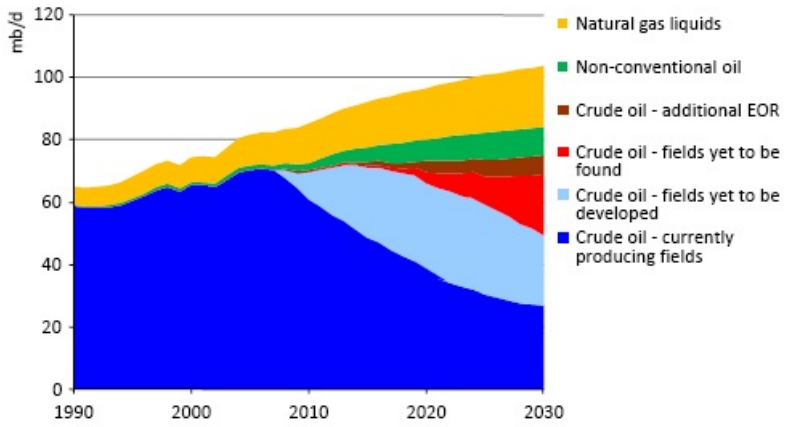
The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

The 2008 IEA WEO - The Oil Drum Initial Review (#1 in a Series)

Posted by Nate Hagens on November 13, 2008 - 9:55am
Topic: Supply/Production
Tags: iea, original, weo 2008, world energy outlook [list all tags]

Today, the world's energy 'watchdog', the International Energy Agency (IEA) published their long awaited annual World Energy Outlook (WEO) for 2008. In stark contrast to bland-to-cornucopian supply commentary in past reports, the initial language in this years Executive Summary is of an urgent nature. This report is a step in the right direction for conveying our rapidly deteriorating energy situation to world policymakers - the IEA should be commended for making the turn and finally acknowledging: costs, investment limitations, new capacity requirements, steep decline rates of existing wells, and externalities (in this case GHGs). In effect, this report shatters the global illusion that oil resources magically turn into cheap flow rates. However, at first glance, the report's details do not support the urgent tone of the beginning paragraphs. Beginning tomorrow, The Oil Drum staff will be running an ongoing daily 'analysis/review' of the new IEA outlook. Below the fold is an overview/introduction to this series.



World Oil Production in IEA's Reference Scenario *(IEA WEO 2008 Slide 8) Source (pdf)*

For the first time sine 1998, the IEA has forecast a higher oil price in the year 2030 than the current market price. In fact, the new price forecast for 2030 of $200 per barrel is not only higher than all previous WEO forecasts, it is higher than all previous WEO 2030 price forecasts *combined*. (1998-$17, 2002-$29, 2004-$29, 2006-$58, 2007-$65).

Here is the lead paragraph from the Executive Summary:

> *The world's energy system is at a crossroads. Current global trends in energy supply and consumption are patently unsustainable — environmentally, economically, socially. But that can — and must — be altered; there's still time to change the road we're on. It is not an exaggeration to claim that the future of human prosperity depends on how successfully we tackle the two central energy challenges facing us today: securing the supply of reliable and affordable energy; and effecting a rapid transformation to a low-carbon, efficient and environmentally benign system of energy supply. What is needed is nothing short of an energy revolution. This World Energy Outlook demonstrates how that might be achieved through decisive policy action and at what cost. It also describes the consequences of failure.*

WOW. Great stuff. Who wrote that? Let's sign him/her up as a The Oil Drum contributor! Basically, this is spot on, and one hopes it will be backed up with data, details, and recommendations going forward.

Second paragraph:

> *Oil is the world's vital source of energy and will remain so for many years to come, even under the most optimistic of assumptions about the pace of development and deployment of alternative technology. But the sources of oil to meet rising demand, the cost of producing it and the prices that consumers will need to pay for it are extremely uncertain, perhaps more than ever. The surge in prices in recent years culminating in the price spike of 2008, coupled with much greater short-term price volatility, have highlighted just how sensitive prices are to short-term market imbalances. They have also alerted people to the ultimately finite nature of oil (and natural gas) resources. In fact, the immediate risk to supply is not one of a lack of global resources, but rather a lack of investment where it is needed. Upstream investment has been rising rapidly in nominal terms, but much of the increase is due to surging costs and the need to combat rising decline rates — especially in higher-cost provinces outside of OPEC. Today, most capital goes to exploring for and developing high-cost reserves, partly because of limitations on international oil company access to the cheapest resources. Expanding production in the lowest-cost countries will be central to meeting the world's needs at reasonable cost in the face of dwindling resources in most parts of the world and accelerating decline rates everywhere.*

Also well said - a public recognition that a) oil is finite, b) it is getting increasingly expensive and c)

market prices do not predict future scarcity but rather oscillate with short term supply/demand unrelated to realizable long term flow rates.

Paragraph 3:

> *Preventing catastrophic and irreversible damage to the global climate ultimately requires a major decarbonisation of the world energy sources. On current trends, energy-related emissions of carbon-dioxide (CO_2) and other greenhouse gases will rise inexorably, pushing up average global temperature by as much as 6°C in the long term. Strong, urgent action is needed to curb these trends. The 15th Conference of the Parties, to be held in Copenhagen in November 2009, provides a vital opportunity to negotiate a new global climate-change policy regime for beyond 2012 (the final year of coverage of the first commitment period of the Kyoto Protocol). The conference will need to put in place a framework for long-term co-operative action to bring the world onto a well-defined policy path towards a clear, quantified global goal for the stabilisation of greenhouse gases in the atmosphere. It will also need to ensure broad participation and put in place robust policy mechanisms to achieve the agreed objective.*

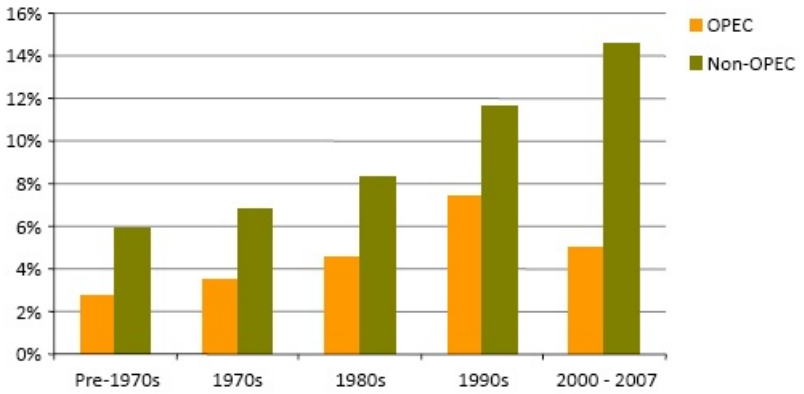
Whoa. I am not a climate expert, but the magnitude, language and tone in this area strikes me as highly political. A further look at the executive summary shows that almost 1/3 deals with carbon emissions, climate change, and sequestration. As a card carrying ecological economist, I welcome the recognition of non-market costs (externalities), but the IEA is first and foremost an 'energy' watchdog and this segment borders on being both incomplete as well as incorrect. Firstly, there are many other non-energy environmental limitations to energy production: (most notably water, but also pollution) as well as limiting industrial inputs such as copper, steel, skilled labor etc that are not addressed at all in this report. Secondly, the focus on a 6 degree temperature rise in the reference case suggests a) they are using different climate sensitivity parameters from those that the IPCC uses - (with MAGICC Dave Rutledge reached 1.8°C with 460 ppm) and b) the scenarios laid out to reach atmospheric CO_2 concentration twice or higher those of today imply ultimate recoverable reserves for the combination of all fossil fuels to be several times higher those estimated by TOD and published by the industry. Though this website focuses on energy, not climate, the sudden attention and scale of these carbon figures in the IEA WEO will have to be analyzed and discussed. Further muddying the water is the new discovery of methane hydrates on the North Slope of Alaska which can apparently be 'safely' harvested with no runaway GHG implications.

In the end, the primary 'solutions' to resource depletion (source side) and climate change and externalities (sink side), are the same (less consumption). The area of contention will be center around how much of our remaining cheap fuel we should allocate to sequestration.

The Full Report

At first blush, the urgency of the executive summary is not replicated in the full report. The devil, after all, is in the details. Here are some initial thoughts, which will be revised and expanded upon in a 2 week The Oil Drum review/critique of this important document.

Decline Rates



IEA WEO 2008 Slide 7 - Average observed oilfield decline rate by year of first production
Source (pdf)

We know that technology and investments have perpetually been in a race with oil depletion. (first and second laws of thermodynamics assure the eventual victor, the pace and rate of change are open for debate). One area we can witness the extent by which technology is 'losing' this battle is in overall decline rates. The IEA production-weighted average decline rate worldwide is projected to rise from 6.7% in 2007 to 8.6% in 2030 as production shifts to smaller oilfields which tend to decline more quickly.

Chapter 10 of the report provides an excellent overview of oil field decline rates based on a total of 798 super-giant, giant and large oil fields and sub-sets thereof. The data are analyzed in terms of field size, field age, reservoir lithology (sandstone / limestone), OPEC/ non-OPEC, onshore / offshore setting, geographic location, etc.

Leaving the detail for future discussion, the key number is a postulated 6.7% global average decline rate that incorporates an extrapolation to thousands of smaller fields that have not been studied directly. This figure is significantly higher than the 4.5% global average decline rate postulated by CERA last year (Peter Jackson, personal communication with Euan).

The IEA data set is based upon IHS field data (and other sources) and is likely comprised of the same data used by CERA. The very large difference in the conclusions has significant implications for future oil supplies and must at some point be debated and resolved.

CERA notes that 41% of production comes from fields that are in the build up phase or on plateau. Their 4.5% average is based on averaging higher observed decline rates for the 59% of fields that are in decline with the 41% of fields that have yet to enter the decline phase using somewhat more sophisticated methodology than may be apparent from this simple summary.

The IEA adopt a different methodology: applying a decline rate to all fields, irrespective of their stage of development. And, for example a decline rate of 0.3% is applied to Ghawar, even though the field is still on plateau and the production history of this field is dominated by political production controls.

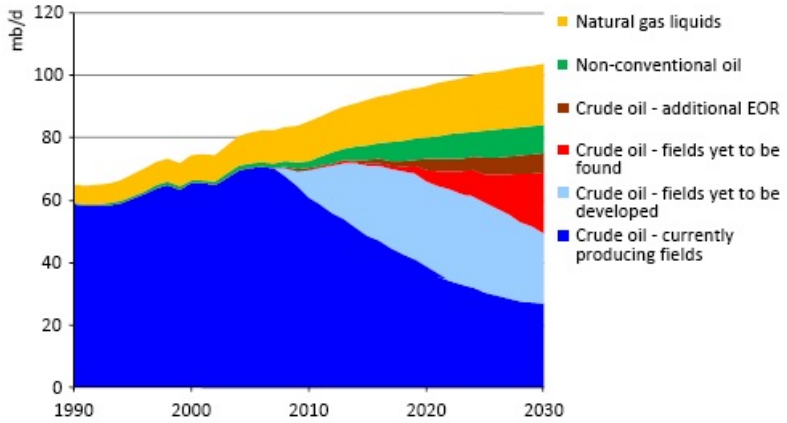
Fields in the build up phase, brim full with reservoir energy, will not actually experience decline in the early years. It seems that the IEA apply a decline rate to this production increment which at face value seems an erroneous practice, though it is premature to draw this conclusion. This may result in over-estimation of decline rates, and this vital issue may only be resolved through dialogue with the IEA to determine how the analysis was undertaken.

The IEA provide evidence for decline rates increasing with time and, if true, this poses a serious challenge to the global oil industry going forward. Especially with current credit conditions - lower oil prices and lack of credit reduce tertiary recovery and make observed decline much closer to natural. What needs to be added to the IEA scenario spectrum, is an analysis where NO new investment takes place - what decline rates and production then?

Finally, the IEA WEO chapter on decline does not mention decommissioning of aging offshore infrastructure in areas such as the North Sea. The boom of recent years has resulted in decommissioning deferred and the slump that is now gathering pace may see an acceleration of

decline rates as aging offshore platforms are sent to the brokers' yard.

Capacity Additions



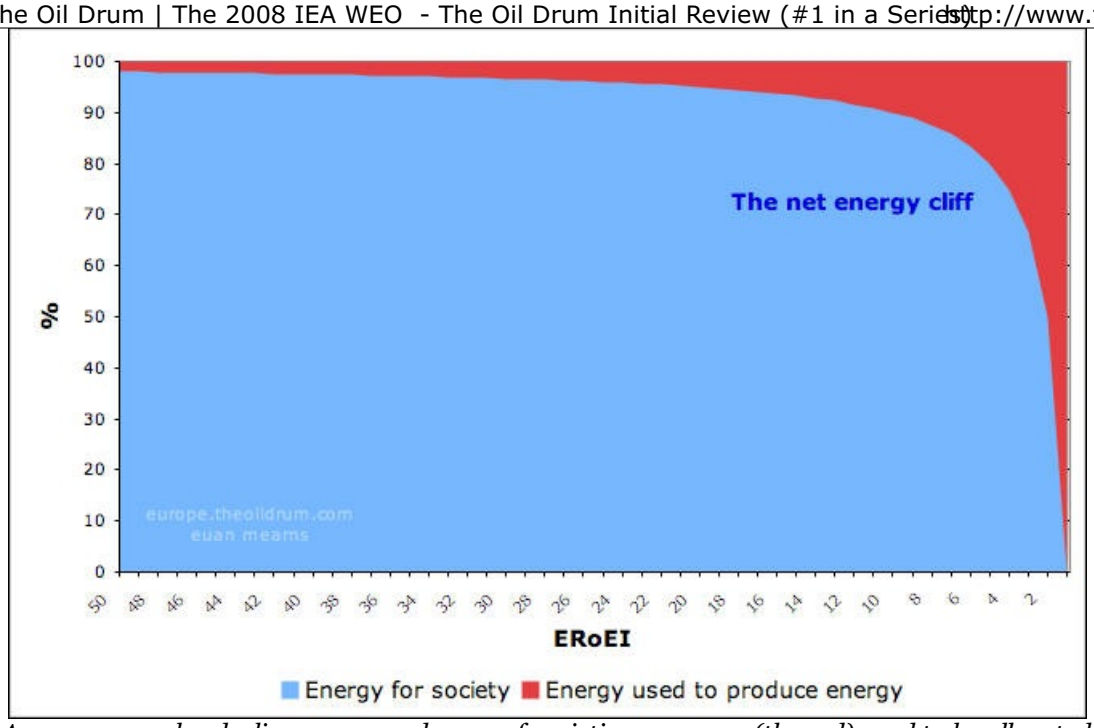
IEA WEO 2008 Slide 8 World Oil Production Under IEA's Reference Scenario[Source](#) *(pdf)*

Under the reference scenario, production reaches 104 mb/d in 2030, requiring 64 mb/d of gross capacity additions –(six times the current capacity of Saudi Arabia) –to meet demand growth & counter decline. Historically, the 1960's was the decade with the largest capacity addition, with about 30 Mb/d added during that 10 year period. So, the IEA Reference Scenario assumes we need to do as well as the best decade ever over the next 22 years.

Technology is clearly better now than in the 1960s - but the resource being worked is in considerably worse shape (fewer large new fields, more old and smaller fields). It's not just the case of doing as well as we did before, it's a case of doing so with a worse resource base - a losing battle. It seems the only way what the IEA is proposing is defendable is if the new resources (like deep water) and/or new technology (EOR) will somehow offset depletion of the old resource base. This has NOT been the case in the United States, where data to measure such a thing at least used to be available, which brings me to my next point.

Net Energy/ Biophysical Economics

The above graph predicts that a full 20% of 'oil production' in 2030 will be comprised of Natural Gas Liquids. On average these liquids have only 70% the BTUs as crude oil, yet this handicap is not reflected in the report as IEA measures by volume, not energy. Of course much deeper than this omission of gross vs net, is the energy cost of harnessing the remaining fossil fuels. No mention of costs in anything other than dollar terms is made in the IEA WEO report. As witnessed by current global currency morass, measuring costs in dollar terms is a moving target. A huge amount of resource may be projected to be recoverable at $100 oil, but once $100 is reached, costs too have increased - this law of receding horizons does not seem to be considered in the IEA analysis. Economic activity is ultimately grounded in energy. It takes energy to procure energy. Therefore, if energy becomes as expensive and difficult to procure as the IEA suggests (requiring $24 trillion investment, etc.), more energy will be used by the energy companies themselves. The only true evidence of this we have (due to lack of data) is the work by energy analysts Hall, Cleveland, Costanza, Kaufman, Herendeen and others on US oil and gas data, showing a 100:1+ energy return in the 1930s, declining to 30:1 in the 1970s and a range of 10-17:1 in 2000. Anecdotally, it is much lower than that at present, though no one keeps data in energy terms anymore. At some point, lower and lower energy gain sends society over a net energy cliff:



As energy surplus declines, more and more of societies resources (the red) need to be allocated towards energy production

Clearly, irrespective the currency or price, if we spend more energy (of equal quality) to procure 1 unit of energy as we get out of it, this energy is no longer a source but a sink. I suspect much of the URR of global fossil fuels in the IEA report will ultimately be shown as such. The recent plunge in crude prices may be like a receding tide, laying bare those companies/projects that are close to energy breakeven. More analysis to follow on that next week.

Investments

> *The Reference Scenario projections call for cumulative investment of over $26 trillion (in year-2007 dollars) in 2007-2030, over $4 trillion more than posited in WEO-2007. The power sector accounts for $13.6 trillion, or 52% of the total.Unit capital costs, especially in the oil and gas industry, have continued to surge in the last year, leading to an upward revision in our assumed costs for the projection period. That increase outweighs the slower projected expansion of the world energy system.* P 39 Exec Summary

> *The current financial crisis is not expected to affect longterm investment, but could lead to delays in bringing current projects to completion, particularly in the power sector.*P39 Exec Summary

Ironically, the day of this IEA release calling attention to the precarious nature of future energy supply is being met with fresh 3 year lows on oil prices. Unfortunately, recent market events, only indirectly related to oil, will now likely set July 2008 in stone as the date of maximum world oil production, despite the 'best-best case' scenario portrayed in the IEA report. Up against near double digit depletion rates and higher cost (lower energy gain) prospects, the oil industry now also faces a growing lack of confidence in the international financial system where near herculean investment is needed ($26 trillion = 37 times the recent controversial $700 billion bailout package in US), and credit, especially when the price of oil is well below the marginal cost of extraction (at 86mbpd) makes approving new projects, let along continuing existing production, problematic. Though not explicitly stated, one may infer that there is now increased risk that these investments will not be made. Furthermore, the goal of OECD governments of procuring cheap energy is incompatible with these investment goals. And still further, the goal of OECD

governments of having cheap energy is incompatible with their goals of reducing CO2 emissions.

As has been written here often, the world's fiat currency reserves and financial assets, which works as a system of exchange and store of value because everyone agrees that it does, nominally dwarfs the amount of real commodities. Leverage, and leverage upon leverage provided by easy credit not checked by biophysical realities unleased a massive speculative bubble in financial asset classes in recent years. Though some claim this was an oil bubble, the facts suggest it has been a bubble in all paper assets, the unwinding of which, though largely over, has spilled over into the real economy. Earlier today Russia, the world's second largest oil producer, lifted their short term interest rates to 12% to defend the ruble. The currency traders, out of defense, are playing increasingly serious games of hot potato. Hedge funds and money managers, part of a global derivatives market measuring north of $700 trillion dollar earlier this year (in perspective that was *10 times* the value of a 1 trillion barrel yet-to-be-recovered oil resource at $70 a barrel)

Bloomberg graph of oil, euroyen cross and SP500 daily closes

Those who rationalize the recent crash in oil prices as evidence of an oil bubble are only partially correct, and miss the greater point entirely. We are in the midst of a global deleveraging of an enormous bubble in financial assets, of which oil futures contracts, is just one. Oil futures peaked on July 14, 2008 (somewhat ironic in that the IEA is headquartered in Paris). In the nearly 4 months since, the daily price moves of oil have an R^2 of .97 with the SP500 - the prior 2 years the correlation was -.29. Similarly, just about all the major asset classes have had a .85+ correlation with the unwind of the carry trade (investments in all sorts of things using borrowed dollars and yen). As the unwind took out banks, insurance companies, countries? (Iceland+), wealthy natural gas entrepreneurs, etc. it had an unseen but far more tragic casualty - energy market disruption and misleading signals of future scarcity of oil (and gas).

The (Initial) Bottom Line of the IEA WEO 2008 Report

Though it is clear there were many different factions and authors writing this report, about 1/2 in the urgent and 1/2 in the complacent camps, the general sea change in opinion, analysis and outlook is long overdue. The certainty of future oil supply painlessly matching demand for decades to come has been replaced with something closer to reality. However, as long time readers of this website are aware, the world energy situation is even worse than the '*best*-best case' scenario this IEA report has portrayed - more analysis to follow after we have read the actual details.

In sum, recent events in the real economy have put us in the liminal space where drops in demand will temporarily exceed drops in supply. Our energy future is a battle being fought

between depletion and investment/technology in a world that is not only interconnected and complex but increasingly fragile. Counterintuitively to most, the lower oil prices go and the longer they stay below $80-$100 per barrel, the steeper the fall off of the crude oil plateau will be, and the dimmer our energy future. In sum, this Jekyll and Hyde IEA WEO 2008 report was needed 10 years ago. Uncertainty, error bands, black swans and the precautionary principle need to be terms injected into international energy discussions. Governments and decisionmakers should assume what is presented here is a 'best-best case', and start making urgent, difficult decisions with respect to social priorities. As many know, without cheap and consistent energy availability, nearly all other social objectives cannot be met. Energy is everything.

In the coming weeks, we will provide analysis and commentary on the details of this IEA report on the following topics:

- Decline Rates
- Saudi Arabia/Ghawar
- Natural Gas (in particular, Europe)
- Net energy and EROI
- Demand
- Coal
- Biophysical economics
- Human belief systems and paradigm shifts
- Reserves
- Renewables (hardly given much attention in the article)
- Energy and Climate Change
- Wikipedia Megaprojects
- and others..

Essays and analysis will be from The Oil Drum contributors as well as guest posts from James Buckee of Talisman Energy and Professor Charles Hall. We will probably raise many more questions than we will have answers. But that is perhaps as it should be.

Stay tuned!