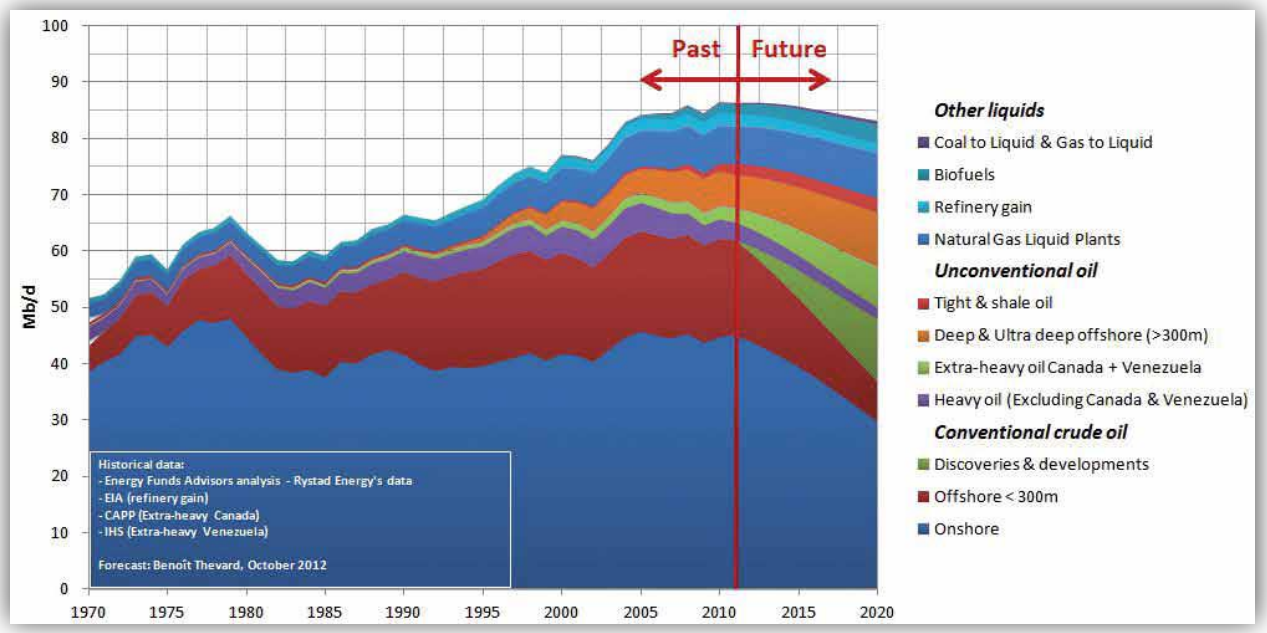
Some useful recent peak oil references and excerpts
March 28, 2013

Comments in brackets by Greg Mello.

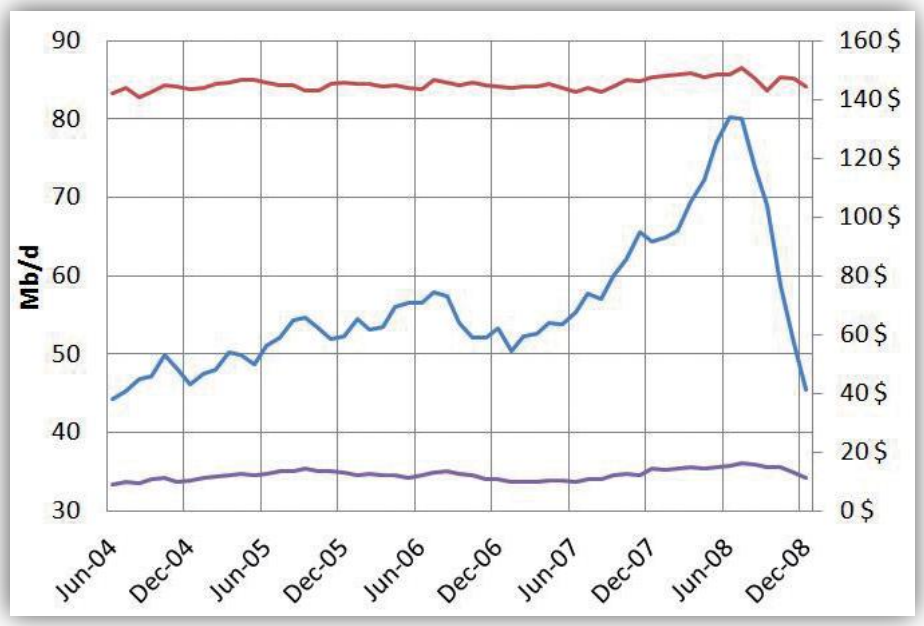
"Europe facing peak oil," The Greens/EFA, November, 2012, http://www.resilience.org/stories/2013-03-19/peak-oil-mar-19 and http://www.peakoil-europaction.eu/home.html.

Excerpts:

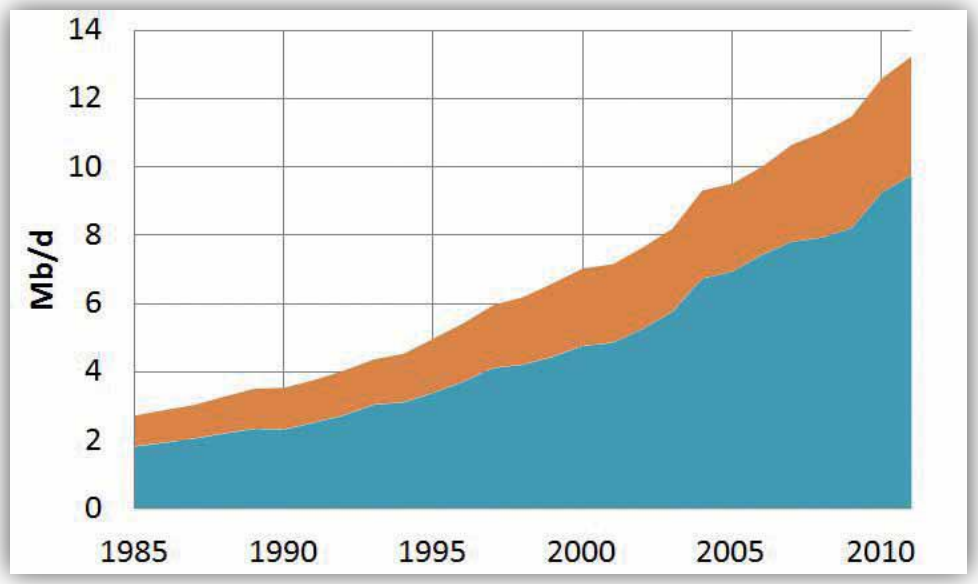
> We have in fact reached "peak oil" – the maximum level of global oil production that geophysicist Marion King Hubbert modelled in the late 1950s. In the latest issues of World Energy Outlook, the International Energy Agency recognises that the production of conventional crude oil levelled out towards 2006 and has begun to decline. This means trouble, given that the decline will happen at a quicker pace than the development of non-conventional hydrocarbons. Until recently, the two key factors determining production capacity were the price of crude oil and the level of consumption. Today, other constraints have become too strong and too numerous to be ignored. The massive investments required, extreme operating conditions, an increasingly low Energy Return on Energy Invested (ERoEI), significant environmental risks and impacts, and serious geopolitical instabilities are a number of limiting factors that might well preclude the higher production levels forecast by many public and private organisations.
>
> Evaluations of global oil reserves are inevitably inaccurate owing to the large number of operators involved, the confidentiality of certain data, the complexity of the evaluation methods used, and the vagueness of international definitions. With so many variables, it is easy for oil-producing countries and private oil companies alike to juggle the figures and paint a conveniently vague and misleading picture of the situation in order to further their own aims.
>
> ….
>
> The ERoEI, though very often neglected, is nevertheless a key concept, since it determines the amount of net energy ultimately available to make society "work".



[The core graphic of this report. Stacking of incommensurable and non-fuel liquids and double-counting follows recent government practice. This delays the onset of peak oil perceptions.]



Overall production of liquids (world and OPEC) and barrel price (Brent) 2004-2008 [illustrating the flatness of the first two in the face of dramatic increases in the third, suggesting inability to increase production]



In the space of 25 years, China and India's combined demand has increased almost fivefold, from 2.7 to 13 Mb/d (BP, 2012).

[Countries with higher-value-added-per-barrel-economies can in general tolerate higher prices than those economies which are less efficient as regards oil. China is a "price maker" that can outbid the developed West for the declining supply of exported oil; the OECD countries tend by contrast to be "price takers," especially the U.S., which is highly oil-inefficient and yet heavily reliant on imported oil.]

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New Economics Foundation, "The economics of oil dependence: a glass ceiling to recovery: Why the oil industry today is like banking was in 2006," 10 November 2012, http://www.neweconomics.org/publications/the-economics-of-oil-dependence-a-glass-ceiling-to-recovery

Abstract:

We have now reached a stage in our exploitation of fossil fuel resources where economic growth, as we have known it over the past century, has come to an end.

The cost of continuing to increase our supplies of oil and gas has reached a level where recession has become endemic. Each time the economy begins to recover from recession, the price of oil will increase and send the economy back into recession.

The only possible response to this situation is very clear. It is the same response that is needed to combat climate change – end our dependence on fossil fuels.

Summary:

As growth in oil production slows and global demand continues to rise, sustained high oil prices and price spikes will have a significant impact on the economy, in effect placing a glass ceiling on economic recovery

The analysis presented in this report shows that this threat is as real and as imminent as was the banking crisis in the middle of the past decade. Without bold and imaginative action, the consequences will cast a shadow on generations to come. Unemployment, underfunded essential services, recession, and depressed and crippled economies provide daily reminders of what the future will hold.

Oil prices and the recession

In the last year, the International Energy Agency (IEA), the International Monetary Fund (IMF), and the G7 have warned that high oil prices have likely been constraining economic recovery from the Great Recession.

Slowing the rate of decrease in oil production can only be achieved by a potential doubling of the price of oil over the next decade. This is likely to usher in the phenomenon of 'economic peak oil'. In this report, we define this as:

...the point at which the cost of incremental supply exceeds the price economies can pay without significantly disrupting economic activity at a given point in time.

Beyond this 'pain barrier', the level of oil prices will have a dramatic effect on a nation's people and its economy, threatening stagnation and hardship.

Using this definition of economic peak oil, our analysis provides a new method for determining the likely timing of peak oil, compared to the more common method of simply looking at new capacity, subtracting depletion, and balancing that against the most likely trajectory for growth.

We find that both approaches seem to point to 2014/2015 as a crunch period.

A crisis of the cost and availability of transport fuels

In this report we argue that the current economic crisis is neither an oil crisis nor an energy crisis, but a crisis related to the cost and availability of transport fuels – gasoline, diesel, jet kerosene, and ship bunker fuel. These liquid fuels account for up to 80 per cent of all oil usage.

Transport fuels link all elements of the economy. If every linkage costs more due to sustained high oil prices, all costs will increase, the economy will slow, and inflation will rise.

The vulnerability of oil-importing economies

Nations that are increasingly dependent on oil imports face two threats over which they have very little control.

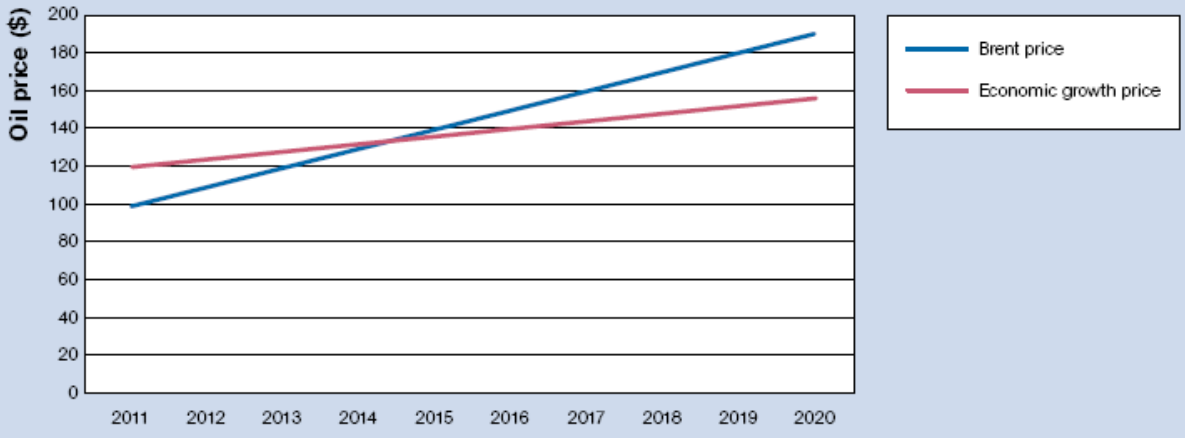
First is the increasing consumption of oil in the producers' own countries. Saudi Arabia, traditionally the largest oil exporter in the world, exported less oil in 2011 than it did in 2005 or even 1985. This is despite large increases in production in recent years.

Second, some importing countries may be better able to accept higher prices for oil.

In mature high-consuming economies like the USA, oil prices greater than $90 per barrel will have a significant economic impact. However, industrialising economies, such as China, are thought to be able to tolerate prices in the $100–110 per barrel range.

Figure 5. Development of oil prices illustrating the $10/year trend (red line).

Figure 6. Brent oil prices rising at $10/year (blue line) and a price that allows economic growth growing at 3 per cent year to reflect an increasing adaptive response (red line).



Both [estimating] approaches, however, seem to point to 2014/ 2015 as a crunch period. [emphasis added] The coincidence is not surprising, because most of the remaining future oil development projects are high-cost, for example in deepwater fields, tar sands and the Arctic (Table 1).

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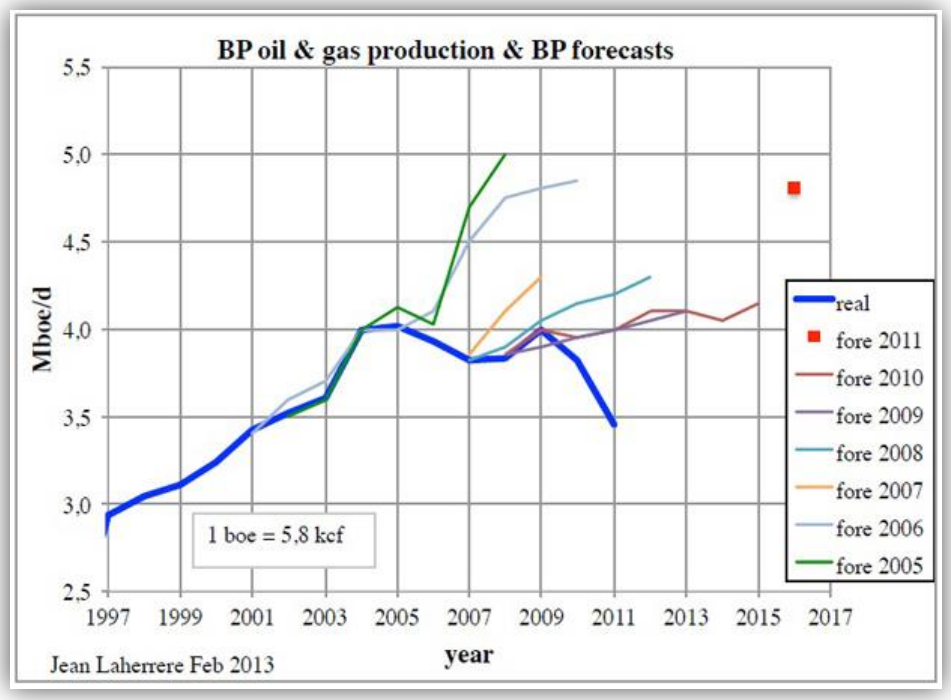
Chris Nelder, "Oil majors are whistling past the graveyard," March 20, 2013, http://www.smartplanet.com/blog/take/oil-majors-are-whistling-past-the-graveyard/584



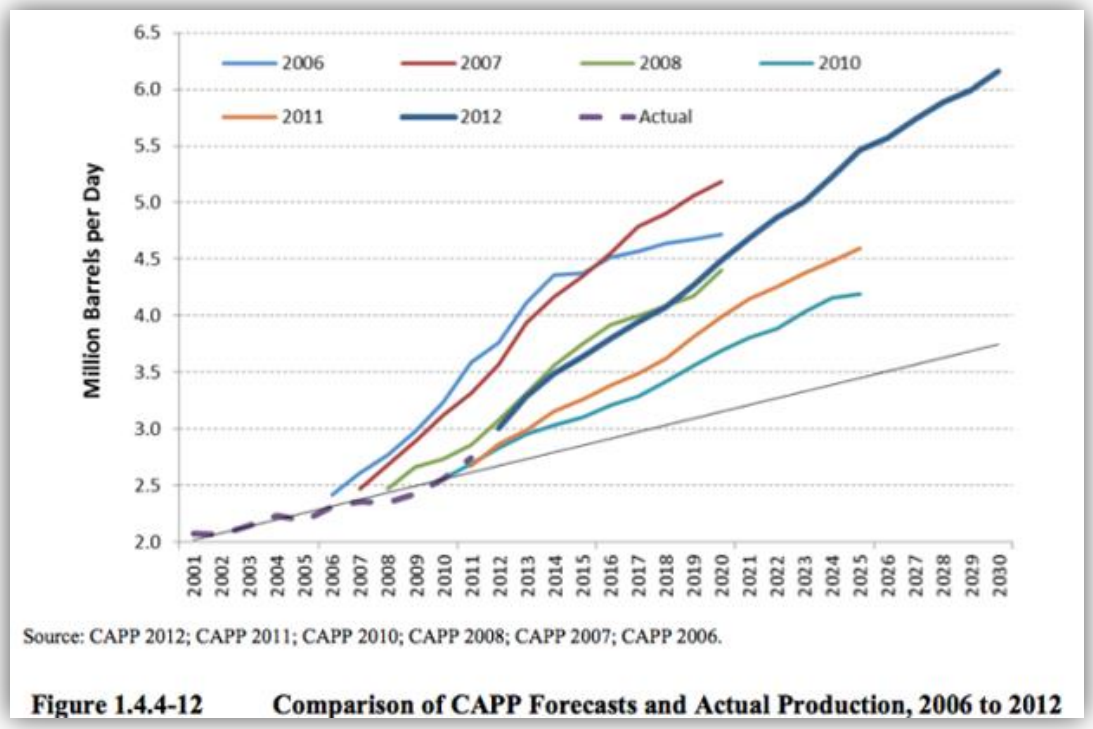
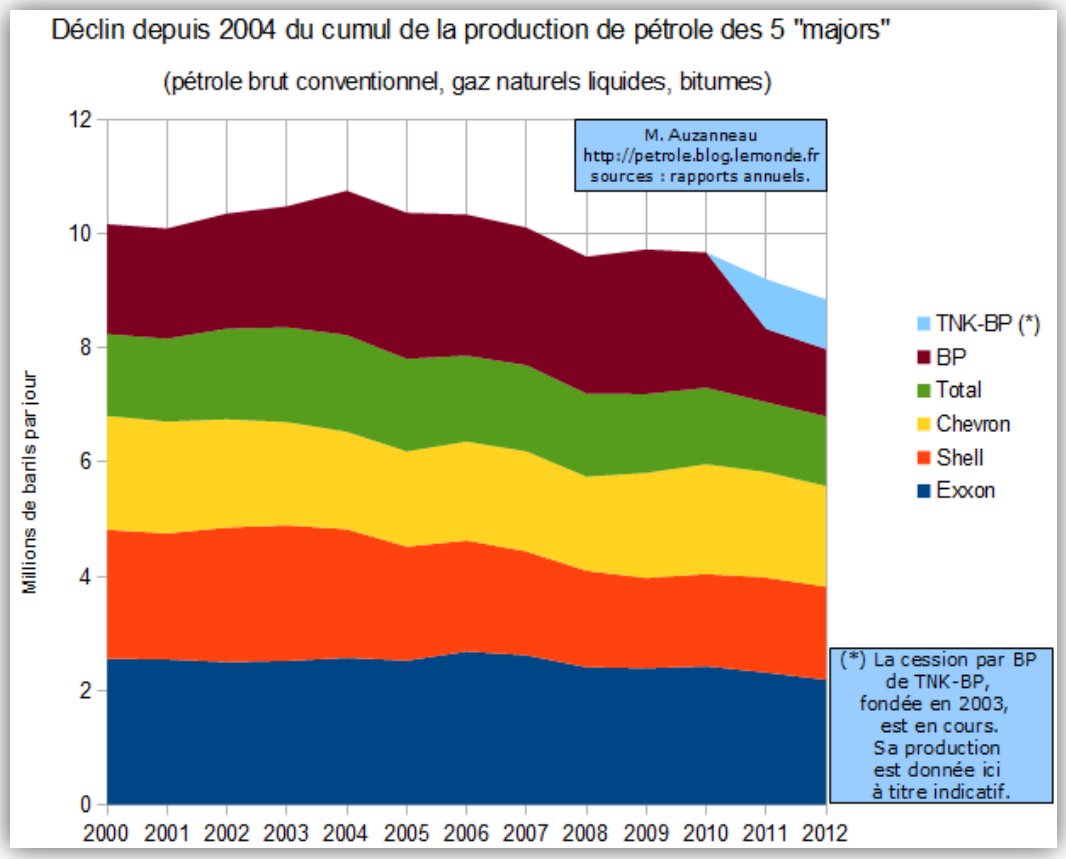


Figure 1.4.4-12 Comparison of CAPP Forecasts and Actual Production, 2006 to 2012



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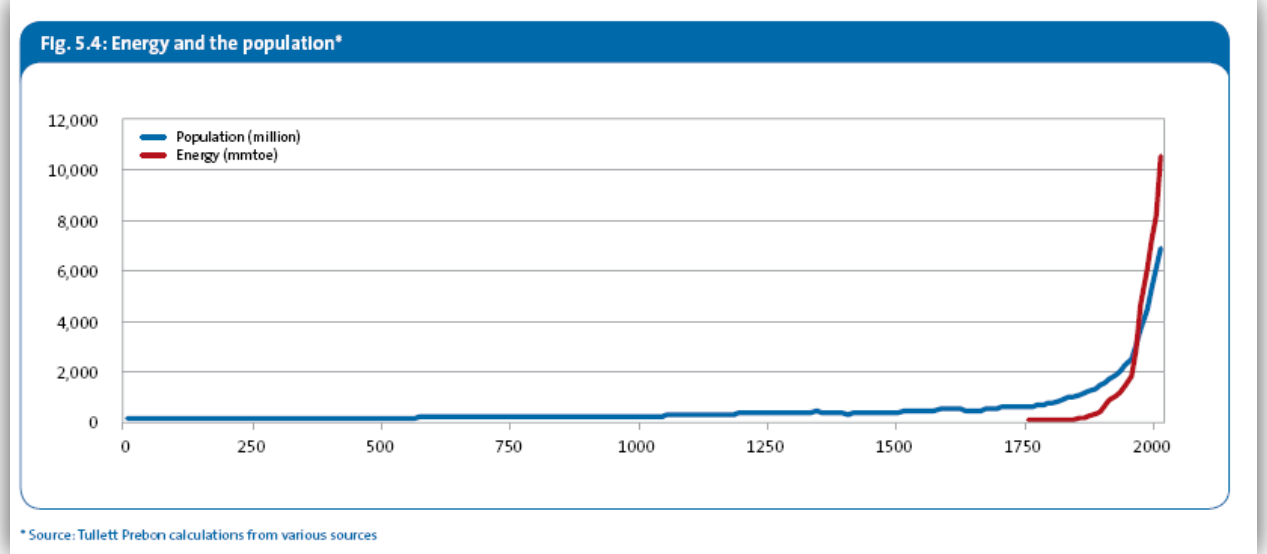
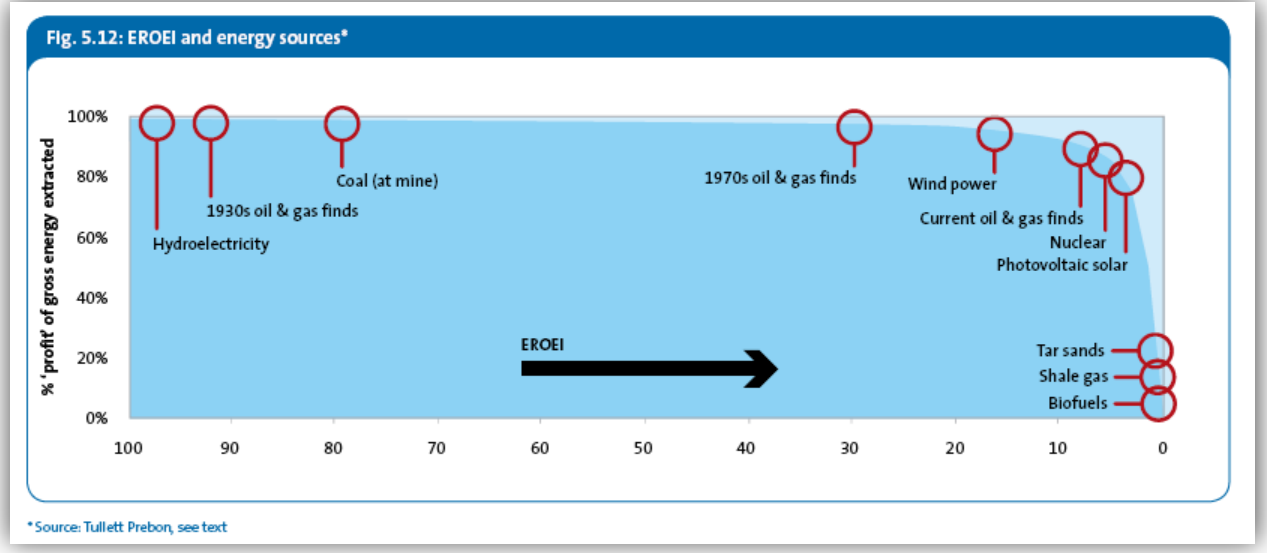
http://www.tullettprebon.com/Documents/strategyinsights/TPSI_009_Perfect_Storm_009.pdf.

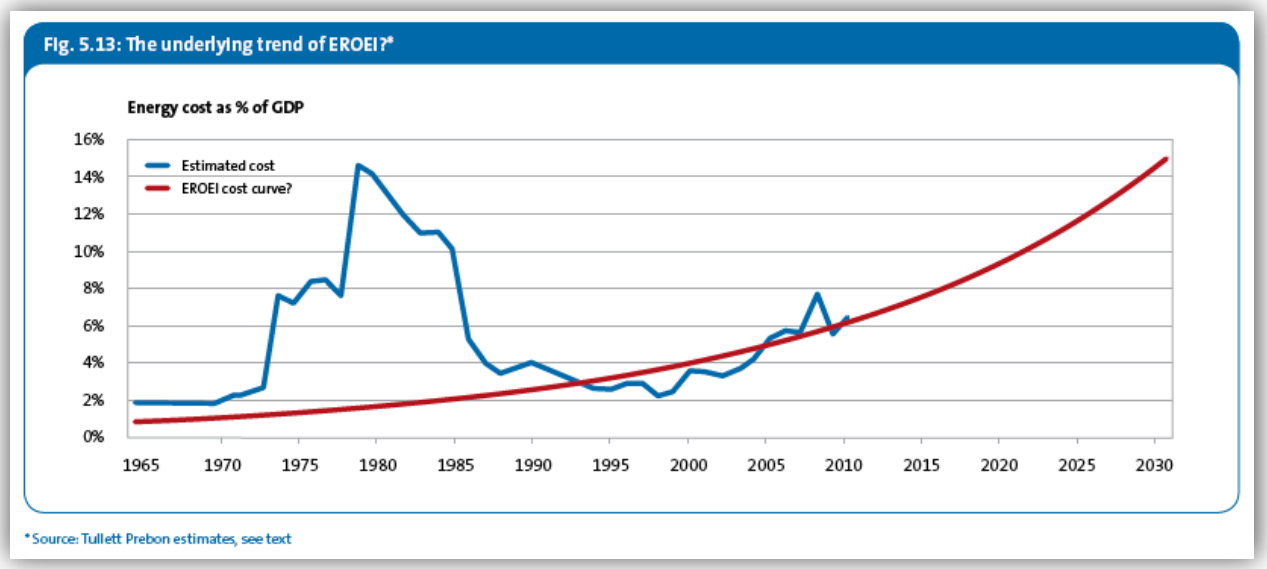
perfect storm: energy, finance and the end of growth
Dr Tim Morgan, Global Head of Research

> This report explains that we need only look beyond the predominant short-termism of contemporary thinking to perceive that we are at the confluence of four extremely dangerous developments which, individually or collectively, have already started to throw more than two centuries of economic expansion into reverse.
>
> Before the financial crisis of 2008, this analysis might have seemed purely theoretical, but the banking catastrophe, and the ensuing slump, should demonstrate that the dangerous confluence described here **is already underway**. Indeed, more than two centuries of near-perpetual growth probably went into reverse as much as ten years ago.
>
> - The economy as we know it is facing a lethal confluence of four critical factors – the fall-out from the biggest debt bubble in history; a disastrous experiment with globalisation; the massaging of data to the point where economic trends are obscured; and, most important of all, the approach of an energy-returns cliff-edge.
> - The 2008 crash resulted from the bursting of the biggest bubble in financial history, a 'credit super-cycle' that spanned more than three decades. How did this happen?
> - The Western developed nations are particularly exposed to the adverse trends explored in this report, because globalisation has created a lethal divergence between burgeoning consumption and eroding production, with out-of-control debt used to bridge this widening chasm.

- The reliable data which policymakers and the public need if effective solutions are to be found is not available. Economic data (including inflation, growth, GDP and unemployment) has been subjected to incremental distortion, whilst information about government spending, deficits and debt is extremely misleading.
- The economy is a surplus energy equation, not a monetary one, and growth in output (and in the global population) since the Industrial Revolution has resulted from the harnessing of ever-greater quantities of energy. But the critical relationship between energy production and the energy cost of extraction is now deteriorating so rapidly that the economy as we have known it for more than two centuries is beginning to unravel.







Remember that what is being measured here is not the value of energy, but its cost as a proportion of the value that we derive from it. Cost and value could only be the same if no surplus existed, which would also mean that the economy could not exist either.

Our assessment of the trend in EROEIs is shown as the red line in fig. 5.13. On this basis, our calculated EROEIs both for 1990 (40:1) and 2010 (17:1) are reasonably close to the numbers cited for those years by Andrew Lees. For 2020, our projected EROEI (of 11.5:1) is not as catastrophic as 5:1, but would nevertheless mean that the share of GDP absorbed by energy costs would have escalated to about 9.6% from around 6.7% today. Our projections further suggest that energy costs could absorb almost 15% of GDP (at an EROEI of 7.7:1) by 2030.

Though our forecasts and those of Mr. Andrew Lees ['In search of energy', in Patrick Young (ed.), *The Gathering Storm*, Derivatives Vision Publishing, 2010] may differ in detail, the essential conclusion is the same. It is that the economy, as we have known it for more than two centuries, will cease to be viable at some point within the next ten or so years unless, of course, some way is found to reverse the trend.

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David Hughes, "Drill, Baby, Drill," Feb. 2013, Post Carbon Institute (full report here, pdf; figures, executive summary, pdf).

[From the executive summary:]

> Crude oil production in the U.S. provides only 34 percent of current liquids supply, with imports providing 42 percent (the balance is provided by natural gas liquids, refinery gains, and biofuels). In fact, the Energy Information Administration (EIA) sees U.S. domestic crude oil production—even including tight oil (shale oil)—peaking at 7.5 million barrels per day (mbd) in 2019 (well below the all-time U.S. peak of 9.6 mbd in 1970), and by 2040 the share of domestically produced crude oil is projected to be lower than it is today, at 32 percent. And yet, the media onslaught of a forthcoming energy bonanza persists.
>
> ...
>
> Shale gas production has grown explosively to account for nearly 40 percent of U.S. natural gas production; nevertheless production has been on a plateau since December 2011 —80 percent of shale gas production comes from five plays, several of which are in decline. The very high decline rates of shale gas wells require continuous inputs of capital—estimated at $42 billion per year to drill more than 7,000 wells—in order to maintain production. In comparison, the value of shale gas produced in 2012 was just $32.5 billion.
>
> ...

Tight oil production has grown impressively and now makes up about 20 percent of U.S. oil production. This has helped U.S. crude oil production reverse years of decline and grow 16 percent above its all-time post-1970 low in 2008. More than 80 percent of tight oil production is from two unique plays: the Bakken in North Dakota and Montana and the Eagle Ford in southern Texas. The remaining nineteen tight oil plays amount to less than 20 percent of total production, illustrating the fact that high-productivity tight oil plays are in fact quite rare.

Tight oil plays are characterized by high decline rates, and it is estimated that more than 6,000 wells (at a cost of $35 billion annually) are required to maintain production, of which 1,542 wells annually (at a cost of $14 billion) are needed in the Eagle Ford and Bakken plays alone to offset declines. As some shale wells produce substantial amounts of both gas and liquids, taken together shale gas and tight oil require about 8,600 wells per year at a cost of over $48 billion to offset declines. Tight oil production is projected to grow substantially from current levels to a peak in 2017 at 2.3 million barrels per day. At that point, all drilling locations will have been used in the two largest plays (Bakken and Eagle Ford) and production will collapse back to 2012 levels by 2019, and to 0.7 million barrels per day by 2025. In short, tight oil production from these plays will be a bubble of about ten years' duration.

...

Tar sands oil is primarily imported to the U.S. from Canada (the number one supplier of U.S. oil imports), although it has recently been approved for development in Utah. It is low-net-energy oil, requiring very high levels of capital inputs (with some estimates of over $100 per barrel required for mining with upgrading in Canada) and creating significant collateral environmental impacts. Additionally it is very time- and capital-intensive to grow tar sands oil production, which limits the potential for increasing production rates.

Production growth forecasts have tended to be very aggressive, but they are unlikely to be met owing to logistical constraints on infrastructure development and the fact that the highest quality, most economically viable portions of the resource are being extracted first. The economics of much of the vast purported remaining extractable resources are increasingly questionable, and the net energy available from them will diminish toward the breakeven point long before they are completely extracted.

...

The U.S. is a mature exploration and development province for oil and gas. New technologies of large scale, multistage, hydraulic fracturing of horizontal wells have allowed previously inaccessible shale gas and tight oil to reverse the long-standing decline of U.S. oil and gas production. This production growth is
important and has provided some breathing room. Nevertheless, the projections by pundits and some government agencies that these technologies can provide endless growth heralding a new era of "energy independence," in which the U.S. will become a substantial net exporter of energy, are entirely unwarranted based on the fundamentals.

...

Unfortunately, the "drill, baby, drill" rhetoric in recent U.S. elections belie any understanding of the real energy problems facing society. The risks of ignoring these energy challenges are immense. Developed nations like the United States consume (on a per capita basis) four times as much energy as China and
seventeen times as much as India. Most of the future growth in energy consumption is projected to occur in the developing world. Constraints in energy supply are certain to strain future international relations in unpredictable ways and threaten U.S. and global economic and political stability. The sooner the real problems are recognized by political leaders, the sooner real solutions to our long term energy problem can be implemented.

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http://www.resilience.org/stories/2013-03-28/the-shale-gale-is-a-retirement-party

> Conventional gas production, which supplies 60 per cent of the market, is steadily declining. In 2001 the decline rate was 23 per cent; today its 33 per cent.
>
> That means 12 billion cubic feet of new gas was needed every year to offset consumption rates of 54 billion cubic feet. Today industry needs to replace 22 billion cubic feet a year to sustain the consumption of 64 billion cubic feet of gas. Calgary-based Arc Financial estimates that major gas producers must spend $22 billion per quarter to replace what's being burned. But most firms are only spending half of that.
>
> It's unlikely that shale gas will be able to make up the difference.
>
> This reality coupled with increasing demand for natural gas to replace coal-fired power based on illusions of cheapness, will soon increase prices as well as the volume of shale drilling. But even hundreds of thousands of newly fracked shale gas wells won't be able to keep up the depletion rates, making natural gas an ugly treadmill industry.
>
> "Shale plays are not a renaissance or a revolution. This is a retirement party."
> ....
> Nor should the illusion of temporary cheap gas dissuade governments from investing in public transportation, energy conservation or encouraging green renewables such as solar and wind power, adds the consultant. "I think our energy future is quite bleak and we are going to need everything we can get."
>
> "The transition we're in now is one from energy abundance to scarcity. I know it doesn't play well. But right now we don't have a bridge to anything. We have a bridge to nowhere and we don't know where the future is."
>
> "Shale gas is a retirement party because we now have to live on what we have left," he explains.

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Kurt Cobb, "Will the final blow for America's shale gas 'revolution' be high prices?," March 24, 2013, http://www.resourceinsights.blogspot.com/2013/03/will-final-blow-for-americas-shale-gas.html

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Arthur Berman, "After The Gold Rush: A Perspective on Future U.S. Natural Gas Supply and Price," February 8, 2012, http://www.theoildrum.com/node/8914.

"U.S. Shale Gas: Less Abundance, Higher Cost," Arthur E. Berman and Lynn F. Pittinger, August 5, 2011, http://www.theoildrum.com/node/8212.

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"Tipping Point: Near-Term Systemic Implications of a Peak in Global Oil Production: An Outline Review," David Korowicz, Feasta & The Risk/Resilience Network, http://www.feasta.org/wp-content/uploads/2010/03/Tipping-Point-Nov.pdf.

"Trade-Off: Financial System Supply-Chain Cross-Contagion: A study in global systemic collapse," David Korowicz, Feasta, http://www.feasta.org/wp-content/uploads/2012/06/Trade-Off1.pdf.

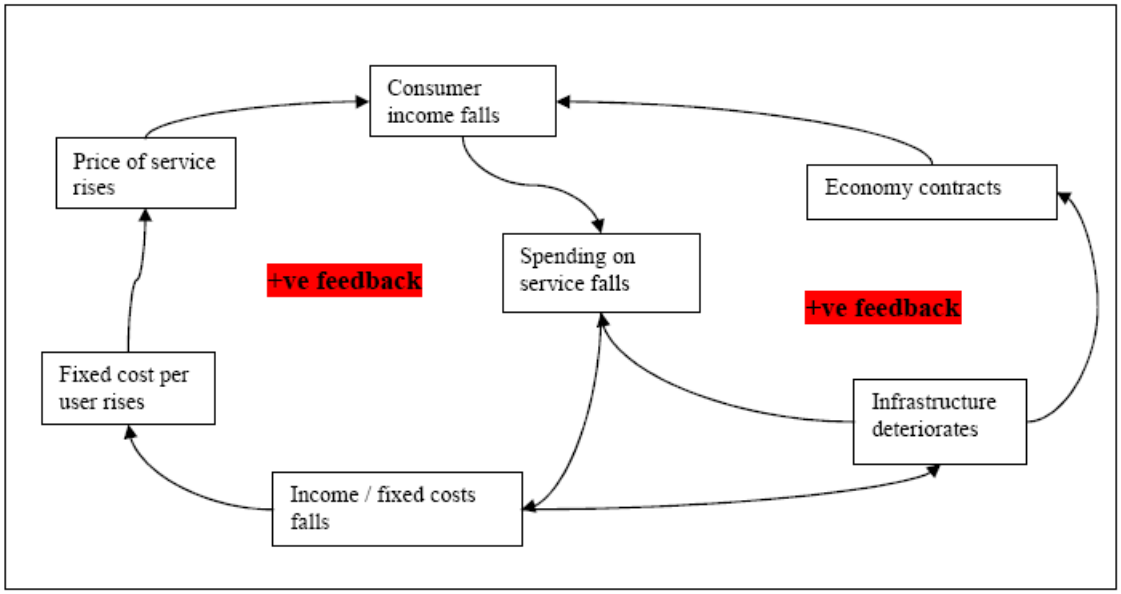

Figure:4 *Reverse economies of scale in critical infrastructure. The fixed costs of critical infrastructure are adaptive to scale and economic activity. As economy contracts and demand falls, fixed maintenance costs remain. A positive feedback of declining utility income and deteriorating infrastructure ensue. Eventually, the infrastructure fails.*

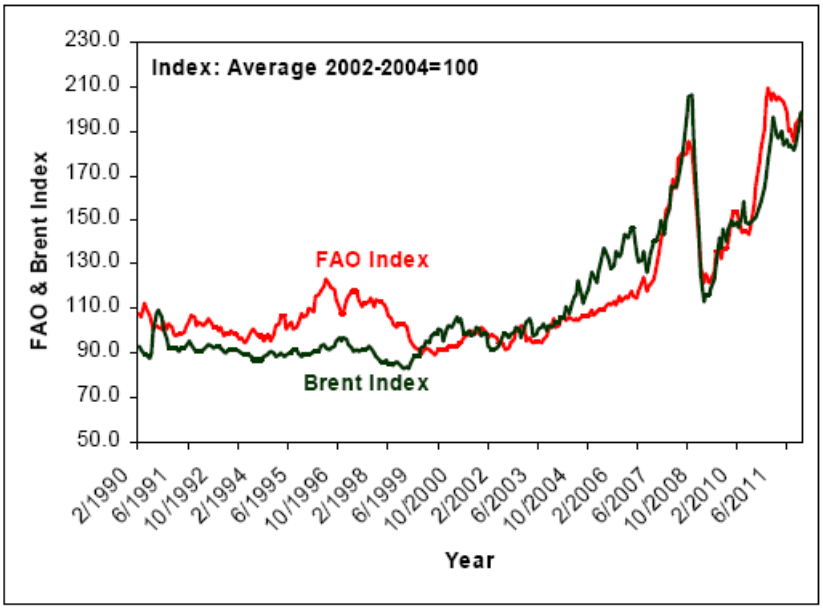

Figure 8: *Beginning about 2005, oil and food prices have risen dramatically. The FOA index represents the cost of a basket of food commodities. Both indexes are scaled so that 100 is the average value between 2002-2004.* (Data: FAO, EIA)

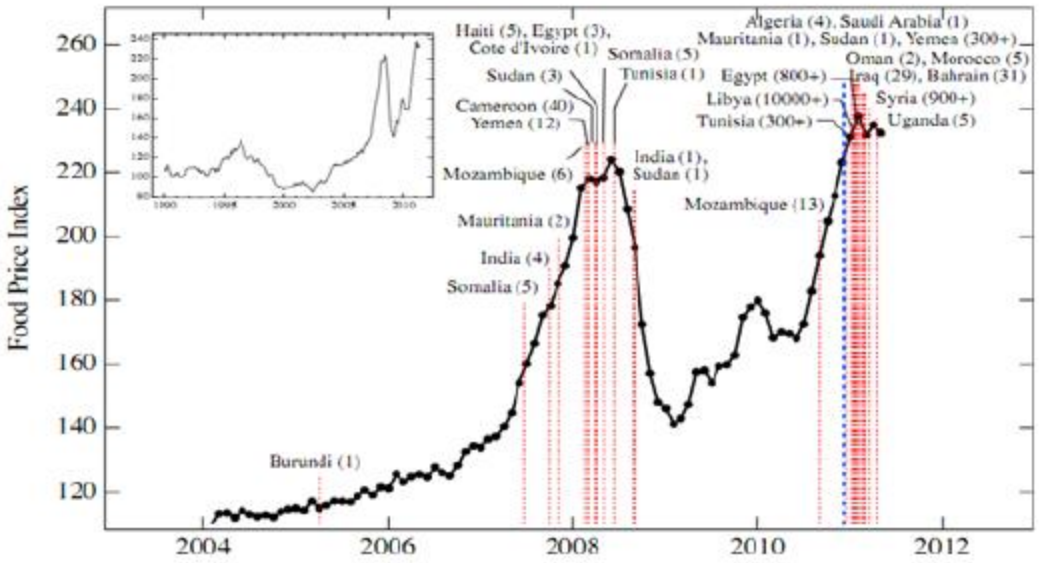

Figure 9: *The FAO food price index and outbreaks of social unrest. (Lagi et. al.[73])*

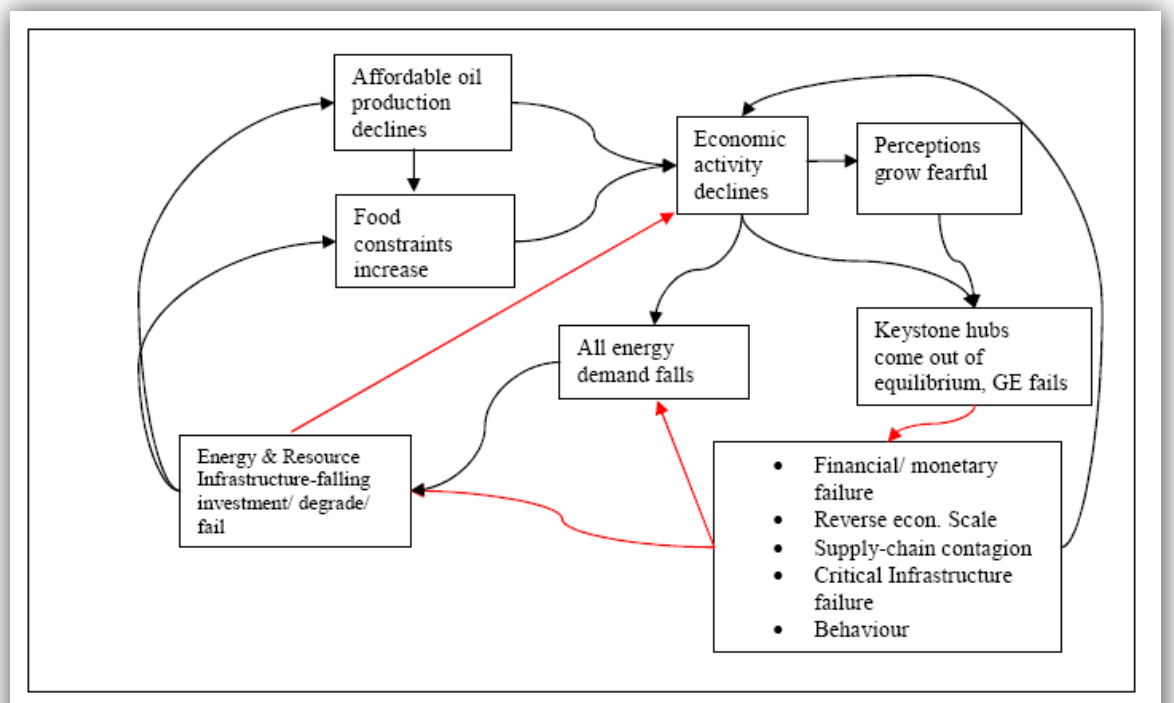

Figure: 10 *The implications of peak oil on the globalised economy. Initially constraints on oil and food squeeze economic activity causing energy demand to fall and investment to drop, squeezing future energy production (black paths). Collapse can occur when the keystone hubs come out of equilibrium (red paths) causing rapid falls in energy demand and a multi-front problem for all energy & resource infrastructure, and a collapsing economy.*

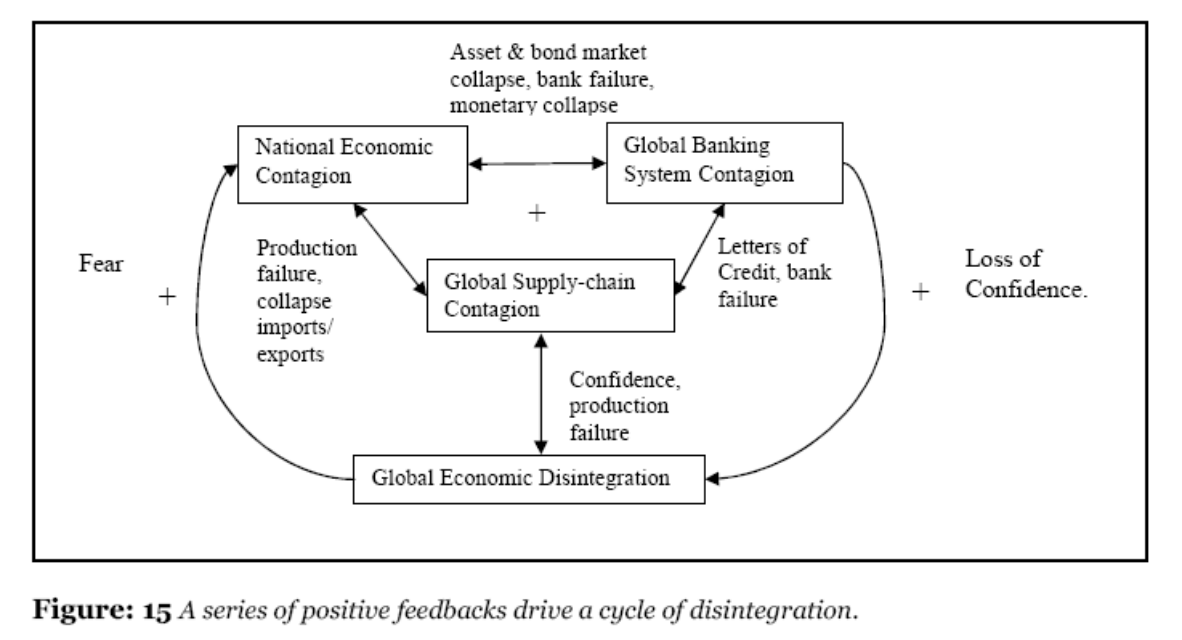

Figure: 15 *A series of positive feedbacks drive a cycle of disintegration.*

We do not like to think of ourselves as potentially irrational herd animals (that will be the

Jones's). We seek narrative frameworks that purport to explain our good fortune, ideally in ways that flatter. Reinhardt and Rogoff called it the *This Time It's Different* syndrome as each age sought to deflect warnings by arguing we're smarter now, better organised, or living in a different world. Just as the sellers of an overpriced home will convince themselves that it was their interior decorating skills not an inflating bubble that got them the good deal.

Of course warnings may keep coming, and almost by definition, from the fringes. When assessing risks that challenge consensus, people are more likely to defer to authority, which generally sees itself as the representative of the consensus. Furthermore, as a species with strong attachments to group affirmation, being wrong in a consensus is often a safer option than being right but facing social shaming, or especially if found to be wrong later.

…

There is no *a priori* reason that there should be a satisfactory solution to any problem that we face.

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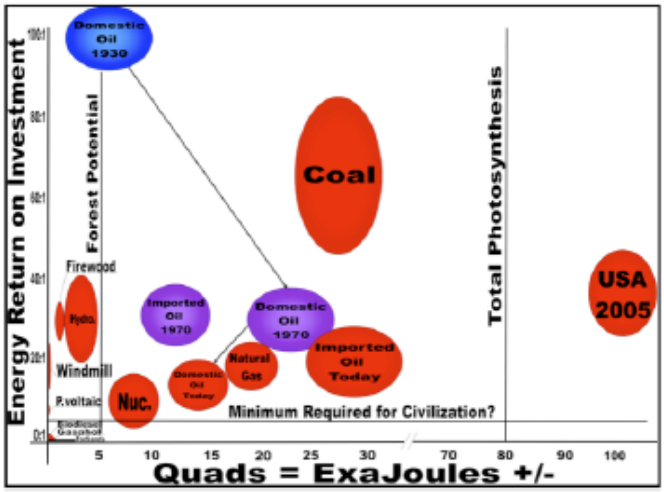
Charles Hall, Stephen Balogh, and David J. R. Murphy, "What is the Minimum EROI that a Sustainable Society Must Have?" (pdf).

Figure 2. "Balloon graph" representing quality (EROI – Y axis) and quantity (X axis) of the United States economy for various fuels at various times. Arrows connect fuels from various times (i.e. domestic oil in 1930, 1970, 2005 – "today"), and the size of the "balloon" represents part of the uncertainty associated with EROI estimates, i.e. larger "balloons" represent more uncertainty. The horizontal line indicates that there is some minimum EROI that is needed to make society work, and the vertical line to the left indicates one estimate of maximum forestry potential and the vertical line to the right is David Pimentel's earlier estimate of total photosynthesis in the United States (Source: US EIA, Cutler Cleveland and C. Hall's own EROI work in preparation). (Reprinted with minor changes from [6]).



The calculation of this [minimum EROI for society] is beyond the scope of this paper but our guess is that we would need something like a 5:1 EROI from our main fuels to maintain anything like what we call civilization.

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Charles Hall and John Day, Jr., "Revisiting the Limits to Growth after Peak Oil," Am. Sci. Vol. 97, pp. 230-237, May-June 2009, http://www.esf.edu/efb/hall/2009-05Hall0327.pdf.

> We do not live in an information age, or a post-industrial age, or (yet) a solar age, but a petroleum age. Unfortunately, that will soon end…
>
> …
>
> The world today faces enormous problems related to population and resources. These ideas were discussed intelligently and, for the most part, accurately in many papers from the middle of the last century, but then they largely disappeared from scientific and public discussion, in part because of an inaccurate understanding of both what those earlier papers said and the validity of many of their predictions. Most environmental science textbooks focus far more on the adverse impacts of fossil fuels than on the implications of our overwhelming economic and even nutritional dependence on them.
>
> The failure today to bring the potential reality and implications of peak oil, indeed of peak everything, into scientific discourse and teaching is a grave threat to industrial society.
>
> The concept of the possibility of a huge, multifaceted failure of some substantial part of industrial civilization is so completely outside the understanding of our leaders that we are almost totally unprepared for it. For large environmental and health issues, from smoking to flooding in New Orleans, evidence of negative impacts has historically preceded general public acceptance and policy actions by several decades.

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"Deficit Reduction = Recession," Richard Heinberg, Feb. 26, 2013, http://www.resilience.org/stories/2013-02-26/deficit-reduction-recession

> Meanwhile, back in the real world, the private sector shows no signs of being ready to pick up the slack. Indeed, US economic growth has been stagnating for decades now. Economist Robert Gordon's research conclusively demonstrates that the lion's share of historic GDP growth occurred in the mid-20th century and was driven by cheap oil and electrification. Since 1970, globalization and an explosion in information technologies have produced comparatively minor economic expansion by comparison, at least in the OECD countries. We kept faux-growth alive largely through borrowing—by an unprecedented accumulation of household, corporate, and government debt. Spending borrowed money on bigger cars and new iPhones kept the consumer economy ostensibly healthy; meanwhile, making and managing the ensuing mountain of debt fattened the financial industry to the point that Wall Street now calls the shots on Main Street, Pennsylvania Avenue, and just about every other thoroughfare in America. Since the US housing bubble burst in 2007-2008, households have stopped taking on increasing amounts of debt; that has left government deficit spending—and one more ephemeral Wall Street bubble, this one based on hyping stock shares in companies specializing in shale gas and tight oil fracking—as the final props holding up the growth facade.
>
> The implication of Gordon's work is that *real* growth is pretty much over and done with no matter what we do at this point. I made the same observation in my 2011 book *The End of Growth*: expensive oil, too much debt, and rising environmental impacts (especially climate change) mean the growth party is over.

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http://www.resilience.org/stories/2013-02-15/the-real-reason-the-economy-is-broken-and-will-stay-that-way

The real reason the economy is broken (and will stay that way)
by Chris Martenson, originally published by Peak Prosperity | Feb 15, 2013

> We are far enough and deep enough into the most heroic monetary and fiscal efforts ever undertaken to finally ask, why aren't these measures working?
>
> Or at least we should be. Oddly, many in DC, on Wall Street, and the Federal Reserve continue to steadfastly refuse to include anything in their approaches and frameworks other than "more of the same."
>
> So we are treated to an endless parade of news items that seek to convince us that a bottom is in and that we've 'turned the corner' – often on the flimsy basis that in the past things have always gotten better by now.
>
> The framework we operate from around here is simply encapsulated in the observation that there has never been global economic recovery with oil prices above $100 over barrel. That is shorthand for the idea that oil is the primary lubricant of economic growth and that it is not just the amount of oil one has to burn but also the quality, or net energy, of the oil that matters.
>
> If we want to understand why all of the tried-and-true monetary and fiscal efforts have failed, we have to appreciate the headwinds that are offered by both a condition of too-much-debt and expensive energy. Neither alone can account for the economic malaise that stalks the world.
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http://www.news.cornell.edu/stories/April11/GasDrillingDirtier.html

> April 11, 2011, "Natural gas from fracking could be 'dirtier' than coal, Cornell professors find"

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http://climateshiftproject.org/2011/08/08/peak-oil-perceptions-how-americans-view-the-risks-of-a-major-spike-in-oil-prices/

> A strong majority of Americans say it is likely that oil prices will triple in the coming five years and that such a tripling would be harmful both to the economy and to public health. Conservatives and those dismissive of climate change are among the most concerned by the threat of a major spike in oil prices, suggesting that a broad cross section of Americans may be ready to engage in dialogue about ways to manage the risks associated with peak petroleum.