workers to cut back on discretionary expenditures. This is what happened in the 2003 to 2008 period as oil prices spiked and other energy prices rose sharply. (See my article [Oil Supply Limits and the](https://ourfiniteworld.com/2016/01/07/2016-oil-limits-and-the-end-of-the-debt-supercycle/))
Continuing Financial Crisis.) Non-elite workers found it increasingly difficult to afford expensive products such as homes, cars, and washing machines. Housing prices dropped. Debt growth slowed, leading to a sharp drop in oil prices and other commodity prices.

It was somewhat possible to “fix” low oil prices through the use of Quantitative Easing (QE) and the growth of debt at very low interest rates, after 2008. In fact, these very low interest rates are what encouraged the very rapid growth in the production of US crude oil, natural gas liquids, and biofuels.

Now, debt is reaching limits. Both the US and China have (in a sense) “taken their foot off the economic debt accelerator.” It doesn’t seem to make sense to encourage more use of debt, because recent very low interest rates have encouraged unwise investments. In China, more factories and homes have been built than the market can absorb. In the US, oil “liquids” production rose faster than it could be absorbed by the world market when prices were over $100 per barrel. This led to the big price drop. If it were possible to produce the additional oil for a very low price, say $20 per barrel, the world economy could probably absorb it. Such a low selling price doesn’t really “work” because of the high cost of production.

Debt is important because it can help an economy grow, as long as the total amount of debt does not become unmanageable. Thus, for a time, growing debt can offset the adverse impact of the rising cost of energy products. We know that oil prices began to rise sharply in the 1970s, and in fact other energy prices rose as well.
Looking at debt growth, we find that it rose rapidly, starting about the time oil prices started spiking. Former Director of the Office of Management and Budget, David Stockman, talks about “The Distastrous 40-Year Debt Supercycle,” which he believes is now ending.

In recent years, we have been reaching a situation where commodity prices have been rising faster than the wages of non-elite workers. Jobs that are available tend to be low-paid service jobs. Young people find it necessary to stay in school longer. They also find it necessary to delay marriage and postpone buying a car and home. All of these issues contribute to the falling wages of non-elite workers. Some of these individuals are, in
fact, getting zero wages, because they are in school longer. Individuals who retire or voluntarily leave the work force further add to the problem of wages no longer rising sufficiently to afford the output of the system.

The US government has recently decided to raise interest rates. This further reduces the buying power of non-elite workers. We have a situation where the “economic growth pump,” created through the use of a rising quantity of cheap energy products plus rising debt, is disappearing. While homes, cars, and vacation travel are available, an increasing share of the population cannot afford them. This tends to lead to a situation where commodity prices fall below the cost of production for a wide range of types of commodities, making the production of commodities unprofitable. In such a situation, a person expects companies to cut back on production. Many defaults may occur.

China has acted as a major growth pump for the world for the last 15 years, since it joined the World Trade Organization in 2001. China’s growth is now slowing, and can be expected to slow further. Its growth was financed by a huge increase in debt. Paying back this debt is likely to be a problem.

Thus, we seem to be coming to the contraction portion of the debt supercycle. This is frightening, because if debt is contracting, asset prices (such as stock prices and the price of land) are likely to fall. Banks are likely to fail, unless they can transfer their problems to others—owners of the bank or even those with bank deposits. Governments will be affected as well, because it will become more expensive to borrow money, and because it becomes more difficult to obtain revenue through taxation. Many governments may fail as well for that reason.

The U. S. Oil Storage Problem

Oil prices began falling in the middle of 2014, so we might expect oil storage problems to start about that time, but this is not exactly the case. Supplies of US crude oil in storage didn’t start rising until about the end of 2014.
Once crude oil supplies started rising rapidly, they increased by about 90 million barrels between December 2014 and April 2015. After April 2015, supplies dipped again, suggesting that there is some seasonality to the growing crude oil supply. The most “dangerous” time for rapidly rising amounts added to storage would seem to be between December 31 and April 30. According to the EIA, maximum crude oil storage is 551 million barrels of crude oil (considering all storage facilities). Adding another 90 million barrels of oil (similar to the run-up between Dec. 2014 and April 2015) would put the total over the 551 million barrel crude oil capacity.

Cushing, Oklahoma, is the largest storage area for crude oil. According to the EIA, maximum working storage for the facility is 73 million barrels. Oil storage at Cushing since oil prices started declining is shown in Figure 7.
Clearly the same kind of run up in oil storage that occurred between December and April one year ago cannot all be stored at Cushing, if maximum working capacity is only 73 million barrels, and the amount currently in storage is 64 million barrels.

Another way of storing oil is as finished products. Here, the run-up in storage began earlier (starting in mid-2014) and stabilized at about 65 million barrels per day above the prior year, by January 2015. Clearly, if companies can do some pre-planning, they would prefer not to refine products for which there is little market. They would rather store unneeded oil as crude, rather than as refined products.

![Oil Products in Storage in US (ex SPR)](image)

EIA indicates that the total capacity for oil products is 1,549 million barrels. Thus, in theory, the amount of oil products stored can be increased by as much as 700 million barrels, assuming that the products needing to be stored and the locations where storage are available match up exactly. In practice, the amount of additional storage available is probably quite a bit less than 700 million barrels because of mismatch problems.

In theory, if companies can be persuaded to refine more products than they can sell, the amount of products that can be stored can rise significantly. Even in this case, the amount of storage is not unlimited. Even if the full 700 million barrels of storage for crude oil products is available, this corresponds to less than one million barrels a day for two years, or two million barrels a day for one year. Thus, products storage could easily be filled as well, if demand remains low.

At this point, we don’t have the mismatch between oil production and consumption fixed. In fact, both Iraq and Iran would like to increase their production, adding to the production/consumption mismatch. China’s economy seems to be stalling, keeping its oil consumption from rising as quickly as in the past, and further adding to the supply/demand mismatch problem. Figure 9 shows an approximation to our mismatch problem.
As far as I can tell, the problem is still getting worse, not better.

There has been a lot of talk about the United States reducing its production, but the impact so far has been small, based on data from EIA's International Energy Statistics and its December 2015 Monthly Energy Review.

Based on information through November from EIA’s Monthly Energy Review, total liquids production for the US for the year 2015 will be about 700,000 barrels per day higher than it was for 2014. This increase is likely greater than the increase in production by either Saudi Arabia or Iraq. Perhaps in 2016, oil production of the US
will start decreasing, but so far, increases in biofuels and natural gas liquids are partly offsetting recent reductions in crude oil production. Also, even when companies are forced into bankruptcy, oil production does not necessarily stop because of the potential value of the oil to new owners.

Figure 11 shows that very high stocks of oil were a problem, way back in the 1920s. There were other similarities to today’s problems as well, including a deflating debt bubble and low commodity prices. Thus, we should not be too surprised by high oil stocks now, when oil prices are low.

Many people overlook the problems today because the US economy tends to be doing better than that of the rest of the world. The oil storage problem is really a world problem, however, reflecting a combination of low demand growth (caused by low wage growth and lack of debt growth, as the world economy hits limits) continuing supply growth (related to very low interest rates making all kinds of investment appear profitable and new production from Iraq and, in the near future, Iran). Storage on ships is increasingly being filled up and storage in Western Europe is 97% filled. Thus, the US is quite likely to see a growing need for oil storage in the year ahead, partly because there are few other places to put the oil, and partly because the gap between supply and demand has not yet been fixed.

What is Ahead for 2016?

1. Problems with a slowing world economy are likely to become more pronounced, as China’s growth problems continue, and as other commodity-producing countries such as Brazil, South Africa, and Australia experience recession. There may be rapid shifts in currencies, as countries attempt to devalue their currencies, to try to gain an advantage in world markets. Saudi Arabia may decide to devalue its currency, to get more benefit from the oil it sells.

2. Oil storage seems likely to become a problem sometime in 2016. In fact, if the run-up in oil supply is heavily front-ended to the December to April period, similar to what happened a year ago, lack of crude oil storage space could become a problem within the next three months. Oil prices could fall to $10 or below. We know that for natural gas and electricity, prices often fall below zero when the ability of the system to absorb more
supply disappears. It is not clear the oil prices can fall below zero, but they can certainly fall very low. Even if we can somehow manage to escape the problem of running out of crude oil storage capacity in 2016, we could encounter storage problems of some type in 2017 or 2018.

3. Falling oil prices are likely to cause numerous problems. One is debt defaults, both for oil companies and for companies making products used by the oil industry. Another is layoffs in the oil industry. Another problem is negative inflation rates, making debt harder to repay. Still another issue is falling asset prices, such as stock prices and prices of land used to produce commodities. Part of the reason for the fall in price has to do with the falling price of the commodities produced. Also, sovereign wealth funds will need to sell securities, to have money to keep their economies going. The sale of these securities will put downward pressure on stock and bond prices.

4. Debt defaults are likely to cause major problems in 2016. As noted in the introduction, we seem to be approaching the unwinding of a debt supercycle. We can expect one company after another to fail because of low commodity prices. The problems of these failing companies can be expected to spread to the economy as a whole. Failing companies will lay off workers, reducing the quantity of wages available to buy goods made with commodities. Debt will not be fully repaid, causing problems for banks, insurance companies, and pension funds. Even electricity companies may be affected, if their suppliers go bankrupt and their customers become less able to pay their bills.

5. Governments of some oil exporters may collapse or be overthrown, if prices fall to a low level. The resulting disruption of oil exports may be welcomed, if storage is becoming an increased problem.

6. It is not clear that the complete unwind will take place in 2016, but a major piece of this unwind could take place in 2016, especially if crude oil storage fills up, pushing oil prices to less than $10 per barrel.

7. Whether or not oil storage fills up, oil prices are likely to remain very low, as the result of rising supply, barely rising demand, and no one willing to take steps to try to fix the problem. Everyone seems to think that someone else (Saudi Arabia?) can or should fix the problem. In fact, the problem is too large for Saudi Arabia to fix. The United States could in theory fix the current oil supply problem by taxing its own oil production at a confiscatory tax rate, but this seems exceedingly unlikely. Closing existing oil production before it is forced to close would guarantee future dependency on oil imports. A more likely approach would be to tax imported oil, to keep the amount imported down to a manageable level. This approach would likely cause the ire of oil exporters.

8. The many problems of 2016 (including rapid moves in currencies, falling commodity prices, and loan defaults) are likely to cause large payouts of derivatives, potentially leading to the bankruptcies of financial institutions, as they did in 2008. To prevent such bankruptcies, most governments plan to move as much of the losses related to derivatives and debt defaults to private parties as possible. It is possible that this approach will lead to depositors losing what appear to be insured bank deposits. At first, any such losses will likely be limited to amounts in excess of FDIC insurance limits. As the crisis spreads, losses could spread to other deposits. Deposits of employers may be affected as well, leading to difficulty in paying employees.

9. All in all, 2016 looks likely to be a much worse year than 2008 from a financial perspective. The problems will look similar to those that might have happened in 2008, but didn’t thanks to government intervention. This time, governments appear to be mostly out of approaches to fix the problems.

10. Two years ago, I put together the chart shown as Figure 12. It shows the production of all energy products
declining rapidly after 2015. I see no reason why this forecast should be changed. Once the debt supercycle starts its contraction phase, we can expect a major reduction in both the demand and supply of all kinds of energy products.

![Tverberg Estimate of Future Energy Production](image)

Figure 12. Estimate of future energy production by author. Historical data based on BP adjusted to IEA groupings.

**Conclusion**

We are certainly entering a worrying period. We have not really understood how the economy works, so we have tended to assume we could fix one or another part of the problem. The underlying problem seems to be a problem of physics. The economy is a dissipative structure, a type of self-organizing system that forms in thermodynamically open systems. As such, it requires energy to grow. Ultimately, diminishing returns with respect to human labor—what some of us would call falling inflation-adjusted wages of non-elite workers—tends to bring economies down. Thus all economies have finite lifetimes, just as humans, animals, plants, and hurricanes do. We are in the unfortunate position of observing the end of our economy’s lifetime.

Most energy research to date has focused on the Second Law of Thermodynamics. While this is a contributing problem, this is really not the proximate cause of the impending collapse. The Second Law of Thermodynamics operates in thermodynamically closed systems, which is not precisely the issue here.

We know that historically collapses have tended to take many years. This collapse may take place more rapidly because today’s economy is dependent on international supply chains, electricity, and liquid fuels—things that previous economies were not dependent on.

I have written many articles on related subjects (unfortunately, no book). These are a few of them:

*Low Oil Prices – Why Worry?*
How Economic Growth Fails

Deflationary Collapse Ahead?

Oops! Low oil prices are related to a debt bubble

Why “supply and demand” doesn’t work for oil

Economic growth: How it works; how it fails; why wealth disparity occurs

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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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Feb. 3-5 I expect to have a chance to talk to some or all of these: Janet McCabe, Acting Assistant Administrator, U.S.