World Energy Projection System Plus (WEPS+): Coal Module

April 2020

Contents

1. Introduction

The WEPS+ Coal Module (Module) projects annual regional prices of coal sold to the electric power sector and to the other end-use demand sectors. The Module incorporates an optional *supply elasticity* approach, described below, to allow projected sectoral coal prices to change in response to projected changes in global coal demand between WEPS+ iterations. The Module projects annual electric power sector and other sectoral coal prices for each of the 16 WEPS+ regions and passes them to the demand modules (residential, commercial, industrial, transportation, electricity, and district heat).

2. Inputs to the Coal Price Calculations

The following variables are inputs to this Module for both historical and projection years (2005 to 2050):

- *Annual Energy Outlook (AEO) base coal prices* (dollars per million British thermal units [$/MMBtu]): Annual U.S. weighted-average, delivered real steam coal prices to the electric power sector from the most recent EIA AEO.
- *Base world coal demand* (quadrillion Btu): Annual, projected total world coal demand quantities, aggregated across all of the WEPS+ end-use sectors, from the previous *International Energy Outlook* (IEO) projection, which will serve as the base demand for estimating supply elasticity responses.
- *Regional coal prices for the electric power sector* ($/MMBtu): EIA estimates for real annual delivered steam coal prices for each WEPS+ region. Each WEPS+ region is associated with the closest port for seaborne-traded steam coal spot prices, based on historical data series published by IHS Markit, for geographic origin or destination ports. EIA analysts assign historical coal prices to the WEPS+ regions based on the coal types and grades used by the established electricity producers. EIA analysts project annual rates of increase in real coal prices based on assessments of market trends for each region, and they apply the growth rates to historical price levels to project annual delivered coal prices by WEPS+ region.
- *Regional non-electricity coal prices* ($/MMBtu): EIA estimates for real annual delivered coal prices for non-electricity end-use sectors for each WEPS+ region using the average of the delivered prices for metallurgical and steam coal in the United States from the most recent AEO. Ratios of historical regional prices relative to the U.S delivered coal price are derived from IHS Markit electricity steam coal prices. The price ratios are used to estimate historical year base prices for the non-electricity sectors for each WEPS+ region. As with the regional electricity coal prices, analyst-determined growth rates are applied to the base prices to project annual regional non-electricity delivered coal prices by WEPS+ region.
- *Price elasticity of coal supply*: Annual estimates indicating the sensitivity of coal supply to changes in the coal price for all regions. Because coal demand will change during repeated cycles of the WEPS modules, the inverse of the elasticity, or *supply elasticity of coal*, is applied to coal prices to determine the extent to which the price of coal will increase or decrease in response to the change in the volume of coal required to supply world coal demand. The greater the assumed elasticity value, the less responsive prices will be to changes in world coal demand.

EIA analysts have assumed a long-run price elasticity for coal of 5.0 for all years, which is very high.

- **Elasticity switch**: A yes or no value indicating whether or not to apply the supply elasticity price adjustments.

The Module converts the nominal price inputs listed above to constant dollars per million British thermal units.

3. Summary of the Coal Price Calculations

The WEPS+ assumes that world coal supply for each projection year equals the total coal consumed in all demand and transformation sectors across all of the WEPS+ regions, and that no change in coal inventory levels occurs between projection years. The Module uses a switch to determine whether or not to adjust the projected coal prices based on the projected world coal supply levels. If EIA analysts turn off the elasticity switch, the unmodified regional electricity and non-electricity coal price inputs listed above are used in all WEPS+ model iterations. If EIA analysts turn the switch on, the Module uses the following elasticity relationship to project how a percentage change in modeled world coal supply, compared with the base world coal demand, translates into a percentage change in modeled electricity coal price, for each projection year:

$$\text{Supply Elasticity of Coal Price} = \frac{\text{Percentage Change in Modeled Coal Prices}}{\text{Percentage Change in Modeled World Coal Supply}}.$$

For each projection year, the Module adjusts modeled coal prices for electricity as follows:

$$\text{Modeled Coal Price} = \text{AEO Base Coal Price} \times \left(\frac{\text{Modeled World Coal Supply}}{\text{Base World Coal Demand}}\right)^{\text{Supply Elasticity of Coal Price}}.$$

The resulting percentage change in the AEO base electricity sector coal price for each projection year is then applied to the regional electricity sector prices and other sectoral coal prices. Higher elasticity values are assumed in the IEO Reference case, relative to the other IEO cases, implying a relatively small change in coal prices in response to an increase in coal supply requirements.