Loose coupling of engineering and interindustry models: benefits and pitfalls

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For many types of modeling analyses, it is helpful to link models of different types. When working with an input-output model, researchers may often link to a macroeconomic model. Other useful linkages include models of satellite accounts (R&D, travel and tourism, or health care, for example). Research on energy supply and demand, GHG and other emissions, new technologies and materials flows often involves detailed information at a finer level of detail than that generally available in an input-output based model. In addition, measurement and modeling in physical units is necessary. In this case, it may be fruitful to link an engineering and technology (E&T) model with the input-output model. An E&T model maintains a detailed energy system representation that captures the flow of energy and technology adoption and the satisfaction of end use demands. It has the ability to model detailed information about costs and characteristics of competing technologies that may be used to satisfy end use demands.

An interindustry model, on the other hand, whether it be econometric or CGE, can provide a consistent and fairly detailed picture of the overall economy, and relates to end use demands by consumers, businesses and government. Such a model can also incorporate forecasts of industry exports and imports, both for energy and non-energy sectors. If the model contains a macroeconomic block which includes national accounting (SNA) by institutional sector, it enables the modeling of policies that have implications for the government budget, including the modeling of revenue recycling mechanisms. An interindustry model can also capture the price effects of policies to reduce GHG and other emissions, including their indirect effects. The model also provides essential economic projections which are exogenous to the E&T model, such as household disposable income, sectoral prices, and interest rates.

This paper draws upon experiences gained in several studies that have been performed using the Inforum LIFT model loosely coupled with E&T models. Two prominent examples are the US MARKAL model, and the Energy Pathways model. We will review the objectives and benefits of coupling these models, and delineate their relative areas of specialization.

Some of the main topics explored include:
â€¢ How are the linkages between models established? What does the IO model provide to the E&T model and vice-versa?
â€¢ What are some of the issues in converting between monetary and physical units? Difficulties due to different product mixes (including geographical distribution), as well as price-discrimination across markets, that belie the IO â€œone-priceâ€• assumption are important to consider.
â€¢ How can technology forecasting from engineering and R&D based projections be translated meaningfully to changes to IO coefficients. A particular example is the modeling of corn and cellulosic ethanol, and their blending with gasoline.

Finally, we will make recommendations on how such hybrid linkages could be improved, with an eye to suggesting changes in both the IO and the E&T models.