



Independent Statistics & Analysis
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Introduction to the International Electricity Market Model (IEMM)

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Background and motivation

The U.S. Energy Information Administration (EIA), an independent statistical and analytical agency within the U.S. Department of Energy (DOE), is required by law to produce energy forecasts under various assumptions that help inform policy-makers, industry, and the public. The International Energy Outlook (IEO) is one of EIA's forecasts and is produced in accordance with Section 205c of the Department of Energy Organization Act of 1977, Public Law 95-91, which requires EIA's Administrator to prepare an annual report containing trends and projections of global energy consumption and supply.

The World Energy Projection System Plus (WEPS+) is the primary analysis tool used to develop the midterm projections of international energy markets in the IEO. WEPS+ is organized and implemented as a modular system. Each module is used to project a component of the fuel supply markets, end-use consumption sectors, transformation (conversion) sectors, greenhouse gases, and the economy. Information is passed among the modules through a main (integrating) module. WEPS+ executes each component module in sequence, communicating using a shared database. It iterates to produce delivered prices and quantities for various energy products.

A major component of WEPS+ is its electricity model, currently the World Electricity Model (WEM). The WEM projects electricity capacity, electricity generation, and the corresponding fuel consumption through 2040. It uses exogenous inputs for nuclear and renewable technologies and then determines the results for fossil fuels using a logit function. The WEM represents 13 energy sources and 16 international regions. The modeling approach for the electricity forecast in the IEO is discussed in *World Energy Projection System Plus Model Documentation 2011: World Electricity Model*.¹

The Office of Energy Analysis (OEA) within EIA is responsible for the development, maintenance, and use of WEPS+. OEA would like to improve the robustness and functionality of its international electricity model by developing a new model – the International Electricity Market Model (IEMM). The goals of the IEMM are to enhance OEA's modeling capabilities, including the ability to:

1. model capacity planning and dispatch (determine generation, capacity, and consumption) as an economic model based on least cost,
2. incorporate all fuels - including nuclear and renewables – as endogenous inputs,
3. react to technology advancements,
4. produce end-use electricity prices, and
5. respond to a variety of scenarios.

Development process and schedule

The following development process is envisioned for the IEMM:

1. Define requirements
2. Host workshop
3. Solicit external component design reports (CDRs)
4. Receive and review CDRs

¹ [http://www.eia.gov/forecasts/archive/m078\(2011\).pdf](http://www.eia.gov/forecasts/archive/m078(2011).pdf)

5. Write technical directive for prototype model
6. Issue technical directive and award contract
7. Construct and test prototype model
8. Integrate prototype model
9. Develop and test final model
10. Integrate final model into IEO

Technical workshop

EIA will hold a technical workshop on international electricity models on Thursday, January 15, 2015. The workshop will be held at the U.S. Department of Energy, 1000 Independence Ave., SW, Washington, DC 20585, in conference room 2E-081. This workshop will explore topics related to the development of the new IEMM. The workshop will bring together experts from the electric power modeling community to discuss approaches, methods, and technical considerations for improved international electricity models and projections.

EIA is soliciting proposals for presentations in the following areas:

- Technology representation
 - o Types and technology advancement
 - o Cost and availability
 - o Learning models
- Geographic representation and considerations
 - o Regional definition; country groupings
 - o Region-specific macroeconomic factors
 - o Regional considerations for planning reserves and resource adequacy
 - o Regional renewable resource potential
- Capacity planning and dispatch models
 - o Foresight and expectations
 - o Expansion, retrofits and retirements
 - o Integration of renewables; projections for nuclear
 - o Load shape considerations
 - o Time horizon and time step granularity
 - o Selection of algorithms

- Electricity pricing
 - o Regional differences
 - o Wholesale/retail; marginal cost/average cost
- Scenario modeling; representing risk and uncertainty
 - o Capability for global carbon policy scenarios
 - o Country- or region-specific policy representation
 - o Representing risk (resource, project, political)
 - o Fuel price uncertainty, demand uncertainty

Questions for discussion

The following list of questions encompasses some of the issues that could be discussed at the technical workshop. It is provided as an aid to the discussion, and to solicit additions where appropriate.

1. What are the major modeling considerations for supply-constrained regions?
2. What are the appropriate geographic aggregations for the model?
3. What risk factors should be considered, and how should they be modeled?
4. What new data sets exist, and how could they influence new modeling approaches?
5. Ultimately, what's the best modeling approach for the IEMM?

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