Cite abstracts as **Author(s) (2008), Title, *Eos Trans. AGU, 89*(53), Fall Meet. Suppl., Abstract xxxxx-xx**

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Hubbert's Peak, The Coal Question, and Climate Change

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The United Nations Intergovernmental Panel on Climate Change (IPCC) makes projections in terms of scenarios that include estimates of oil, gas, and coal production. These scenarios are defined in the Special Report on Emissions Scenarios or SRES (Nakicenovic et al., 2000). It is striking how different these scenarios are. For example, total oil production from 2005 to 2100 in the scenarios varies by 5:1 (Appendix SRES Version 1.1). Because production in some of the scenarios has not peaked by 2100, this ratio would be comparable to 10:1 if the years after 2100 were considered. The IPCC says "... the resultant 40 SRES scenarios together encompass the current range of uncertainties of future GHG [greenhouse gas] emissions arising from different characteristics of these models ..." (Nakicenovic et al., 2000, Summary for Policy Makers). This uncertainty is important for climate modeling, because it is larger than the likely range for the temperature sensitivity, which the IPCC gives as 2.3:1 (Gerard Meehl et al., 2007, the Fourth Assessment Report, Chapter 10, Global Climate Projections, p. 799). The uncertainty indicates that we could improve climate modeling if we could make a better estimate of future oil, gas, and coal production. We start by considering the two major fossil-fuel regions with substantial exhaustion, US oil and British coal. It turns out that simple normal and logistic curve fits to the cumulative production for these regions give quite stable projections for the ultimate production. By ultimate production, we mean total production, past and future. For US oil, the range for the fits for the ultimate is 1.15:1 (225- 258 billion barrels) for the period starting in 1956, when King Hubbert made his prediction of the peak year of US oil production. For UK coal, the range is 1.26:1 for the period starting in 1905, at the time of a Royal Commission on coal supplies. We extend this approach to find fits for world oil and gas production, and by a regional analysis, for world coal production. For world oil and gas production, the fit for the ultimate is 640Gtoe (billion metric tons of oil equivalent). This is somewhat larger than the sum of cumulative production and reserves, 580Gtoe. Because future discoveries are not included in the reserves, it is to be expected that our fit would be larger. On the other hand, there have been large increases in OPEC reserves that have not been subject to outside audit, so it is not clear how close the two numbers should be. For world coal, the sum of the fits for regional ultimate production is 660Gt (billion metric tons). This is considerably less than the sum of cumulative production and reserves, 1,100Gt, but it is consistent with the British experience, where until recently, reserves were a large multiple of future production. The projection is that we will have consumed half of the ultimate world oil, gas, and coal production by 2019. This means that the current intense development of alternative sources of energy can be justified independently of climate considerations. When these projections are converted to carbon equivalents, the projected future emissions from burning oil, gas, and coal from 2005 on are 520GtC. The projected emissions for the 2005-2100 period are smaller than for any of the 40 SRES scenarios. This suggests that future scenarios should take exhaustion into account. These projections, if correct, are good news for climate change.