MINNESOTA
PUBLIC UTILITIES COMMISSION

Staff Briefing Papers

Meeting Date:	May 30, 2019	Agenda Item **3
Company:	Xcel Energy	
Docket No.	**E002/M-18-684**	
	In the Matter of Xcel's 2018 Hosting Capacity Study	
Issues:	What action, if any, should the Commission take on Xcel's 2018 Hosting Capacity Study?	
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Relevant Documents	**Date**
17-777: PUC – Order Accepting Study, Setting Further Requirements	July 19, 2018
Xcel Energy – Initial Filing (2 Parts)	November 1, 2018
Fresh Energy – Comments	February 28, 2019
DOC DER – Comments	February 28, 2019
Xcel Energy – Reply Comments	March 28, 2019
Interstate Renewable Energy Council – Reply Comments	March 28. 2019
DOC DER – Reply Comments	March 29, 2019

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I. Statement of Issue

What action, if any, should the Commission take on Xcel's 2018 Hosting Capacity Analysis (HCA)?

II. Background

Minn. Stat. §216B.2425, Subd. 8, directs a public utility that is subject to the statute and operating under a multi-year rate plan (currently applies only to Xcel Energy) to "… conduct a distribution study to identify interconnection points on its distribution system for small-scale distributed generation resources and shall identify necessary distribution upgrades to support the continued development of distributed generation resources…".

Under the statute, the study must be conducted biennially and included in the utility's biennial transmission projects report - Xcel has agreed to conduct the study annually and files the Study (Hosting Capacity Analysis) separately. Xcel has filed a Hosting Capacity Analysis (HCA) in 2016, 2017, and now, 2018.[1]

In response to the 2018 Hosting Capacity Analysis Report (2018 HCA Report), initial comment were received from Fresh Energy and the Department of Commerce Division of Energy Resources (Department). Replies were received from Xcel, the Department, and the Interstate Renewable Energy Council (IREC).

Many topics raised are continued or similarly raised issues from the past three years of review; including, the usefulness of the HCA, its fundamental purpose, and its ability to provide value to persons seeking to interconnect to Xcel's distribution system – discussed in more detail below.

III. Hosting Capacity Analysis Overview and Background

The Electric Power Research Institute (EPRI) has defined hosting capacity as the amount of DER that can be accommodated on the existing system without adversely impacting power quality or reliability under existing control configurations and without requiring infrastructure upgrades.[2] Hosting capacity analysis (HCA) is the evaluation of a utility's distribution system to find and report these locations. The authorizing statute in Minnesota also requires Xcel to identify distribution upgrades needed to support continued DER development.

[1] 2016 HCA Report (E002/M-15-962), 2017 HCA Report (E002/M-17-777), and 2018 HCA Report (E002/M-18-684).
[2] EPRI, Impact Factors, Methods and Considerations for Calculating and Applying Hosting Capacity, 2018 Technical Update, p. v

No party in this docket has requested, nor does statute require, the Commission to take any formal action on Xcel Energy's Hosting Capacity Analysis Report.[3] The Commission has issued orders setting further requirements in review of the Company's past two HCA reports.[4] Due to past Commission guidance and ongoing stakeholder interest in the evolution of Xcel's HCA, staff believes it is reasonable to bring the matter before the Commission in the instance it would like to provide additional guidance or recommendations to Xcel on future reports.

IV. Xcel's 2018 Hosting Capacity Study Report

Xcel asserts that the 2018 HCA Report is responsive to, and in compliance with, the Commission's 2018 Order, and provided a compliance matrix itemizing the Order points and where each requirement was addressed in the Company's filing or in the record.[5] The Company summarizes:

> Xcel Energy recognizes hosting capacity as a key element in the future of distribution system planning and anticipates it will have the potential to further enable Distributed Energy Resources (DER) integration by guiding future installations and aiding individuals and developers in identifying areas of constraint. We have made significant progress in our efforts to advance the value of this report in a meaningful way –in response to stakeholder feedback, learnings from other utilities, and our work with EPRI."[6]

Xcel evaluated and modeled 1,000-plus feeders across Minnesota[7], and provided a spreadsheet with the results of the analysis - the minimum and maximum hosting capacity and the limiting violation.[8] The 2018 HCA Report also describes the online, color-coded heat map displaying the HCA results.[9]

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[3] In the Commission's 2018 Order on the 2017 Report, the Commission authorized Xcel to file the HCA Report independently from the biennial report, but on the same day. See 2018 Order.

[4] MN PUC, Order Accepting Study and Setting Further Requirements (July 19, 2018), Docket No. E002/M-17-777 (**2018 Order**) and Order Setting Additional Requirements for Xcel's 2017 Hosting Capacity Report (August 1, 2017), Docket No. E002/M-15-962

[5] *Id.*, Attachment B, pg. 1-1

[6] Xcel Energy, Hosting Capacity Analysis Report, November 1, 2018, pg. 1. (Xcel's 2018 HCA Report)

[7] *Id*., p. 8. "Created 1049 feeder models in Synergi Electric using GIS data and clean up… includes tasks such as setting the head-end voltage, setting the burial depths on underground cable, setting the height of overhead conductor above the ground, and placing equipment settings into capacitors, reclosers, and regulators, among other things... dug deeper to find the source(s) of the issues, which included consulting other maps, performing visual inspections in the field, and calling Synergi to assist with unique occurrences... allocated the load (2018 load forecast prepared in 2017) to the feeder based on demand data and customer energy usage data.. ran a load-flow and performed a final check for any abnormalities on the feeder... After creating all of the feeder models, we analyzed them using DRIVE, which performed the hosting capacity technical analysis."

[8] *Id.,* Att. A, pp. 1-31. Also e-filed as an excel worksheet.

[9] *Id.,* pp. 22-23. Available online: https://www.xcelenergy.com/working_with_us/how_to_interconnect/hosting_capacity_map_disclaimer

Notable changes to the 2018 report, as outlined by Xcel: 1) the ability for the DRIVE model to consider a reverse power flow threshold[10], 2) adjustment of the voltage deviation threshold[11], 3) inclusion of fuses for thermal violations[12], 4) correction of regulator bandwidth adjustment[13], and 5) removal of not-in-service solar gardens.

EPRI DRIVE and Method

Xcel continues use of EPRI's Distributed Resource Integration and Value Estimation (DRIVE) tool. The tool incorporates detailed hosting capacity analysis to screen for voltage, thermal, and system protection impacts of DER. Xcel maintained the use of the Large Centralized method, noting it "… results in smaller minimum thresholds because of concentration at a specific location vs. distributing across the feeder.... that concentration also unmasks the potential to add more generation at ideal locations on the feeder (max hosting capacity.)"[14] In considering the inclusion of HCA results using the Small Distributed Method, Xcel suggests "limited usefulness"[15]:

> [t]he Small Distributed Method would be appropriate for a distribution system experiencing a lot of smaller scale PV installations rather than the CSG experienced in MN... accuracy of the results using [this method] are dependent on the inclusion of secondary voltage equipment data in the modeling, because most violations for small scale installations occur on the secondary voltage level from the service transformer to the customer's meter... Company does not maintain detailed secondary information beyond the transformer in its systems necessary for this analysis.

In addition to the methodology, Xcel provides a description of assumptions; including more detailed data on load profile assumptions, including peak load (kW) by substation and feeder.[16]

Inclusion of Storage and Electric Vehicles

Xcel noted that the electric system's hosting capacity depends on the operating characteristics of the DER and the location on the system. Xcel notes load characteristics of DER (storage, EVs, etc.) were not incorporated in the 2018 report[17]:

> DRIVE does have the ability to output load capacity and future releases of the tool are expected to have added functionality to better address what certain distributions of load, like EVs or storage, might do to a feeder... we have not run the analysis to look at load

[10] *Id.,* p. 13 "… better align with criteria we use in the interconnection process." Reverse Power Flow is the limiting violation on 217 feeders.
[11] *Id*, p. 13 "… minimal effect on the results, but better aligns with…interconnection studies…"
[12] *Id.,* p.2 "… minimal impact on the hosting capacity for small portions of the system"
[13] *Id.,* "… aligns with the Simplified IEEE 1453 approach."
[14] *Id*., p. 9
[15] *Id.* addressing Order Point 7b
[16] *Id.*, pp. 10-12. #7f response at 12.
[17] *Id,* p. 7 addressing Order Point 7e

> additions, which we see as more of a traditional distribution planning function rather than a part of a HCA.

Xcel noted the upgrades necessary for continued support of distributed generation directly correlate to the type of constraints identified, and that the report identifies potential solutions for increasing hosting capacity.

Security and Privacy

Xcel redacted 120 of 1049 feeders due to security and privacy concerns, and developed criteria to apply to the visual hosting capacity results that would protect what the Company believes is sensitive and therefore non-public grid and customer information. Some of the guidance the Company used included: Commission's Orders on Customer Energy Use Data (CEUD) and Personally Identifiable Information (PII)[18], National Institute of Standards and Technology (NIST), North American Energy Reliability Corporation (NERC) and Federal Energy Regulatory Commission (FERC).[19] However, Xcel concluded[20]:

> We found that existing regulatory, legal, and industry frameworks provide little to no specific guidance with respect to data security protections and customer privacy and confidentiality considerations as it relates to distribution grid data. [staff emphasis]

Sensitivity Analysis

In response to the 2018 Order and stakeholder feedback, Xcel ran two sensitivity analyses on a subset of five feeders broadly representing their system: 1) adjusting power factor from unity to both .98 leading and .95 leading; and 2) adjusting the standard bus voltage from 104 percent to both 102 percent and 100 percent. The power factor adjustments resulted in an average hosting capacity gain of 240 kW to 428 kW respectively. The bus voltage results were 260 kW with the 2 percent reduction; with no additional gain with a full 4 percent reduction. While theoretically slightly increasing hosting capacity, the Company found the changes led to other system issues: need for reactive power support, potential low voltages for customers, and loss of resilience to alternatively serve load during contingency situations. Thus, Xcel concluded the power factor and bus voltage decisions used are reasonable.[21]

The Department reviewed these sensitivity analyses and requested additional information on the technological options mentioned in the bus voltage analyses.[22] Xcel responded that lowering bus voltage without deeper grid visibility may lead to poor service quality due to low voltage and limit the Company's operational flexibility. However, lowering bus voltage reduction would potentially

[18] Docket No. E999/CI-12-1344
[19] *Id.*, pp. 28-30
[20] Xcel Reply, p. 6
[21] Xcel, 2018 HCA report, pp. 23-26
[22] Department Initial, pp. 12-14

be more reliable paired with Integrated Volt-Var Optimization (IVVO) functionality, which automates and optimizes operation of distribution voltage regulating devices. Xcel has a discussion of IVVO, which relies on advanced metering infrastructure (AMI) and advanced distribution management system (ADMS), in its 2018 Integrated Distribution Plan.[23]

Staff Analysis

Table 1 shows a comparison of the change in results from 2016 to 2018. These changes were due to change in DER penetration on Xcel's system and/or a change in the HCA inputs or assumptions described in the filings). However, it should be noted: "… this [HCA] presents the discreet hosting capacity of individual feeders without analysis of the cumulative effects of DER additions to substations or the transmission system."[24]

Table 1. Xcel Hosting Capacity Results 2016 to 2018

	2016		2017		2016 to 2017		2018		2017 to 2018	
(MW)	**Min**	**Max**	**Min**	**Max**	**Net change in Min HC**	**Net Change in Max HC**	**Min**	**Max**	**Net change in Min HC**	**Net Change in Max HC**
Sum	1833	2630	1525	6271	-308	3641	706	1311	-819	-4960
Ave	1.8	2.5	1.5	6.1	-0.3	3.5	0.7	1.3	-0.8	-4.7

Table 2. Min/Max by Year (Subset of Table 1)

(MW)	Min	Max	Min (Ave)	Max (Ave)
2016	1833	2630	1.8	2.5
2017	1525	6271	1.5	6.1
2018	706	1311	0.7	1.3

Minimum Hosting Capacity: The (total of all feeder) minimum hosting capacity has decreased from 1,525 MW in 2017 to 706 in 2018; the minimum hosting capacity is the green area on graphic shown below, and represents the available capacity for DER to connect without system upgrades. The feeder averages have decreased in a corresponding manner from 1.5 MW in 2017 to 0.7 MW in 2018.

Maximum Hosting Capacity: However, the MWs on feeders in which DER additions *may* trigger a violation decreased considerably, (yellow area) from 6,271 (2017) to 1,311 (2018) MW[25]. To

[23] Xcel Reply, pp. 3-4. Xcel's 2018 Integrated Distribution Plan was filed on November 1, 2018 in Docket No. E002/M-18-251

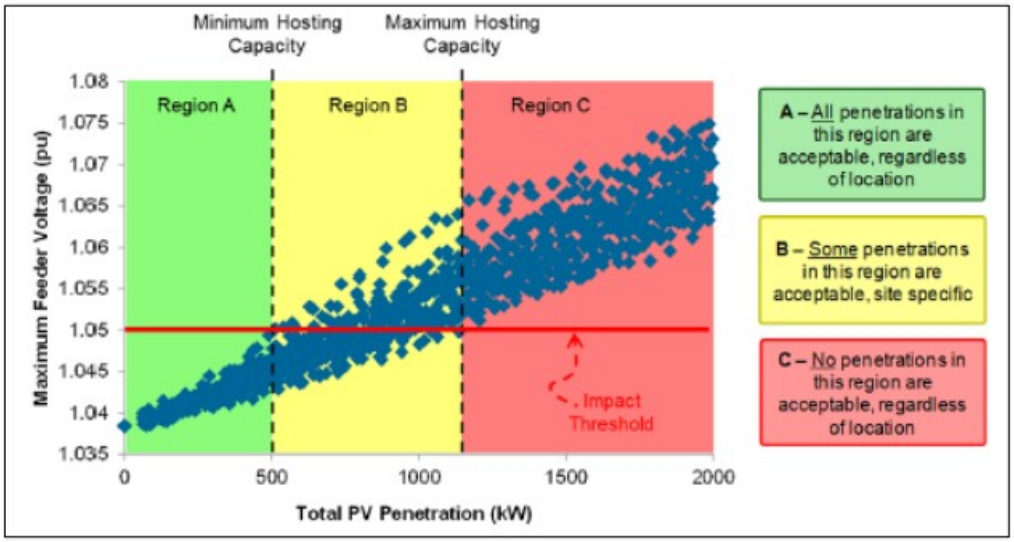
[24] Xcel, 2018 HCA Report., p. 2

[25] Xcel, pg. 4: We remind readers that this study presents the discreet hosting capacity of individual feeders without analysis of the cumulative effects of DER additions to substations or the transmission system. As distributed

determine whether a DER addition of a certain size (between the minimum and maximum capacity) would trigger a violation would require a more detailed review by Xcel (and would depend on its location along the feeder, among other considerations). Capacity beyond the maximum hosting capacity is assumed from the study to trigger a violation.

Xcel provided EPRI's visual representation of the minimum and maximum hosting capacity concept in the following figure (Figure 5 from the 2016 HCA Report):

Figure 5: Minimum and Maximum Hosting Capacity Visualization



Staff notes that due to changes to the EPRI DRIVE methodology that occurred from 2016 to 2017, the results from the 2016 study are less comparable than the 2017 to 2018 results. In 2016, Xcel used the DRIVE small-decentralized methodology for conducting the modeling and has since moved to the DRIVE large-centralized methodology to better reflect the types of DER Xcel was seeing added to its system (large, concentrated solar).

V. Stakeholder Comments

Common themes among comments emerged surrounding a few core issues that were also raised during previous iterations of Xcel Energy's HCA reports: 1) whether the report fulfilled the statutory and Commission order requirements, 2) the use cases of the HCA, 3) accuracy of the results, and 4) methods to improve the current HCA and recommendations for further consideration.

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generation (DG) penetration increases, system constraints are likely to limit hosting capacity in various geographical areas. For instance, a substation may have three feeders with 3 MW of available capacity on each – but the substation or transmission systems may not have 9 MW of available capacity. As actual penetration increases, we will need to further analyze upstream ramifications. As a result, this study is not a holistic system view, but rather a snapshot of the capabilities of individual feeders as they are positioned today.

A. Completeness and Compliance with Statute and Commission Order

Parties' positions differ on whether Xcel complied with the Statute and Commission Order requirements for various reasons. Both Xcel and the Department believe that the 2018 HCA Report met the requirements. The Department provided a detailed analysis which outlined how it determined that the report was complete and complied with both Minn. Stat. §216B.2425, Subd. 8 and the Commission's orders.[26] Fresh Energy argues Xcel's HCA does not meet the 2018 Order points 2, 3, 4, 6, and 7(d, f, g).[27] While agreeing (in reply) with some of Fresh Energy's analysis and recommendation, the Department maintains Xcel's 2018 HCA report complies with the Commission's 2018 Order. [28] The Department supports Xcel filing additional information in future HCAs as discussed later in these briefing papers, and expects Xcel will continue to make good-faith efforts to improve upon the HCA methodology and value to stakeholders.[29]

Fresh Energy surveyed "the most active developer members of the Solar*Rewards Community (SR*C) Workgroup" for insight into the usefulness of the hosting capacity report. Fresh Energy argued that the scope of the hosting capacity report has narrowed in scope such that it now provides "little, if any, value" – consistent with the six survey responses.[30]

Additionally, Fresh Energy argued that the HCA could be significantly improved and while it appears that Xcel sees the value the report could bring, Fresh Energy argued the HCA does not succeed in doing so. Fresh Energy has high-level concerns with the following: [31]

- Unclear expectations of use cases and timelines for delivery of results;
- HCA only considers new generation and not new load - which it views as problematic in light of state emission-reduction goals and electric vehicle adoption.

IREC argued that, consistent with comments it has filed on Xcel's 2016 and 2017 HCA Reports, it does not believe the 2018 HCA produces a reliable estimate of hosting capacity and the hosting capacity map lacks functionality – among numerous other related concerns, so much so that the Commission should consider the limitations of the report to avoid additional ratepayer and Commission resources be spent on a tool that does not provide value or function as expected.[32]

[26] Department Reply, pg. 5. Department Initial provides the Department's analysis of whether and how Xcel's HCA complies with the Minn. Stat. §216B.2425 at pp. 4-5 and the 2018 Order at pp. 5-22
[27] Fresh Energy Initial, pp. 3-7
[28] Department Reply, p. 5
[29] *Id.*
[30] Fresh Energy Initial, pg. 2 and Exhibit A – Survey Responses.
[31] *Id.*
[32] IREC Reply generally and p. 8

B. Interconnection Use Case and Accuracy

1. HCA as Interconnection 'Starting Point'

Several 2018 Order points address how the HCA should be considered as a "starting point for interconnection applications" and evaluated for accuracy:

> *Order Point 2. Xcel's 2018 Hosting Capacity Report must be detailed enough to provide developers with a reliable estimate of the available level of hosting capacity per feeder at the time of submittal of the report to the extent practicable. The information should be sufficient to provide developers with a starting point for interconnection applications.*
>
> *Order Point 6 - Xcel must provide information on the accuracy of the Hosting Capacity Report information; both estimates on the accuracy of the 2018 report and an analysis of the 2017 results compared to actual hosting capacity determined through any interconnection studies or other reasonable metric.*
>
> *Order Point 7 (a) consider the methodological options to both improve and measure accuracy of the hosting capacity analysis, including identification and analysis of industry best practices and an explanation of the Company's methodological choice*;

Xcel Energy demonstrated that 19 of 21 locations in the 2018 HCA had a positive correlation between the HCA and the interconnection screening results; consistent with the 18 of 21 locations with the 2017 HCA with interconnection study results. Xcel summarized two reasons for when the results did not correlate in the 2017 results: 1) daytime minimum load values were estimated (for HCA) versus actual data (in the study); and 2) potential islanding or reverse power flow issues. The inclusion of the new threshold for Reverse Power Flow in the 2018 HCA resolved the latter issue. Xcel does not believe it is practical or efficient to estimate a default daytime minimum load value as the percent of the peak feeder load to increase the correlation between the HCA and screen results; as such, the Company proposes to keep working with EPRI to identify other ways to improve accuracy.[33]

Xcel reiterates the Company's position that HCA is a "starting point" and outlines how the HCA paired with the CSG queue, which may include capacity since the HCA was compiled, gives a snapshot. The Pre-Application Report data (similar to the Capacity Screen for Xcel's CSG program) provides additional information for a fee; and only when a complete interconnection application has been submitted is the capacity reserved.[34] The interconnection application is then subject either to screening or study depending on a number of factors to determine whether or not it can be approved for interconnection. Xcel suggests parties' expectation for the role of the HCA in interconnection process is misaligned and further claims[35]:

[33] Xcel Energy Initial, pp. 18-19
[34] Id, p. 21
[35] Xcel Reply, p. 11

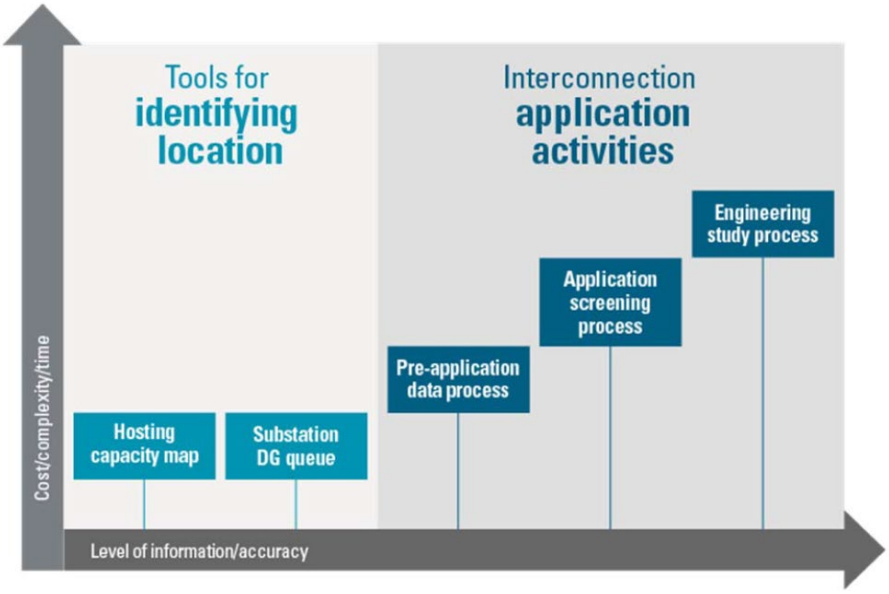
> If the Commission determines HCA should become part of MN DIP and as such, all utilities need to perform an HCA – among other considerations, it would be important for the Commission to [*clarify*] the role of HCA in the standardized interconnection process along with other supporting details, such as update frequency. [*staff inclusion*]

Fresh Energy highlights survey responses from six developers who found the hosting capacity analysis map to be "of almost no value at all" and that over half the time the Capacity Screen indicate more capacity than the HCA map.[36] IREC highlighted Fresh Energy's survey results as showing DER developers are not using and do not trust Xcel's hosting capacity maps or analysis to provide them with a starting point for interconnection application. IREC further reiterated ongoing concerns with Xcel's HCA: results differ greatly from the interconnection study results, the available map does not provide data that would help developers make informed decisions, and the annual frequency of updates hinders its usefulness.[37]

Fresh Energy recommended the Commission require Xcel to complete analysis of the DRIVE tool, including a comparison of other methodologies and interconnection study results on a selection of representative feeders. If the DRIVE tool is unable to provide results that match the results of the interconnection studies, the Commission should order Xcel to use a different methodology.[38]

Xcel reiterates the Company's position on DER interconnection tools and processes[39] illustrated in the following:

Figure 1: Xcel Energy DER Interconnection Tools and Processes



[36] Fresh Energy Initial, p. 2
[37] IREC Reply, p. 3.
[38] Fresh Energy Initial, p. 2
[39] *Id*., pp. 16-19

Xcel offers that if the Commission determines automating the interconnection process is an objective, the Company views a logical first step to be achieving a level of accuracy for the hosting capacity tool that allows using the results in placed of the technical screens found in the initial and supplemental review found in the MN DIP, and cautions fully automating the interconnection study process is at the nascent stages of development.[40]

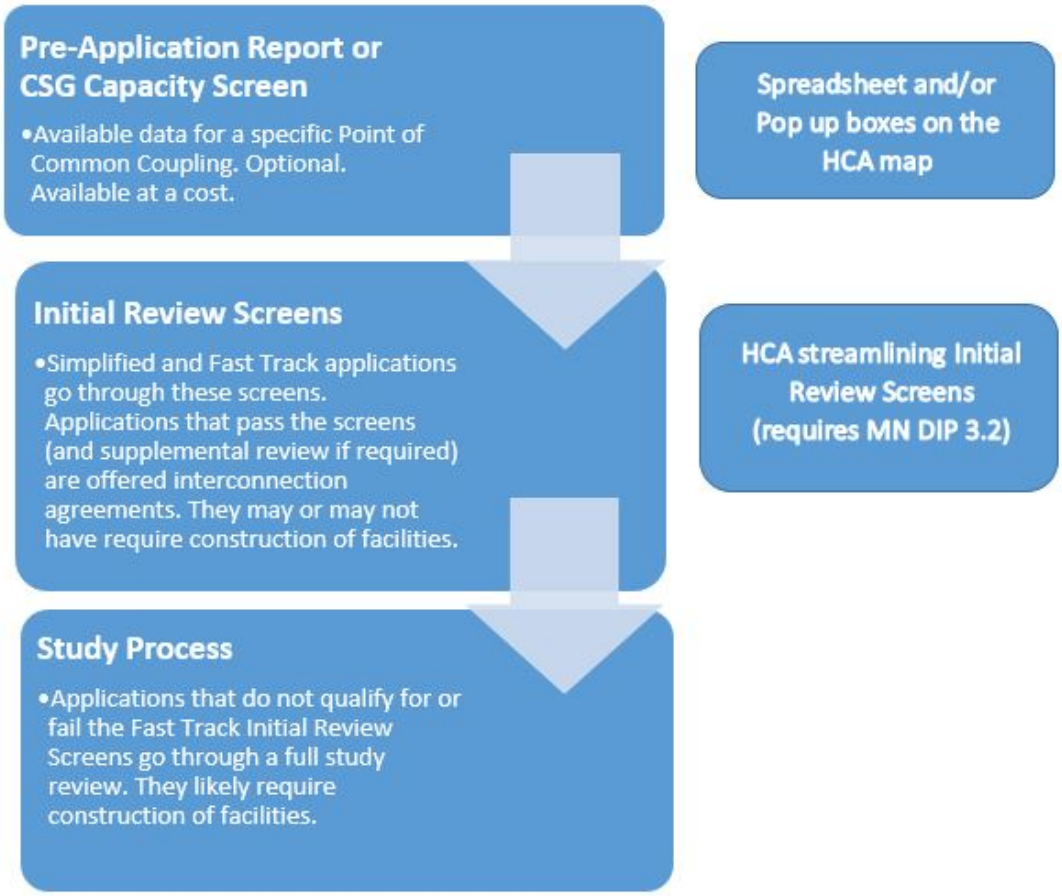
2. Staff Analysis on Interconnection "Starting Point"

Parties remain in disagreement and request clarification from the Commission on whether the HCA is solely a "starting point" or if that includes a streamlining of the interconnection process.[41] Further, whether Xcel's current HCA achieves Minn. Stat. §216B.2425; Subd. 8 which reads in part:

> … a distribution study to identify interconnection points on its distribution system for small-scale distributed generation resources and shall identify necessary distribution upgrades to support the continued development of distributed generation resources.

Xcel Energy properly distinguishes the various steps in the interconnection process to gain clarity in how the hosting capacity analysis either serves as a "starting point" or streamlines the interconnection process - staff adds boxes to the right to highlight where the parties' recommendations fit:

[40] *Id,* p. 20
[41] IREC Reply, p. 3



Xcel Energy correctly highlights that the Commission strives for consistent, statewide interconnection standards with the MN DIP; however, staff disagrees with the Company's interpretation of what is allowed under the MN DIP.[42] MN DIP 3.2 states:

> ….. The technical screens listed in this section **shall not preclude the Area EPS Operator from seeking approval of tools that perform screening functions using different methodology given that the analysis is aimed at preventing the same voltage, thermal and protection limitations** as the initial and supplemental review screens described below. [**staff emphasis**]

In reaching the agreed upon technical review screens, a subgroup that included Xcel Energy, IREC and the Department among others, discussed proposed language by Xcel Energy to allow flexibility to allow hosting capacity analysis or another tool to do an automated, and more detailed, analysis than the screens proposed. IREC strongly supported moving toward a hosting capacity tool in place of screening as a more accurate review; however, wanted a utility's proposed tool to be subject to vetting. Xcel cautioned if you want to incentivize utilities to use

[42] Xcel Reply, p. 16. Xcel claims "… the MN DIP precludes the use of hosting capacity for technical screening without Commission action to make it part of the statewide standard."

automated tools there needs to be a clear path/signal they will be able to use the tools.[43] Ultimately, the MN DIP included the language above.

The Commission may wish to consider the costs and benefits associated with an HCA able to achieve the following use cases or objectives: 1) remaining an early indicator of possible locations for interconnection; 2) replacing or augmenting initial review screens and/or supplemental review in the interconnection process; and/or 3) automating interconnection studies. Given the status of the HCA today, the first two use cases or objectives seem more achievable than the third.

C. Substation and Feeder Data

Fresh Energy, IREC and the Department recommend the Commission require Xcel to include additional, location-specific information with the hosting capacity analysis in spreadsheet format and in the public facing hosting capacity map.[44] Data requested to be filed in the 2019 HCA includes:

Data Requested in spreadsheet and/or pop up on map	**Department[45]**	**Fresh Energy[46]**	**IREC**
Peak load data by substation and feeder	X	X	X[47]
- Daytime minimum load	X	X	X[48]
- Installed generation capacity	X	X	Note[49]
- Queued generation	X	X	X[50]
- Voltage of feeder			X[51]

[43] DGWG Subgroup Discussion of Technical Screens – Notes (October 6, 2017), DGWG Meeting #5 Packet, p. 8 [pdf pg. 21]. Available in e-dockets [Document ID: 201712-138167-04]: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={10F15560-0000-CD5A-8813-8E40DF6945DC}&documentTitle=201712-138167-03

[44] Dept Initial, pp. 20-21; Fresh Energy Initial, p.7

[45] Dept Reply, p.3

[46] Fresh Energy Initial, p. 7

[47] IREC Initial (Docket No. E002/M-17-777), p. 15

[48] *Id.*, p. 27

[49] *Id.* IREC cautions rather than installed generation capacity that is assumed at 100% of allowed DG output, HCA should strive for actual generation profiles.

[50] *Id.* p. 15

[51] *IBID*

1. Load Profile Data

Order Point 7(f) file more detailed data on load profile assumptions used in the analysis, including peak load (kW) by substation and feeder;

Xcel provided a written description in its 2018 HCA of Loading Levels and Load Allocation[52], but did not provide peak load data by substation and feeder. Xcel responded that the Company does not have the technical ability to efficiently *forecast* detailed load profiles, but is examining planning tools to support efforts such as this through its Integrated Distribution Plan (IDP).[53] Xcel noted that providing *actual* load data would provide a bad actor with information to target an attack on the grid where it would have maximum impact; Xcel's concerns regarding providing this level of detail due to security and customer privacy are further discussed below.[54]

Regardless of Xcel's concerns, peak load data by substation and feeder, was requested by Fresh Energy, the Department and IREC.

2. Day Time Minimum Load; Additional Data Requested

All three commenters also supported inclusion of daytime minimum load in the HCA Report. Fresh Energy specifically noted Xcel could make the HCA more accurate by measuring and using actual daytime minimum load on each feeder, rather than the 20% of peak load assumption used in the current HCA. Fresh Energy believes the Company's 20% assumption is contributing to the new "Reverse Power Flow" threshold which limits 84% of the Company's feeders' maximum capacity, and recommends that the Commission require Xcel to prioritize the capability to publish full feeder load profiles and actual daytime minimum loads as part of its 2019 HCA filing.[55]

Xcel does not currently gather actual minimum daytime load values for every feeder on an annual basis due to technical capability and resource limitations. Xcel currently has Supervisory Control and Distribution Automation (SCADA) capabilities necessary to collect this data on 61% of Minnesota substations[56] – serving approximately 90% of Xcel's customers.[57] When the data is available, Xcel explains how minimum daytime load (MDL) is calculated today compared to the actual MDL data that Fresh Energy et al. request[58]:

> … reviewing historical MDL values by year and forecasting a value based on that historical view, plus any known changes or other growth assumptions… existing system planning software is not capable of helping determine [MDL] values like it does for peak load

[52] Xcel, 2018 HCA Report, pp. 12-13
[53] Xcel Reply, p. 5; IDP Docket 18-251
[54] *Id.*
[55] Fresh Energy Initial, p. 8.
[56] Xcel Reply, p. 14. Xcel notes it would cost $30-40 million to equip the remaining 39% of Minnesota substations.
[57] Xcel IDP Filing (November 1, 2018), E002/M-18-251, p. 34
[58] Xcel Reply, pp. 14-15

> values… we would need to manually pull the raw data from the SCADA system for each of the feeders, analyze the data, then filter the values to only include daytime hours… labor-intensive manual process that may be improved upon in the future with additional software capabilities… …determining the MDL values for each feeder in Minnesota would take approximately 350 to 400 hours….
>
> Even though DRIVE performs the analysis feeder by feeder, we achieve efficiencies by grouping the process by substations, with individual feeder peak loads for each of the feeders attributed to that substation, peak loads are then reduced to 20 percent... to provide the minimum load cased that is needed for the analysis… then we run 228 subsequent analyses (total number of substations) using the DRIVE tool.

Xcel posits incorporating minimum daytime load values for each feeder would effectively double the number of scenarios run in DRIVE with an associated, estimated incremental engineering time of approximately 1250 – 1600 hours.[59]

The Department concludes "… that the current hosting capacity analysis methodology appears to be reasonably accurate and that improvements suggested by the Company to determine actual daytime minimum load values are not a prudent use of ratepayer resources… the Company's commitment to identify and examine…process improvements, and to continue its partnership with EPRI, appear to be reasonable and appropriate options for improving and measuring the accuracy of the [HCA]."[60]

Staff Analysis

Daytime Minimum Load is an important indicator of possible solar hosting capacity on a feeder. This data point, when available, may - at the utility's option - be used in the Simplified and Fast Track initial review screen for solar interconnection requests (MN DIP 3.2.1.2). Solar generation above the daytime minimum load can result in reverse power flow and requires additional consideration in interconnection review. This data point, if available, is provided on the optional, $300 pre-application report for a specific point of common coupling (MN DIP 1.4.2.8). If this data is provided with the HCA, the disclaimer that the data is not necessarily current is important to avoid dispute about whether Xcel is using the right data at time of interconnection review.

3. Installed and Queued DG Data

Stakeholders requested that Xcel provide information on the installed and queued distributed generation both in the tabular format and on the online heat map. Xcel suggested in its 2018 HCA and on the website that contains the HCA map, that following review of the data in the annual report and viewing on the online heat map, developers can then review publically available S*RC interconnection queue:

[59] Id.
[60] Department Initial, pp. 10-11

> Review the publicly-available Solar*Rewards Community interconnection queue. The queue is updated monthly, and may include additional generation that was proposed after the snapshot in time from which HCA data is drawn.[61]

In response to requests to include the information on the map, Xcel raises concerns about misperception if a map user clicks an incorrect area on the map - which provides hosting capacity in a "given general location" - relative to the point of common coupling information sought.[62]

Staff Analysis

As with most of the additional data being requested, there is a trade-off between having a more complete "snapshot" and the usefulness when the HCA is only updated annually and displayed generally rather than by feeder or location on a feeder. Stakeholders appear to recognize this trade off and still want the data included. While the information is more current on the monthly updated SR*C interconnection queue (and the future MN DIP queue for all interconnections), Xcel has provided this information in the past on the tabular spreadsheet (2016 HCA Report). Staff is unclear what amount of work is required to include it on the online map. Further, it is not clear to staff that including this data without addressing the other concerns related to the timing of updates and granularity of results provides real value to interconnection customers.

4. Security and Customer Privacy Concerns

> *Order Point 4 - Xcel must file a color-coded, map-based representation of the available Hosting Capacity down to the feeder level. This information should be provided to the extent it is consistent with what Xcel believes are legitimate security concerns. If security concerns arise, Xcel must explain in detail the basis for those concerns.*
>
> *Order Point 7(d) - explore a range of options for better presenting the public-facing results of the Hosting Capacity Analysis after consideration of, but not limited to, any security and privacy issues that may be implicated in providing more detailed information and what information might be useful to developers and stakeholders;*

IREC and Fresh Energy argue Xcel's HCA maps do not comply with the Commission's Order to provide the "… level of hosting capacity *per feeder.*"[63] IREC points to California and New York utilities' hosting capacity maps as containing the following data at the feeder level: name of substation, substation capacity, capacity of distributed generation connected, capacity of distributed generation in queue, and load profile.[64] Xcel responds with security, privacy and confidentiality concerns:

[61] Xcel 2018 HCA, p. 21
[62] Xcel Reply, p. 13-14
[63] Fresh Energy Initial, pp. 10-11; IREC Reply, p. 16 ftn. 15
[64] IREC Reply, p. 6

> From a security perspective, we believe providing actual load data would provide a bad actor with the information necessary to target an attack on the grid where it would have maximum impact. In terms of customer privacy and confidentiality, we have looked to the Commission's decisions on customer Personally Identifiable Information (PII) and Customer Energy Usage Data (CEUD), and believe we have a responsibility to protect customer anonymity. While grid and customer connection details are not directly implicated in that proceeding, the Commission directed utilities to look to NIST [National Institute of Standards and Technology] principles for guidance with regard to collection and protection of customer PII4 – and required utilities to refrain from disclosing CEUD without customer consent unless the utility has adequately protected the customer's anonymity.[65] …
>
> We believe our judgement that actual load information and the approach we applied to our heat map results are based on sound principles, and reasonably balance grid security, customer privacy, confidentiality, and energy security and public policy objectives. We are the first utility in Minnesota to encounter these privacy and security questions as they relate to hosting capacity. We are open to participating in a Commission proceeding that builds on the Commission's framework around PII and CEUD to include to examine grid-related security and privacy considerations. [66]

Staff Analysis

At this time, staff does not have the information in the record, or in other Commission dockets, to confirm the statement made by Xcel that the release of certain feeder information could compromise customer data. In the future, it may be necessary to build on the foundational work of these privacy-related orders (that Xcel acknowledges do not directly apply to grid data) to be able to consider them in the context of grid modernization and for future application. Staff notes (as do stakeholders) that other utilities in the United States are releasing this level of data. Staff questions whether Xcel could utilize the same security and customer privacy screens it has used for the online heat map feeder data to provide the additional substation and feeder data requested by stakeholders.

D. Distribution System Planning Use Case

Staff includes two topics under the Distribution System Planning Use Case section, 1) the inclusion of mitigations and distribution upgrades to facilitate the continued, efficient integration of DER, and 2) the ability of the DRIVE model to incorporate load as well as solar generation.

[65] Xcel Reply, p. 5 referencing Docket No. E999/CI-12-1344
[66] Xcel Reply, p. 6

1. Efforts and Upgrades Necessary to Facilitate DER Integration

Order Point 3 - Xcel's 2018 Hosting Capacity Report must be detailed enough to inform future distribution system planning efforts and upgrades necessary to facilitate the continued efficient integration of distributed generation.

Order Point 7(g) – Xcel shall file supplemental information that would result in a broader understanding of how to guide distribution upgrades for additional hosting capacity.

Fresh Energy argued that Xcel's response to Order Point 7g is insufficient and questions whether the DRIVE model is able to meet this "key objective" of the HCA.[67] The Department shares Fresh Energy's concern about the DRIVE tool's capability to meet this objective.[68]

Fresh Energy recommended that the Commission require Xcel to complete an individual analysis of the 95 feeders that have a hosting capacity of zero. Fresh Energy argued that this analysis could have the beneficial outcome of allowing the discussion of costs and benefits of traditional and non-wires alternatives to increase the hosting capacity in these areas.[69]

The Department recommended that the Commission require Xcel to provide feeder-specific mitigation options, information on the frequency in which constraints occur, the range of cost of mitigation options for individual feeders, how much hosting capacity could be gained on a technical and economic basis, etc.[70]

Generally, Xcel responded that the frequency of a constraint can be determined by the tabular spreadsheet, the range of cost of mitigation options for individual feeders often ranges between $50,000 to $1 million (and is dependent on an interconnection study), and detailed engineering studies are needed to inform interconnection details.[71]

Staff Analysis

There are two types of solutions discussed: distribution upgrades and other mitigation options (which may also require utility investments.)

With regard to distribution upgrades, Fresh Energy notes generic or system-wide "[i]nvestments in incremental distribution system capacity, sensors, and automation, in addition to advanced voltage regulation, can increase hosting capacity"[72]; whereas, Xcel Energy notes the unique

[67] Fresh Energy initial, pp. 4-5.
[68] Department Reply, p. 3
[69]Fresh Energy, p. 5.
[70] Department Initial, p. 18 and Department Reply, pp.3-4.
[71] Xcel Reply, p. 8
[72] Fresh Energy, p. 5.

considerations of each DER interconnection application and location in determining actual hosting capacity or needed distribution upgrades.

The issue of how, and if, advanced inverter capabilities (including voltage regulation modes) introduced with the adoption of IEEE 1547-2018 should be utilized has been discussed in a number of dockets before the Commission; including Phase II of the Docket No. E999/CI-16-521 focused on statewide technical interconnection and interoperability requirements. Several Community Solar Garden dispute dockets[73] include the developer arguing advanced inverters could increase hosting capacity and/or reduce distribution upgrade costs.

E. Scope of Current HCA – Ability of DRIVE to Assist in Future Planning

Order Point 7(e): provide an update in each report on the evolving capability of the EPRI DRIVE tool and whether it is capable of incorporating the technologies included in the broadened definition of DERs;

1. Capabilities of DRIVE

Fresh Energy posed questions about the evolving potential of the DRIVE tool to achieve the following:

- Can load DER (storage, EVs) be modeled? If yes, by when?
- Will Xcel be able to use actual daytime minimum load? If yes, by when?
- Can advanced inverter functionality be modeled? If yes, by when?
- Can Xcel's secondary be modeled such that the addition of small DG such as rooftop solar be considered? If yes, by when?
- Can the map provide results that match the interconnection screens and include the information currently provided by Xcel's pre-application report? If yes, by when?
- Can the HCA replace the interconnection screens and streamline Xcel's interconnection process? If yes, by when? [74]

The Department recommended that the Commission "continue to require Xcel to provide an update on the evolving capabilities of the EPRI DRIVE tool and whether it is capable of incorporating the technologies included in the broadening definition of DERs, including a discussion of how Xcel's hosting capacity analysis can be used to assist state energy policy goals related to beneficial electrification."[75] The Department noted that this would clarify how new load characteristics could be considered in the analysis.[76] IREC also expressed concerns on

[73] Most recently, E002/M-19-203 (Schiller complaint) and E002/M-19-29 (Linden IE Dispute)
[74] Fresh Energy Initial, p. 8
[75] Department Reply, p. 4.
[76] *Id.*

DRIVE's potential inability to consider load and the lack of precision of the final hosting capacity on a given feeder.[77]

Staff Analysis

Staff agrees with Fresh Energy and IREC that there is limited information on hosting capacity when considering new load additions (like EV and batteries) and believes this analysis should be expanded in the future. However, as Xcel noted, the adoption of these DERs is relatively low – but ensuring that the HCA is capable or prepared to consider these load-effects should be contemplated and prepared for now. Staff recommends Xcel provide a broader discussion of this issue in its 2019 HCA and include at least one (more is preferable) case example where Xcel considers generation and load on a feeder.

2. Methodological Choice (Small Distributed, Large-Centralized)

> *Order Point* 7 (b): consider the feasibility and practicality of including the results of both the Small Distributed methodology and the Large Centralized methodology in future hosting capacity analyses;

The Department concludes Xcel's use of DRIVE's Large-Centralized Method is appropriate at this time.[78] Further, the Department requests, and Xcel agrees, the 2019 HCA Report provide updates on: 1) the appropriateness of the methodological choice of the hosting capacity analysis, 2) a discussion of the Company's ability to obtain more detailed secondary voltage equipment data, and 3) the types of DER being interconnected and updates on the evolving capabilities of the DRIVE tool and its capabilities of incorporating technologies included in the broadened definition of DER which includes storage and electric vehicles.

VI. Additional 2019 HCA Report Considerations

Hosting capacity is an emerging tool in the electric industry. Xcel Energy and stakeholders have contributed to continuous improvements of the Company's annual hosting capacity analysis over the past three years; however, there appears to be fundamental concerns over the usefulness and use of the report moving forward if some key issues are not addressed. IREC recommends "[t]he Commission should take this opportunity to seriously evaluate the limitations of Xcel's efforts relative to identified objectives and provide clear direction to remedy the current shortcomings, lest more ratepayer and Commission resources be spent to continue developing a tool that does not provide value or function as expected."[79] Xcel Energy adds: "… we believe we may be at a critical juncture where the Commission may need to re-iterate or clarify the

[77] IREC Reply, p. 7
[78] Department Initial, p. 12
[79] IREC Reply, p. 8

objectives of the HCA to avoid potentially conflicting objectives or misplaced expectations on future HCA reports."[80]

Before requiring Xcel to conduct work improving the hosting capacity, or spending more hours collecting data for a HCA that has a limited use, stakeholders recommend two fundamental assessments should occur: 1) an assessment on the cost to conduct the study, 2) and a survey to potentials users of the HCA.

As noted by the survey results provided by Fresh Energy and the summary from Xcel Energy's Solar*Rewards Community (Community Solar Garden) Workgroup, it is not clear that developers understand or find much value in the HCA as it exists today,[81] Yet, the HCA, in the current yearly updated format takes up to 2,000 hours of Xcel's time to run.[82] Even with finding efficiencies and work stakeholders, Xcel does not believe it could get the time required for the HCA update to below 1,000 hours.[83] The Department recommends:

> …Require Xcel to conduct a survey directed to DER developers, whether identified in this docket or through its other stakeholder outreach activities related to distributed energy resource integration and development (such as the Solar*Reward Community Workgroup) and independent of any utility-led working groups or outreach activities (such as Community Solar Garden participants). Such a survey should be conducted before the next 2019 Hosting Capacity Report is filed, and the results should be provided in that report. At a minimum, the survey should contain questions similar to the questions contained in Fresh Energy's survey of S*RC Workgroup members.

In addition, Fresh Energy recommends Xcel provide the total time and costs related to the hosting capacity exercise to be useful, and it should be broken down by category and personnel type.

Staff Analysis

Parties, including Xcel Energy, suggest the Commission may need to provide additional guidance on the objectives of the HCA; however, beyond the discussion on its role in interconnection review, there is not explicit recommendations on what specific guidance is requested. This makes it difficult for staff to offer decision options.

Staff believes that it would be useful for Xcel to include in future reports the information on the time and cost spent per year in modeling and compiling the HCA report. This information, potentially combined with the Department's recommendation on requiring Xcel to conduct a survey directed to DER developers (similar to the survey attached to Fresh Energy's filing) would

[80] Xcel Reply, p. 3
[81] Xcel Reply, p. 2
[82] Xcel Reply, p. 11
[83] Xcel Reply, p. 11

be useful information for the Commission to determine what level of effort should continue to be put into this report in the near term. If the survey results show that developers do not understand what the report and online map tool does, or results are received that indicate that the HCA data and online map are not able to be used by developers, as Fresh Energy claims, then the Commission would likely want to modify its input into the HCA Report and requests for improvements in future years. Additionally, staff believes this information, combined with Xcel filing data on this record of the total number of capacity screens conducted in the previous year, including the total amount charged to developers for those screens may also provide context to assess the usefulness of the HCA Report for its cost.

Staff has added a 'catch-all' decision option, below, to require Xcel to continue to consider past party requests and recommendations in future year reports.

Last, staff believes guidance from the Commission would be useful on whether it wishes to see the report return to a full Commission agenda meeting for 'acceptance' in the future. If the Commission directs staff to process the report as a compliance filing, the next (2019) report would likely not undergo a stakeholder comment period and it may stifle stakeholder involvement (which staff believe has been beneficial to improve and iterate the reports to date).

VII. Commission Decision Options

Clarify Role of HCA in Interconnection Review

1. Determine if the Commission intends hosting capacity analysis to streamline or replace any of the interconnection review process under the Minnesota Distributed Energy Resource Interconnection Process (MN DIP) that will be developed through a statewide update of the MN DIP and address the frequency of updates. (*Staff interpretation of Xcel's position*)

2. Require a complete analysis of the DRIVE tool, including a comparison of other methodologies and interconnection study results on a selection of representative feeders. If the DRIVE tool is unable to provide results that match the results of the interconnection studies, the Commission should order Xcel to use a different methodology. (*Fresh Energy*)

3. Request Xcel and stakeholders collaborate to consider the costs and benefits associated with a hosting capacity analysis able to achieve the following use cases or objectives: 1) remaining an early indicator of possible locations for interconnection; 2) replacing or augmenting initial review screens and/or supplemental review in the interconnection process; and/or 3) automating interconnection studies. (*Staff Alternative*)

Additional Data

4. To the extent practicable, require Xcel to include peak load data by substation and feeder, including daytime minimum load, installed and queued generation capacity, in a

spreadsheet format and in the public-facing hosting capacity map with appropriate disclaimers. (*Department with Staff clarification*)

5. Require Xcel to make the tracking and updating of actual feeder daytime minimum load a high priority in 2019 and include those values in the 2019 HCA. (*Fresh Energy)*

6. Require Xcel to work with stakeholders to improve the value of the Company's hosting capacity analysis, including but not limited to the provision of more detailed substation, feeder, and other equipment data in the hosting capacity map. *(Department*)

Distribution System Planning – Efforts and Upgrades Necessary to Facilitate DER Integration

7. Require Xcel to complete an individual analysis of the Company's 95 feeders that have a hosting capacity of zero and options available to increase the hosting capacity of those feeders. (*Fresh Energy)*

8. Require feeder-specific mitigation options in addition to providing the following information in future reports (*Department)*:
   a. The frequency at which the constraints to individual feeders occur throughout the distribution system;
   b. A range of potential costs for each of the mitigation options available for an individual feeder and a range of total costs;
   c. How much additional hosting capacity could be obtained by implementing the identified mitigation options on a technical and economic basis (i.e. the technical potential of the mitigation options and the economic potential of the mitigation options); and
   d. Whether there would be a cost-effective impact on the value of DERs if such mitigation options were pursued (i.e. do any of the mitigation options impact the value proposition of DERs and if so, what is that impact?)

9. Require Xcel to provide at least one DRIVE case example, to the extent practicable, of a feeders hosting capacity with different locations and levels of generation and load. (Staff)

Scope of Current HCA – Ability of DRIVE to Assist in Future Planning

10. Require Xcel to provide an update on the evolving capabilities of the EPRI DRIVE tool and whether it is capable of incorporating the technologies included in the broadened definition of DERs, including a discussion of how Xcel's hosting capacity analysis can be used to assist state energy policy goals related to beneficial electrification. (*Department)*

11. Require Xcel to provide updates on the appropriateness of the methodological choice of the hosting capacity analysis, a discussion of the ability of the Company to obtain more

detailed secondary voltage equipment data, and the types of DERs being interconnected in future reports. (*Department)*

Additional Considerations for 2019 HCA Report

12. Require Xcel to conduct a survey directed to DER developers, whether identified in this docket or through its other stakeholder outreach activities related to distributed energy resource integration and development (such as the Solar*Reward Community Workgroup) and independent of any utility-led working groups or outreach activities (such as Community Solar Garden participants). Such a survey should be conducted before the next 2019 Hosting Capacity Report is filed, and the results should be provided in that report. At a minimum, the survey should contain questions similar to the questions contained in Fresh Energy's survey of S*RC Workgroup members. (*Department)*

13. Require Xcel Energy to file all costs related to the hosting capacity exercise with the 2019 Report, including the time of Xcel's engineering staff and any efforts the Company is making to reduce the costs over time. (*Fresh Energy*)

14. Require Xcel to file in the 2019 Report information on the number of pre-application capacity screens conducted in the previous year, the amount collected for each, and the total amount collected to conduct the pre-application screens, in the previous year. *(Staff)*

15. Require Xcel Energy to continue to consider and address relevant requests from parties, and Commission order points made during the 2016, 2017, and 2018 HCA iteration in future filings. *(Staff)*

Attachment A - 2018 HCA Report - Order Requirements Table and Location in Report

Source	Requirement	Location Response is Addressed
Docket 17-777 7/9/18 Order	2. Xcel's 2018 Hosting Capacity Report must be detailed enough to provide developers with a reliable estimate of the available level of hosting capacity per feeder at the time of submittal of the report to the extent practicable. The information should be sufficient to provide developers with a starting point for interconnection applications.	Attachment A - Hosting Capacity Results
Docket 17-777 7/9/18 Order	3. Xcel's 2018 Hosting Capacity Report must be detailed enough to inform future distribution system planning efforts and upgrades necessary to facilitate the continued efficient integration of distributed generation.	2018 Report: Section G - Impacts and Mitigations
Docket 17-777 7/9/18 Order	4. Xcel must file a color-coded, map-based representation of the available Hosting Capacity down to the feeder level. This information should be provided to the extent it is consistent with what Xcel believes are legitimate security concerns. If security concerns arise, Xcel must explain in detail the basis for those concerns.	Page 22 provides link to: https://www.xcelenergy.com/working_with_us/how_to_interconnect
Docket 17-777 7/9/18 Order	5. Xcel must provide the Hosting Capacity results in downloadable, MS-Excel or other spreadshe	Attachment A - Hosting Capacity Results
Docket 17-777 7/9/18 Order	6. Xcel must provide information on the accuracy of the Hosting Capacity Report information; both estimates on the accuracy of the 2018 report and an analysis of the 2017 results compared to actual hosting capacity determined through any interconnection studies or other reasonable metric.	2018 Report: Section H - Accuracy
Docket 17-777 7/9/18 Order	7. The Commission hereby requests that Xcel Energy address stakeholder recommendations in the Company's 2018 Hosting Capacity Report filing, including: a. consider the methodological options to both improve and measure accuracy of the hosting capacity analysis, including identification and analysis of industry best practices and an explanation of the Company's methodological choice;	2018 Report: Section H - Accuracy
Docket 17-777 7/9/18 Order	b. consider the feasibility and practicality of including the results of both the Small Distributed methodology and the Large Centralized methodology in future hosting capacity analyses;	2018 Report: Section D - Methodology, 2. DER Allocation Method
Docket 17-777 7/9/18 Order	c. conduct a sensitivity analysis;	2018 Report: Section J - Sensitivity Analysis
Docket 17-777 7/9/18 Order	d. explore a range of options for better presenting the public-facing results of the Hosting Capacity Analysis after consideration of, but not limited to, any security and privacy issues that may be implicated in providing more detailed information and what information might be useful to developers and stakeholders;	2018 Report: Section K - Presentation of HCA Results Considers Privacy and Security Interests
Docket 17-777 7/9/18 Order	e. provide an update in each report on the evolving capability of the EPRI DRIVE tool and whether it is capable of incorporating the technologies included in the broadened definition of DERs;	2018 Report: Section C - Hosting Capacity Tool -DRIVE
Docket 17-777 7/9/18 Order	f. file more detailed data on load profile assumptions used in the analysis, including peak load (kW) by substation and feeder; and	2018 Report: Section E - Assumptions
Docket 17-777 7/9/18 Order	g. file supplemental information that would result in a broader understanding of how to guide distribution upgrades for additional hosting capacity.	2018 Report: Section G - Impacts and Mitigations