

Staff Briefing Papers

Meeting Date: May 31, 2018 Agenda Item **4

Company: Xcel Energy

Docket No. **E002/M-17-777**

In the Matter of Xcel’s 2017 Hosting Capacity Study

Issues: What action, if any, should the Commission take on Xcel’s 2017 Hosting Capacity Study?

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Relevant Documents	Date
Xcel Energy – Initial Filing (2 Parts)	November 1, 2017
Communities United for Responsible Energy – Comments	November 30, 2017
Xcel Energy IR Responses to MNPUC IRs (11 Parts)	January 22, 2018
Fresh Energy - Comments	February 2, 2018
Interstate Renewable Energy Council – Comments	February 2, 2018
DOC DER	February 2, 2018
PSC Memo on Xcel’s 2017 HCR	February 22, 2018
Institute for Local Self-Reliance – Reply Comments	February 28, 2018
Xcel Energy – Reply Comments	February 28, 2018
DOC DER – Reply Comments	February 28, 2018
Interstate Renewable Energy Council – Reply Comments	February 28, 2018
Fresh Energy – Reply Comments	February 28, 2018

I. STATEMENT OF THE ISSUES

What action, if any, should the Commission take on Xcel's 2017 Hosting Capacity Study?

II. BACKGROUND

Minn. Stat. § [216B.2425](#), enacted in 2001, requires all entities that own or operate transmission lines in Minnesota to submit biennial state transmission plan reports (Biennial Transmission Plan) in November of each odd-numbered year. In the 2015 Legislative Session, the Legislature expanded Minn. Stat. § 216B.2425 to require two additional reports: first, a Biennial *Distribution Plan* (in addition to the Transmission Plan) on investments that Xcel¹ considers necessary to modernize its distribution system; and second, a distribution study to identify interconnection points for distributed generation (DG) and necessary distribution upgrades to support additional distributed generation (Hosting Capacity Report or HCR).

On October 30, 2015, Xcel Energy filed its first report under the new legislation, the *Biennial Distribution Plan: Distribution Grid Modernization Report* (Biennial Distribution Report). The Biennial Distribution Report provided a high-level overview of Xcel's approach to grid modernization, requested certification of a solar with battery project and an Advanced Data Management System (ADMS) and requested additional time to complete the Hosting Capacity Report portion.

The Commission, in its June 28, 2016 *Order Certifying ADMS Project Under Minn. Stat. § 216B.2425 and Requiring Distribution Study* made several ordering points, two pertaining to hosting capacity. It required Xcel to file by December 1, 2016 its first Hosting Capacity Report that:

- Included an analysis of the hosting capacity of each feeder on the Xcel distribution system for small-scale distributed-generation resources, defined as resources that are 1 MW or less; and,
- Identified potential distribution upgrades necessary to support expected distributed-generation resource additions, in aggregate, distributed-generation resources that are in the Company's integrated resource plan filings and those that are active in the Company's community solar garden process.

On December 1, 2016, Xcel Energy filed its Distribution Study (Hosting Capacity Report) that it compiled using the Electric Power Research Institute's (EPRI) Distribution Resource Integration and Value Estimation (DRIVE) tool. The report outlined Xcel's approach to the analysis, its methodology, assumptions, and results on the available capacity on its distribution feeders. Additionally, through this process, Xcel committed to stakeholders to file its hosting capacity updates annually moving forward.

¹ The statute pertains only to utilities under a multi-year rate plan which currently is only Xcel.

On August 1, 2017, the Commission issued its Order Setting Additional Requirements for Xcel's 2017 Hosting Capacity Report (2017 HCR Order). The 2017 HCR Order required:

1. The Commission will require that the 2017 Hosting Capacity Report 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.
2. The Commission will require that the 2017 Hosting Capacity Report be detailed enough to inform future distribution system planning efforts and upgrades necessary to facilitate the continued efficient integration of distributed generation.
3. Xcel shall provide 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 shall explain in detail the basis for those concerns.
4. Xcel shall provide the Hosting Capacity results in downloadable, MS-Excel or other spreadsheet file formats.
5. Xcel shall provide (at a minimum) in its next Hosting Capacity Report the information requested by Commission staff and parties in response to the 2016 Report (through comments or information requests) regarding data used in the modeling, including model assumptions and methodology, reasons for the model assumptions and methodological choices, additional detail on the model used and its inherent assumptions.
6. Xcel shall provide information on the accuracy of the Hosting Capacity Report information; both estimates on the accuracy of the 2017 report and an analysis of the 2016 results compared to actual hosting capacity determined through any interconnection studies or other reasonable metric.
7. Xcel shall file a Hosting Capacity Report on an annual basis, by November 1 of each year.

On November 1, 2018, Xcel filed its 2018 Hosting Capacity Report in this instant docket.

Comments were received by Communities for Responsible Energy (CURE), Fresh Energy, Interstate Renewable Energy Council (IREC), the Department of Commerce – Division of Energy Resources (DOC DER), the Institute for Local Self-Reliance (ILSR), and Xcel Energy.

Additionally, the Minnesota Commission was granted an award of assistances from the Department of Energy. Through that award, and facilitate by Lawrence Berkeley National Labs,

Commission staff worked with PSC Consulting to evaluate, understand and analyze the HCR process and results. The resulting memo from PSC Consulting is included as a relevant document to this paper.

III. STATUTES AND RULES

At this time, the Commission does not need to take any formal action on the Hosting Capacity Report as the statute does not require certification or approval (only that the study be conducted and included in the biennial reports). However, due to the nature of this filing (the level of interest from parties) and in response to parties' comments, staff believed it would be reasonable to bring the matter before the Commission in the instance it would like to provide any guidance or recommendations to Xcel on future reports (as it did in the 2017 HCR Order).

Minn. Stat. §216B.2425, Subd. 8. Distribution Study for Distributed Generation.

Each entity subject to this section ... shall 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, and shall include the study in its report required under subdivision 2.

IV. Hosting Capacity Reporting Overview and Background

As noted above, the legislature required Xcel to conduct a distribution study to identify interconnection points for distributed generation and necessary distribution upgrades to support additional distributed generation. This analysis, often referred to as hosting capacity, is increasingly common to the industry and is utilized in other states.

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 *studies* are evaluations of a utility's distribution system to find and report these locations (also known as a hosting capacity analysis or HCA). The authorizing statute in Minnesota also requires Xcel to identify distribution upgrades needed to support continued DER development (not just report on locations in which DER can be accommodated).

V. Xcel's 2017 Hosting Capacity Study Report

Xcel submitted its second hosting capacity report on November 1, 2017, and the report is included as a relevant document to this brief.³ As an attachment to the report, Attachment B,

² EPRI, Impact Factors, Methods and Considerations for Calculating and Applying Hosting Capacity, 2018 Technical Update, p. v

³ For purposes of the report, Xcel defined distributed energy resources as the following: Sources and groups of sources of electric power that are not directly connected to a bulk electric system. DER includes both generators and energy storage technologies capable of exporting active power to the area electric power system (EPS). Xcel noted it would adopt the IEEE 1547 definition of DER as it comes available.

Xcel itemized the Commission’s 2017 HCR Order points and detailed where each item was addressed in its filing or in the record.⁴

Again in its 2017 HCR, Xcel utilized the EPRI DRIVE tool to conduct the study. The DRIVE tool analyzes large volumes of utility distribution system data to screen for voltage, thermal and other impacts from DER. The end result is a list of the potential available capacity (in MW) at substation feeders (subject to interconnection review). Xcel evaluated and modeled all of its 1,000-plus feeders across Minnesota. It noted that the electric system’s hosting capacity (ability to add DER) to either add or reduce capacity depends on the operating characteristics of the DER and the location on the system. DER on the system typically tends to reduce hosting capacity and availability of storage tends to increase hosting capacity.

Notable changes to the 2017 report, as outlined by Xcel: 1) an interactive heat map of the hosting capacity map was made available⁵, 2) existing DER was incorporated into the analysis, 3) use of the voltage fluctuation thresholds based on IEEE 1547 methodology, 4) use of the DRIVE Tool’s Large Centralized Methodology, 5) use of advanced inverter settings (use of a non-unity fixed power factor setting), 6) the inclusion of storage as a DER (but not load), 7) the removal of back-up DERs from the data, and 8) an increase in the threshold for protection changes. Xcel also outlined how it continues to believe its analysis conforms to general industry concepts of a hosting capacity method of being: granular, repeatable, scalable, transparent, proven and available.

Xcel provided a spreadsheet including the results of the analysis on each of its substation and feeders, and at each, the minimum and maximum hosting capacity and the limiting violation. Table 1 shows a comparison of the change in results from 2016 to 2017. These changes were due to change in DER penetration on Xcel’s system and/or a change in the HCR inputs (all described in the filings).

Table 1. Xcel Hosting Capacity Results 2016 to 2017

2016 Data (MW)					2017 Data (MW)			2017-2016 Values (MW)	
	Min	Max	Installed	Proposed		Min	Max	Change Min	Change Max
Sum	1,833	2,630	220	558	Sum	1,525	6,271	-308	3,641
Ave	1.76	2.53	0.21	0.54	Ave	1.49	6.14	0.30	3.50

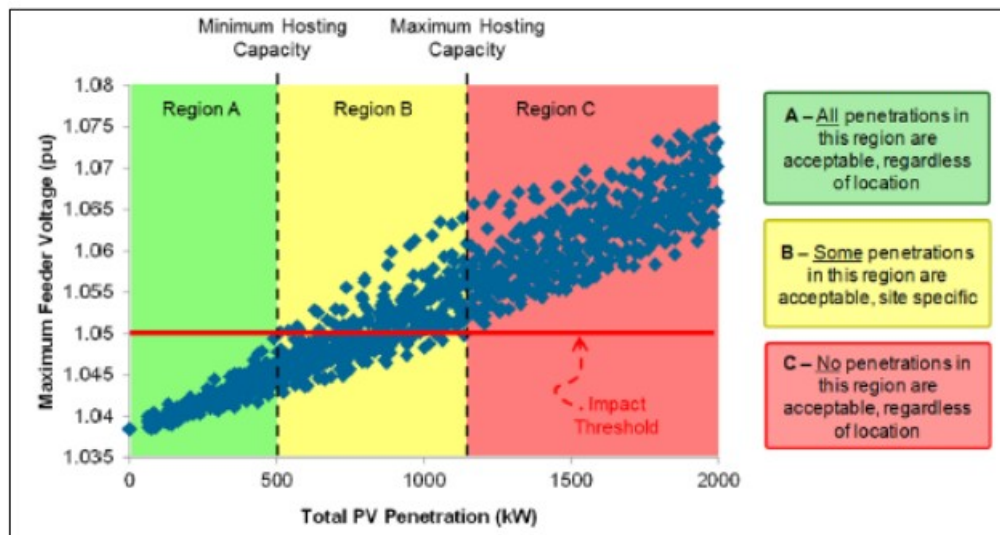
Overall, the 2017 HCR results showed more potential capacity on the feeders (subject to interconnection studies) and a reduced level of minimum hosting capacity. The minimum hosting capacity, the areas in which DER can interconnect anywhere on the feeder without causing a violation, decreased from 1,833 MW to 1,525 MW (green area on graphic shown

⁴ See Attachment B, pg. 1-2 ([Xcel’s 2017 HCR Report](#))

⁵ Staff recommends Commissioners view the interactive map if they have not already: [Xcel 2017 HCR Heat Map](#)

below). However, the number of MWs on feeders in which DER additions *may* (dependent on location along the feeder) could trigger a violation increased considerably (yellow area) from 2,630 MW to 6,271 MW⁶. To determine whether a DER addition would trigger a violation would require a more detailed review by Xcel. Xcel provided EPRI’s visual representation of the minimum and maximum hosting capacity concept in the following figure (Figure 5 from the 2016 HCR Report):

Figure 5: Minimum and Maximum Hosting Capacity Visualization



VI. Power System Consultants Memo

Through the Commission’s award of support from the Department of Energy, Power System Consultants (PSC) and Lawrence Berkeley National Labs worked with staff to develop a technical review of Xcel’s HCR. This assistance was invaluable to staff in better understanding utility use of hosting capacity analyses, generally.

MNPUC requested Berkeley Lab and PSC to:

- Review Xcel’s hosting capacity report
- Comment on whether the report meets MNPUC’s requirements from a technical perspective
- Compare Xcel’s analysis with DER hosting analysis in other jurisdictions

⁶ Xcel provided on page 4 of their filing: 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 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.

- Describe current issues associated with DERs
- Discuss how hosting capacity analysis is being used elsewhere
- Make recommendations for possible improvements in Xcel's next hosting capacity analysis

Takeaways from the report⁷ are as follows:

- The availability of the EPRI Drive model to stakeholders (due to cost) limit the ability of others to evaluate and compare results from the models.
- While Xcel converted to use of the Large Centralized methodology (from the Small Distributed methodology) in DRIVE tool for the 2017 HCR based on stakeholder input, that methodology may also not be a good fit for anticipated photovoltaic (PV) adoption forecasts. PSC recommended the use of multiple methodologies.
- PSC largely concluded that the technical inputs to the Drive Tool were reasonable and supported by Xcel's filing.
- Many of considerations, inputs and outputs made in Xcel's HCR were common across utilities conducting HC analyses.
- PSC noted there were additional mitigation options not listed by Xcel that could increase HC (storage, Volt/Var and Volt/Watt controls).
- From a technical perspective, PSC indicated Xcel provided the information requested of the Commission.
- PSC made 8 recommended areas for improvement of Xcel's next HCR (attached).⁸

VII. Stakeholder Comments and Staff Discussion

Staff notes that the comments and responses in this docket are thorough, and staff only provides a cursory summary of these issues here since Xcel's HCR does not need Commission approval. If any Commissioner would like further information staff is available to provide additional detail on any of these positions or issues and can assist in crafting additional decision options.⁹

Common themes among comments emerged, largely surrounding: 1) whether the report fulfilled the statutory and Commission order requirements, 2) the use cases of the HCA, 3) information and questions on the report, and 4) methods to improve the current HCA.

⁷ LBNL/PSC Review of Xcel's 2017 Hosting Capacity Report. e-filed by PUC in this docket on February 22, 2018

⁸ IBID, p. 13

⁹ Additionally, staff notes it did not summarize CURE's comments here. CURE's comments were submitted in three dockets, this instant docket, Xcel's Biennial Grid Modernization docket (17-776) and the Biennial Transmission Projects Report (17-377). CURE's comments generally encouraged a creation of a comprehensive state-wide integrated distribution and transmission process. CURE's comments have been summarized in recent dockets, the Commission's distribution planning investigation dockets (CI-15-556 and 18-251 (-255) and the Biennial Transmission Plan).

B. Completeness and Compliance with Statute and Commission Order

Largely commenters agreed that the report was complete in relation to the statute and Commission order.

Fresh Energy and ILSR noted that the HCR does not identify necessary distribution upgrades to support the continued development of distributed generation as it did not identify proactive measures to integrate the hosting capacity analysis with distribution system planning. ILSR points to “statutory requirements that the study support upgrades for distributed generation deployment” in Minn. Stat. 216B.2425, Subd. 8:

“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 .” [ILSR emphasis]¹⁰

ILSR supports identifying necessary distribution upgrades for continued DG development and calls for an independent analysis to “address the fundamental problem of the utility’s inherent conflict of interest in meeting the statutory goal.”¹¹

According to Xcel:

... whether the Company uses the hosting capacity view of its system into its planning processes may raise a policy question – whether the Company should undertake system upgrades or changes in order to expand hosting capacity to accommodate greater levels of DER, where capacity may be more limited at present.¹²

DOC DER provided thorough comments which indicated it found Xcel’s HCR complete in regard to the statutory and order requirements and suggested the Commission advise Xcel that an independent docket assignment and filing of the HCR is a proper interpretation of statute (which requires including the HCR ‘in’ the Biennial Transmission Projects report).

C. Use Cases and Accuracy of the Hosting Capacity Analysis

The Department of Commerce and Xcel Energy interpret the goals or use case of hosting capacity established by the Commission’s August 1, 2017 Order as:

These goals are to: (1) provide a high level understanding of the distribution system’s hosting capacity as a starting point for interconnection applications; and (2) serve as a guide for the orderly development and investment in the distribution system to further integrate Distributed Energy Resources (DER).¹³

¹⁰ ILSR Reply, p. 2

¹¹ ILSR Reply, p. 3

¹² Xcel, IR #10 Response (Jan. 22, 2018), p. 1-2

¹³ DOC Initial, p. 9; Xcel Energy Reply, p. 1

Xcel highlights how the 2017 HCA meets those goals:

The hosting capacity tools are publicly available at no cost via our website, and provide a indication of our distribution system's ability to support distributed energy resources. Areas with a higher level of hosting capacity allow customers or developers to quickly identify potential interconnection sites that will likely have minimal impact on Xcel Energy's distribution system, thereby resulting in lower installed costs. Once a prospective interconnection location has been chosen, developers or individuals can enter into the interconnection process for increased levels of detail and refined estimates of system impacts and costs.

Interstate Renewable Energy Council and Fresh Energy acknowledge improvements between 2016 and 2017, but caution there is limited value in both the methodology and use case:

Xcel's hosting capacity maps are an important innovation and key to providing customers with easily accessible information for identifying optimal grid locations to interconnect DERs. Ultimately, however, these maps are only as valuable as the accuracy and reliability of the underlying data. Any improvements to the hosting capacity methodology will increase the usefulness of this application. In addition, the commenting parties agree that modifications [more frequent updating and more granular data] should be made to the deployment of the tool and release of the results to increase the value of Xcel's hosting capacity efforts.¹⁴

Xcel's hosting capacity analysis should aim to streamline the interconnection process by providing a starting point for applications and replacing engineering screens and/or streamlining study analysis.¹⁵

IREC and Fresh Energy suggest the Commission should provide further clarification and discuss the level of precision required to achieve it; such as, the desired level of granularity (line section, node, feeder, etc.); types of DER modeled; validation of techniques, etc.

Xcel Energy cautions against any effort at this time to supplant hosting capacity analysis for technical review and engineering judgment in an effort to streamline the interconnection process.¹⁶ Xcel argues IREC has not provided evidence from the United States or other countries to suggest that hosting capacity can be used as they described.¹⁷ Xcel:

¹⁴ IREC Reply, p. 14

¹⁵ Fresh Energy Initial, p. 2; IREC Reply, p. 4

¹⁶ Xcel IR Response No. 9 (January 11, 2018) and Xcel Reply, p. 5

¹⁷ Xcel Reply, p. 5

The one-size-fits all approach proposed by IREC, to use hosting capacity as the sole tool for technical interconnection processing, is not practical presently – and may not be the best option in the future.¹⁸

IREC points to California and Hawaii where utilities and Commissions see a role for hosting capacity in expediting the screening process, but do not use the DRIVE tool.¹⁹

Despite the disagreement on the current goal and methodological choices of HCA, Xcel Energy looks forward to refining and advancing the tool:

We believe a HCA plays an important role in streamlining the interconnection process, and we look forward to continuing to refine and advance our HCA in concert with the industry. However, a HCA is only one tool among several necessary to accommodate and integrate DER without causing adverse impacts on the distribution system.²⁰

Xcel suggests “... that interconnection processing be addressed comprehensively as is underway in the open statewide interconnection standards proceeding – and as part of that, target enhancements for streamlining the overall process.”²¹ Further, Xcel argues discussion on specifically what parts of interconnection streamlining is targeted by hosting capacity in Minnesota should consider *all* utilities (Xcel’s emphasis). IREC recommends the Commission “... establish a working group process or workshop(s) led by a neutral facilitator could be a useful vehicle for elaborating the hosting capacity use cases and their methodological needs.”²²

The Department does not advocate for a specific interconnection-related use case; instead, asserts the Commission has not ordered a more detailed analysis for this or future reports.²³ The Department’s reply comments prioritize the need for continued improvement in the underlying modeling and analysis of Xcel Energy’s distribution system and Distributed Energy Resources; such as, identification and analysis of industry best practices regarding measuring the accuracy of hosting capacity analysis²⁴, incorporate a sensitivity analysis²⁵, broaden DER definition to include load characteristics²⁶; ongoing consideration of EPRI DRIVE tool and which methodology(y/ies) used²⁷, and more detailed data on hourly load profile assumptions.²⁸

¹⁸ Xcel Reply, p. 5

¹⁹ IREC Reply, p. 4-5 & ftn. 10

²⁰ Xcel Reply, p. 6

²¹ Xcel Reply, p. 13

²² IREC Reply, p. 5

²³ DOC Initial, p. 5

²⁴ DOC Reply, p. 2

²⁵ DOC Reply, p. 3

²⁶ DOC Reply, p. 5

²⁷ DOC Reply, p. 5-6

²⁸ DOC Reply, p. 10

The Department of Commerce concludes:

... the Company is in compliance with Order Point #1 as they provided “a reliable estimate of the available level of hosting capacity per feeder at the time of submittal of the report to the extent practicable” and that information provided is sufficient to provide developers with a starting point for interconnection applications.²⁹

Staff notes that the Distributed Generation Workgroup in Docket No. E999/CI-16-521 discussed whether a utility could use engineering judgment or new tools; such as, hosting capacity analysis, in place of the initial review screens for simplified and fast track eligible distributed energy resource interconnection applications.³⁰ The FERC Small Generator Interconnection Process’s initial review described in this docket by Xcel Energy³¹ was the focus, and Xcel Energy wanted flexibility to encourage the development of new review tools; whereas, IREC wanted to encourage the development of new tools, but with transparency via a Commission review and approval process. In that docket, the flexibility to develop and test a tool was desired by Xcel Energy to explore the future potential of hosting capacity analysis or other tools to streamline interconnections; whereas, IREC was concerned about the limitations of the current hosting capacity tool and the risk of a tool that was not transparently being vetted streamlining the interconnection process. The staff draft recommendation in that docket includes this language in the initial review screen section:

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.³²

Distributed Generation Workgroup discussions has assumed there would be some ongoing, interconnection-related workgroup. All of the commenters in this docket, with the exception of ILSR, are members of the Distributed Generation Workgroup.

With regard to whether a specific hosting capacity methodology or another tool may be better suited for achieving the goals outlined in Minn. Stat. 216B.2425, Subd 8, parties currently support different approaches, but seem to agree that this is an area of innovation and research. Further, they appear to agree that improvements to the underlying assumptions and inputs and validation of results matter to ensure safety, reliability and resiliency.

²⁹ DOC Initial, p. 5

³⁰ Technical Review Screen Subgroup Notes (Docket No. E999/CI-16-521), October 6, 2017, p. 8

³¹ Xcel Energy Reply, p. 7

³² MN PUC Notice of Comment (E999/CI-16-521), Feb. 27, 2018, Att. A: Draft Staff Recommendation on Minnesota Distributed Energy Resource Interconnection Process, p. 13. Unchanged in Updated Staff Recommendations filed with Staff Briefing Papers in same docket on May 16, 2018.

D. Information and Questions on the Report

Commenters had various suggestions for improvement of the HCA, including requests for additional information in the next report iteration. Some of the larger issues are summarized below. This is not a comprehensive list, staff refers Commissioners to party comments for all recommendations. Some issues are not discussed here as they appeared to be largely addressed by reply comments, however, in preparation of the 2018 Hosting Capacity Report, staff would suggest Xcel review the comments for this report (and the 2016 Report) to address any issues or questions parties had here for inclusion in its next report.

Transparency

IREC reiterated its concern over the use of the DRIVE tool, its cost and therefore, it argued it is difficult to assess its details and application (similar to PSC's comments).³³

Accuracy

IREC and Fresh Energy suggested to improve the HCA Xcel could conduct more complete accuracy analyses; including the conduct of a more rigorous evaluation of hosting capacity results by comparing them to actual hosting capacity values derived from a power-flow based analysis on representative circuits. IREC suggested that the Commission require it to identify deviations of any kind from actual hosting capacity, so that parties can understand the deviations of actual hosting capacity to the report results; Fresh Energy recommended Xcel conduct more complete accuracy analysis, with sufficient data and transparent results with the goal of tracking continued improvement.^{34, 35}

The Department ultimately recommended that Xcel include in its next report: (1) the methodological options available to measure the accuracy of the HCA; (2) an explanation of why Xcel chose the approach taken to measure the accuracy of the 2017 report, and; (3) identification and analysis of industry best practices regarding measuring the accuracy of HCAs.

Sensitivity Analysis

Fresh Energy recommended, and the Department agreed with the recommendation to Xcel, that conducting a sensitivity analysis could show the impact of varying assumptions within the tool. The DOC DER, in its reply comments suggested that the selection of a few representative feeders may be used to compare results. The DOC DER:

“The specific methodology requires consideration of the usefulness of performing sensitivity analysis on a given variable, the time and resources that go into performing

³³ IREC Reply Comments, at 8.

³⁴ IREC Comemnts, at 11.

³⁵ Fresh Energy Comments, at 5.

the sensitivity analysis, and whether meaningful changes are likely to result from performing a sensitivity analysis that improves the HCA overall.”³⁶

Update Frequency

IREC suggested, and Fresh Energy supports a more frequent update of the hosting capacity results more frequently—ideally on a monthly basis, to start—or creating a phased approach through which Xcel will gradually move toward more real-time updating of the results. As Fresh Energy stated in its reply comments:

“A DER provider looking to the tool this October [2018] would be without 15 months of DER development. As the pace of DER integration accelerates, that lag-time becomes more and more significant. Without increasing the frequency of publication, the tool may be useful for the first month or two after publication and then immaterial the remainder of the year.”³⁷

DOC DER noted in reply comments it supported Xcel’s annual submittal of its hosting capacity results as the results are continued to be refined, Xcel is continually learning from its experience and other stakeholder, and the accuracy and reliability of the results is still being determined.

Improved Data

IREC seeks, and Fresh Energy and the Department support, Xcel providing additional details in Xcel’s hosting capacity results, specifically maximum and minimum load data. IREC and Fresh Energy further supported Xcel providing additional details on Xcel’s hosting capacity map, including in particular pop-up windows that show the actual hosting capacity and other relevant data for feeders.

DOC DER did not recommend this additional information for the public-facing available data at this time (but agreed they were ideal goals in the long run) as DOC DER believed it was more important to focus on accuracy of the results. DOC DER encouraged Xcel to continually refine the public-facing data.

However, DOC DER did support Xcel providing the following additional data on load profile assumptions, as clarified in reply comments:

- Peak load (kW and kWh) by substation and feeder;
- Customer sector characteristics by feeder (e.g. % residential, % commercial)

³⁶ DOC DER, Reply Comments, at 3.

³⁷ Fresh Energy Reply, at 2.

- Any reasonable information for hourly load profile assumptions and the basis for such assumptions (SCADA, metered data, etc.)³⁸

Evolution of the DRIVE Tool and Expansion of the Definition of DER

The DOC DER acknowledged that the current DRIVE Tool could not model batteries as storage (but only as load) and requested that Xcel continue to provide on the evolving capabilities of DRIVE in relation to a broadened definition of DERs (beyond the limited definition Xcel used in this filing).

Use of Both the Large Centralized and Small Distributed Modeling Methodologies

The DOC DER recommended that, consistent with the PSC comments, Xcel should consider the time and cost of running two methodologies (Large Centralized and Small Distributed) in future reports to capture more potential futures.

VIII. Staff Conclusion

Hosting capacity is an emerging tool in the electric industry, and the progress made between Xcel Energy's 2016 and 2017 reports is on par with advances in the industry. Some of the suggestions made by stakeholders will ensure Xcel's hosting capacity analysis continues to improve; while other suggestions point to ongoing, unresolved discussions in the industry about the costs and benefits of certain methodologies and the tool's current ability to meet some of the use cases envisioned.

The process of stakeholder engagement and consideration appears to be working. Parties generally appear to agree that Xcel Energy's 2017 HCR complies with the Commission's August 1, 2017 Order and the filing requirements outlined in statute -- despite a robust discussion of the difference between being used as a starting point for versus streamlining the interconnection process. Parties also appear to agree that stakeholder engagement and review has been useful in helping to ensure the tool is useful to the end users. Lastly, the parties in this docket, and the LBL/PSC memo, provide much fodder for continued improvements for Xcel Energy's 2018 HCR, and the Company has expressed its intent to incorporate some of these improvements and other learnings in its next filing.

Again, as the HCR does not require approval by the Commission, at a minimum, staff believes the Commission should 'accept' the 2017 HCR Report. If the Commission believes additional guidance to Xcel for future reports is warranted, it could select from the following decision options put forth by parties.

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 (2018) report

³⁸ DOC DER Reply Comments, at 9-10.

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).

Going forward, the Department recommends that the Commission decide that filing the Distribution System Hosting Capacity Report in a separate docket is a permissible interpretation of the statutory requirement that the Distribution System Hosting Capacity Report be included in the Biennial Transmission Projects Report. Accordingly, the Department recommends that the Commission make explicit in its order that the Distribution System Hosting Capacity Report need not be included in the Biennial Transmission Projects Report, as the plain language of the Statute appears to require. Staff believes making a finding that a separate report is reasonable, however, it may need to be revisited in future years as the distribution system plans (and the Biennial Distribution Grid Modernization Reports) continue to evolve.

IX. COMMISSION DECISION OPTIONS

Staff supports, at a minimum: A, B1, B3, B4, B5, B7, B9, B10, 12 (all), E.

- A. Accept Xcel Energy's 2017 Hosting Capacity Report as in compliance with the Commission's August 1, 2017 Order and Minn. Stat. 216B.2425, Subd. 8.
- B. Request Xcel Energy address stakeholder recommendations made in this docket in the Company's 2018 Hosting Capacity Report filing; including, but not limited to:
 - 1. the methodological options to measure accuracy of the hosting capacity analysis; including identification and analysis of industry best practices and an explanation of Company's methodological choice. (DOC)
 - 2. continue using the DRIVE tool in partnership with EPRI (DOC)
 - 3. 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. (DOC)
 - 4. modify Company tools, where possible, to eliminate assumptions that result in meaningful inaccuracies (IREC, ILSR)
 - 5. conduct sensitivity analysis (DOC, Fresh Energy)
 - 6. add pop-up boxes with hosting capacity details, and that it be accompanied by downloadable data files with granular hosting capacity information and feeder load profiles with maximum and minimum load data. (IREC, FRESH ENERGY, ILSR)
 - 7. explore a range of options for better presenting the public-facing results of the HCA after consideration of, but not limited to, any security and privacy issues may be implicated in providing more detailed information,

- and what information may be useful to developers and stakeholders.
(DOC)
8. broaden definition of DERs to account for the suite of technologies that ultimately will impact the hosting capacity of Xcel's distribution system, including, but not limited to: traditional DER technologies such as solar PV and wind energy systems, energy efficiency, energy storage, electric vehicles, and demand response. (DOC)
 9. 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. (DOC)
 10. more detailed data on load profile assumptions used in the analysis; including peak load (kW and kWh) by substation and feeder, Customer sector characteristics by feeder (e.g., % residential, % commercial); Any reasonable information for hourly load profile assumptions and the basis for such assumptions (SCADA, metered data, etc.).
 11. an explanation of the measures taken to create a hosting capacity tool capable of the following use cases: interconnection streamlining and improving distribution system planning. (IREC, ILSR)
 12. supplemental information that would result in a broader understanding of how to guide distribution upgrades for additional hosting capacity (Fresh Energy, ILSR):
 - a) frequency at which the constraints to individual feeders occur throughout the distribution system (Department)
 - b) A range of potential costs for each of the mitigation options available for an individual feeder; and a range of total costs (Department)
 - c) How much additional hosting capacity could be obtained by implementing the identified mitigation options on a technical and economic basis (Department)
 - d) Whether there would be a cost-effective impact on the value of DERs if such mitigation options were pursued (Department)
 - e) Descriptions of all projects (including scope, estimated cost, in-service dates) planned by Xcel, which directly or indirectly will increase hosting capacity on each circuit.
 - f) Operating characteristics (i.e., the magnitude, frequency and duration) required for DER solutions to provide grid services (e.g., injection or absorption of real or reactive power) to mitigate each circuit constraint.
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13. Xcel Energy's hosting capacity maps should be updated annually until accuracy improves (DOC)

OR

14. Require Xcel to update its map and data on at least a monthly basis or phased approach that clearly defines a plan to accelerate the frequency of publication over time (IREC, FRESH ENERGY, ILSR)

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15. Provide a stakeholder process during study design and analysis to allow commenters to address, question, and modify study shortcomings before they are embedded. (ILSR)

OR

- C. Delegate to the Executive Secretary to approve an independent third party, to be paid by the utility, to conduct the hosting capacity analysis using the most appropriate software tool as determined by the contractor. (ILSR)
 1. Require Xcel Energy to supply all necessary data on its distribution system to this contractor to scope, design, analyze, and file publicly available results, assumptions, sensitivity analysis, and other factors highlighted by other commenters. (ILSR)
 2. Provide a stakeholder process during study design and analysis to allow commenters to address, question, and modify study shortcomings before they are embedded. (ILSR)

Administrative Items

- D. Direct the Executive Secretary to establish a working group process or workshop(s) led by a neutral facilitator to further consider hosting capacity use cases and their methodological needs. (IREC, FRESH ENERGY, ILSR)
- E. Determine the hosting capacity report identified in Minn. Stat. 216B.2425, Subd. 8 may be filed separately from the Biennial Transmission Projects Report. (DOC)

Attachment A. PSC Summary of Recommendations for Xcel's 2018 HCR

1. Analyze and present hosting capacity for a range of periods during the year, not just for the peak and minimum demand. Timing information will help developers understand when DERs are most useful or should be curtailed. (The CPUC requires California utilities to calculate hosting capacity for each hour of the year.)
2. Add total quantities of existing DERs and queued DERs to the published tables of hosting capacity for each feeder. This will help developers better understand the technical environment they are working in.
3. Widen the types of DERs considered in the hosting analysis, such as battery storage and electric vehicles (if forecasts predict a high uptake).
4. Expand the analysis to include both the Small Distributed method as well as the Large Centralized method for DER allocation to show the hosting capacity available for future high uptake in domestic rooftop PV.
5. Modify the methodology used to estimate the primary voltage deviation threshold (presently limited to 5%) to account for cloud cover that may reduce PV output on multiple feeders simultaneously (not just one feeder as presently modelled). In PSC's opinion, Xcel's hosting results may be optimistic with respect to voltage deviation due to their analysis ignoring cloud effects on adjacent feeders.
6. Model the normal operating feeder topology for the hosting analysis (not just the topology at the time the network snapshot was taken). Different topologies that may occur during maintenance may be better studied during detailed investigations.
7. Incorporate more advanced inverter functions into the analysis, as they become available in the DRIVE tool.
8. Gradually extend the hosting analysis from a feeder level to a system level to help understand how much DERs can be hosted at a substation, or Minnesota-service territory-wide.