Dockets UE-170485 & UG-170486
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Page 1 of 2

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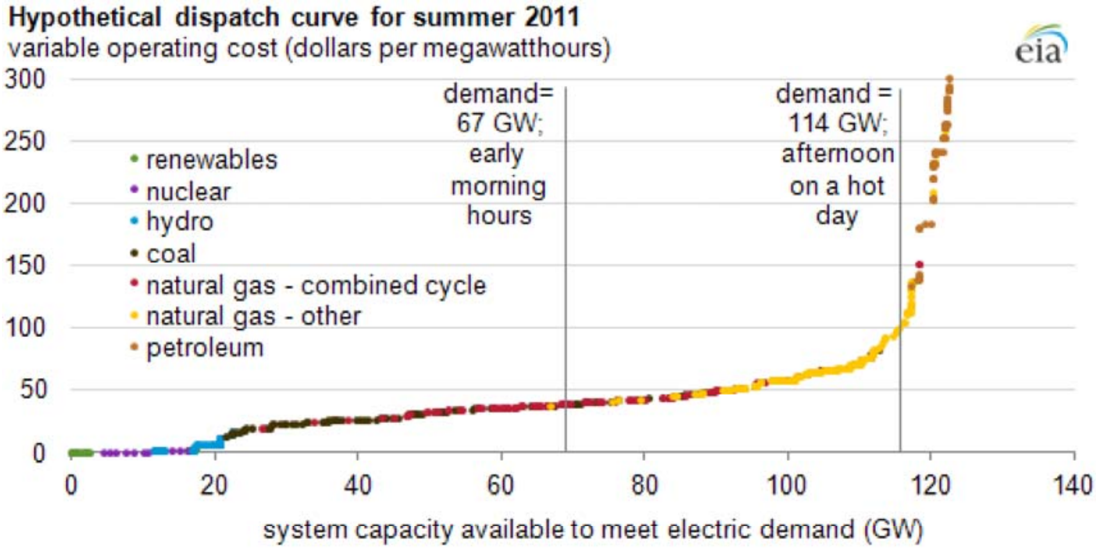
Electric generator dispatch depends on system demand and the relative cost of operation



Source: U.S. Energy Information Administration.
Note: The dispatch curve above is for a hypothetical collection of generators and does not represent an actual electric power system or model results. The capacity mix (of available generators) differs across the country; for example, the Pacific Northwest has significant hydroelectric capacity, and the Northeast has low levels of coal capacity.

The variable operating cost of electric power generators is a key factor in determining which units a power system operates (or "dispatches") to meet the demand for electricity. Other things being equal, plants with the lowest variable operating costs are generally dispatched first, and plants with higher variable operating costs are brought on line sequentially as electricity demand increases. This sequence can be seen in an electricity supply curve—also referred to as a dispatch curve—that represents the order in which units are dispatched to meet the demand.

Electric system operators strive to have sufficient generating capacity available to meet the expected demand for electricity, plus a "reserve margin" to account for unexpected events (such as abnormally hot weather). The order in which these units are brought on line is primarily a function of variable cost. The two vertical lines on the chart represent different electricity demand situations; generators falling to the left of the line for each situation would supply electricity at that time.

Baseload generating units, which generally operate 24 hours per day year-round baring maintenance outages, appear on the left side of the supply curve. Toward the right side of the supply curve are peaking generators, which mainly operate when hourly loads are at their highest. Intermediate generating units (also known as cycling units), which operate between base load and peaking generators, typically vary their output to adapt as demand for electricity changes over the course of the day and year.

The exact order of dispatch varies across the United States, depending on such factors as fuel costs, availability of renewable energy resources, and the characteristics of local generating units. The type of generators with the lowest variable costs are nuclear, hydroelectric, and renewable power (wind and solar). For economic and technical reasons, nuclear plants in the United States are almost invariably operated as baseload units at maximum output. While wind and solar plants have very low operating costs, their availability is limited by the availability of the resource (i.e., whether the wind is blowing or the sun is shining). Some electric power systems dispatch these variable resources, others do not, and wind generators are sometimes curtailed to keep electric supply in balance with demand.

Although hydroelectric plants also have very low variable costs, their dispatch patterns are influenced by many factors, including: current and projected reservoir levels, environmental factors, timing output to maximize revenues, and the need in some locations to balance variable wind and solar output. For these reasons hydroelectric dispatch patterns can be complex.

The variable cost of generating electricity from fossil-fueled units is primarily a function of the fuel price and the efficiency of the plant's conversion of the fuel into electricity. Historically coal plants have operated as baseload units while natural gas-fired plants in many regional power markets have have met intermediate and peak load needs. This was a function of the low cost of coal fuel compared to natural gas. This fuel cost advantage was sufficient to overcome the efficiency advantage of the new vintage of gas-fired generators built beginning in the 1990s. However, more recently gas prices have declined, and these efficient gas-burning combined cycle plants have begun to displace coal as baseload generation.

Peaking generators typically have the highest variable operating costs, appearing on the far right of the supply curve, and are dispatched during the hours when demand for electricity is highest. Peaking unit technology includes diesel generators and, most commonly, combustion turbines (CTs) fueled by natural gas. Combustion turbines have been used for many years, and older units are inefficient. However, the newest units have greatly improved efficiency, to the point that, with the advantage of low gas prices, the newer CTs have begun to back-out some coal generation. This dispatch pattern has only been seen in recent years.

Since petroleum is significantly more expensive than natural gas, it is used less frequently in the electric power sector.

While variable operating costs are the primary driver of the dispatch decisions made by an electric power system operator, other factors can lead to deviations from the hypothetical economic dispatch curve presented above. Power plant startup times and ramp rates; air permit requirements; electric transmission system constraints that require non-economic dispatch of generating units for system reliability purposes; and the preference of operators to avoid cycling nuclear units are several other factors that play a role in dispatch decisions.