



The Global Citizen

By Donella Meadows

In this article, Donella Meadows shows how computer models—products of structural thinking—can help bring clarity to a complex issue. As she explains, the well-orchestrated interplay between mental and computer models can enhance the richness of both.

Every policy is shaped by two forces: background analysis and foreground politics. The politics of energy are well known. Long before the Bush White House looked at a single statistic [for its National Energy Strategy] it was committed to nuclear power, to supply strategies, to market

details of the oil sector, or the transportation fleet or greenhouse gas emissions. One model pulls the detailed sectors together and makes them consistent—so, for example, all supply sectors compete realistically for investment money. Or so a rise in the price of imported oil starts a move toward substitutes, and those substitutes come on line only as fast as the economy can actually finance and build them.

In a refreshing break from the short-term focus of most government policy, the models look as far ahead as the year 2030. Any energy discussion has to do that, to include the lifetimes

their models can Predict or Pronounce, only that they can explore assumptions and test uncertainties.

No model can tell us what to do, but an honest one centered on physical facts can tell us that some things are impossible. So, for example, the energy models won't convert the car fleet to 40 mpg within a year, or construct 100 nuclear power plants without raising the capital for them—mental-model tricks that are regularly invoked in the policy debate. The models show that the nation cannot be run by solar or nuclear energy within 40 years. Nor can any policy free us from oil imports (except, perhaps, strong efficiency measures, which the Energy Department hasn't tested).

Another thing a model can't do is answer questions that are never asked. The Bush administration never asked its analysts to explore some of the more interesting questions. What would be the effect of a carbon tax? How much could efficiency be increased? Could a combination of efficiency and renewables meet our needs? If so, how fast?

Computers are not to be trusted, no more than mental models. They begin to be credible only when they're openly available, for all points of view to examine and criticize, to correct, to try assumptions and ask questions. The Energy Department is trying to do just that—to make its models available to critics. If the White House lets it happen, both the computer models and our mental models can move toward greater realism. That won't happen soon enough to help this year's National Energy Strategy, but it's a step in the right direction.



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incentives, and to drilling for oil in the Arctic National Wildlife Reserve.

Bush politics were predictable, but not Bush analysis. One of the reasons the administration has taken so long to come up with its strategy is that the analysis has been serious and thorough.

It's one thing to gather numbers and opinions about energy. It's another to put together all that information and make sense of it. That requires a tremendous amount of "bean counting." The beans to be counted include all existing sources of energy, potential sources of energy, existing and potential energy demand, pollution emissions, conservation options and more.

Only a computer can keep track of all these beans. The Energy Department has resurrected, updated, and expanded several computer models, most of which originate from the energy-crisis days of the Ford and Carter administrations, to do the job.

Some of the models contain the

of present fuel reserves and capital plant and the time it takes to bring on new sources, whether solar or nuclear. The models also capture important feedbacks, like the possibility that a strong conservation policy might decrease the price of energy so much that people would start wasting energy again. The computer models also make a more balanced attempt than the White House does to include options on both the supply and the demand side.

But, of course, even computer models are riddled with oversimplifications. They are biased. (For example, the Energy Department calculates air pollutants, but not nuclear wastes.) They are as weak as their assumptions, many of which are inherently uncertain. It would be better to have access to Truth, but that we will never have. We only have models, in computers or in our heads.

The DOE modelers recognize these limitations. They do not claim