Appendix B

Impact of Output-based Allocations on the Ordering of Dispatch

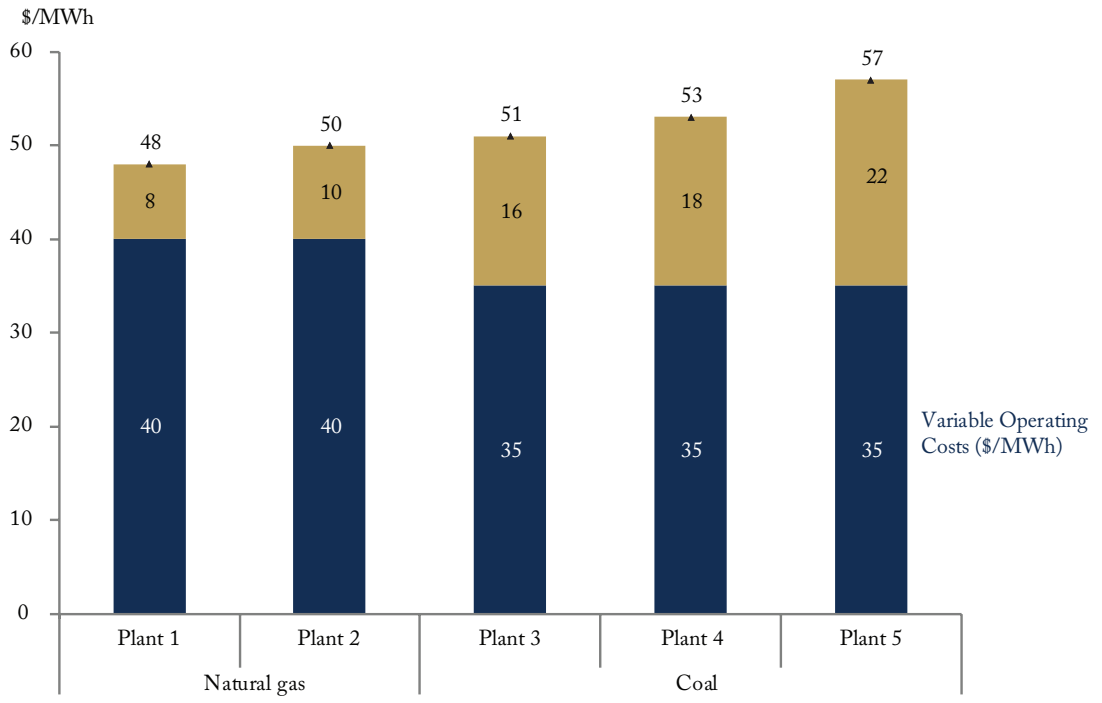
To see the impact of the output-based allocations on the ordering of dispatch, consider a hypothetical power market with five 100 MW plants (two natural gas and three coal) with equal per unit variable operating costs and the emissions intensities given in below.

Table B1: GHG Emission Intensity and Operating Costs for Power Plants in Example

	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5
Fuel	Natural Gas	Natural Gas	Coal	Coal	Coal
"GHG Emission Intensity (CO_2 Eq./GWh)"	400	500	800	900	1,100
Variable Operating Costs ($/MWh)	40	40	35	35	35

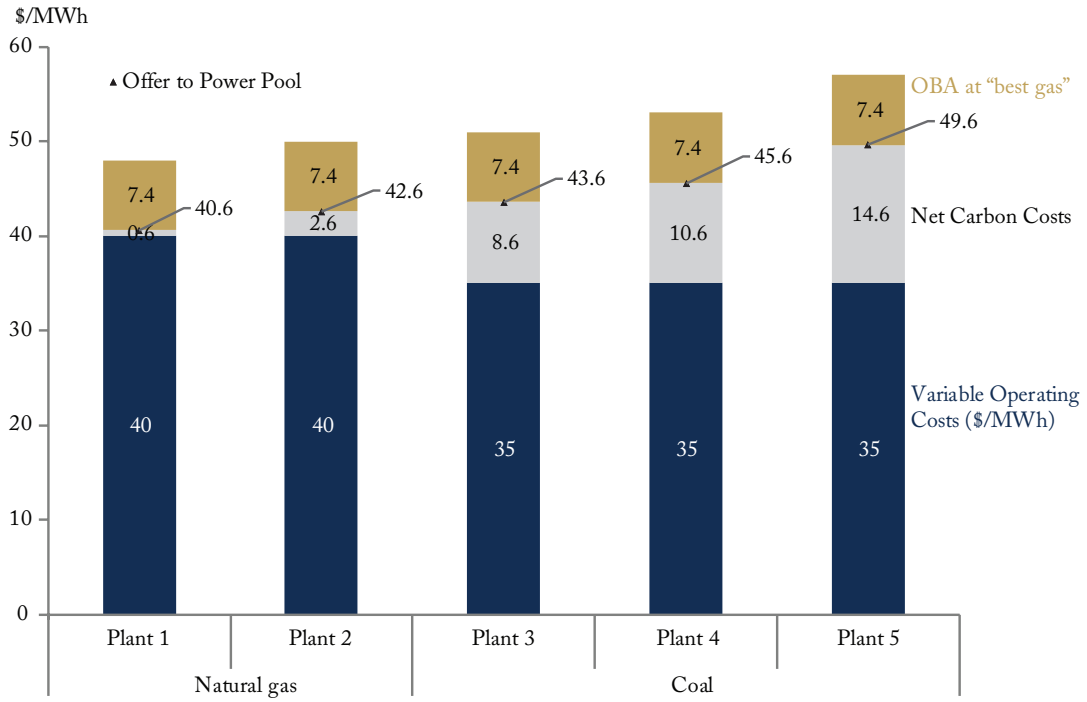
Source: Author's assumptions based on levelized costs from US EIA (2018).

Figure B1: Offers to Power Pool by Example Plants with Carbon Pricing and No Output-based Allocation



Source: Author's assumptions based on levelized costs from US EIA (2018).

Figure B2: Offers to Power Pool by Example Plants with Carbon Pricing and Output-based Allocation at Uniform "best gas" Benchmark



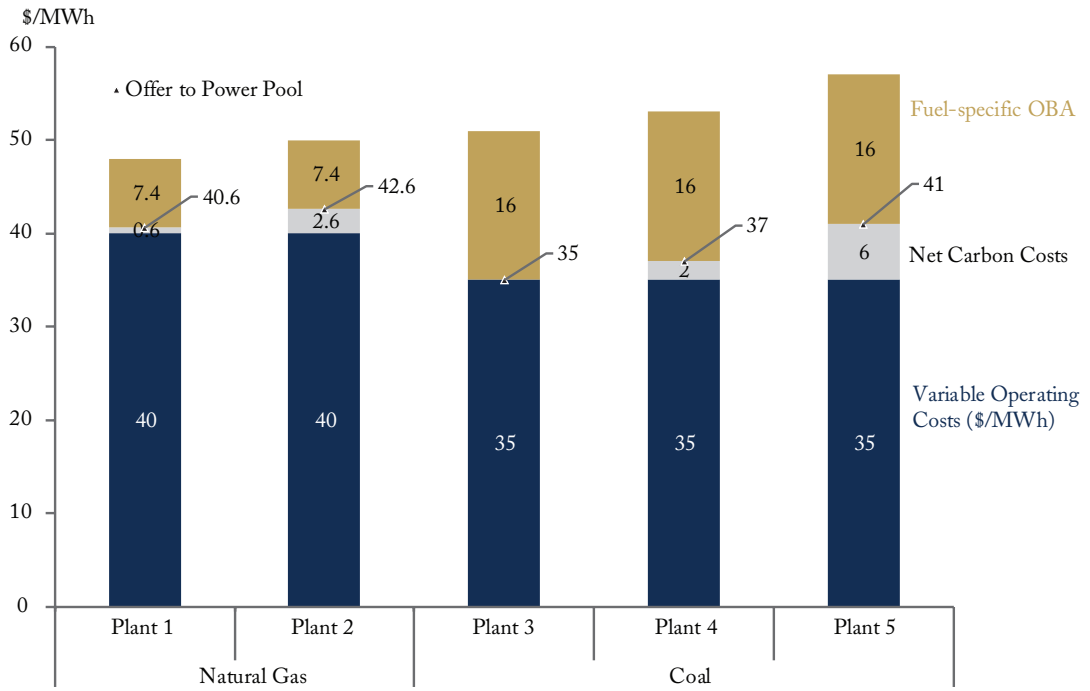
Source: Author's assumptions based on levelized costs from US EIA (2018).

If not facing a carbon price, the operators of the plants would each offer output into the power pool at their respective variable operating costs. Without a carbon price, the coal plants would be dispatched ahead of the natural gas plants because these have lower variable operating costs. When faced with a carbon price of $20/tonne (but with no output-based allocations), each operator would incorporate the carbon costs into the offer price. The ordering of the offers from each plant then would be as shown above in Figure B1, with natural gas plants dispatched ahead of coal plants. The carbon price efficiently ensures that operators incorporate the social cost of GHG emissions into their offers to provide power to the market.

To see the neutrality of a uniform benchmark on the dispatch order, consider the impact of a "best gas" benchmark of 370 tonnes CO_2 Eq./MWh in this hypothetical power market. The net carbon costs (i.e., after adjusting for OBAs) and offers by each power plant are shown above in Figure B2. The output-based allocation reduces the carbon costs paid by each plant – and the operators should be willing to offer the plants for dispatch at a relatively lower price. However, the ordering of plants for dispatch is not impacted because the allocation is based on a uniform benchmark that applies equally across plants regardless of the fuel-type.

In contrast with the uniform benchmark, a fuel-specific benchmark risks distorting the ordering of plants on the dispatch curve. illustrates the impact on ordering in the hypothetical example when the coal plants receive OBAs based on a coal-specific benchmark of 800 tonnes CO_2 Eq./GWh while natural gas plants receive OBAs based on a 370 tonnes CO_2 Eq./GWh benchmark. Using the example of five plants with equal variable operating costs and the given emission intensities, the fuel-specific standard results in a reordering of the dispatch curve:

Figure B3: Offers to Power Pool by Example Plants with Carbon Pricing and Output-based Allocation at Fuel-specific Benchmark



Source: Author's assumptions based on levelized costs from US EIA (2018).

as shown in Figure B3, the coal facilities (Plants 3, 4 and 5) will make offers into the power market at a lower price than Plant 2 – despite the significantly lower GHG emission intensity for Plant 2. That is, because of the greater offset from fuel-specific OBAs, certain high emission coal plants would now be inefficiently dispatched ahead of a lower emission natural gas plant.