A Description on how to Build an Alternative Gas Resource Assumption Input for Modeling: An Intermediate Option between EPA and AEO 2010 Resource Assumptions

EPA believes that the assumptions regarding natural gas resource in the primary base case are the appropriate ones to use. EPA is however providing information on an alternative set of assumptions (AEO 2010), as well as a third way that gas price assumptions could be developed.

Intermediate Natural Gas Scenario

In addition to two sets of base and policy case runs that incorporate the EPA and AEO 2010 resource view for natural gas, EPA is requesting comment on performing an additional set of reference and policy runs with a gas scenario that starts with the resource assumptions in the EPA primary case but limits production of those resources due to uncertainties affecting their development. These uncertainties include still to be resolved environmental and land use issues affecting shale gas development.

Below is a brief description of the how natural gas resources are modeled in EPA Base Case v.4.10 and an identification of parameters and constraints that are available to represent limitations on the production of the resource base. Among the parameters described below, the "Inertial Constraint" and the Exploration & Development (E&D) cost parameters are the ones most likely to be employed in the intermediate natural gas resource scenario. EPA is requesting comment on the choice of parameters and constraints and the respective values of those parameters.

Resource Cost Curves in EPA Base Case v.4.10

Natural gas resources in the primary EPA Base Case v.4.10 are modeled by a set of base year resource cost curves, which represent undiscovered resource availability or recoverable resource as a function of E&D cost. The construction of the resource cost curves are based on resource characterizations and economic evaluations from a Hydrocarbon Supply Model (HSM) developed and maintained by ICF, International. The model provides resource cost curves by supply region (77 regions in the U.S. and Canada) and by resource type such as conventional gas (non-associated gas from gas fields and associated-dissolved gas from oil fields), coalbed methane gas, shale gas, and tight gas. Shortly before the release of EPA Base Case v.4.10 the HSM shale gas resource cost curves for major basins in the U.S. and Canada were updated using the latest available gas industry information on the geology, well production characteristics, and costs. These new shale gas curves are included in the EPA Base Case v.4.10.

Resource and Cost Parameters/Constraints

The natural gas resource base in the EPA Base Case v.4.10. represents economically recoverable resources using current technology under existing regulatory frameworks. It is also based on a set of assumptions such as accessibility factor and geological risk factors. The accessibility factor represents the level of restrictions to the E&D activity in areas of high population density. Generally speaking, such areas represent a very small portion of the major plays, with the exception of the Barnett (in Texas) and Marcellus (in Pennsylvania and New York) shale plays. The geological risk factors limit the amount of recoverable resource and are applied to shale plays to reflect uncertainties due to their emerging nature and often large geographic extent. The geological factors include distance to established production within the play, net pay

thickness, and thermal maturity. The rationale is that areas that are far from established production, have unusually thin net pay, or have very low or high maturity should carry a higher risk. Changes to the assumptions for technology, E&P regulations, accessibility, and geological risks will impact the level of the recoverable gas resources and costs.

Other resource related parameters or constraints in the IPM Natural Gas Module include the level of remaining resources that could be developed in a year (inertial constraints), drilling rig constraints, and natural gas reserves to production (P/R) ratio. Changes to these parameters/constraints will impact the development and production of the recoverable resources.

The table below lists the parameters/constraints that could be used to change the level of recoverable resources, costs, resource development, and production. It provides brief description and the level of granularity of the parameter/constraint and the related supply scenario.

Parameter/ Constraint	**Description**	**Granularity**	**Scenario**
Recoverable Resource	Base year recoverable resource (in the resource cost curves)	Region, Resource Type, Resource Step[1]	E&P Regulation, Accessibility, Geological Risk
E&D Cost	Wellhead price (in the resource cost curves) needed for capital expenditures, cost of capital, operating costs, royalties, severance taxes and income taxes	Region, Resource Type, Resource Step[1]	E&P Regulation, Technology
Inertial Constraint	Maximum share of remaining resource that could be developed in a year	Region, Resource Type, Resource Step[1]	E&P Regulation, Technology
Drilling Rig Constraints	Number of drilling rigs, rig retirement rate, and rig growth rate	Onshore, Offshore Shelf, Offshore Deep	Technology
P/R Ratio	Natural gas reserves to production ratio	Region, Resource Type, Resource Step[1]	Technology

[1] *Resource cost curve for each region and type is divided into 40 resource steps. Each step represents incremental recoverable resource and E&D cost.*