

Re: Request for Comments

Possible Amendment to Rules Relating to the Definition of "Capacity," Minnesota Rules, 7835.0100, subp. 4; Revisor's ID Number R-04926; PUC Docket No. E-999/R-25-86

I am responding to the Minnesota Public Utility Commission's request for comments as an individual. I have a personal interest in energy policy and a residential DER for which the precise definition of "capacity" may be relevant.

I urge the Commission to **reject** the proposed rule, as it is contrary to Minnesota statute, current policy, industry practice, and common sense.

7835.0100 DEFINITIONS

Subp. 4. Capacity.

"Capacity" means the capability to produce, transmit, or deliver electric energy, and is measured by the number of megawatts alternating current at the point of common coupling between a qualifying facility and a utility's electric system. "Capacity," as defined under Minn. Stat. § 216B.164, subd. 2a (c), for purposes of eligibility for net-metering in Minn. Stat. § 216B.164, subd. 3(d), is determined by, and measured at, the qualifying facility's inverter or a power control system or supplemental device that controls production at the qualifying facility before the net-metered customer's load.

Minnesota statute

The statute defines "capacity" in [MN 216B.164 Subd. 2a.\(c\)](#):

(c) "Capacity" means the number of megawatts alternating current (AC) at the point of interconnection between a distributed generation facility and a utility's electric system.

Watts are a measure of power, a physical quantity equal to energy over time. The point of interconnection is a physical place. On its face then, capacity – power at a place – is a tangible thing to be measured, rather than an abstract thing to be calculated. The questions are where and how to measure this power. The only answers consistent with the statute are to measure power at the utility's meter using the utility's meter, since this is the place where both electric systems interconnect to exchange AC power. The proposed rule selectively redefines "capacity" as being power at a different place.

The statute could have defined "capacity" in a way which covers total electric energy production, i.e. the DC production from a solar array, but it does not. The statute could

have defined "capacity" in a way which covers all AC power produced by an inverter or generator, i.e. before serving behind-the-meter load as the proposed rule states, but it does not. The statute defines "capacity" as power between a distributed generation facility and the utility *after* serving behind-the-meter load. The Commission must follow.

Additionally, I ask the Commission not to lose sight of [MN 216B.164 Subd. 1](#):

Scope and purpose. This section shall at all times be construed in accordance with its intent to give the maximum possible encouragement to cogeneration and small power production consistent with protection of the ratepayers and the public.

Even if the statute were ambiguous about "capacity", the statute is explicit that it should be interpreted "to give the maximum possible encouragement" to small power production. The proposed rule discourages small power production by disincentivizing self-consumption and by arbitrarily favoring DC-coupled over AC-coupled designs.

Current policy

The Commission's request for comments reads in part:

The Commission requests comments on whether to measure capacity based on a qualifying facility's electric energy production, rather than its nameplate capacity.

This framing is incorrect and misleading. Current policy is not "nameplate capacity", since current policy allows DER Operators to limit DER capacity below the aggregate nameplate rating using power controls. The proposed rule does not measure "electric energy production", since the proposed rule ignores DC energy production.

The current rule in [Minn R. 7835.0100 Subp. 4](#) defines "capacity" as:

Subp. 4. Capacity. "Capacity" means the capability to produce, transmit, or deliver electric energy, and is measured by the number of megawatts alternating current at the point of common coupling between a qualifying facility and a utility's electric system.

Compared to the statute, the current rule's definition of capacity introduces the notion of "capability", but it maintains the statutory focus on power exchanged where the qualifying facility's electric system and the utility's electric system meet.

[MN DIP \(adopted April 19, 2019\)](#) explains how to quantify this. MN DIP § 5.14.1 defines capacity as an aggregate nameplate rating or a lesser value limited by power controls:

5.14 Capacity of the Distributed Energy Resource

5.14.1 If the Interconnection Application is for an increase in capacity for an existing DER, the Interconnection Application shall be evaluated on the basis of the new total alternating current ("AC") capacity of the Distributed Energy Resource. The maximum

capacity of a Distributed Energy Resource shall be the Aggregate Nameplate Rating or may be limited as described in 5.14.3.

...

5.14.3 If the maximum capacity of the DER(s) is limited (e.g., through use of a control system, power relay(s), or other similar device settings or adjustments), then the Interconnection Customer must obtain the Area EPS Operator's agreement that the manner in which the Interconnection Customer proposes to implement such a limit will effectively limit active power output so as to not adversely affect the safety and reliability of the Area EPS Operator's system. Such agreement shall not to be unreasonably withheld. If the Area EPS Operator does not so agree, then the Interconnection Application must be withdrawn or revised. Nothing in this section shall prevent an Area EPS Operator from considering an output higher than the limited output (e.g. Aggregate Nameplate Rating), if the limitations do not provide adequate assurance, when evaluating system impacts. See Minnesota Technical Requirements for more detail.

MN DIP § 5.14.3 refers to [MN TIIR § 11 \(adopted January 22, 2020\)](#) for detail:

11.1 Introduction

The DER Operator may choose to limit the AC capacity of a DER system using Power Controls. Power Controls may also be used to limit DER system export levels to the Local EPS and/or the Area EPS. There are many possible reasons for implementing Power Controls, including meeting specific tariff terms or to mitigate the maximum level of power which can flow on the Local or Area EPS.

...

11.2 Power Control Limited Capacity

Using Area EPS Operator's approved Power Control methods, the DER Operator may limit the DER AC capacity. ...

...

For rotating machines or inverter-based DER systems larger than 20 kW in Nameplate Rating, the DER Operator shall submit details of the proposed Power Control limiting method for maximum capacity limiting, along with settings, if applicable. The Area EPS Operator shall review and either approve the proposed Power Control method and settings or provide a response as to why the method does not provide adequate control. The DER system should use the IEEE 1547 configuration settings as the preferred means of Power Control limited capacity.

The TIIR § 11 is extremely clear. The DER Operator may choose to limit the DER's capacity using power controls, at the DER Operator's discretion, for reasons including to meet specific tariff terms. (What are the stipulations in [MN 216B.164 Subd. 3\(d\)](#) if not specific tariff terms?) For all DERs in scope here, the DER Operator shall submit a proposal for the Area EPS Operator to review. The TIIR then proceeds to specify the

basis on which that review must be conducted. The Area EPS Operator must either 1) approve the controls or 2) explain why the proposed controls do not provide adequate control. The Area EPS Operator is not permitted to refuse the proposed power controls for any other reason. (As MN DIP § 5.14.3 says, "[s]uch agreement shall not be unreasonably withheld.") If the proposed power controls are technically adequate, the Area EPS Operator must approve, and the DER Operator may use them to restrict DER capacity to a value below the aggregate nameplate rating.

Note that the TIIR § 11.1 provides that "Power Controls may also be used to limit DER system export levels to the Local EPS and/or the Area EPS". One DER causes two different power flows, and power controls can be used to limit either or both.

The [TIIR § 3.2](#)'s definitions reinforce the distinction between these two power flows:

Power Control: System that controls the output (production or discharging) and input (charging) of one or more DER in order to limit output, input, export and/or import.

Non-export, Non-exporting: When the DER is sized and designed such that the DER output is used for host load only and is designed and operated to prevent the transfer of electrical energy from the DER to an Area EPS or TPS.

The TIIR definition of "power control" distinguishes the term "output" from "export". The TIIR definition of "non-export" clarifies that "export" refers to power sent to the Area EPS, as distinct from "output" meaning power sent to the Local EPS. Power that is output but not exported includes power used to serve behind-the-meter load as well as transmission losses between the DER and the point of interconnection.

The statutory definition, the current rule's definition, and MN DIP's definition of "capacity" all concern power exported to the Area EPS *after* serving behind-the-meter load. The TIIR provides that operators may use power controls to limit DER export capacity to meet specific tariff terms after serving behind-the-meter load, and they may operate non-export DERs for the sole purpose of serving behind-the-meter load. The proposed rule restricts power output to the Local EPS *before* serving behind-the-meter load. This conflicts with every other facet of current policy.

Industry practice

The legislature and the Commission use different terminology. [MN 216B.164 Subd. 2a\(c\)](#) defines capacity "at the point of interconnection", while [Minn R. 7835.0100 Subp. 4](#), MN DIP, and MN TIIR use the term "Point of Common Coupling" (PCC). The legislature says "utility's electric system", while the Commission's work says "Area EPS". This is because the Commission's work follows [IEEE 1547](#), the *IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with*

Associated Electric Power Systems Interfaces, which ultimately provided these terms. This standard is widely used across the industry and provides much of the technical basis for implementing the statute.

The downstream documents either believe they are implementing the statute or they explicitly defer to the statute: [Minn. R. 7835.0200](#) ("The purpose of this chapter is to implement certain provisions of Minnesota Statutes, section 216B.164"), [TIIR § 1.1](#) ("In the event of an inconsistency between various laws, rules, standards, contracts, or policies over interconnection requirements, the resolution to this inconsistency shall be resolved by assigning an order of precedence from highest to lowest as follows: 1. State of Minnesota statutes"), etc. These documents understand these precise industry terms as corresponding to the terms in the statute.

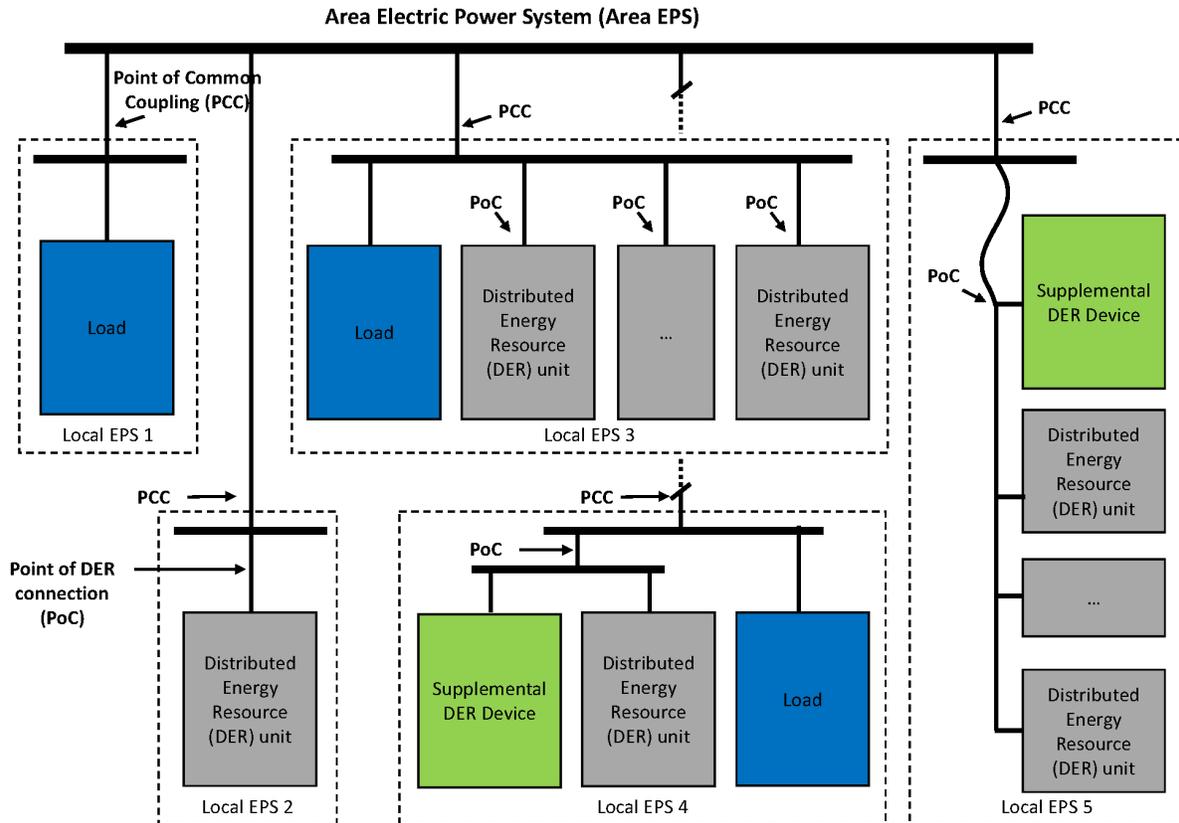
The [TIIR § 1.1](#) describes at length about how it relates to standards like IEEE 1547, and [MN DIP](#)'s Glossary of Terms follows IEEE 1547's definitions so closely that it copied a diagram directly from IEEE 1547. MN DIP's definitions of "Point of Common Coupling (PCC)" and "Point of DER Connection (PoC)" are consistent with industry practice:

Point of Common Coupling (PCC) – The point where the Interconnection Facilities connect with the Area EPS Operator’s Distribution System. See figure 1. Equivalent, in most cases, to “service point” as specified by the Area EPS Operator and described in the National Electrical Code and the National Electrical Safety Code.

Point of DER Connection (PoC) – When identified as the Reference Point of Applicability, the point where an individual DER is electrically connected in a Local EPS and meets the requirements of this standard exclusive of any load present in the respective part of the Local EPS (e.g. terminals of the inverter when no supplemental DER device is required.) For DER unit(s) that are not self-sufficient to meet the requirements without (a) supplemental DER device(s), the Point of DER Connection is the point where the requirements of this standard are met by DER in conjunction with (a) supplemental DER device(s) exclusive of any load present in the respective part of the Local EPS.

PoC is defined in part by the term "Reference Point of Applicability", which has a cascade of definitions ultimately landing at [IEEE 1547-2018](#) § 4.2 and 1547 Annex H, but this is not consequential. The important thing is that the PoC is somewhere inside a Local EPS, while the PCC is where a Local EPS interconnects with the Area EPS.

[MN DIP](#)'s Glossary of Terms contains "Figure 1: Point of Common Coupling and Point of DER Connection". This diagram is copied from [IEEE 1547-2018](#) § 1.4 Figure 2 and is reproduced below. It depicts an Area EPS interconnected with Local EPS #1-5 via five PCCs, with several DERs interconnected at various PoCs. Notice Local EPS 3 and Local EPS 4. Both include one or more DERs interconnected with load inside a Local EPS, while the Local EPS interconnects with the Area EPS at the PCC.



The statutory definition of capacity in [MN 216B.164 Subd. 2a.\(c\)](#) is power "at the point of interconnection between a distributed generation facility and a utility's electric system" – power at the PCC. The current rule in [Minn R. 7835.0100 Subp. 4](#) defines capacity as power "at the point of common coupling between a qualifying facility and a utility's electric system" – power at the PCC. The proposed rule overreaches by defining capacity as power at the PoC instead, a point where the utility is not involved.

Industry practice is to transact at the interconnections between systems. This is why utilities install electric meters at interconnections and send bills relating to the energy which flowed from one system to another. The proposed rule improperly gives utilities an interest inside the customer's electric system, beyond the point where the customer's electric system interconnects with the utility's electric system.

Common sense

Suppose that the proposed rule is adopted. How are utilities expected to measure power at each PoC for enforcement purposes? The necessary information is simply not available. Operational data about DER generation, load, and losses within a Local EPS are known only to the Local EPS Operator, if the operator measures them at all.

Imagine a scenario where the utility sees 39 kW exported to the Area EPS via the meter at the PCC. Is this because the customer's DER is generating 39 kW and the customer's load is 0 kW, or is this because the customer's DER is generating 44 kW and the customer's load is 5 kW? The proposed rule would allow the first case while restricting the second – yet the utility cannot distinguish these cases unless they ask the customer. This is an absurd result of the proposed rule which the statute avoids. Under the statute, 39 kW at the point of interconnection is less than 40 kW, and this remains true irrespective of total AC generation, total DC generation, behind-the-meter load, losses, or any other measurements which are unavailable to the utility.

Changing topics, I will point out that while Qualifying Facilities are commonly solar at present, they can be any system with a permissible primary energy source per [16 USC § 796 \(17\)](#). This includes solar, wind, hydro, or even a normal generator burning biodiesel. PURPA's Qualifying Facility definition does not care about storage, nor does it distinguish between AC and DC power; a Qualifying Facility can export energy stored in batteries just like it can export energy stored in biomass. PURPA's concern is the primary energy source, not the method or timing of turning it into exportable AC power.

With that in mind, consider the [motivation in this docket](#):

Because the definition of “capacity” affects the level of compensation a facility is entitled to from a utility for its net input into the utility’s system, the parties claimed that an unreasonable definition could result in compensation levels inconsistent with amounts authorized under the statute. The parties have therefore requested that the Commission either retain or amend the rule’s existing definition.

MN 216B.164 authorizes Qualifying Facilities with capacity less than 40 kW AC at the point of interconnection to net meter at average retail rates for the purpose of encouraging such power producers. The statute places no restriction on duty cycle, meaning a small Qualifying Facility may export 39 kW AC continuously, exporting as much as 28 MWh/month. At \$0.125/kWh, the statute authorizes \$3500/month.

Putting all this together in the context of a solar plus storage DER: under current and proposed rules, a DER Operator may have as many solar panels as they like, and they may have as many batteries as they like, and they may serve as much DC load from their batteries as they like, and they may export 39 kW from their DER to the utility at average retail rates, and assuming they have the energy, they may export 39 kW every hour of every day. Under the statute and the current rule, they may also serve their own AC load from their DER behind the meter while exporting 39 kW. Under the proposed rule, they may not – yet because DC load is ignored, they *could* serve their own AC load off-grid while exporting 39 kW by installing separate inverters powered by the DER's batteries. This is an absurd result, and again the statute avoids it.

As shown in the preceding diagram, a single Local EPS may have more than one DER connected in parallel, with or without load, with or without a supplemental DER device. Consider a customer who prioritizes self-consumption and who wants 30 kW of solar plus 20 kW/60 kWh of battery storage. The customer can choose a DC-coupled design using DC-DC converters and 30 kW of inverters, or they can choose an AC-coupled design with a 30 kW solar DER plus a 20 kW battery DER, applying power controls to make the battery DER a non-export DER (0 kW capacity at the PCC). Under the statute and the current rule, both designs would be treated the same because they look the same at the PCC: 30 kW of capacity. Under the proposed rule, the AC-coupled design (Local EPS 3) would be adversely affected (perhaps by insisting that it be reworked at significant expense to have a single PoC like Local EPS 4), while the DC-coupled design would be unaffected. This is an absurd result, and again the statute avoids it.

Next steps

Some utilities might believe that the legislature is too generous with their money. I agree. My view is that net metering at average retail rates is unsustainable, and that flat rate structures are unsustainable in general. I assert the underlying problem here is that flat rate structures deny an undeniable fact: some kWh are a lot more expensive than others. I am dismayed by the lack of progress in this area, especially on this 2019 recommendation from [Minnesota Energy Storage Cost-Benefit Analysis](#):

- Develop electric retail rate structures as soon as possible to align customer price signals with system marginal costs so that behind-the-meter (BTM) storage provides societal benefits and does not shift costs to other ratepayers.

Averaging away variable energy costs and averaging away capacity costs for system peaks erases vitally important price signals. Flat rates cause misaligned incentives for DER operators and retail electric customers alike. I will continue advocating against flat rates, and I will continue operating my DER in a way that attempts to maximize benefits for my utility despite not having any financial incentive to do so. In fact, I elected not to interconnect my DER via net metering at average retail rates, because that would have resulted in my utility paying me what I see as an inappropriate amount of money.

At the moment though, this *is* the law. The legislature chose to encourage small power production by giving producers the option to compel utilities to buy energy at average retail rates for power levels less than 40 kW at the point of interconnection. If parties find this unreasonable, they should seek to change the law, rather than seeking to change a rule in a way that it is contrary to the law.

The Commission should reject the proposed rule.