US Multi-region MARKAL Modeling

US 9-region National Model

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US9r Data Development Process

EIA surveys, NEMS, eGRID
Regional base technology characterizations and end-use fuel shares

NEMS Supply/Trade Options
Supply curves and regional transportation capacity and costs

Base year state-level system characterization

NEMS/DOE technology options
AEO2006 demand projections
AEO2006 fuel price projections
Supply and Trade

Reference case evolution
R0 (Supply Region)

Coal, Oil and Gas Domestic Supply Steps

Imported Coal, Oil and Gas and Petroleum Product Supply Steps

Supply Links
Each IMP<ent> process includes bounds on "supply.

R0 EXP<ent> process for each resource supply has a corresponding IMP<ent> process in each region (R1 to R9) where supply of the <ent> is allowed. (r = import region number)

Recommended Coal, Oil and NG Resource Supplies

11 Coal Supply Basins
1 Coke Imports
4 Natural Gas Wells (on/off shore, Lower 48 and Alaska
1 Natural Gas Imports
4 Crude Oil (on/off shore, Lower 48 and Alaska)
5 Crude Oil Import grades* 6 Imported Petroleum Products* * Individual Supplies

9 Regions according to US Census Bureau Districts
1 New England
2 Middle Atlantic
3 East North Central
4 West North Central
5 South Atlantic
6 East South Central
7 West South Central
8 Mountain
9 Pacific

Trade Links
Each EXP<ent> links to one IMP<ent> option in the regions to which <ent> may flow. Bounds on trade infrastructure/transportation process. (r = import region number) (# = export region number)

Coal Resource Supply and Upstream Mapping Example

R0 (Supply Region)
South Appalachia Bit/High Sulfur, Underground

Under Mining (MINCSABHUA-K)
Imported Supply and Trade of Refined Petroleum Products (Diesel)

EXP/IMP links only for Rs associated with each PADD

Pipeline Capacity (Annual Throughput) and Investment for Refined Petroleum Product Trade (Diesel)

* Costs for import or trade into the region are added to the X-process costs in the load-sheet Scenario Gen.
* All Refined Products that use the import or trade link contribute to the capacity annual throughput and expansion processes.
* Note: refinery output limited by refinery processes and Barge/Vessel trade are not capacity limited.
Electricity Generation, Import and Trade Processes

- Case 1

**Region 1**
- Electricity Demands
- IMPELC
- IMPELC*1
- R1 Conversion Technologies
- XELC'E (Existing)
- XELC'N (New, if needed)
- XELC* (Existing)
- International Electricity Exports

**Region 2**
- Electricity Demands
- EXPELC1
- EXPELC*1
- R2 Conversion Technologies
- IMPELC*1

* corresponds to the Import Source
- MX = Mexico
- BC = British Columbia
- MA = Manitoba
- ON = Ontario
- QU = Quebec
- NB = New Brunswick

**Current Status**
- Initial complete model is assembled
- Calibration to AEO2006 underway
- Initial sensitivity runs this fall