Graph of Projected World Emissions of Carbon Dioxide from Conventional Oil for Different Values of Peak Production

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Abstract

The parabolic technique developed for the projection of geological resource assessments has been applied to the prediction of carbon dioxide emissions from conventional oil production. In a previous note, it was found that the magnitude of the peak in oil production is a linear function of the date at which it occurs. This relationship is used here as the basis of a graph of emissions of carbon dioxide for various values of the peak in production of conventional oil on a world basis. The most probable date for the peak is expected about 2015 based upon the 1990 Assessment of the U.S. Geological Survey. Emissions in this case rise substantially above those from conventional oil production in 1990, the base year specified for reductions in the Kyoto Protocol which is expected to come into force in February 2005. Not until the period from 2038 to 2053 do the emissions from conventional oil production return to the 1990 level. Other cases are correspondingly higher.

Introduction

In 2003, world emissions of carbon dioxide released from oil consumption amounted to 3030 million tonnes when expressed in terms of the carbon contained or 43.4% of the total of 6979 MT C released from all the fossil fuels consumed that year.[1] The recent historical trend is plotted on the graph extending back to 1990, the base year chosen for the reduction of emissions of this gas in the Kyoto Protocol which is expected to come into force in February 2005. It is clear that emissions from oil are a high proportion of the total and that these have been rising over the intervening years since 1990. This trend is likely to continue until the peak in the world production of conventional oil is reached.

There is considerable controversy as to when this peak year will occur. The policy aspects of this significant event in the energy economy has drawn the most attention in recent years and not its relation to carbon dioxide emissions as related to climate change. Nevertheless, Anders Sivertsson, in a thesis presented at Uppsala University in Sweden in 2004, has made the claim that since he shares the belief of the *Association for the Study of Peak Oil and Gas* (ASPO) that the peak is imminent (perhaps as soon as 2005 expressed in terms of `regular oil' and 2007 for all oil production), the emissions of carbon dioxide from conventional oil production will be lower than those projected in the scenarios developed by the *Intergovernmental Panel on Climate Change*.[2] In contrast, the Energy Information Administration of the U.S. Department of Energy takes the view that production will reach 120 million barrels per day in 2025. The question of when the peak will occur is thus important not only to the economy which remains heavily dependent upon oil but also its relationship to emissions related to climate change.

Complicating this issue is the fact that the low technical cost of production of conventional oil suggests that it is very likely that all such oil discovered will be ultimately consumed. The major uncertainties then become: How much is there and when will it be produced? Though oil prices may rise due to OPEC policies and actual or perceived shortages, any replacement strategy based upon other energy sources or even savings in consumption is faced with a fundamental dilemma. With its low technical cost of production, any alternative to conventional oil, whether on the supply or the demand side, must cope with the ever present possibility that the price could fall substantially before conventional production would be curtailed especially during the period before the peak is reached. After the peak has passed, the price will not only be higher but more stable because it will be determined (at least at equilibrium) in large measure by that of the least costly substitute. This price will then act as a supporting floor. To explore this question further, the parabolic model developed for the projection of geological resource assessments[3] is extended here to estimate future carbon dioxide emissions for a likely range in timing for the peak in world conventional oil production.

Methodology

The two Reference Cases – The Unconstrained Parabola (UC) and its No Further Discovery (ND) variant - are calculated using the technique elaborated in Reference 3 based upon world production data taken from the annual *BP Statistical Review of World Energy*. The two basing points used to determine the unconstrained parabola were the reported production in 2003 and 1993. The ND Case was calculated as a special case of the UC Case by assuming there would be no further discovery of conventional oil after 2003. The ND Case represents a lower boundary of the possible range with the peak occurring in 2005 because, with the peak so close, any new discoveries in the brief intervening period will not affect the situation to any significant extent. It is similar to the ASPO `regular oil' case in magnitude and timing.

Cases A, B, C, D were also based upon production data for the years 1993 and 2004 but the parabolas were computed according to the procedure in Reference 4. Peaks of 85, 90, 95 and 100 million barrels per day respectively for these cases were specified and the corresponding timing then calculated according to the technique developed in this reference. This series of peaks for the various cases were found to lie upon a straight line with respect to the determined dates as shown in the graph.

Two paired production projections were calculated for each case after the peak has passed: the lower ‘standard’ parabola made no provision for a Reserve Addition but the upper ‘extended’ parabola assumed a further production of 672 gigabarrels for this addition, a value taken from the 1990 Resource Assessment of the U.S. Geological Survey. The Reserves Addition was assumed to come into play only when the peak has passed. These paired projections approximate the boundaries of the uncertainty and the true value is expected to lie somewhere between these paired curves.

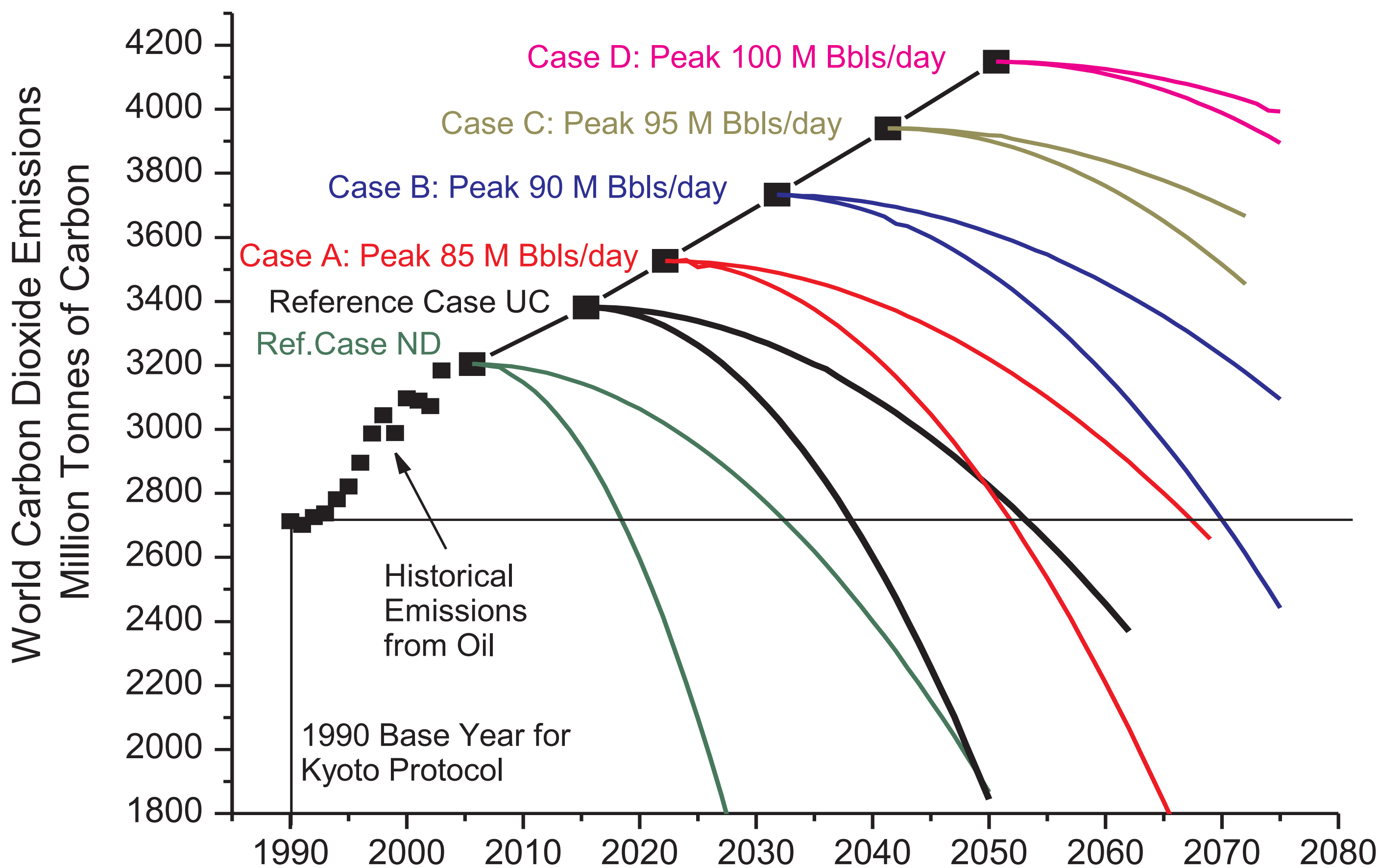
The predicted production of conventional oil was converted to its carbon content by using a factor of 113.65 million tonnes of carbon per gigabarrel.

Utility of the Graph

As more information becomes available, other values for the peak may become of interest. The straight line linking the peaks for the various cases may be interpolated for intermediate values. The line could also be extrapolated but, as noted in Reference 4, the error increases systematically with the time elapsed after the base year of 2003. This question is important because the International Energy Agency and other official bodies have projected higher peaks occurring later than in this note. It is true, however, that some of these estimates are not restricted to oil from conventional sources, but may include substantial non-conventional production from other sources such as the oils sands of Alberta, the extra heavy oils of Venezuela, and the production of liquid hydrocarbons from stranded natural gas resources around the world.

Based upon the parabolic projection methodology, it will be seen in the graph that only in the unlikely No Further Discovery (ND) scenario do emissions of carbon dioxide from conventional oil production fall in the near future. Such emissions increase markedly as the value of the peak production increases. The Unconstrained Reference Case (UC) seems the most probable projection for future supplies of conventional oil on a world basis. The peak of 81.5 million barrels per day (29.75 GB/year) in 2015 is lower and sooner than most official forecasts but even so there are substantially greater emissions of carbon dioxide over the 1990 base year until the 2038-2053 period.

Projected Carbon Dioxide Emissions for Different Values of World Peak Conventional Oil Production



Projected Paired Curves for each Peak: Lower Curve No Reserves Addition; Upper Curve Extended with Reserves Addition of 672 GB after Peak

References

1. J.H. Walsh, *2003 Carbon Dioxide Fact Sheet*, June 2004. (Web: ca.inter.net/~jhwalsh/fsesr.html)

2. Anders Sivertsson, Masters Thesis, Uppsala University, Sweden. Conclusions summarized in the *New Scientist,* London, 2 October 2004.

3. J.H. Walsh, *Procedure for the Parabolic Projection of Geological Assessments of Conventional Oil and Gas Resources with Examples*, Revised January 2004. (Web: ca.inter.net/~jhwalsh/wpara1.html)

4. J.H. Walsh, *Parabolic Prediction of the Timing of Specified Peaks for World Conventional Oil Production*, September 2004. (Web: ca.inter.net/~jhwalsh/wpeakproduction.html)

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