

Christoph Böhringer and Thomas F. Rutherford
**COMBINING TOP-DOWN AND BOTTOM-UP IN ENERGY POLICY
ANALYSIS: A DECOMPOSITION APPROACH**

C. Böhringer: Centre for European Economic Research (ZEW), Mannheim
& Department of Economics, University of Heidelberg, Germany, E-mail: boehringer@zew.de
Th. F. Rutherford: Ann Arbor, MI, U.S.A.

The formulation of market equilibrium problems as mixed complementarity problems (MCP) permits integration of bottom-up programming models of the energy system into top-down general equilibrium models of the overall economy. Despite the coherence and logical appeal of the integrated MCP approach, implementation cost and dimensionality both impose limitations on its practical application. A complementarity representation involves both primal and dual relationships, often doubling the number of equations and the scope for error. When an underlying optimization model of the energy system includes upper and lower bounds on many decision variables the MCP formulation may suffer in robustness and efficiency. While bounds can be included in the MCP framework, the treatment of associated income effects is awkward.

We present a decomposition of the integrated MCP formulation that permits a convenient combination of top-down general equilibrium models and bottom-up energy system models for energy policy analysis. We advocate the use of complementarity methods to solve the top-down economic equilibrium model and quadratic programming to solve the underlying bottom-up energy supply model. A simple iterative procedure reconciles the equilibrium prices and quantities between both models. We illustrate this approach using a simple stylized model.