OSEIA Comments on Capacity Issues (UM 2011)
December 16, 2019

A. Which Resource Attributes are Appropriate to "Capacity"?

The Oregon Solar Energy Industries Association (OSEIA) applauds the Oregon Public Utilities Commission (OPUC) efforts in this investigation to focus on capacity issues. We expect this effort will be comprehensive and forward-looking, so that future capacity issues are appropriately considered, in the context of changes to the utility systems that will occur over time. Given the importance of solar, and increasingly solar paired with battery storage, as a growing element of the utility supply portfolio, it will be important for the Commission to recognize the locational and temporal aspects of capacity for these resources, in addition to the capabilities they can provide. These ideas are emphasized below.

1. **Which of these capacity definitions are applicable for which types / categories of capacity, if at all?**
    a. **Nameplate capacity**
    b. **Maximum dependable capacity**
    c. **Baseload capacity**
    d. **Ability to meet energy needs**
    e. **Effective Load-Carrying Capability (ELCC)**
    f. **Peaking capacity**

RESPONSE:

Nameplate. The installed "nameplate" capacity of a generating resource is applicable to just about every type of generating resource and capacity category. It is generally the maximum kW output level that a power plant can produce. The term originates from the nameplates on electric generators, describing the model, manufacturer, and rated output of the facility. For a solar photovoltaic (PV) unit, the MW-DC nameplate rating is usually converted to a MW-AC amount, which considers inverter capacity and various system losses and provides the maximum output of 60 Hz AC power at the busbar. While other measures of capacity may differ from the nameplate rating, they will all be limited to something less than nameplate.

Maximum Dependable Capacity is the amount of electricity that a generator can reliably produce during some particular period, e.g. during the peak demand hours of the year. For example, the Nuclear Regulatory Commission (NRC) uses this definition for a nuclear power reactor, noting that output varies over the year due to temperature variations that affect water cooling.[1] It also defines the Net Dependable Capacity as the Maximum Dependable Capacity less station power requirements. Thus, the term Net Dependable Capacity is used to refer to the maximum amount of electricity a plant or system can provide to the grid in a given time interval.

The maximum dependable capacity concept is typically applicable to dispatchable or baseload forms of generation, e.g. gas-fired generation. For example, a multi-hour test at the times of winter or

[1] https://www.nrc.gov/reading-rm/basic-ref/glossary/maximum-dependable-capacity-gross.html

summer peak demand could provide an indication of net capacity by season. The California Independent System Operator (CAISO) uses the acronym "Pmax" to indicate net dependable capacity, as many dispatchable generators will have a range of levels (Pmin to Pmax) at which they can operate.

Baseload capacity is generally understood to be the amount of capacity that is provided constantly throughout the year. For example, the minimum level at which a gas-fired, coal, or nuclear unit operates throughout the year would define the baseload capacity it provides. In contrast, when a unit is dispatched to higher levels, the output is considered peaking or load following, and not baseload generation. Similarly, for a solar PV resource whose output fluctuates over the daylight hours, the output is often called intermittent or variable generation, and again not baseload. Thus, baseload capacity is a concept that is generally applicable only to certain types of generation that operate (for at least a fraction of their output) with a relatively constant, "base," or "flat" output profile over time. Peaking generation, ramping capacity, or statistical measures of capacity from intermittent resources such as wind or solar generally would not be forms of baseload capacity.

Ability to Meet Energy Needs. This concept appears to be more related to a utility system than to a specific resource. As the utilities must plan for the ability to meet energy needs, they must be sure to have acquired adequate generation capacity to serve load. Thus, the ability to meet energy needs appears to be more a result of having obtained an adequate portfolio of generation capacity, rather than being a form of capacity in itself. Analysis of resource portfolios relative to expected demand includes determinations of whether existing and new resources of various kinds will combine to provide an adequate ability to meet future energy needs.

Effective Load Carrying Capacity (ELCC) analysis typically involves modeling to determine how much of a particular type of resource (i.e. wind or solar PV) must be added to the system in order to provide the equivalent reliability level (in terms of loss of load probability or expectation) as adding a dispatchable gas-fired or storage unit. ELCC analysis can be based on weighting the hours of the year according to which are most important for meeting peak demands. For example, even though solar PV capacity (without pairing with batteries) is limited to daylight hours, to the extent utility peak loads tend to occur during daytime hours, the ELCC-weighted average capacity factor of solar PV is a measure of expected PV capacity. ELCC analysis is typically not needed for other types of resources, such as baseload gas-fired generation. ELCC can be considered as a derating factor to account for how effective a particular type of resource is at providing a similar level of reliability as a standard dispatchable gas-fired combustion turbine.

It should be noted that there are several alternative methods to assign a capacity value to intermittent resources such as solar PV. OSEIA supports the use of ELCCs. However, we note that the Oregon utilities have supported other methods in the RVOS proceeding, such as using an exceedance methodology (i.e. the capacity factor that a resource exceeds more than X% of hours during a particular set of defined peak period hours). Exceedance approaches have also been used by the CAISO for determination of a unit's Net Qualifying Capacity (NQC) in the California Resource Adequacy program. Exceedance calculations are very conservative, given they are generally closer to the minimum rather than average or expected level of production. Finally, another common approach is to determine an average capacity factor during a particular set of peak hours. This method can be benchmarked to more complex ELCC calculations and has the virtue of being easy to use.

Peaking Capacity applies to resources that provide capacity to meet peak loads. For example, a certain amount of utility load is baseload and is present in every hour of the year, whereas the peak load of a utility will be at a higher level for relatively brief periods. Thus, resources needed to serve the peak utility loads will have to include certain resources that are used only infrequently rather than in a baseload fashion, so as to meet those peak demands. A typical example is a gas-fired combustion turbine (CT), which is sometimes referred to informally as a "peaker." It is less expensive to build than a combined cycle gas turbine, but generally costs more to run. Thus, the CT often is viewed as the benchmark, least-cost form of incremental capacity. Going forward, with less reliance on new natural gas-fired generation regionally and with declining costs for battery storage, we expect that batteries may become the new benchmark form of peaking capacity (i.e. storing off-peak energy from the system or from solar PV in order to provide on-peak energy to the system).[2]

Finally, to the extent that the peaking capacity concept refers to all resource output at the time of peak system load, we note that solar PV capacity value to the utility is sometimes measured, as noted above in the ELCC discussion, in terms of average resource capacity factor during key peak hours.

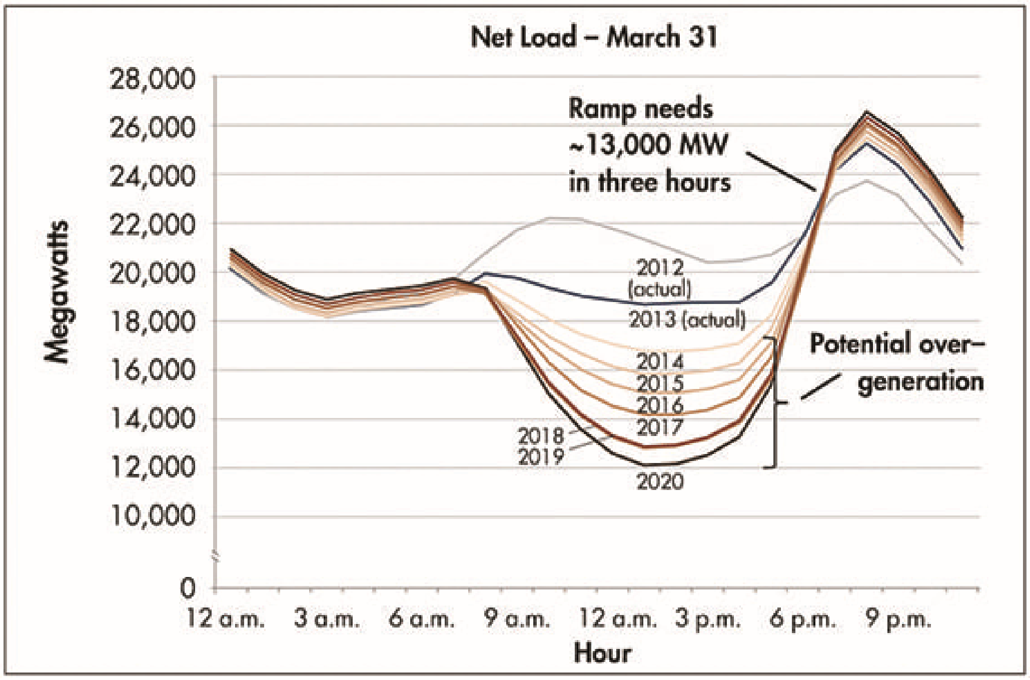
2. To what extent should flexibility and/or ability for the utility to dispatch a given resource (or resource category) be considered? In other words, should it be treated as a distinct capability or type/category of capacity, or as an enhancement to that resource's capability / capacity offering?

RESPONSE:

Flexible capacity typically refers to the ability of a generating unit to ramp up or down quickly. The CAISO has begun to acquire flexible capacity, out of a concern for the increasingly steep evening ramps in California's load net of the state's large (20 GW) solar PV fleet. As solar drops off at the end of the day, the amount of capacity that must be provided with other generation resources ramps up, which leads to a need for flexible, peaking capacity in the evening hours. The famous CAISO "duck curve" is a picture of the CAISO net load during a typical spring day.[3] Given that generation from solar resources occurs during the daytime, the net system load that must be served by other resources such as gas-fired generation ramps down in the morning and ramps up in the evening.

[2] For example, see the NREL announcement regarding the potential for battery storage peaking capacity, at https://www.publicpower.org/periodical/article/storage-could-meet-big-chunk-peaking-capacity-needs-nrel

[3] https://www.powermag.com/wp-content/uploads/2018/06/figure-1-caiso-screen-shot-2018-05-07-at-4-08-21-pm.jpg



We note that California's experience with the duck curve is a function of the high solar penetration in the state, approaching 20%. This will be less of a concern in Oregon until there is more substantial growth in solar resources. California has about 26,000 GW of installed (nameplate) solar capacity, as opposed to about 600 MW of solar capacity in Oregon.[4]

Flexible capacity resources that are dispatched at Pmin in a low load hours should be able to quickly ramp up to Pmax in a high load hour. By obtaining specific quantities of flexible ramping resources, with a sufficient kW/hour ramp rate, the CAISO strives to ensure it will have sufficient capacity to meet its evening net load ramps.[5] It should be noted that storage can provide flexible ramping capacity, by discharging energy during load ramp hours. It should also be noted that the extent to which solar PV causes a duck curve effect, it is mitigated to some extent by combining different types of renewable resources in a utilities supply portfolio, e.g. wind and solar together may provide a flatter supply profile than solar alone.

[4] See SEIA's state map summary of solar statistics at https://www.seia.org/states-map. SEIA estimates 1.47% of Oregon's electricity comes from solar, compared to 18.74% in California.

[5] It should be noted that this, of course, is essentially what happens through energy-market based resource dispatch: resources selected in high load hours must have sufficient flexibility to ramp up at that time, to the extent they are not a baseload resource. Thus, flexible ramping capacity is simply an explicit designation for a type of capacity that is implicitly included in energy market dispatch.

3. Similarly, how should potential ancillary services offered by a resource or resource category be considered? Do they represent a distinct category of capacity? Or an enhancement to the available capacity offered by a given resource?

RESPONSE:

Ancillary services (A/S) are simply a set of uses for capacity. For example, if a unit does not utilize 100% of its capacity for generating energy, it can provide some capacity for ancillary services such as upward spinning reserves or regulation. Thus, similar to flexibility, A/S are distinct services that capacity can provide, rather than a form of capacity. Power systems typically have a limited need for ancillary services, and only units that are dispatchable can provide them. Battery storage is a dispatchable resource that can provide various types of ancillary services. In systems with markets for ancillary services, units that provide peaking capacity can be available to compete to provide A/S in non-peak hours, as an additional source of revenue. Sometimes, the typical uses of capacity for (energy, A/S, flexible ramping, etc.) are important to understand and evaluate, in order to determine the net costs of capacity after any economic rents are obtained from these activities. Typical ancillary services include regulation (up or down), spinning reserves or non-spinning reserves. Ancillary services are location and time specific. Although typically procured by an ISO or utility, at the system level, ancillary services at the distribution level may provide important resiliency/reliability benefits.

It has been widely assumed that a grid with an increasing penetration of variable solar and wind resources will require more ancillary services to integrate the higher penetration of intermittent resources. The initial studies of wind and solar integration costs found increased ancillary service costs in the range of $2 to $5 per MWh of renewable output. However, more recent solar integration analyses have calculated substantially lower integration costs; this includes studies by utilities with increasing penetrations of solar resources. For example, recent solar integration studies from PacifiCorp and Idaho Power have reported integration costs of about $0.60 per MWh.[6] In addition, a recent analysis of ancillary service costs on the CAISO grid found no increase in these costs, as a percentage of wholesale market costs, over the last 15 years (2014-2018), despite the addition in this period of more than 20 GW of solar resources to a grid in California that has a peak demand of 50 GW.[7] These lower integration costs are attributable to (a) methodological improvements in the studies themselves, (b) reduced market prices, (c) "learning by doing" experience operating the grid with wind and solar resources, and (d) the increased availability of regulation-capable gas-fired resources displaced by new renewables (i.e., a greater supply of ancillary services).

[6] See PacifiCorp's 2017 IRP, Volume II, at Appendix F, pp. 120-123, esp. Tables F.14 and F.16. Also see Idaho Power, *Solar Integration Study Report*, (April 2016), at pp. vi and 21, esp. Tables 2 and 9.

[7] This analysis was presented recently in testimony before the North Carolina Utilities Commission. See *Direct Testimony of R. Thomas Beach on behalf of North Carolina Sustainable Energy Association* in Docket No. E-100, Sub 158 (June 21, 2019), at pp. 8-16.

4. **Are there distinct types of capacity that could be separately compensated, assuming that adequate information, communications and control systems are in place? For example, should capacity that has the following capabilities be considered distinctly:**
    a. **Available to meet system Resource Adequacy (RA) needs?**
    b. **Available to meet system flexibility needs?**
    c. **Available in a certain time frame?**
    d. **Available in a certain location?**

RESPONSE:

All of these types of capacity can be considered, and even compensated, distinctly. System RA is similar to Integrated Resource Plan (IRP) planning to ensure that peak demands can be met. Flexible capacity is to help meet ramping needs, which may increase as solar resources are added to the system. Capacity "in a certain time frame" appears to be similar to peaking capacity, but could also measure capacity provided by resources during other periods. The California RA program also has local capacity requirements to ensure that adequate capacity is available in load pockets and to protect against the exercise of local market power. It is important to recognize that the locational distinction includes resources on the distribution system, which may be able to displace both centralized generation capacity and transmission capacity.

5. Utilities and stakeholders have already submitted a good deal of relevant information in the form of presentations and workshop participation. Staff appreciate these contributions and will continue to draw upon them, and interested parties do not need to file the same presentation materials again. However, are there other comments pertinent to the questions asked in Phases I and II (i.e. "What is Capacity," and "How do we value Capacity today?") that you would like to share with all parties, to clarify, deepen, or add nuance to your position or understanding of these issues?

RESPONSE:

No additional comment beyond the responses provided above.

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