MI POWER GRID

Making the Most of Michigan's Energy Future

Integration of Resource, Distribution, and Transmission Planning Report Appendix A-E

Michigan Public Service Commission Staff Report

MI Power Grid Phase II

May 27, 2021

MPSC

Michigan Public Service Commission

Appendix A

Meeting Summaries for Advanced Planning Report

SEPTEMBER 24, 2020 (Presentation | Comments | Recording)

The first meeting on the topic of Integration of Resource, Distribution, and Transmission Planning began with opening remarks from Chairman Scripps. Both Chairman Scripps and Staff Leads, comprised of MPSC Staff Naomi Simpson, Jesse Harlow, and Roger Doherty, discussed the overall goal, summary, and timeline of this workgroup as a whole. Staff Leads, along with Zach Heidemann and Pat Hudson, then detailed each subsection's current status, plans, and background information. These subsections include: Generation Diversity, Transmission Planning, Alignment, and Forecasting. Richard Blumenstock (Consumers Energy), Joyce Leslie (DTE), and Andrew Williamson (I&M) then presented on their company's high-level perspective on the direction resource distribution and transmission planning should take. At the end of this meeting, Staff solicited comments from interested parties on whether additional clarification was needed and/or if additional topics should be included.

Staff posed the following written feedback requests to the participants; stakeholder responses are contained in the link.

Are there additional areas within the four subjects introduced on 9/24/2020 (Alignment of IRP/DP/TP, Forecasting, Transmission Planning, Valuing Generation Diversity) that need additional clarification?
Are there subtopics within these subjects that Staff did not mention, and you would like to see addressed during future meetings?
Do you believe Staff adequately introduced the items addressed in the August 20, 2020 order in Case No. U-20633 during the 9/24/20 meeting? If not, please explain.

OCTOBER 21, 2020 (Presentation | Comments | Recording)

This second stakeholder meeting expanded on topics of the importance of aligning the respective regulatory planning processes and was the first to host subject matter experts from national groups. Jeff Smith and Jason Taylor (EPRI), spoke on ways to align distribution planning and IRPs, what should be aligned and why? John Shenot (Regulatory Assistance Project) spoke to the coordinated efforts of NARUC and NASEO and shared his perspectives on the importance of aligning planning processes. Juliet Homer (Pacific Northwest National Laboratory) delved into the planning alignment focused on distributed generation and non-wires alternatives. In addition, due Governor Whitmer's Executive Directive 2020-10, and updated guidance in MPSC Order in U-20633, which directed staff to develop a Straw Proposal to present to stakeholders within the MI Power Grid Phase 2 Advanced Planning workgroup and file a report in the docket summarizing the proposal, other proposals from stakeholders, along with a recommendation. Staff member

Jesse Harlow presented on Staff's initial straw proposal towards approaching the state's carbon emission goals.

Staff posed the following written feedback requests to the participants; stakeholder responses are contained in the link.

What specific externalities do stakeholders think should be addressed that are not currently addressed in the Michigan Integrated Planning Parameters (MIRPP) document. What specific changes to the MIRPP would address these externalities?
In what ways could resiliency be addressed in an IRP?
What are appropriate ways to address the disconnect between resource needs in an IRP and future unknown resource locations? Are there studies that need to be performed, communication channels that need to be established, or other possible solutions?
Is there any general feedback that you would like to share regarding the October 21 meeting?

NOVEMBER 6, 2020 (Presentation | Comments | Recording)

The third stakeholder meeting continued to dive into perspectives on aligning planning processes. Adam Diamant (EPRI), Bob Thomas (Dominion), and Michael Rib (Duke Energy) shared best practices from their utility perspectives. Numerous stakeholders also presented additional proposals and considerations to Staff's Straw Proposal regarding ED 2020-10. Andrew Williamston (Indiana Michigan Power) spoke to certain considerations and recommendations for multi-state companies; Douglas Jester (5 Lakes Energy) presented A Sketch for Construction of IRP Scenarios Reflecting ED 2020-10, on behalf of Joint Commenters: Ecology Center, ELPC, MEC, NRDC, Sierra Club, UCS, and Vote Solar. Staff also led facilitated discussion on questions and clarifications to the responses received in previous feedback requests, including the benefits cost analysis, resiliency, externalities not currently addressed in the MIRPPs, and observations on non-wires alternatives.

With respect to resilience regarding aligning planning processes and reflecting that in the MIRPP/Filing Requirements; • Is resilience accounted for in sensitivities analysis and risk assessment? If not, should it be and if so, how? • Is resilience accounted for through the MISO planning process by meeting PRMR requirements? If not, should it be and if so, how? • Is the N-1-1 planning criteria used in transmission planning useful for distribution planning?

- Should resiliency investments be identified in distribution planning feed into IRP or vice versa?
- What are the touchpoints between distribution planning and IRP that will align the processes when addressing resiliency?

With respect to externalities regarding the MIRPP/Filing Requirements;

- To what extent do current scenarios, sensitivities, and risk address externalities?
- Does a probabilistic risk assessment play a role in addressing externalities?
- What externalities best lend themselves to a qualitative analysis?
- To what extent should the analysis of externalities influence the IRP filing? Transmission planning? Distribution planning?

With respect to Non-Wires Alternatives regarding the MIRPP/Filing Requirements and aligning planning processes;

- Do stakeholders agree that non-wires alternatives include storage, solar, wind, demand response, CVR and energy waste reduction?
- Do stakeholders agree that a non-wires alternative is location specific and alleviates some traditional investment in a targeted geographic area?
- Juliet Homer's presentation identified several types of NWA analyses identifying benefits and costs across planning processes. Do stakeholders feel one planning process drives another when evaluating and selecting NWAs?

Please provide any comments related to the expert presentations from EPRI, Duke Energy, Dominion.

Please provide comments about the Staff Straw Proposal and alternative proposals.

Please provide any comments related to today's presentations.

NOVEMBER 18, 2020 (Presentation | Recording)

The fourth meeting began with a Staff presentation by Naomi Simpson on the feedback received between this meeting and the last. The topics focused on resiliency, externalities, and non-wires alternatives. Kwafo Adarkwa and Chuck Marshall (ITC) presented on planning integration from a transmission planning view with a focus on the bifurcated nature of the IRP process and the MISO MTEP process. Margrethe Kearney and Nikhil Vijaykar (ELPC) discussed how Distribution Planning integrates into Integrated Resource Planning and how critical it is to get the right information from Distribution Planning to inform an IRP. Brady Cowiestoll (NREL) categorized the grid planning process and discussed the benefits of integrating the planning process. She also gave examples of planning tools used as NREL and how they can assist with alignment. Sarah Mullkoff from Staff ended the meeting with discussing environmental justice and how the MPSC will be working with EGLE on a statewide plan.

DECEMBER 16, 2020 (Presentation | Comments | Recording)

The fifth meeting focused on forecasting within advanced planning. Aditya Jayam Prabhakar (MISO) presented on MISO's generation fleet breakdown, the changing planning environment, and the importance of developing an accurate load shape. Curt Volkmann, President of New Energy Advisors, discusses why distribution forecasting matters and how climate change and Covid-19 has impacted on load shapes. He proposes new approaches to load and DER forecasting using various analytical tools. Brady Cowiestoll (NREL) joins us again to present on forecasting DER/EVs, how they are leading to a decentralized grid, and how to plan for it. Tom Eckman (LBNL) then outlined the limitations and gaps of current forecasting methods and lack of parity in cost-effectiveness analysis planning. He suggested ways to improve valuation of demand flexibility so that DERs can compete with other resources more fairly.

Staff posed the following written feedback requests to the participants; stakeholder responses are contained in the link.

1.	Please provide any comments related to today's expert presentations.
2.	What is an appropriate growth rate to be used for a high load growth sensitivity? Should there be a different growth rate applied for high load with and without deep electrification? Should the rate be different for the lower peninsula and the upper peninsula? If so, what should they be?
3.	What is an appropriate growth rate to be used for low load growth sensitivities? How should the low load growth sensitivity consider customer adoption of distributed energy resources? Should the rate be different for the lower peninsula and the upper peninsula? If so, what should they be?
4.	Are there publicly available recommended sources that should be used for technology and fuel price forecasts? Are there other collaborative ways to develop technology and fuel price forecasts that could be used by all Michigan utilities filing an IRP?
5.	Are there publicly available recommended sources that should be used for capacity and energy price forecasts?

JANUARY 19, 2021 (Presentation | Comments | Recording)

In the sixth meeting, Marc Keyser (MISO) led the presenters and discussed MISO's transmission planning process and its role in coordinating with municipalities, utilities, and co-ops to form an 18-month plan in the MISO Transmission Expansion Plan (MTEP). Bonnie Janssen, manager of Energy Markets at the MPSC, explained the MPSC's role in transmission planning and participation in MISO, PJM, and FERC. Anish Gaikwad (EPRI) then focused his presentation on reliability and resiliency withing transmission planning and the impact of implementing risk-based approaches for system reliability. Erin Buchanan and Drew Siebenaler (Xcel Energy) outlined their resource and transmission planning process while encouraging the importance of integrating planning processes. There were then presentations from Kwafo Adarkwa (ITC), Kamran Ali (AEP), Heather Andrew (ATC), and Robert Morton (ATC) on the perspectives from transmission owners. Heather Andrew and Robert Morton explained ATCs commitment to meeting regularly with customers in

planning dialogue meetings to discuss interconnection issues. Kamran Ali outlined the transmission planning process for AEP and discussed their focus for the 2020-2021 RFP. Kwafo Adarkwa detailed ITC and METC transmission coverage in Michigan and what they believe are the five factors for IRP success. Ending the meeting, Zachary Heidemann (MPSC) led a Q&A discussion with input from various stakeholders and Naomi Simpson (MPSC) introduced the questions for the written feedback request which can be found on the website under the comments link.

Staff posed the following written feedback requests to the participants; stakeholder responses are contained in the link.

1. What should be changed within the transmission planning section of the filing requirement?
   a) Are there specific changes that stakeholders would recommend based upon the conversation today that would clarify, add, or change the existing filing requirements?
   b) What documentation would stakeholders find helpful in the filing?
2. How should transmission constraints be modeled in an IRP?
   a) How should the transmission import capability forecast be developed given that the CIL and CEL are historically volatile?
   b) Should CIL and CEL be used in modeling at all? Or should another measure be the transmission constraint?
   c) How should energy and capacity availability in other zones be modeled and how should the utilities acquire this information? How is this done in a way that doesn't create undue burden or an impossible task for utilities filing an IRP? Should out of state resources be allowed to enter RFPs provided they have firm transmission rights? Given the LCR has been a limiting agent in the last MISO year does it make sense to consider out of state resources?

FEBRUARY 9, 2021 (Presentation | Comments | Recording)

Zach Heidemann (MPSC) kicked off the meeting with a presentation on generation diversity with a specificity on what diversity means in a utility context and why diversity does not equal resilience. Marc Keyser (MISO) then discussed the local reliability issues behind growing renewables and how their Reliability Imperative and transparency efforts will assist with coordinated enhancements. Drew Siebenaler and Erin Buchanan (NSP) then presented on resource diversity's strengths in ensuring reliability and mitigating risk. They describe generic resource profiles as insufficient in showing diversity's value and how additional testing for adequacy is critical. Next, Dr. Michael Mulligan (Grid Lab) discussed how diversity provides flexibility, the changing nature of risk assessment, and the critical role transmission can play in increasing reliability, enhancing markets, and reducing the need to build resources. Tom Eckman (LBNL) focused his presentation on managing the risk when considering resource diversity. He accomplished this by illustrating the use of stochastic risk analysis to value resource diversity. Gary Melow (Michigan Biomass) then advocated for biomass as a diverse energy resource by detailing what historically exists, currently exists, and the environmental, social, and economic value of adding more in the future. Tim Lundgren (IPPC) then presented on examples of hydroelectric power, waste to energy facilities, and landfill gas facilities after which he explained the system benefits, energy value, and ancillary

benefits of each technology. Jesse Harlow (MPSC) closed the meeting by asking for feedback requests which are provided below.

Staff posed the following written feedback requests to the participants; stakeholder responses are contained in the link.

1.	Should generation diversity be valued through risk assessment in an IRP to assess how different diverse resource portfolios can mitigate various risks? The assumption is that this would allow for a comparison of the costs associated with maintaining diverse resources vs the benefit of mitigating certain risks.
2.	Are there other methodologies that stakeholders recommend using to determine the value of generation diversity?
3.	Will better alignment of planning processes help to identify the value of generation diversity by identifying benefits across multiple planning processes, such as blackstart capability, grid resiliency, etc.?
4.	Should utilities provide a calculation of resource diversity for the proposed course of action assuming a 5-, 10-, and 15-year planning horizon in the IRP filing?

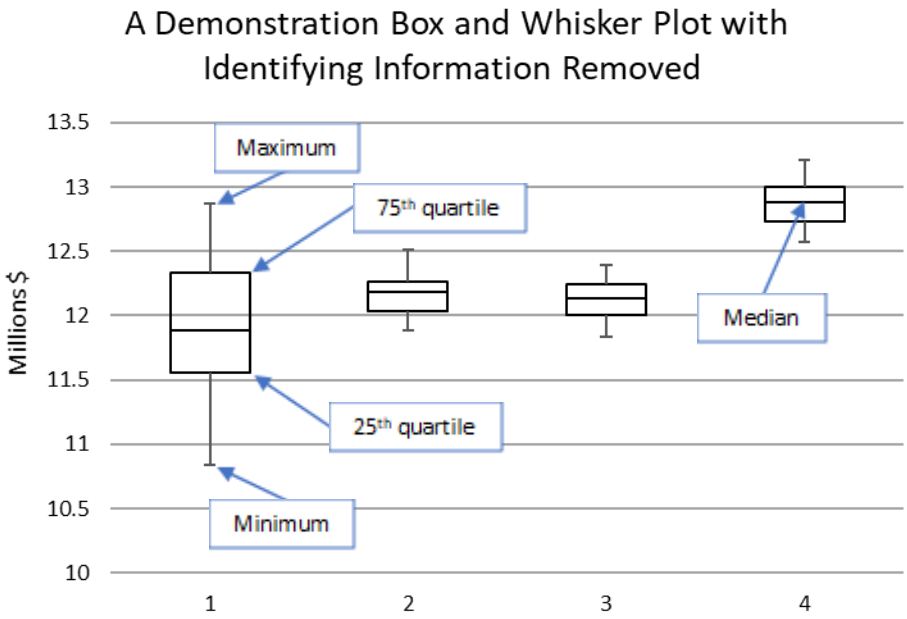
MARCH 2, 2021 (Presentation | Recording)

The eighth and final meeting for this workgroup began with a presentation by Regina Strong (EGLE) on the new MI EJ Screen, which is expected to launch in spring 2021. Jon DeCooman (MPSC) then presented on the Emissions Reporting Requirements for Utility IRPs report posted to the docket on December 15th, 2020. Naomi Simpson (MPSC) closed the final meeting by discussing the timelines for phase 2 and 3 and provided an overview of recommendations that will be included in the draft report.

Appendix B

Box and Whisker Plot

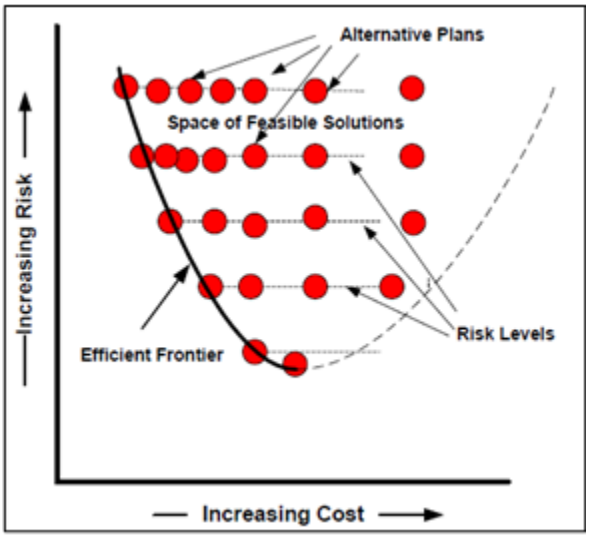
A box and whisker plot, also called a box plot, is a graphing technique that is used to display statistical data. Traditionally, box and whisker plots are comprised of a centerline which denotes the median of the data and the top and bottom of the box are given by the 25th and 75th quartile while the "whiskers" are lines that denote the minimum and maximum of the data. With all five of these data points for a given probability distribution function, the plot shows the skewness of the data.[1] Staff has seen variations of these types of statistical graph where the ends of the whiskers are at the 5th and 95th percentile or where the average is used as the center mark rather than the median. Another variation of this graph is to perform an outlier test and remove the outliers from the "whiskers" and place them as dots beyond the "whiskers".[2] A demonstration box and whisker plot for four sets of data with identifying information removed has been provided below.

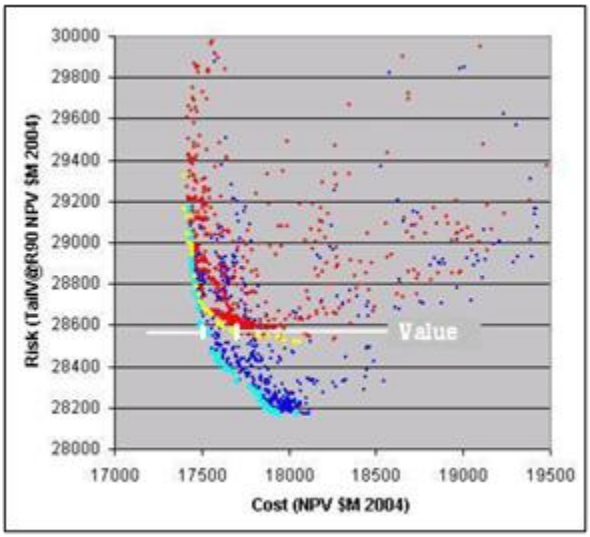


Appendix C

Efficient Frontier

Efficient frontier is a method to display various plans or portfolios where the expected cost is given on one axis and the standard deviation or risk percentage of the statistical data is given on the other axis. Plans should eventually form a curve with a defined edge and other plans scattered behind it. Plans that lie on the edge of the frontier are optimal portfolios and offer the least cost for a given amount of risk. This method allows for the utility to determine the risk-cost combination that is right for it from amongst the optimized plans.[3] Two example graphs are provided from the Northwest Council's fifth power plan.[4]





Appendix D

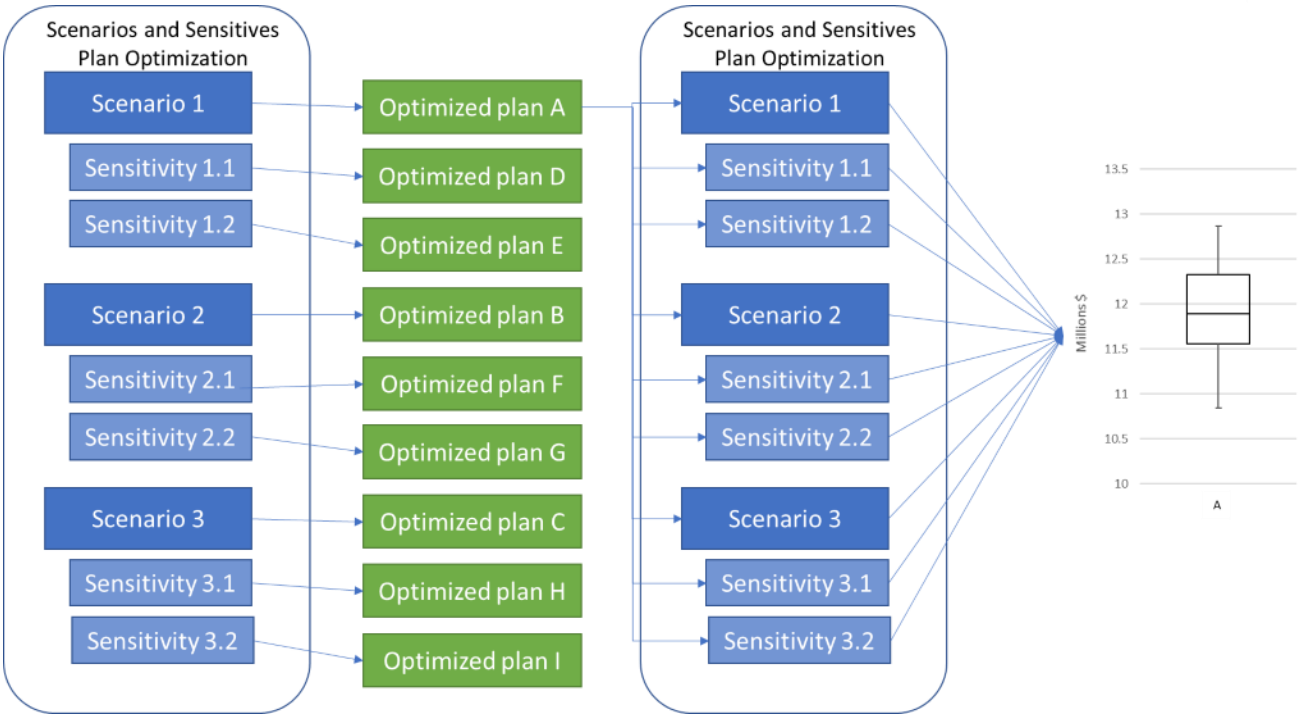
Deterministic vs Stochastic Risk Analysis

When discussing risk assessment, it is important to understand the distinction between deterministic and stochastic analyses. Presented below are several flow diagrams to illustrate these two different methods.

Deterministic

In a deterministic risk analysis, a build plan that has been optimized for a specific scenario is run through the other scenarios and sensitivity combinations to test how that plan would perform in those specific future states. A flowchart of this process is shown in Figure 1. Each scenario and sensitivity produces an optimized plan. These plans are then run through all the other scenarios and sensitivities. The resulting cost distribution is then represented by a box and whiskers plot. Plans can also be compared by running all the plans through the scenario and sensitivities of the single future deemed most likely to occur.

Figure 1 Deterministic Risk Analysis Flowchart

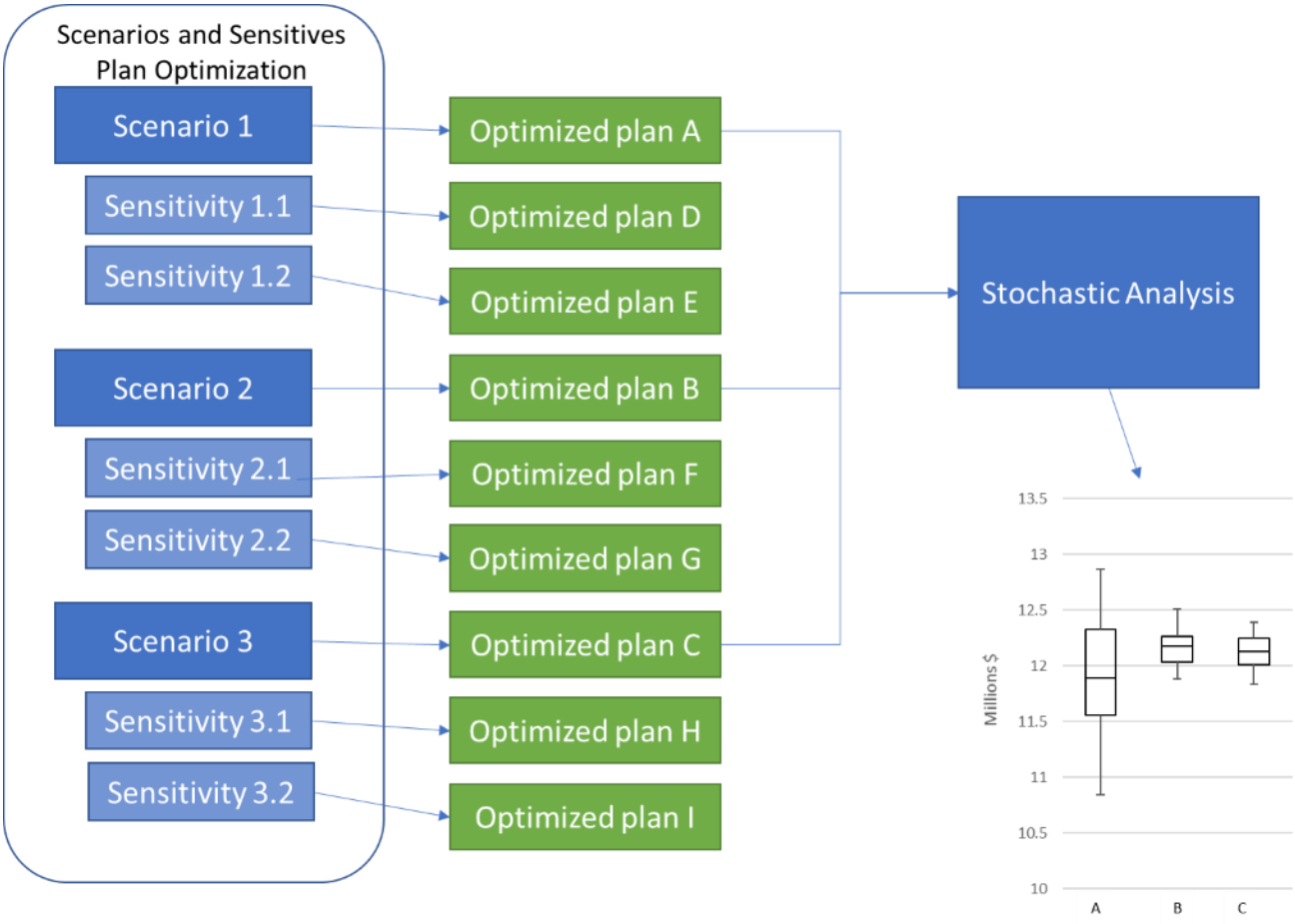


Stochastic

Stochastic analyses begin with the same step as deterministic; plans are optimized for each scenario and sensitivity, shown in *Figure 2*. But instead of then running those optimized plans through the other futures, each plan is run through many iterations of a run with multiple variables being randomly selected from a probabilistic distribution, thus introducing randomness into the process. The probabilistic distributions are typically based on historical data for a selected period using standard time-series techniques. Variables can also be linked so one follows the other, such as wind turbine capacity being

linked to wind speed. This produces an NPV cost distribution for each plan that can be represented as a box and whisker plot, allowing for comparison of risk.

Figure 2 Stochastic Risk Analysis Flowchart



Appendix E

Diversity Indices

There are three main indices used to quantify diversity and each emphasize various aspects of diversity differently. These indices are non-dimensional numbers that help to quantify diversity. While there are simplistic measures of diversity, such as the number of categories, these metrics provide a calculation that considers all 3 aspects of diversity. The three main indices used to quantify generation diversity are the Shannon-wiener Index, the Simpson Index, and the Stirling Index.

Shannon–Wiener Index

The Shannon-Wiener index considers two of the three components of diversity: variety, and balance. The Shannon-Wiener Index was originally developed by Bell Telephone to describe information entropy.[1] The equation for the Shannon-Wiener index is given by:

$$Shannon - Wiener\ Index = e^{H}$$

$$H = -\sum_{i=1}^{n} p_i \ln(p_i)$$

where p_i is the proportion of the population that category i occupies out of the total number of categories n. The Shannon–Wiener Index, as a measure of diversity, emphasizes smaller contributors more than the Simpson index described below.[2] This is due to the presence of the natural logarithm of the proportion in the equation, which means that relatively small proportions or "rare species" contributes more than they otherwise would.

Simpson Index

The Simpson index also does not consider disparity. It was originally developed to examine ecological biodiversity, looking at the concentrations of species.[3] It has the same equation as the Herfindahl-Hirschman Index (HHI), which is a measure of concentration of an industry. The HHI is used by the United State Treasury to determine if a merger will increase market concentration to an unacceptable amount.[4] The equation for this index is as follows:

$$HHI = Simpson\ Index = \sum_{i=1}^{n} ({p_i}^2)$$

The Simpson index grows smaller with increasing diversity because it is concerned with concentration rather than diversity. As concentration decreases, its measure (The Simpson

[1] Shannon C. E. (1948) A Mathematical Theory of Communication. *The Bell system Technical Journal*, 27, pp. 379-423,623-656.

[2] Cook H., Keppo I., Wolf S., (2013). Diversity in theory and practice: A review with application to the evolution of renewable energy generation in the UK. *Energy Policy*, pp. 61, 88-95.

[3] Simpson E. H. (1949). Measurement of Diversity. *Nature*, pp. 163, 688.

[4] Cook H., Keppo I., Wolf S., (2013). Diversity in theory and practice: A review with application to the evolution of renewable energy generation in the UK. *Energy Policy*, pp. 61, 88-95.

Index) will decrease as well. In this case, diversity and concentration are inverse of each other. To this end, there is a modified version of the Simpson index where diversity indices are directly correlated with diversity, not inversely correlated. The modified Simpson Index is the inverse of the standard Simpson index.[5]

$$Modified\ Simpson\ Index = \frac{1}{\sum_{i=1}^{n}(p_i{}^2)}$$

Staff uses this version in the projection of Michigan's generation diversity that is shown later in the paper. This version is preferred because it trends along with the other indices and results in less confusion.

Stirling Index

The Stirling index is the only index commonly used for electrical generation that includes all three components of diversity: variety, balance, and disparity. It was developed specifically to look at electrical generation and is also the newest of the indices covered here. The equation for the Stirling index is:

$$Stirling\ Index = \sum_{ij,i\neq j}^{n} d_{ij}(p_i * p_j)$$

This equation compares the proportion of two different categories to one another. Each pair will have a disparity coefficient (d_{ij}) that represents how dissimilar the two different categories are from one another. The lower the disparity coefficient, the more similar two categories are to one another.[6]

[5] Wu, T. Y., Varun, R. (2017). Quantifying Diversity of Electricity Generation in the U.S. *Model Documentation and Results for ERCOT Scenarios*.

[6] Stirling, A. (2007) A general framework for analyzing diversity in science, technology and society. *Journal of The Royal Society Interface*. pp. 4 ,707-719.