MISO Long Range Transmission Planning

Base System Modeling for the MTEP21 LRTP Effort

An overview of the Long Range Transmission Plan (LRTP) study initiative was presented to the Planning Advisory Committee (PAC) at their October 2020 meeting. As discussed at that meeting, MISO has developed this document to provide information regarding the modeling efforts for the LRTP initiative. This is for the purpose of giving Stakeholders an overview of the base assumption set that will comprise the engineering analytics to come in the MTEP21 planning cycle. Details of that presentation can be found at: https://www.misoenergy.org/events/planning-advisory-committee-pac---october-14-2020/

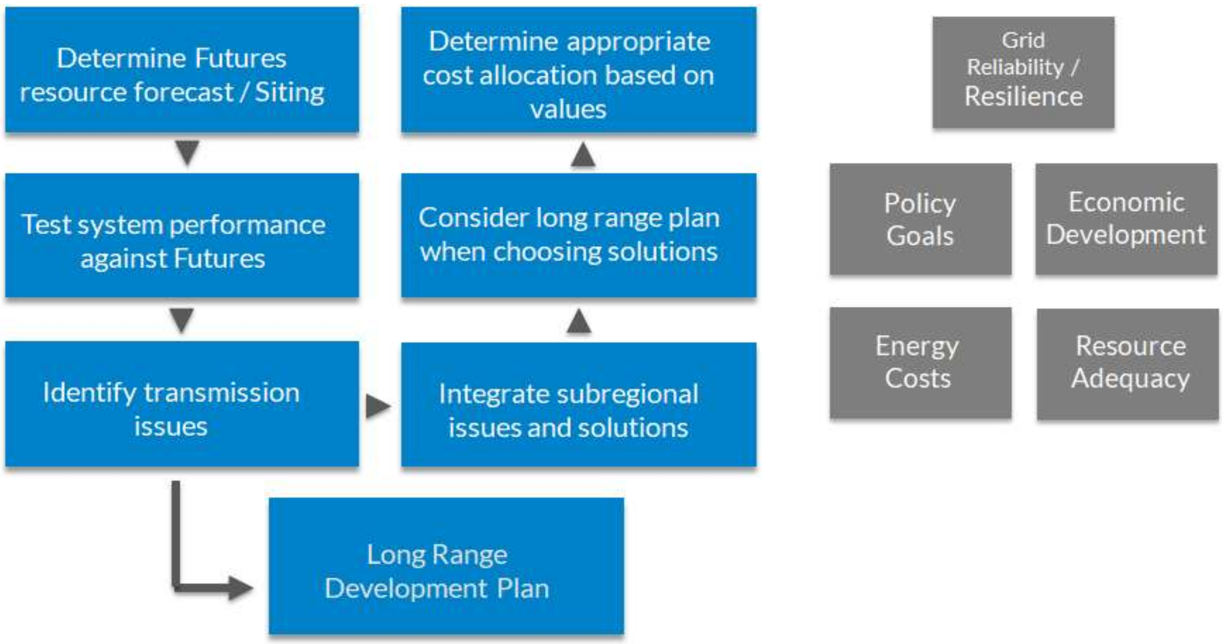
This is not an exhaustive and detailed description of the modeling needs for the LRTP work under the MTEP21 planning cycle. It is, rather, a summary of MISO's direction with the LRTP modeling effort and is written primarily for transmission planners familiar with modeling processes at MISO and NERC. This document only discusses models to be created and does not delve into the actual analysis to be performed.

Overview

Long Range Transmission Planning ensures an optimized system for the changing portfolio across the short and long term. The Long Range Transmission Planning initiative is intended to develop a comprehensive Long Range Transmission Plan (LRTP or Plan) that uses the Futures scenarios and assumption set to transmission issues and needs. The initiative is intended to holistically incorporate reliability and economic planning processes and perspectives with future generation needs and expectations.

The evaluation of future requirements for sub-regional, regional, and interregional transmission requires a broader approach and will be conducted under MISO's value-based planning process.

Value Based Transmission Planning



This approach will capture synergies for future needs of the transmission system and will be used for development of business case justifications.

The technical analysis to be employed in the MTEP21 portion of LRTP will focus on Future 1 and the 5-20 year horizon. This will be the first round of LRTP analytics and creates a workable scope of analysis to be completed in the MTEP21 cycle. It will be used to develop a business case for any initial recommendations that may ensue from it. Future 2 models will be created as needed to support robustness and least regrets business case. As we move into the next phase of LRTP post-MTEP21, the horizon will be expanded to the 20-40 time frame with Futures 2 and 3 and supporting models that are yet to be determined.

<u>Base Model Assumption Set</u>

Futures

MISO's MTEP21 Futures will be used to develop models for the MTEP21 effort of LRTP. The Futures encompass several factors that were reviewed and acted upon through the MISO stakeholder process during the 2019-2020 timeframe. These factors led to the final version of the MTEP21 Futures in three data sets referred to as Future 1, Future 2 and Future 3. This document will not go through the various Futures details as they can be found via numerous Futures Workshops (available on the MISO website). The Futures are shown below:

Variables / Futures	Future 1	Future 2	Future 3
EGEAS Ready Gross Load^ Energy Demand	Low-Base EV growth 0.63% CAGR growth rate 0.59% CAGR growth rate	30% energy growth 1.23% CAGR growth rate 1.09% CAGR growth rate	50% energy growth 1.91% CAGR growth rate 1.94% CAGR growth rate
Potential Load Modifiers^^ *(Technical Potential by 2040)* DR EE DG	Technical Potential Offered 5.2 GW 13.3 GW 14.7 GW	Technical Potential Offered 5.9 GW 14.5 GW 14.7 GW	Technical Potential Offered 5.9 GW 14.5 GW 21.8 GW
Carbon Reduction* *(2005 baseline)* MISO Footprint currently at 22%**	40%	60%	80%
Min. Wind & Solar Penetration	No minimum	No minimum	50%
Utility Announced Plans	85% goals met 100% IRPs met	100% goals met 100% IRPs met	100% goals met 100% IRPs met
Retirement Age-Based Criteria Coal Natural Gas-CC Natural Gas-Other	46 years 50 years 46 years	36 years 45 years 36 years	30 years 35 years 30 years

* Entire footprint in aggregate
** 2005-2017; MISO calculation from EIA Form 860 data
^ Compound annual growth rate (CAGR); does not include impact from DERs, DSM, or Wind/Solar
^^ Distributed Energy Resources (DER); Demand Response (DR); Energy Efficiency (EE); Distributed Generation (DG): Capacity technical potential offered into EGEAS as resources; final amounts selected to be determined by EGEAS simulations.

Reliability

The MTEP20 reliability power flow models will be used as the transmission topology baseline since the MTEP21 reliability modeling process will be completed at the end of Q1 2021. Transmission updates from the MTEP20 planning cycle will be applied as needed. Applicable load and generation profiles from the Futures will be applied to the reliability (power flow) models to create the LRTP base models. These power flow models will provide the basis for any steady state and dynamic analysis.

Economic

Economic (PROMOD) models and associated load/generation profiles will be developed in the same fashion as MISO annually builds MTEP economic models. For MTEP21, those models will be based on the MTEP21 Futures with the MTEP20 base transmission topology. The MTEP21 economic model building process is already underway including Stakeholder review. Base Model Structure

Reliability

MISO annually builds reliability models based off NERC requirements. This generally means a 2, 5 and 10 year set of models. This does not suffice alone for the purpose of LRTP given the proposed horizon of 10-20 years. Renewables introduce many different possible dispatch scenarios. Combining these different renewable output possibilities with different load scenarios would cause many different models to be created. Capturing all these scenarios is untenable for several reasons and as such, MISO will focus on a set of base models determined most relevant of attention, based on engineering experience and judgement, for the MTEP21 cycle. These set of broad base models provides bookend to multiple possible uncertainties around renewables portfolio, load profiles, unit retirements and seasons, thus providing the platform to perform wide range of reliability studies.

The base reliability models MISO will be developing will be a year 10 and year 20 set of models (2030 and 2040). Those models will encompass Summer Peak, Spring/Fall Light Load, Fall/Spring Shoulder Load, and Winter Peak. Load levels for each of those model periods will apply the Futures load forecast in a manner consistent with regular MTEP process

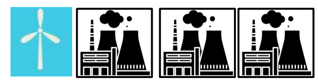
The study effort will look at other modeling scenarios as necessary and appropriate based on issues seen from these base analytics. As such, other scenarios and sensitivities may be created with the base models to further investigate specific system issues (e.g. N-S and S-N flows). It is too early to determine what additional models or specific sensitivities may be.

Generation additions and placement will be consistent with the Futures data set.

Wind and Solar drive a need to think more closely about daytime versus nighttime generation patterns. It goes without saying that solar does not operate at night and it is the case that wind patterns are historically stronger at night. It is also known that while wind and solar may be distributed across the MISO footprint to some degree, wind is the dominant renewable provider in the northern region and solar the same for the southern region.

California has a well-known ‘duck curve’ driven by rapid loss of solar at the end of the day. While this is a real-time operating condition, the concerns still lend itself as insight into LRTP.

Reliability Base Models:

Base Model	Variation	Reasoning for inclusion	Wind/Solar Dispatch
Summer Peak	Day	-Typical system summer peak load -Low wind scenario -Represents MISO west import -S-N flows	Current MTEP planning assumptions based on Capacity Credit for wind and Solar 
	Night	-Typical system peak load level at night -No solar generation -Low wind -N-S Flows	Current MTEP planning assumptions based on Capacity Credit for wind and Solar 
Spring/Fall Light load	Day	-Explore voltage and dynamic stability concerns	High Solar output during low load conditions 
	Night	-Explore voltage and dynamic stability with minimal thermal units available for reactive support -N-S flows	High Wind output during low load conditions 
Fall/Spring shoulder load	Day	-Explore thermal, voltage and stability concerns with minimal thermal units available for reactive support	High renewable output during approximate shoulder load conditions 
Winter Peak	Day	-Typical system winter peak load -Represents high wind in North Observe different geographical loading pattern (Minnesota/Manitoba flow)	Typical wind with high Minnesota to Manitoba flow 
	Night	-Typical system winter peak load at night -N-S flow	Typical wind with high Minnesota to Manitoba flow 

Economic

MISO typically creates annual 5, 10 and 15 year out economic model based on the latest Futures. For LRTP this will also include a 20 year model consistent with MISO's economic modeling process and the MTE21 Futures data set. That process will develop an economic model for each of the four years and for each of the three Futures.