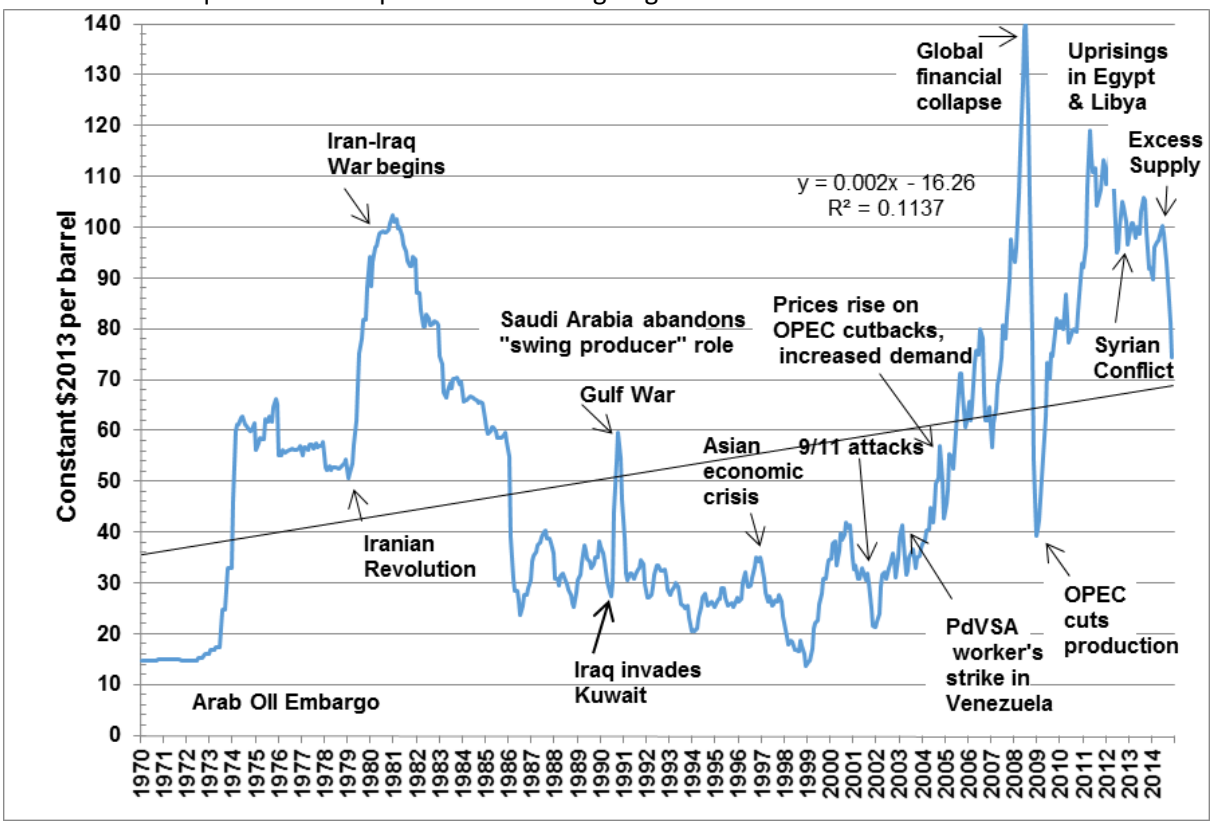
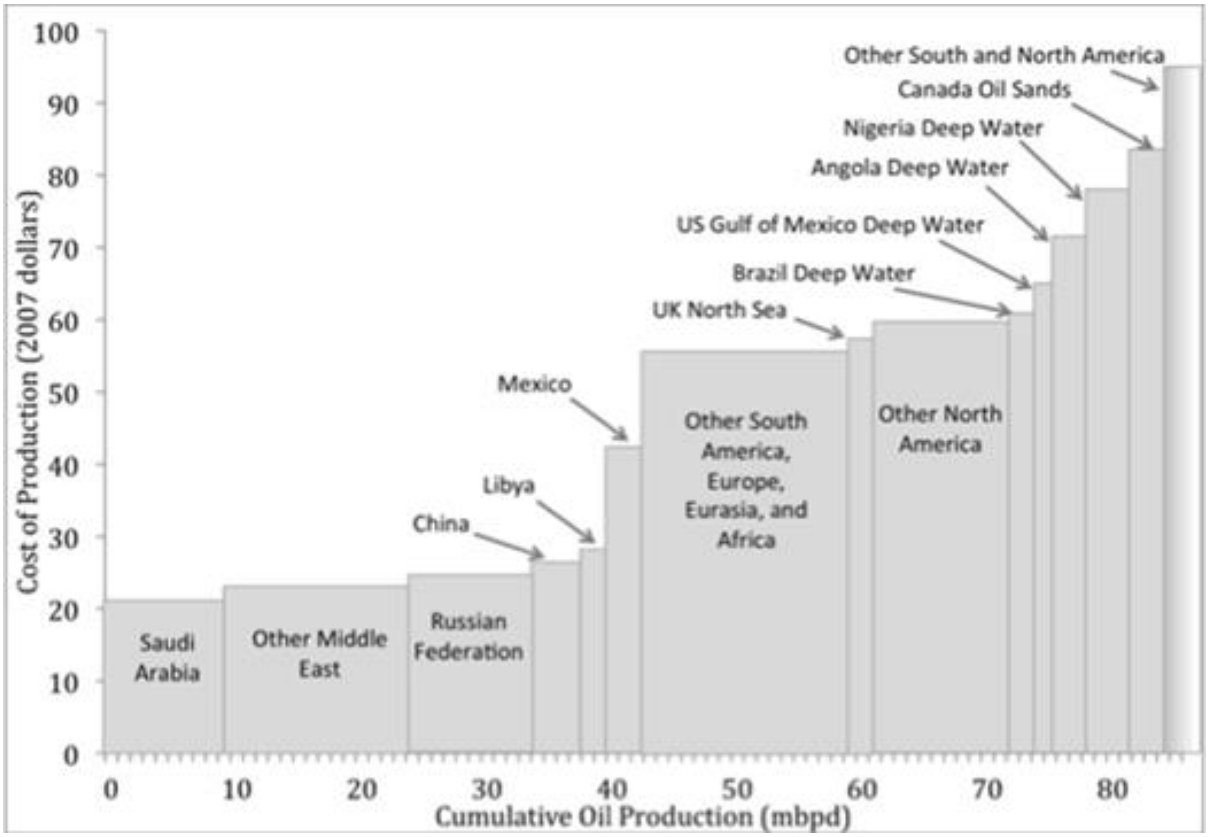
Energy and declining economic growth

Energy

Increasing costs of energy are already causing economic problems and this will have more serious economic consequences as the problem worsens going forward.



Energy price, particularly oil price is very volatile. This makes it hard to see the underlying reality hidden in the noise. As the graph above shows, during the period from 1970 to 2014 oil prices followed a very volatile trajectory, starting high, bottoming in 1998, and generally rising until the recent fall. When we add the overall price trend line shown in the graph above we see about a doubling in price from $35/b to $70/b on top of a big initial $20/b step up due to the OPEC cartel.



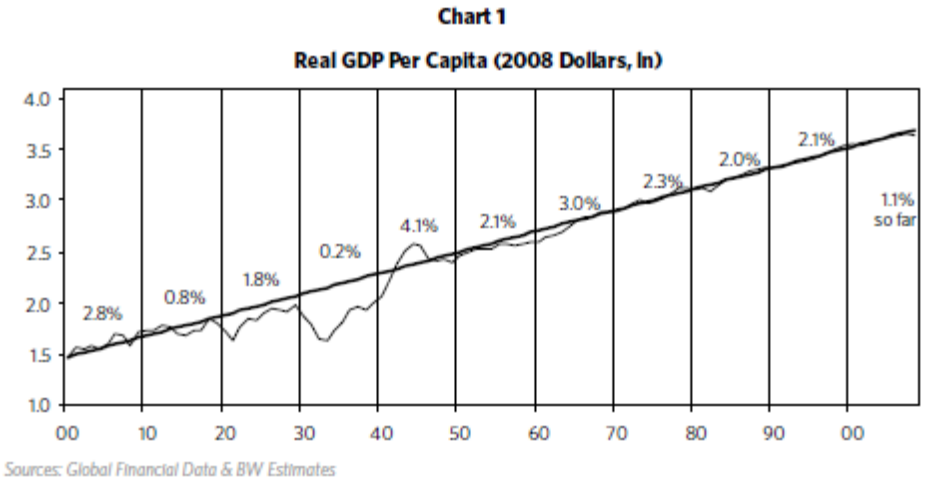
If instead we look at the cost of production the situation is easier to understand. This graph from a few years back captures the **cost** of oil production in about 2010. This graph only covers variable O&M and fixed O&M financial costs. The oil **price** paid is the sum of these costs, the investment in developing new supply and profit (or loss).

Up to about 1980, most oil cost around what Saudi oil costs to produce ($15/b to $20/b). By 2010, more than half of oil production was more expensive due to the expense of enhanced oil recovery technologies, deep water wells, and oil sands, with production cost averaging around $50/b. US fracking appears to have production costs between $50/b and $80/b and its volume growth since 2010 has slowed the rate of increase of average cost somewhat.

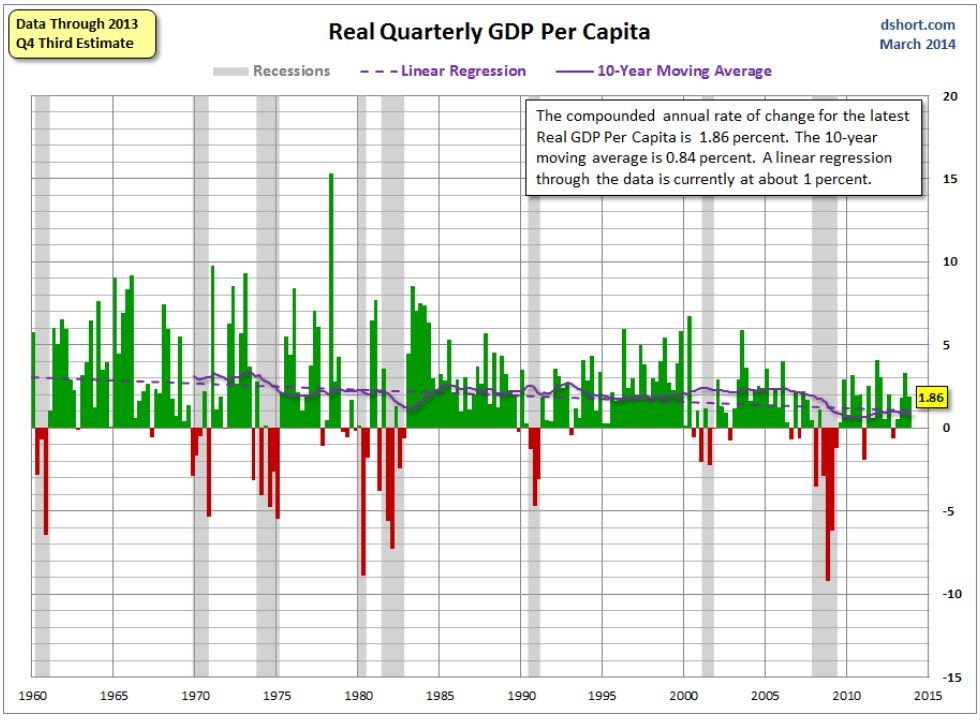
The fundamental issue for the economy is that as time is passing an increasing percentage of oil is more expensive to produce and the average cost of production is rising steadily. Despite the volatility of the oil market, this rising cost of production also shows through clearly in the rising price trend shown in the first graph. This means the energy sector of the economy is getting less productive. The economy as a whole is still productive, so logically the combination of oil and the rest of the economy must be less productive than the rest of the economy alone. This should help with estimating the relative size of the productive and non productive sectors of the economy using the statistics for economic growth.

Economic growth

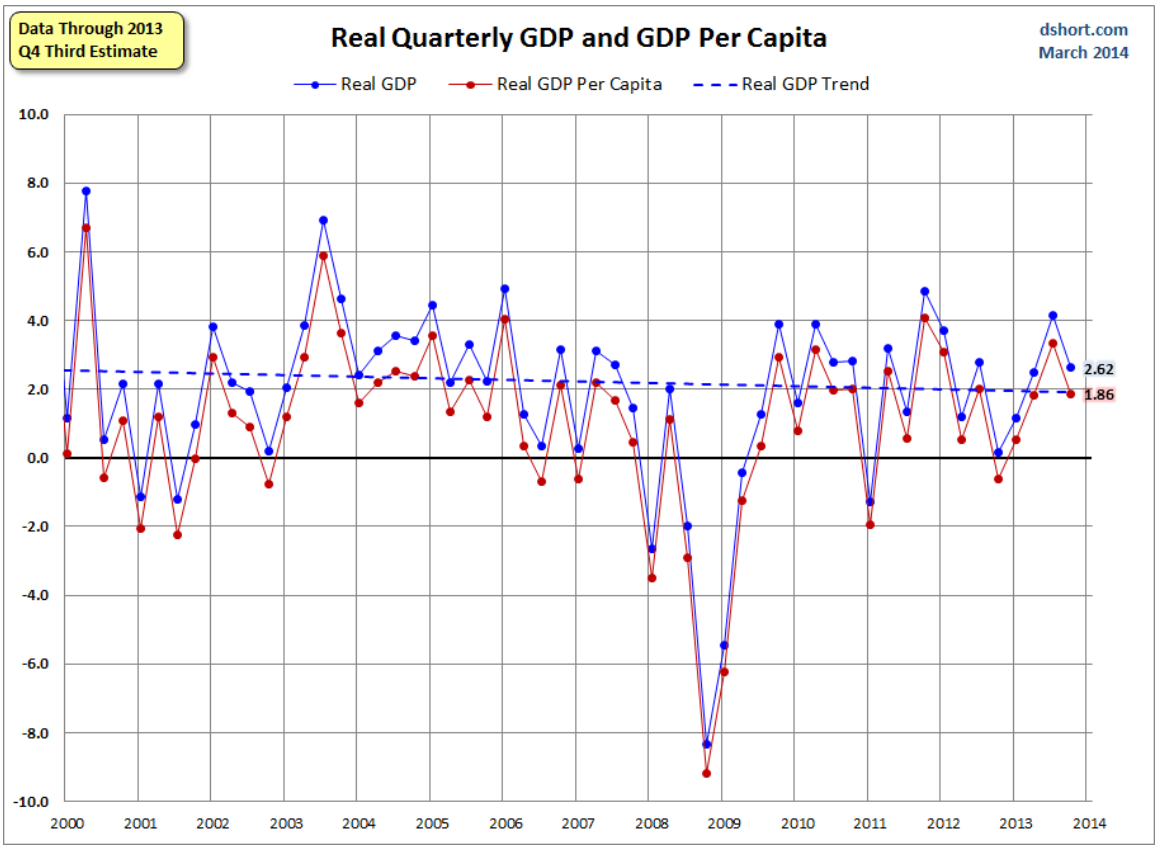
The fundamental economic issue is the increasing cost of oil and other energy production. Energy is a very large part of the economy and fundamentally linked to economic growth. If energy costs more resources to produce, the rest of the economy has fewer resources.



As the graph of real US GDP per capita from 1900 to 2015 above shows, over the last 115 years, US real GDP per capita has grown with a very stable long term trend of 2%/y.



This graph of real quarterly change in US GDP per capita from the shorter period of 1960 to the present (54 years) shows a declining growth rate trend that is currently at 1%. This implies that we may no longer be at the 2% longer term 115-year trend in economic growth seen in the first graph. Visually there is clearly a lot less green on the right hand side of the graph.



If we narrow our focus to 2000 to 2014, the trend line in this graph shows a relatively small decline in economic growth rate of GDP per capita between 2000 and 2014 (14 years) from about 2.3% to 1.86%. Its always unwise to focus on recent trends, but for the sake of a more optimistic forecast the following section is based on this more recent US GDP growth trend.

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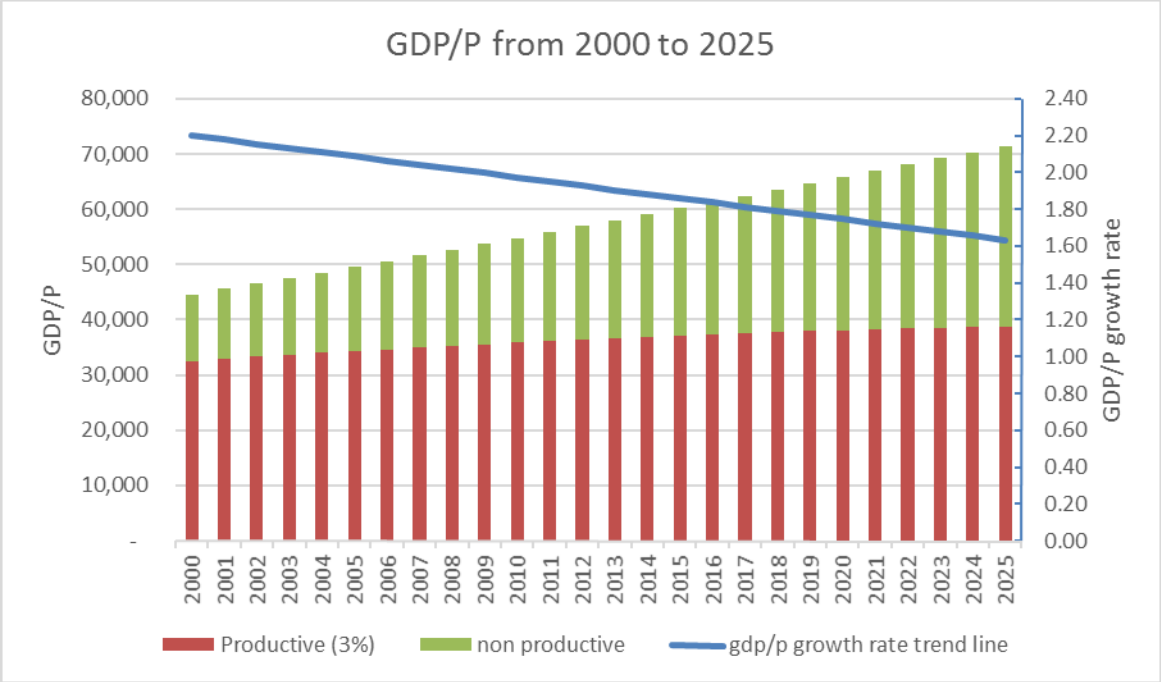
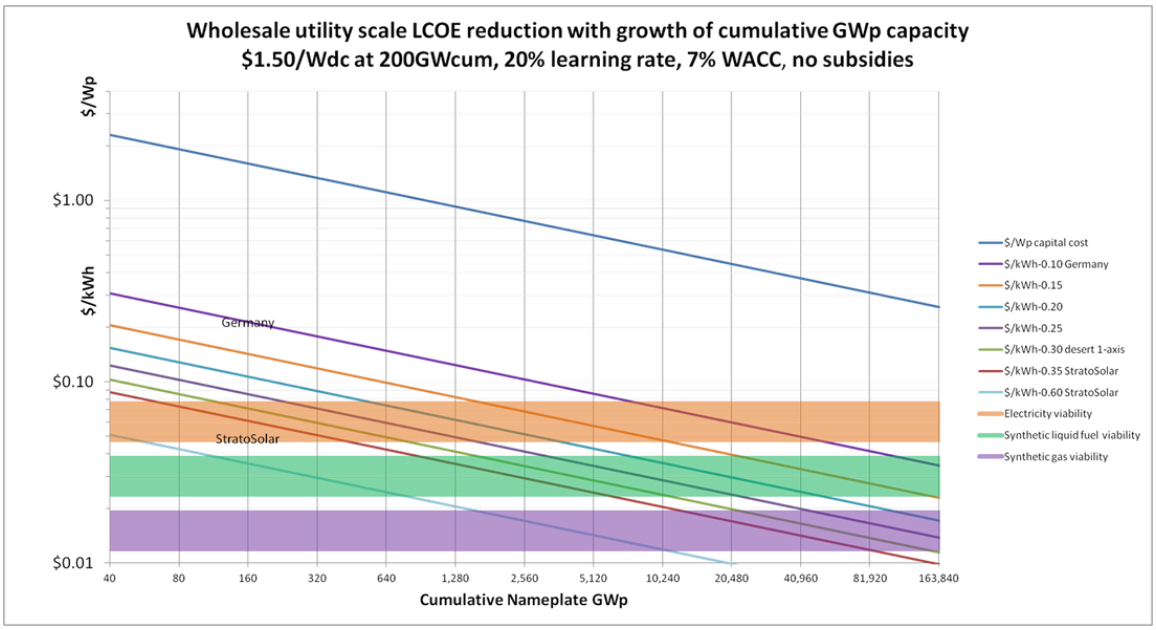


The straight line in the graph above (axis on the right) shows a snapshot of the actual downward trend from 2000 to 2015 projected forward to 2025. The stacked colored bars representing GDP per capita (axis on the left) illustrate a simple model that assumes the economy has two sectors. The red sector has a high productivity growth rate of 3% and the green sector is stalled out with 0% productivity growth rate. To make the growth rate numbers fit the actual growth rate trend data we need to start with the non productive green sector at 25% of GDP. This produces a breakdown like that shown, with the non productive sector continually increasing as the overall growth rate declines.

These numbers imply that a larger sector of the economy than just energy is contributing to the recent decline in economic growth rate. Increased energy costs seem likely to account for about a third of the decline by 2015. The other likely contributors to decreasing growth rate are substantial and growing parts of the financial sector, health care and education.

This reduced rate of overall economic growth is already causing severe economic problems, contributing to income inequality and stagnant wages. The problems will only get worse if the growth rate continues on its current downward trend. This illustrates that economic growth is a sensitive thing that cannot survive a large and growing part of the economy becoming less productive. This simple model shows that fixing the problem of lower growth means reducing the size of the non productive sectors. For the service sector problem areas, like finance and healthcare, the solutions are mainly political, but for energy the solution has to be mainly technological.

Energy solution



The last section showed that the current rising cost of fossil fuel energy is already reducing US economic growth, regardless of it's impact on CO2 emissions and climate change. There is no broad understanding of this reality. Awareness would make it clear that a competitive, lower cost source of clean energy is already the most important thing to enable an energy transition that restores US economic growth. In fact, to maintain US economic growth, an energy solution should not only be low cost but should also become more productive and cost less to produce over time.

The graph above shows that PV generation meets the need for a cost reduction trend with increased capacity over time. However, the upper trend lines for ground based PV for various geographical locations at the current 200GW installed capacity, show that ground based PV solar is currently several times the needed lower cost (shown by the orange band) and is reducing in cost at too low a rate to be an affordable solution for a long, long time.

The graph trend lines for StratoSolar show a cost of electricity (LCOE) with current PV technology that is already lower than fossil fuel generation, with continuing cost reduction as more is deployed over time. StratoSolar also solves daytime intermittency, nighttime generation with gravity energy storage and geographical location problems that plague current ground PV.

Conclusion

Awareness of the degree to which rising energy costs are already reducing economic growth should make the need for a lower cost energy solution more compelling. Politicians can ignore climate change, but sustained economic growth is at the heart of modern prosperity and it is already in serious trouble and an immediate political concern for everyone.