Improving Projections of Global Oil and Gas Supply

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By

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The Global Hydrocarbon Supply Model (GHySMo) is an important addition to the international analysis toolkit at U.S. Energy Information Administration (EIA)
GHySMo captures the entire supply chain from upstream to downstream.

End-user demands (WEPS+)

Upstream

Data Prep

Capacity Expansion (Capital Allocation)

Runtime

Logistics

Conversion

Integration

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Highlights of Global Hydrocarbons Supply Model (GHySMo)

Upstream model structure

• Model incorporates resource data for whole world down to country-basin level

• Model data is separate from model algorithms

• Model represents co-production of liquids and natural gas

• Model can deliver multiple “worlds” representing uncertainties in the parameters used to estimate resources and drilling/completion costs

• User has flexibility in topology/regionality, and in commodity types

• Model represents geopolitical risks through discount rates by country and year
Upstream model overview – Functional representation & data flow

*The 4 categories are: (1) existing production (EP); (2) reserve growth (RG); (3) undiscovered resources (YF); (4) continuous/unconventional

**Offline**
- **Input data**
- **Preprocessor**

**Runtime**
- “Blending” of resource cost curves to help with runtime –
  - Large fields above an input-specified size left distinct/unblended;
  - Smaller fields blended

**Calculation of production profiles**

**Capacity Expansion and Dispatch**
- Commodity-specific supply quantities over time for each production region for a given price path
- Ranking and scheduling of projects (by NPV-per-available-drill-rig and available rigs)
- Calculation of costs, revenue, NPVs
- Calculation of available rigs

**Economic calculations**

**Data prep**
- Resource properties (e.g., water depth, drilling depth)
First half of the upstream model data prep is an offline preprocessor

**Third party data sources**
- Drilling costs
- Volumes (resources)
- Resource information category-specific parameters
- API gravity
- GOR
- …

**Discovery process**
- Modeling for undiscovered resources

**Preparatory calculations**
- Related to operating expenses

**Aggregate, process, and standardize data**

**Additional calculations and preprocessing**
- Drill rig-years required to develop resource type by type of drill rig (onshore/offshore big/small)

**Resource cost curves**
Resource information is organized into major categories

• Four current resource information categories
  – Existing production
  – Reserve (field) growth
  – Undiscovered resources / yet to find (similar to undiscovered technically recoverable resources)
  – Tight/shale resources (based on US analogs)

• Structure of resource information categories is such that resources within the above groups or additional ones can be added or incorporated within existing structure
  – Hydrates
  – Oil shale
At runtime, price paths are applied to generate supply cost curves and production profiles…

- Price paths from GHySMo Logistics model
- Oil and gas composition profiles
- Modeler’s controls
- Commodity type cross reference

Computations of volumetric totals and OPEX, creates annual profiles, bins in smaller price parcels, and aggregates small parcels within basins

- Discount rates
- Formula parameters for fixed and variable operating expenses
- Technology improvement factors

End of data prep

Supply cost curves

Production profiles
...which are then dispatched as annual production volumes

- Price paths from GHySMo Logistics model
- Modeler's controls
- Calculations of net present values, ranking of projects, scheduling of projects subject to drilling rig constraints
- Number of available drilling rigs
- Price deflators
- Annual commodity-specific production volumes for each region
- GHySMo Logistics

Beginning of capacity expansion and dispatch
Preliminary results – regional shares of annual total crude oil production for 21 regions

Source: EIA GHySMo upstream model test results
Preliminary results – regional shares of annual total natural gas production for 21 regions

Source: EIA GHySMo upstream model test results