2016 Levelized Cost of New Generation Resources from the Annual Energy Outlook 2010

The table on the following page provides the average national levelized costs for the generating technologies represented in the National Energy Modeling System (NEMS) as configured for the *Annual Energy Outlook 2010* (AEO2010) reference case.[1] Levelized costs represent the present value of the total cost of building and operating a generating plant over its financial life, converted to equal annual payments and amortized over expected annual generation from an assumed duty cycle. The key factors contributing to levelized costs include the cost of constructing the plant, the time required to construct the plant, the non-fuel costs of operating the plant, the fuel costs, the cost of financing, and the utilization of the plant.[2] The availability of various incentives including state or federal tax credits can also impact these costs. The values shown in the table do not incorporate any such incentives. As with any projections, there is uncertainty about all of these factors and their values can vary regionally and across time as technologies evolve. When evaluating actual plant proposals, the specific technological and regional characteristics of the project must be taken into account.

In the AEO2010 reference case a 3-percentage point increase in the cost of capital is added when evaluating investments in GHG intensive technologies like coal-fired power plants without carbon control and sequestration (CCS) and coal-to-liquids (CTL) plants. While the 3-percentage point adjustment is somewhat arbitrary, in levelized cost terms its impact is similar to that of a $15 per ton CO2 emissions fee when investing in a new coal plant without CCS, well within the range of the results of simulations that utilities and regulators have prepared. The adjustment should not be seen as an increase in the actual cost of financing, but rather as representing the implicit hurdle being added to GHG intensive projects to account for the possibility they may eventually have to purchase allowances or invest in other GHG emission-reducing projects that offset their emissions. As a result, the levelized capital costs of coal-fired plants without CCS are higher than would otherwise be expected.

Levelized costs can be useful when comparing different technology options to satisfy a given duty cycle requirement. For example, levelized cost could be used to determine the lowest cost new capacity available to satisfy a need for baseload[3] power that would be expected to operate at a 70 percent capacity factor or higher. In the table below, the levelized cost for each technology is evaluated based on the capacity factor indicated, which generally corresponds to the maximum availability of each technology. However, it should be noted that a technology such as a conventional combined cycle turbine that

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[1] The original full report and updated reference case are available at http://www.eia.doe.gov/oiaf/aeo/index.html.

[2] The specific assumptions for each of these factors are given in the *Assumptions to the Annual Energy Outlook*, available at http://www.eia.doe.gov/oiaf/aeo/index.html.

[3] While there are no definitive utilization breakpoints, baseload plants are facilities that operate almost continuously, generally at annual utilization rates of 70 percent or higher. Intermediate load plants are facilities that operate less frequently than baseload plants, generally at annual utilization rates between 25 and 70 percent. Peaking plants are facilities that only run when the demand for electricity is very high, generally at annual utilization rates less than 25 percent.

looks relatively expensive at its maximum capacity factor may be the most attractive option when evaluated at a lower capacity factor that would be associated with an intermediate load duty cycle. Simple combustion turbines (conventional or advanced technology) are typically used for peak load duty cycles, and are thus evaluated at a 30 percent capacity factor. The duty cycle for intermittent renewable resources of wind and solar is not operator controlled, but dependent on the weather or solar cycle (that is, sunrise/sunset). The availability of wind or solar will not necessarily correspond to operator dispatched duty cycles and, as a result, their levelized costs are not directly comparable to those for other technologies (even where the average annual capacity factor may be similar). In addition, intermittent technologies do not provide the same contribution to system reliability as dispatched resources, and may require additional system investment (not shown) to achieve a desired level of reliability.

As mentioned, the costs shown in the table are national averages. However, there is significant local variation in costs based on local labor markets and the cost and availability of fuel or energy resources such as windy sites. For example, regional wind costs range from 91 $/MWh in the region with the best available resources in 2016 to 271 $/MWh in regions where the best sites have been claimed by 2016. Costs for wind may include additional costs associated with transmission upgrades needed to access remote resources, as well as other factors that markets may or may not internalize into the market price for wind power.

Estimated Levelized Cost of New Generation Resources, 2016.

Plant Type	Capacity Factor (%)	U.S. Average Levelized Costs (2008 $/megawatthour) for Plants Entering Service in 2016				
		Levelized Capital Cost	Fixed O&M	Variable O&M (including fuel)	Transmission Investment	Total System Levelized Cost
Conventional Coal	85	69.2	3.8	23.9	3.6	100.4
Advanced Coal	85	81.2	5.3	20.4	3.6	110.5
Advanced Coal with CCS	85	92.6	6.3	26.4	3.9	129.3
Natural Gas-fired						
Conventional Combined Cycle	87	22.9	1.7	54.9	3.6	83.1
Advanced Combined Cycle	87	22.4	1.6	51.7	3.6	79.3
Advanced CC with CCS	87	43.8	2.7	63.0	3.8	113.3
Conventional Combustion Turbine	30	41.1	4.7	82.9	10.8	139.5
Advanced Combustion Turbine	30	38.5	4.1	70.0	10.8	123.5
Advanced Nuclear	90	94.9	11.7	9.4	3.0	119.0
Wind	34.4	130.5	10.4	0.0	8.4	149.3
Wind – Offshore	39.3	159.9	23.8	0.0	7.4	191.1
Solar PV	21.7	376.8	6.4	0.0	13.0	396.1
Solar Thermal	31.2	224.4	21.8	0.0	10.4	256.6
Geothermal	90	88.0	22.9	0.0	4.8	115.7
Biomass	83	73.3	9.1	24.9	3.8	111.0
Hydro	51.4	103.7	3.5	7.1	5.7	119.9

Source: Energy Information Administration, Annual Energy Outlook 2010, December 2009, DOE/EIA-0383(2009)