Analysis
Of the UK Oil Production

A contribution to

ASPO (Association for the Study of Peak Oil)

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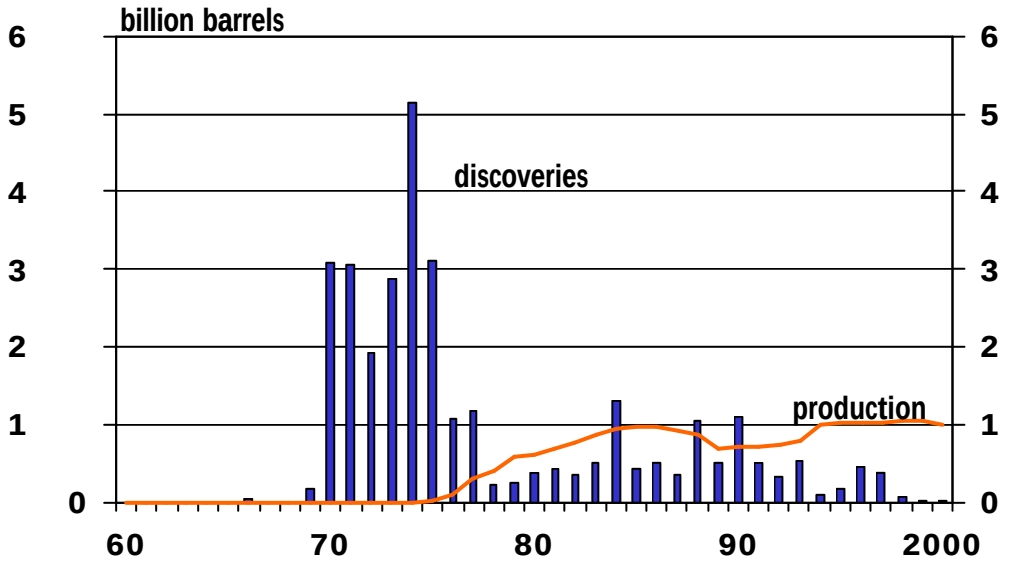
Analysis of UK oil production

United Kingdom produces approximately half of Europe's oil. Analysis of its production, based on data published by the UK Department of Trade and the Industry (IHS) shows that production follows a clearly defined trend. The larger fields were evidently discovered in the early phases of exploration and were brought on stream first. As these old fields peak and head into decline, their place has to be taken by an increasing number of smaller fields which can sustain overall production for a limited period of time. However the rate of new discovery of ever smaller fields cannot be maintained indefinitely, and it is evident that the country passed its peak in 1999, and that production is set to fall by about 60% over the next ten years. The example of the UK demonstrates a pattern that sooner or later applies to all oil provinces, given the finite nature of the resource. Oil and NGL/Condensate are treated together in the analysis, although it is recognised that their production profiles may differ.

1 Discoveries and Reserves

Figure 1 shows the oil discovery by year in UK. Most of the oil was found in the 1970s. Later discoveries increased in terms of the number of fields, but their size was considerably smaller. These late discoveries contribute only marginally to the total oil reserves.

The figure also shows the annual oil production on the same scale. As can be seen, today's production mainly depends on the early discoveries.



Source: IHS-Energy, Royal Bank of Scotland, LBST

Figure 1: History of annual discoveries and production

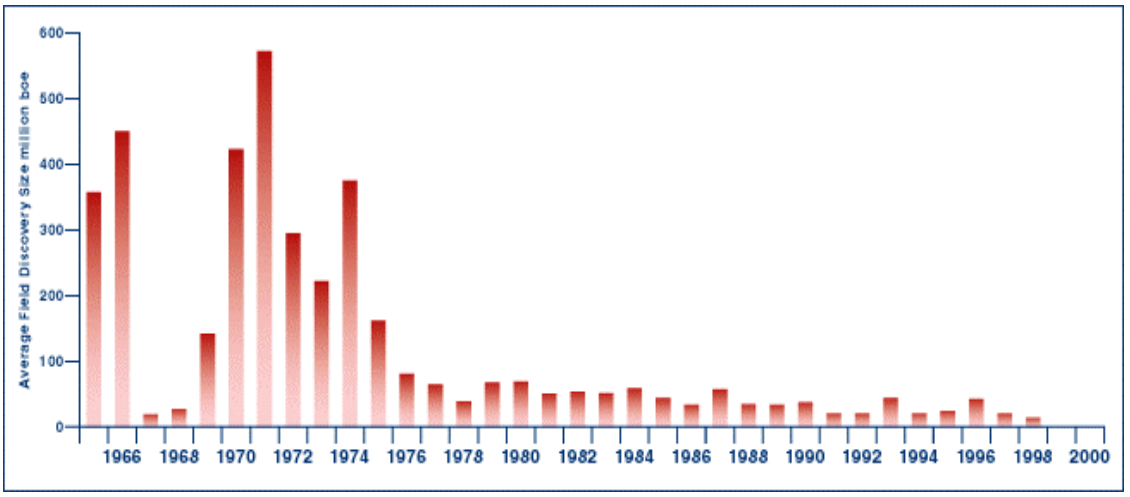


Figure 2: Average size of new field discoveries (Source: United Kingdom Offshore Operators Association - UKOOA)

Figure 3 shows cumulative discovery, exhibiting the historical pattern, which if extrapolated to assymptote shows a total endowment of about 32 Gb (Giga-barrel). There have been great advances in seismic technology and interpretation with the help of colossal computing power, which now makes it possible to identify the smallest trap. But there is no reason to suggest that there will be any impact on the general trend. It is evident that large positive surprises become increasingly unlikely.

The red curve shows the cumulative production. The historical trend of oil reserves is obtained by substracting cumulative production from cumulative discovery.

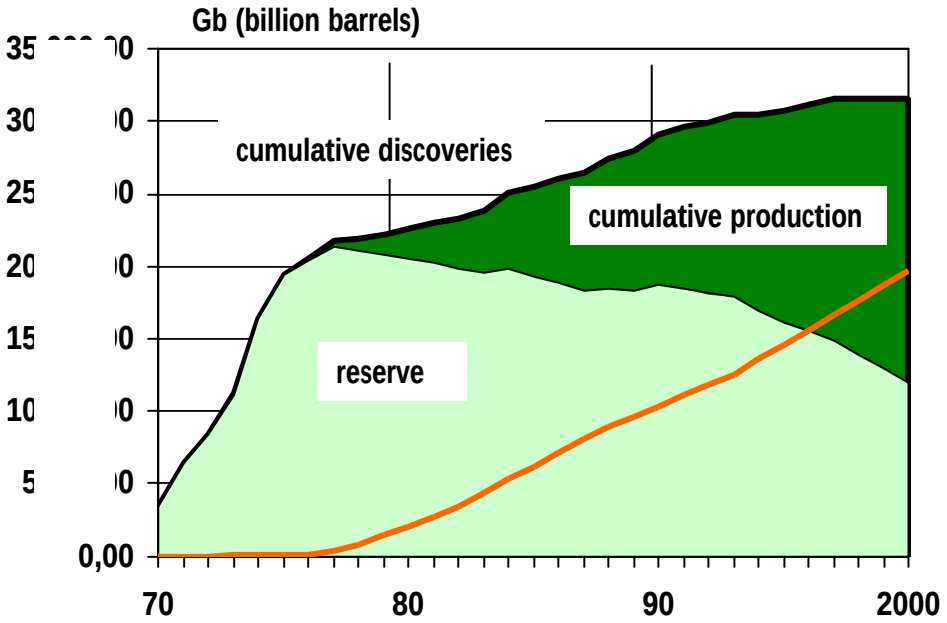


Figure 3: Cumulative oil discoveries and oil reserves (Source: IHS Energy)

Reserves have been declining generally since the late 1970s, but the sharp decline of discovery in the 1990s has accelerated the rate of decline. Today, about two-thirds of UK's total endowment of oil (20 Billion Barrel) has been already consumed. About one third (11 Billion Barrel) is left for future production. Extrapolation of the cumulative discoveries leads to the conclusion that about one billion barrel are yet to find. Future reserve reassessments might increase the numbers somewhat. This will result in a slight increase of absolute figures, but will not change the discovery pattern and certainly will not increase the potential for future discoveries.

2 Field analysis and production forecast

The production profile of each individual field has a characteristic shape, which for off-shore fields is different from the classic bell shaped curve: Since exploration and the operation of the oil fields and platforms is very expensive, economic considerations force the companies to try to recover the investments as fast as possible by producing the fields at high rate. Since it makes no sense to build the facilities for a short-lived peak, production is normally capped at a lower level. This maximum flow rate can be kept on plateau for some years by gas or water injection or other IOR-methods, and by efforts to tap subsidiary traps and reservoirs within the field and its immediate facility by long reach drilling and subsea completions. But very soon the unavoidable decline starts. It is driven by the decrease of pressure in the field and rising water levels, which isolates parts of the oil bearing structure. This results is a decline of the production rate, year by year. Plotting annual production versus cumulative production shows a charactieristic behaviour. As soon as the plateau has passed, the production decline is almost linear. The extrapolation of that decline line to the x-axis permits a good estimate of the field's ultimate recovery. This pattern is exhibited in figure 4 for the largest and longest producing UK oil field, namely the Forties Filed.

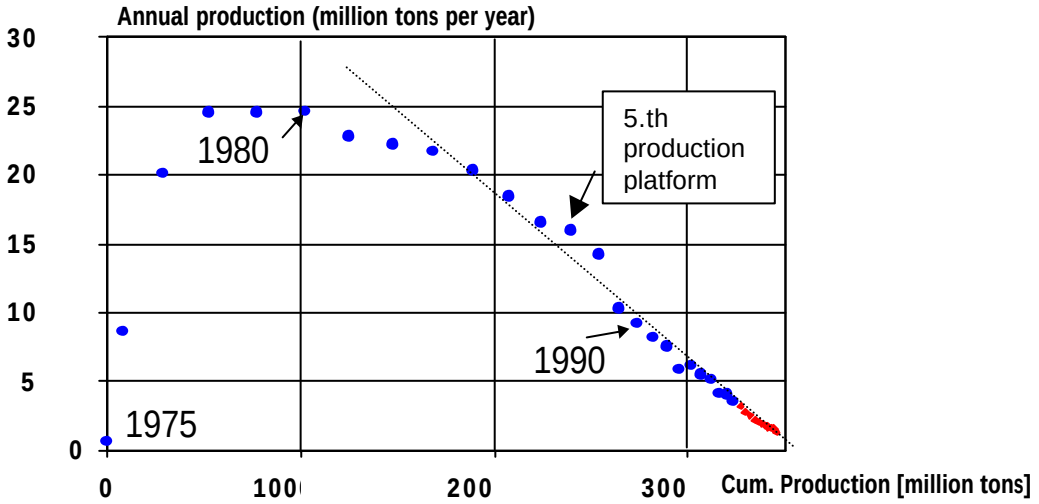


Figure 4: Analysis of oil production of Forties and production forecast; The annual production rate is plotted against the cumulative or total production (data source: Department of Trade and Industry; Analysis: C. Campbell and J. Laherrere; Forecast: LBST)

Each dot represents annual production. Production started in 1975, reaching plateau three years later. Plateau lasted for about three years before the unavoidable decline started in 1981. A fifth production platform was installed in 1986 and arrested the decline in production for only a few years, before it resumed at a steeper rate returning to the original decline rate. Although production rate was kept high, the reserves themselves were unaffected : in effect the installation of an additional platform did nothing but accelerate depletion.

An accurate forecast of future oil production may be made from a relatively simple analysis of decline rates. This is illustrated in figure 4 by the red dots until the annual production of the year 2010. Such an analysis can be made for each producing field (see annex). The farther depletion has progressed, the more accurate the forecast will be. For fields, not yet in decline, such a forecast can be based on the operator‘s estimate of peak production, date of peak production and estimated ultimate recovery (EUR). The uncertainties in future production levels of individual fields will likely average out.

The production profiles of UK fields are plotted in figure 5, with those found over five years intervals being grouped together. The historical trend is extrapolated until 2010 in the same manner.

An obvious pattern emerges with fundamental consequences: the larger fields were brought into production during the first period from 1975 to 1979. Even today these old fields contribute by more than 15 percent of total production. The fields found during subsequent periods were progressively smaller delivering less and less. Whereas thirteen new fields started production in the first period, in the most recent period from 1995 to 1999 about 69 new fields were needed. But these fields in total produced less than half of the oil coming from the first thirteen fields.

The large fields which came into production first show a slow decline, which contrasts the later smaller fields. They rise raspidly to a short plateau of production and decline steeply. The effect is cumulative and steepens the decline rate of total production over the years.

Production was drastically reduced in the period 1985 to 1989 as a result of the Piper accident which forced the government to introduce new safety standards generally. The next period (1990 to 1994) saw production recover strongly. But by contrast, the following period from 1995 to 1999 gave only a very moderate increase, though as much oil was brought onstream in that time as in the previous period. These new fields were needed just to compensate for the steeping decline of older fields. Note, that the decline rate of the fields prior to 1990 is only about half that of ten years later.

The final graph shows new discoveries whose development is planned for the next period. Even if that delivered as much oil as the previous period, it would still not prevent the overall decline.

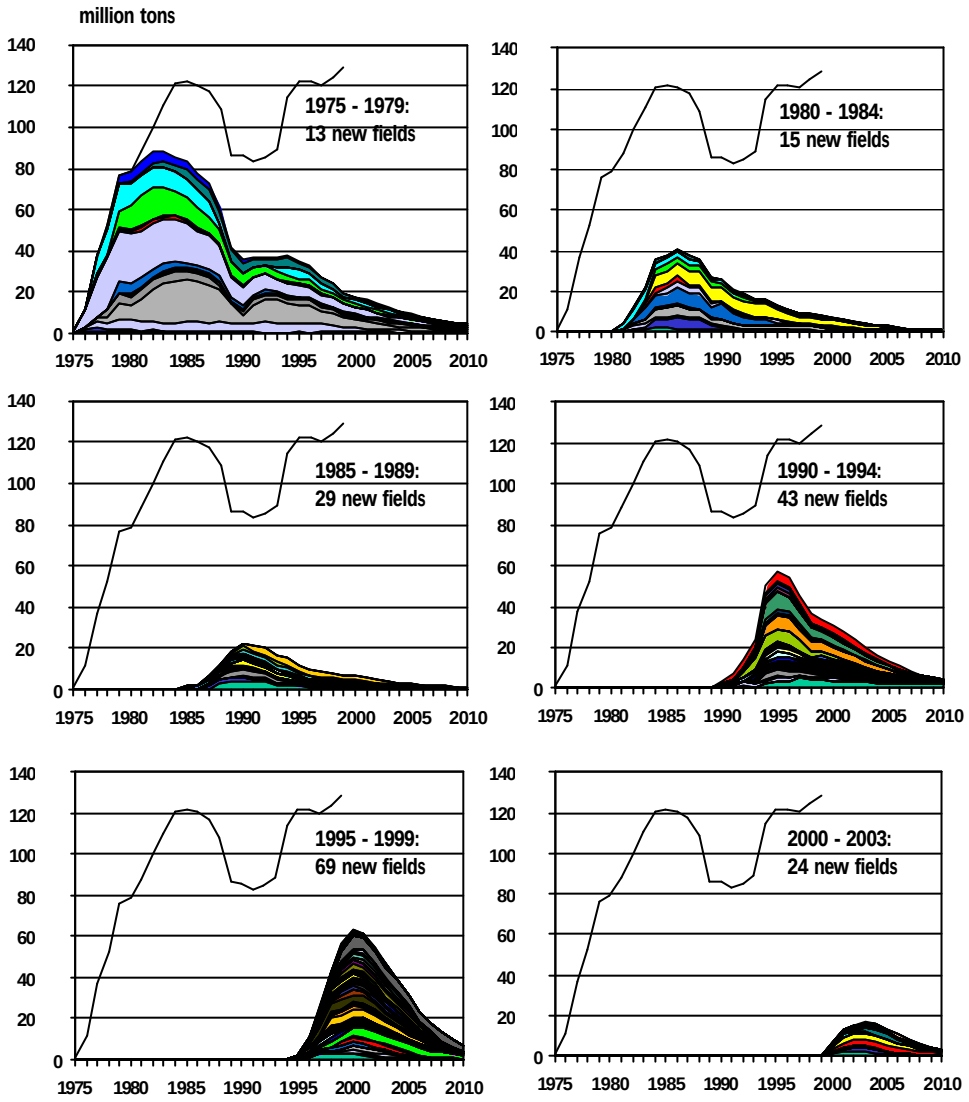


Figure 5 a-f: Analysis of all fields brought into production within each five-year-period (Data source: Department of Trade and Industry; Analysis and forecast: LBST)

Summing all fields which were in production to the end of 1999 gives the graph shown in figure 6. Including the forecast production for the year 2000, shows cumulative production of about 20 Gb. Another 6 Gb remain as reserves in these fields, of which it is estimated about 5 Gb will be produced by 2010.

The plot exhibits the steep decline which will set in when no more new fields are brought onstream. But, about 5 Gb are known in discoveries not yet producing, and an additional one Gb is expected from new discovery. These fields will dampen the steep decline somewhat. When exactly the decline of the total production starts, depends on the strategy and time schedule of the oil companies for tapping the remaining unconnected reserves.

The historical pattern shows that, without external control, the oil companies have a strong economic incentive to produce discoveries as fast as possible. Otherwise it would be hard to explain the production increases in 1998 and 1999 during a time of relative low oil prices. It could be argued that a better policy would have been to

restrict production and conserve the reserves for later so as to reduce the decline rate and benefit from higher prices.

The dotted line shows a possible production profile when all known fields are brought onstream.

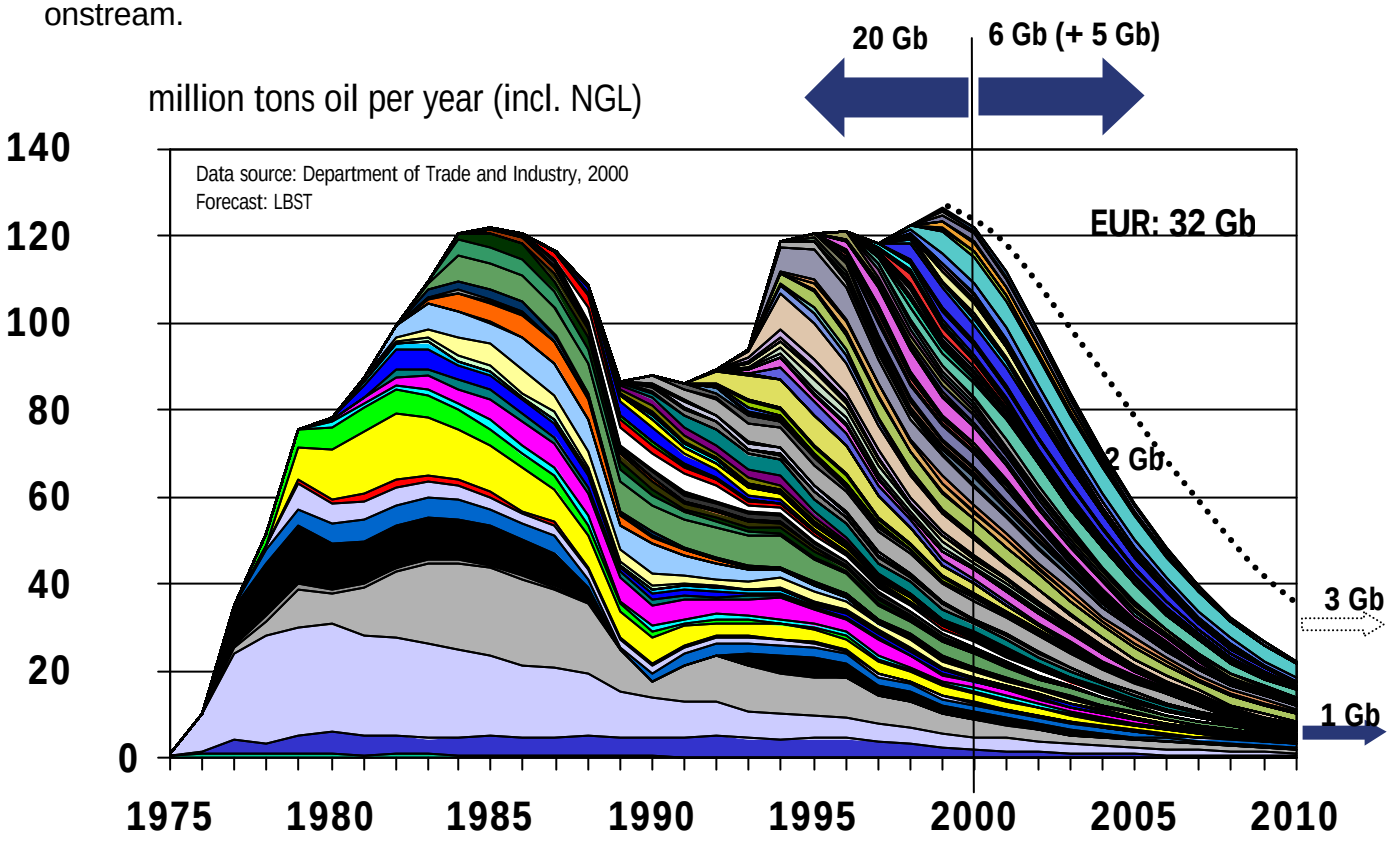


Figure 6: Field by field analysis of UK oil production (data source: Department of Trade and Industry; Analysis and forecast: LBST)

Figure 6 exhibits the principal problem of the accelerating pressure to produce ever more oil from ever smaller fields, in order to compensate for the decline in already producing fields. Since the fields are getting smaller and have earlier and steeper decline rates, the problem will get worse over time, making it impossible to maintain a high rate of production A more sensible energy policy would postpone the production of new fields so as to soften the total decline rate, and allow a smoother switch to alternatives.

But facing the reality of present economic principles and government policy the industry is forced to try to keep production as high as possible for as long as possible at the expense of a steeper subsequent decline. It leads to a greater short-lived depency on oil with no provision for what follows.

3 Presumably peak production has been passed in 1999

Figure 7 shows the UK oil production with historical annual data from 1975 to 1998 and actual monthly data from Octobre 1998 to Octobre 2000.

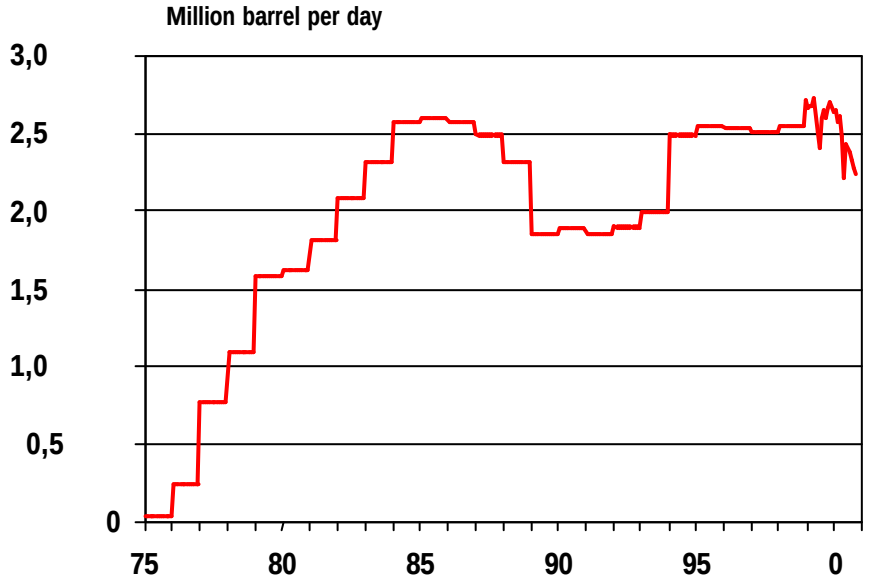


Figure 7: UK oil production in 2000. Presumably in november 1999 UK oil production started to decline. The production decline within one year is 17 percent, though the average production in 2000 was only 7 percent below the comparable period of 1999. (data source for the period 1975 to 1998: IHS-Energy; monthly data: Royal Bank of Scotland)

Since October 1999 the production declined by about 17 percent. In total, the decline of 2000 was about 7 percent with respect to 1999. The newly developed fields in 2000 could not compensate for the decline of older fields. UK has passed its peak production. Theoretically, of course, UK could reach a new maximum with highest efforts in bringing all fields into production. But the result would be that the reserves would be exhausted even faster and the decline would become even steeper. This would be the worst of all possible options.

It is very doubtful that the decline in 2000 was due to workovers and scheduled maintenance as was claimed by some press releases and notes. In fact, while it could perhaps explain a month long interruption in May 1999 or June 2000, it cannot explain an increasing decline of already six months' duration in a time where the prices are the highest for a decade.

4 Total North Sea: Preliminary Outlook for Norway

This general pattern of depletion is to be found in every oil province, although there are naturally quantitative differences. It is also important to note that the pattern offshore differs from that onshore. It follows that Norway will follow the UK example closely. It is likely to have an imminent peak, having been spared the effects of the Piper accident which distorted the UK profile, thanks in part to a more stringent safety regime. The result of a similar analysis for Norway is given in figure 8. It refers to crude oil only, but the inclusion on NGLs would add no more than a few percent to the production.

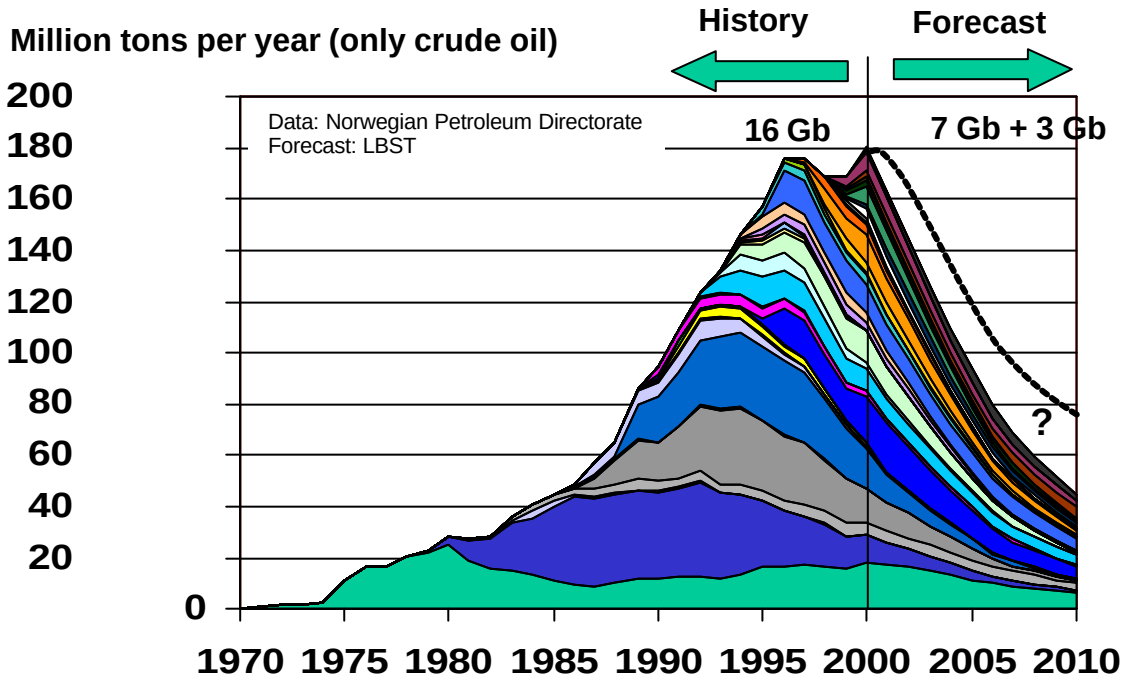


Figure 8: Field by field analysis of crude oil production of Norway; The different phases „pre-peak“ (before 1995), „plateau“ (1995 to 2000) and „decline“ (beyond 2000) are visible.

The first phase which might be called „pre-peak“ signals an ever increasing production rate without any significant problem. But once the larger fields, which are found early and provide most of the total production, pass their maximum the picture changes from having no problems to a world where increasing efforts are needed to maintain the high production level. We might call that phase „plateau“. It started about 1995 and lasts to 2000 or maybe even one or two years longer. Due to the steepening decline rates the effort to keep a constant production level increases year by year. Therefore it is only a matter of several years until the increasing speed of the „treadmill“ cannot keep pace with needed increasing output levels and the unavoidable decline sets in. In Norway this third „decline“ phase may start in 2001 or 2002 whereas in UK it has already started. The predicted decline rates are more or less similar in the range of between 7 – 10 percent annualy.

5 Decline in other Oil Basins

In Alaska the decline had already started in 1989, again with a decline rate of about 7-8 percent. Even in Russia the production rate declined within five years by about 40 percent after having held the high production level for about ten years. This ten percent decline was initiated by the break down of the political system (or vice versa as some argue?), but, once no new capacity was added, it exhibited the steep decline rate of the already producing fields.

These accelerating decline rates, which control the different phases of oil production, occur in every oil province – even in the OPEC states and the rest of the world. According to analysis of Matthew Simmons or Jeff Rubin (Canadian Imperial Bank of Commerce), the world producing oil fields as a whole have a decline rate of at least 10 percent per annum, at present.

Adding the increasing hints that even the world‘s largest oil fields Burgan in Kuwait and Ghawar in Saudi Arabia are passing (or already have passed) their production maximum, world oil production has switched from phase one („pre-peak“) to phase two („plateau“).

The present world situation differs markedly from the experience over the past century. Further production increases (if indeed they are possible) would consume huge efforts in bringing large numbers of small new fields on stream. Further production increases would be even counter-productive in the sense that they increase the oil dependence once again at the cost of increasing future depletion rate. But even to keep the present production level constant will need increasing efforts, year by year. It is only a matter of a short period until the increasing efforts are no longer followed by increasing new field developments and the unavoidable worldwide decline starts, bringing the world‘s oil production from phase two to phase three.

Conclusion:

This analysis shows how false it is to base our confidence on oil reserves being sufficient to maintain, let alone increase current production levels. Once the peak production of the large fields has passed, the situation may switch very fast. According to our experience, individual oil companies are tempted to keep a high production rate as long as possible, instead of planning to smooth the future decline. Therefore it might be feared that future decline will be the steeper, the longer the world’s oil companies try to hold high production levels

Remark:

For critical review of the text and valuable suggestions I would like to thank Prof. Blendinger, Dr. Colin Campbell and Dr. Jean Laherrere.

1 ton = 7.35 barrel

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