# The ultimate energy input-output model

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Conventional energy input-output models (i.e. hybrid-unit and direct impact coefficient models) were developed about 40 years ago and have not been significantly improved since. These conventional models have a modest description of energy flows. This paper introduces an alternative energy input-output model that has a better representation of energy flows according to the processes of energy conversion in the economy: the Primary-to-Final Energy Input-Output Model (PF EIO model). The model characterizes the vector of total energy consumption as a function of seven factors: economic structure; efficiency and structure of primary-to-final energy conversion (i.e. energy sector); final energy demand composition; direct energy intensity; magnitude of final demand; composition of final demand; and average energy prices. The proposed model is empirically equivalent to the hybrid-unit energy input-output model of Bullard and Herendeed (1975), which is considered the standard, and can also replicate the form of the direct impact coefficient model. Nevertheless, it includes a detailed description of the primary and final levels of energy use and of the primary-to-final conversion stage in the economy, which is absent in conventional models. Furthermore, the PF EIO model enables the inclusion of other levels of energy use, which led to the development of the Primary-to-Useful Energy Input-Output Model, which is the first ever energy input-output model to include the useful level of energy use and the final-to-useful energy conversion stage. In addition, the proposed models are especially suitable to evaluate energy efficiency trends in the economy.

Bullard, C. W. and R. A. Herendeen (1975). "The energy cost of goods and services." Energy Policy 3(4): 268-278.