This is a working document prepared by the Energy Information Administration (EIA) in order to solicit advice and comment on statistical matter from the American Statistical Association Committee on Energy Statistics. This topic will be discussed at EIA's spring 2006, meeting with the Committee to be held April 6 and 7, 2006.

A New Oil Supply Representation for the SAGE Model

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The Current Oil Supply Representation

The United States Energy Information Administration (EIA) uses the System for the Analysis of Global Energy Markets (SAGE) linear-program model for its annual International Energy Outlook. The model forecasts to 2030 in 5-year periods for 16 regions; on the supply side, 4 regions are further divided into OPEC and non-OPEC, effectively making 20 supply regions.

Supply in a forecast period is governed by a 9-step resource curve and a 3-step production curve. The 9-step curve represents the cumulative resources available to a region going forward, with the steps differentiated by the cost to extract a certain quantity of the resource. However, cumulative resource quantities and the differentiation between the highest and lowest cost resources alone do not place any effective limits on production in a 5-year period.

The 3-step curve represents the production capacity of the region in a given period and changes from period to period. All other supply costs are added at this point. While the model theoretically has the ability to choose a point anywhere on the 3-step curve, the edge of the second step has an inordinate weight in the resulting production in a region and is determined by the results of a separate World Oil Model.

Purpose of the New Oil Supply Representation

The three main goals of the new supply representation are to:

- Make the model more explicit in the costs associated with production, including connecting investment costs associated with finding and developing reserves to actual data and thus, allowing us to be more explicit about any assumed costs, such as taxes, royalties and product rents, that will shift the marginal cost supply curve and therefore impact the equilibrium price paid by consumers.
- Make an explicit link between reserves, price expectations, investments and production, so that we can evaluate the affect on production of changing price expectations or investments, and
- Replace the existing 3-step production curves with a more granular representation of supply.

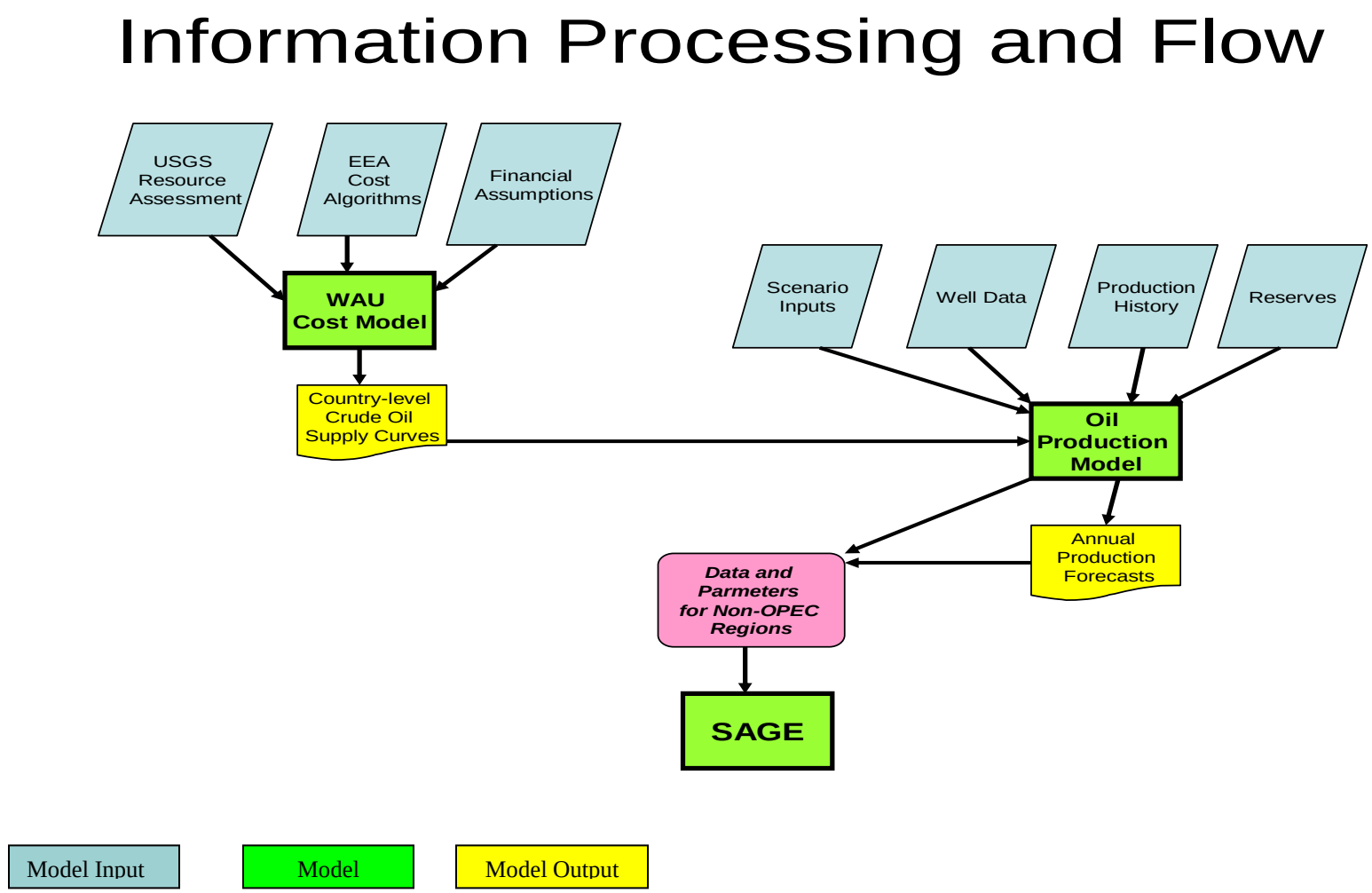
Model Structure

We are currently working with a contractor who has developed a model that can produce resource curves that show what portion of the undiscovered resources can be developed at any given price taking into account: field size distribution, location (onshore, offshore water depth), drilling depth, finding rate and financial parameters. Another model is being developed which uses those resource curves and a series of assumed world oil price projections to come up with a series of curves for future oil production.

This second model is a country-level spreadsheet model with annual historical data from 1980 to the present and forecasts to 2100. The underlying concept of the forecast is a "resource depletion model" (akin to a Hubert Curve) for which the area under the production curve is equal to the resource base. This model will differ from simpler depletion models in that:

- The resource base economics are explicit and depend on the assumed oil prices and technology drivers.
- Oil production is represented by equations, which include key economics and resource variables, and is endogenously determined.
- For each period, the oil model will incorporate key factors such as exploratory drilling, reserve additions, development drilling, production per well, oil prices, optimal drilling activities, and resource constraints, in its dynamic production analysis.

Questions for the Committee

- How explicit do we need to be with finding and development costs given that there is limited data for the relationship between dollars invested in exploratory drilling and barrels of recoverable reserves found?
- How to structure inputs to SAGE to account for both the cost of producing oil as well as the market price of oil which is not entirely based on costs?
- How granular does the supply representation fed into SAGE need to be?

Flow diagram for the oil supply models: