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BERNE SEMINAR

Find the slides here:

http://www.energie-schweiz.ch/imperia/md/content/energiemrkteetrgertechniken/erdl/3.ppt

Slide#1 Title
Ladies and Gentlemen, the depletion of oil and gas is a very large and difficult subject, but it is also possibly the most important issue facing the modern world.

I cannot hope to cover it in full in the time available, but I can try to give you the essentials.

For simplicity, I will speak of oil and gas together, except where there is a specific need to distinguish them.

The first important point is to recognise that oil was formed in the geological past. In fact, the great bulk of it was formed in just two periods of extreme global warming, 90 and 145 million years ago.

Slide#2 Generation
This slide shows how organic matter from excessive algal growths fell to ber preserved at the bottom of stagnant troughs. They were formed where the tectonic plates pulled apart.

Slide #3 Burial
This shows how, once formed, the organic material was buried under younger sediments washed in from the surrounding lands by rivers and currents. When it was buried to about 2000m, it was heated sufficiently for chemical reactions to convert it into oil.

Slide #4 Migration
Once formed, it began to move upwards under high pressure. Some was dissipated, some was lost at the surface, but some was trapped in structures large enough to become oilfields.

Slide #5 An Oilfield
If we could cut a slice through the Earth, this is what an oilfield would looks like. The oil is trapped at the top of this geological fold. There is not a big cavern full of oil. The oil lies trapped in the minute pores of the rock. Gas commonly separates above it. The water, below it, rises as the oil is removed. I

draw attention to the presence of a good seal, such as clay or salt above the reservoir. Without a seal, it would leak away over time.

These simple undisputed facts tell us that it is a finite resource, subject to depletion. We started running out when we produced the first barrel. But "running out" is not the main issue. The tail end of production can drag on for a very long time. Producing the last drops will mean as little as the first in the 19th Century. What matters is when production will peak and decline. That is the devastating turning point facing the modern world, which runs on oil.

Since oil has to be found before it can be produced, the starting point in forecasting future production, including the critical peak, is the discovery trend of the past. Determining that trend should pose no particular problem, but is in fact very difficult to do because of unreliable and misunderstood information about reserves.

The total discovery at any point in time is the sum of past production and the estimated future production from known fields, commonly called reserves.

I should say a few words about the reporting of reserves, which is the cause of most of the confusion on this subject. The estimation of reserves poses no particular technical challenge, especially with the help of modern methods. The confusion arises from the reporting practices.

They arose in the early days of the United States. That country is almost unique in that the landowner owns the mineral rights. It meant that the ownership of the early fields was fragmented. To prevent fraud, the Securities and Exchange Commission imposed strict rules, which allowed the owners to claim as reserves for financial purposes, such as borrowing money, only the amounts that their current wells were expected to produce. Accordingly, the reserves grew as the fields were drilled up. I stress what was reported were financial reserves not what was in the ground

The same practice was followed outside the United States, because most companies were listed on the American Stock Exchange. Most fields were then operated as a single entity under concession from the government concertned. The operating companies did estimate the full size of their fields, but in practice reported only as much as they needed to report to provide a satisfactory financial result, following the spirit of the strict SEC rules. Gradual growth provided a better image and also reduced tax.

But although the reported size was gradually revised upwards, in discovery terms, all the oil in the field is clearly attributable to the original discovery well.

To obtain a valid discovery trend we need both valid numbers and valid dates. This information cannot be obtained from public data but is held in industry databases, such as that maintained by IHS (formerly Petroconsultants) in Geneva.

Slide #6 – Discovery Trend : reality and illusion
This shows the colossal impact of properly backdating of revisions. The red line shows the growth of discovery as reported to the public. Many economists are misled into thinking it is growing. The black line shows how real discovery with properly backdated revisions is declining. The decline points to a finite limit.

Slide #7 Discovery Trend and Extrapolation
This is the most important slide I can show you, which has been released by no less than ExxonMobil. It shows the best reserve estimates with revisions properly backdated. It is evident that discovery reached a peak in the mid-1960s and has been falling ever since.
It has been falling :

- despite a worldwide search always aimed to find the biggest and best remaining prospects;
- despite better geological knowledge and all the technological advances we hear so much about; and
- despite a favourable economic regime whereby most of the cost of exploration was offset against taxable income

In short, if more could have been found it would have been. That tells us that there is no good reason to expect the trend to change direction. That in turn allows us to extrapolate what is left to find.

#8 Repeat Slide #6 Reality and Illusion
Let us take a second look at this slide and ask why there was such a steep climb in reserves in the late 1980s

#9 Spurious OPEC Reserves.
This shows the reported reserves of the main OPEC countries who were vying with each other for quota based partly on reserves

- In 1985 Kuwait added 50% although nothing changed in the oilfields
- In 1989 Venezuela doubled its reserves by the admission of large deposits of heavy oil that had been known for many years but had not previously been counted
- That caused Abu Dhabi, Dubai, Iran, Iraq and later Saudi Arabia to retaliate with huge over night increases, needed to protect their quota
- Note to how the numbers have remained implausibly unchanged despite production, as shown in green.

No serious analyst could accept such numbers, yet they remain in the public data, as published for example by BP, without comment.

But it is not as simple as it seems because the earlier numbers were too low having been inherited from the foreign companies before they were expropriated. Some upward revision was justified. The point is that the revisions, whatever the right number might be, have to be backdated to the discovery of the fields concerned. They had been found up to fifty years before.

I hope this helps you understand why so many people are misled by the public numbers.

#10 Depleting the tanks
If we unscramble all the misleading information as well as we can, we come to this picture which we can depict in terms of three tanks

- At the top is the tank of new discovery, which I estimate holds about 170 Gb. It is dripping into the discovered tank at falling rate. Last year only about 3.75 Gb was found.
- Below it is the Discovered Tank which held about 1700 Gb but is more than half empty, having only about 800 left. It is draining at about 23 Gb a year. In other words we consume about 6 barrels for every one we find.
- But over here on the side is the surprise tank. We know enough to say it cannot be very large.

But yet again, this is not the full story, for the numbers refer to what I call Regular Oil, namely the easy cheap stuff which has supplied most to-date and will dominate all supply far into the future. It controls peak. I will mention in a moment all the other categories and gas, which are important too.

Slide #11 Where is it ?
This shows the distribution of oil. The Green has been produced. The Red is Reserves and the Yellow is yet to find. It is no surprise that North America has used most of its endowment, and the Middle East has most left. There is a certain irony about depleting a finite resource : the better you are at doing it, the sooner it is gone.

Now that we have a rough idea of the amounts, let's turn to consider their depletion. A moment's reflection tells us that in an unconstrained environment peak comes at the half-way point and that production has to mirror earlier discovery after a time lag.

#Slide 12 US-48
This is admirably demonstrated by the most thoroughly explored and mature country of oil, the US-48. Discovery peaked in 1932 to be followed almost 40 years later by peak production in 1971. The decline has been relentless despite all the technology, all the money and all the incentive. Nothing can change the downward trend.

#Slide 13 UK
The same pattern is repeated in one country after another, but the time lag from peak discovery to peak production is being reduced thanks to technology. The peak of production in the UK was in 1974, followed 25 years later by peak production. The anomalous saddle was caused in part by the Piper accident, which caused a fall in production while new safety measures were introduced. Norway and the North Sea as a whole show the same pattern.

#Slide 14 UK by DTI
This picture has been confirmed by no less than the UK Department of Trade and Industry, showing that oil and gas production will have ended in less than 20 years. Yet the government remains oblivious, so far having done virtually nothing to prepare.

There is n't time to show you more examples, so let's move on to the world picture, covering also all the other categories of oil

#Slide #15 World Depletion
- The Green represents Regular Oil. The scenario assumes flat average production out to 2010 with the Middle East making up the difference between world demand and what the other countries can deliver. That swing role is assumed to end in 2010, when the Middle East would be called on to provide almost 40% of the world's needs, which is seen as its practical limit. The terminal decline then sets in at about 2.5% a year;
- The Brown represents the heavy oils, principally from Canada and Venezuela, whose production is set to rise slowly in what is effectively a mining process, giving a low net energy yield and carrying environmental costs;
- The Blue represents the deepwater that comes booming in from the few places with the right geology ands decline equally fast;
- The White represents new polar oil, mainly in Siberia, which is fairly optimistic;
- The striped represents Gas Liquids, which are produced in parallel with gas providing an important supply for the future.

There are of course other scenarios. Personally I begin to doubt if the Middle East can in fact perform the swing role as required by the model. I doubt that there is any significant spare capacity anywhere. I suppose we face another price shock. It may trigger a new deeper recession, which in turn will dampen demand and take pressure on price. I think we face a very volatile few years: it is hard to imagine a more stupid way to manage a critical resource on which we all depend.

I should say a few words about gas. More was generated in Nature than was the case for oil, but more was lost over geological time. The Depletion profile is also very different. Normally gas has been produced at far below capacity to deliver a long plateau with most fluctuation being seasonal. But the plateau ends abruptly and without market signals as it is cheaper to produce the last cubic foot than the first. The United States is now falling off this cliff, and Britain did not even manage to organise a plateau, facing now a steep decline.

It if difficult to model world depletion because so much depends on the construction of pipelines and liquefaction plants. But I picture a plateau from 2015 to 2040 at about 130 Tcf/a followed by a steep decline.

Finally, the production of non-conventional gases, such as coalbed methane, will grow slowly.

In short, the world faces a crippling energy crisis, which may already be building. Oil provides 40% of trade energy and over 90% of transport fuel on which trade depends. It also has a critical role in agriculture, which means food.

Slide #16 Population
Perhaps it is worth planting a rather devastating thought. If the world's population increased six-fold exactly in parallel with oil supply, does that mean that it will have to fall in parallel with the decline of oil? Or will some new miracle energy source present itself ? Don't hold your breath.

Whatever the long term future, it is clear that the transition will be a very difficult time of great tension, probably involving resource wars. Different countries will be forced to compete with each other for access to the Middle East supply.

Slide #17 Depletion Protocol Graphic
So I would like to end with a proposal to ameliorate the tensions by calling for a Depletion Protocol

There are three paths. We can let the Middle East profiteer from shortage. Alternatively we can take the Middle East by military might, so that we can profiteer from shortage. A third option is to act responsibly by organising a protocol, by which to manage depletion sensibly

Slide #18 Depletion Protocol

In summary, it would call on each importer to cut imports by the World Depletion Rate. That is annual production as a percent of what is left, which is currently running at about 2.5% a year.

I dare say that 100 cars go by this building every hour. If Switzerland observed the Protocol, next year there would be either 97 cars of today's size or 100 smaller cars. It would not be an impossible or heavy burden.

But it would carry many great benefits:

- The world price would remain moderate in reasonable relationship with actual cost, thus avoiding profiteering from shortage. That means that the poor countries of the world could afford at least minimal supplies;
- The massive and destabilising financial transfers to the Middle East, associated with high market prices, would be avoided, helping those countries to prepare for their future when their unearned oil inheritance dries up.
- The consumers would be encouraged to avoid waste and turn to renewables wherever possible. They could achieve their reduction in various ways – relying on an open market to sell to the highest bidder under traditional capitalist principles; taxing it higher and reducing other taxes; rationing; or a happy compromise.
- Above all, everyone would be forced to face reality so that they could better plan their lives within the limits imposed by Nature.

It may be argued that not all countries would join. Indeed, I cannot imagine the United States agreeing to co-operate in this way. But it would not matter. If Switzerland adopted the principles of the Protocol, it would be investing its future. Accordingly it would soon find itself better prepared and at an advantage over the non-compliers, who continue to live in the past.

Side#19 Wake up
It is time to wake up. Let beautiful Switzerland take the lead.