

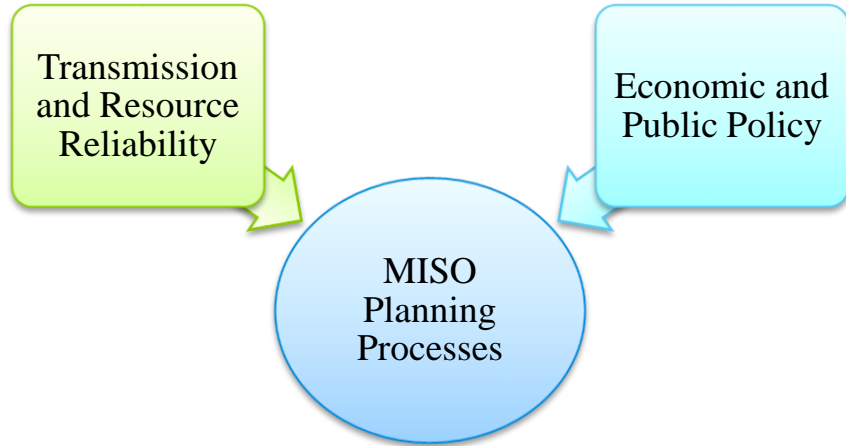


# Planning Models Used by MISO

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# MISO's planning tools can be grouped into two study factions



No single tool or process can be used to find complete planning solutions without input from other tools and processes

- Each tool provides different information that is required for a comprehensive planning approach

# Transmission and Resource Reliability Assessments

## What is Reliability Planning?

- Transmission Planning - Reliability assessment and coordination for Transmission Planners within MISO and across the Planning Coordinators
- Resource Reliability – Probabilistic assessment of resource adequacy within the footprint

## How is it applied?

- NERC Transmission Planning
- Generation Retirement or Suspension Studies
- Access Planning
  - Transmission Service Requests
  - Generator Interconnection
- Loss of Load Expectation

## Key Tools

- PSS/E
- TARA
- POM
- TSAT
- VSAT
- SERVIM

# MISO performs a number of analyses to support system reliability planning efforts

Analysis	Software Tool	Use
Steady-State	PSS/E, TARA, POM	Reliability
Dynamic Stability	PSS/E, TSAT	Reliability
Voltage Stability	PSS/E, VSAT	Reliability, Resource Adequacy
Transfer Analysis	TARA	Reliability, Resource Adequacy
Probabilistic	SERVM	Resource Adequacy

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What is the question being answered?

- Substation voltage and thermal loading of circuits under system intact and contingent operations

Time Frame?

- Multiple single hour snapshots representing typical loading levels in a year

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What is the question being answered?

- Transient stability, which is the ability to reach a steady state after a system change (fault, loss of generator, etc.)

Time Frame?

- Analyzes up to 30 seconds of system reaction after a change of state occurs in multiple single hour snapshots

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What is the question being answered?

- Ability of the system to maintain compliant voltage requirements while transferring power from one area of the system to another

Time Frame?

- Generally one single hour snapshot representing peak loading

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What is the question being answered?

- Identify the limits of transferring power between areas/subsystems.

Time Frame?

- Multiple single hour snapshots representing typical loading levels in a year



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What is the question being answered?

- Determine Loss of Load Expectation in support of seasonal and long term resource assessments

Time Frame?

- 8,760 hour view for next year, one year within 2-5 years out, and one year within 6-10 out

# MISO uses a suite of tools in its reliability analyses

## PSS/E

- Power System case development
- Useful for understanding and visualizing the power flow

## TARA

- Used to run bulk of DPP analysis
- Used for Import and Export limits associated with Resource Adequacy evaluation

## POM

- Useful in evaluation of double contingency events
- Useful in evaluating Optimal Power Flow mitigation strategies

## VSAT

- Used for Import and Export limits associated with Resource Adequacy evaluation

## TSAT

- Utilizes more details about the bulk system to track system transient stability issues

## SERVM

- Monte-Carlo analysis to determine risk metrics around generation fleet ability to meet demand requirements

Used to meet requirements governed by local and federal planning criteria

Supports States in resource adequacy planning

# Economic and Policy Assessments

## What is Economic and Policy Planning?

- Economic Planning – Market congestion assessment and coordination for Transmission Planners within MISO and across the Planning Coordinators
- Policy Planning – Market and bulk system assessment focusing on impacts of broad federal or state initiatives

## How is it applied?

- Market Congestion Planning Studies
- Targeted studies like
  - State RPS integration
  - EPA rules around emissions
  - Impacts of intermittent energy resources on the grid

## Key Tools

- EGEAS
- PROMOD
- PLEXOS

# MISO's economic and policy planning processes leverage the generation production costs

Analysis	Software Tool	Use
Regional Resource Forecasting	EGEAS	Economic Public Policy
Detailed Production Cost	PROMOD, PLEXOS	Economic Public Policy

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Regional Resource Forecasting	EGEAS	Economic Public Policy
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What is the question being answered?

- Resource fleet projections under various economic and policy driven scenarios

Time Frame?

- Forecasts can be created for 1 to 30 years representing every hour of each year

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Regional Resource Forecasting	EGEAS	Economic Public Policy
Detailed Production Cost	PROMOD, PLEXOS	Economic Public Policy

What is the question being answered?

- Fleet and bulk grid operations under various economic and policy driven scenarios

Time Frame?

- Up to 1 year of hourly production simulation

# MISO uses three tools in its economic planning processes

## EGEAS

- Provides resource forecasts under specified assumptions
- Objective function is to maintain resource adequacy at the lowest total cost of expansion (capacity and energy costs)
- Can be constrained for emissions and RPS requirements
- Does not include transmission

Used in support of detailed production cost modeling

## PROMOD

- Hourly production simulation
- Objective function is least cost dispatch constrained by transmission system capabilities
- Robust capability in energy market simulation
- Represents full transmission system capabilities

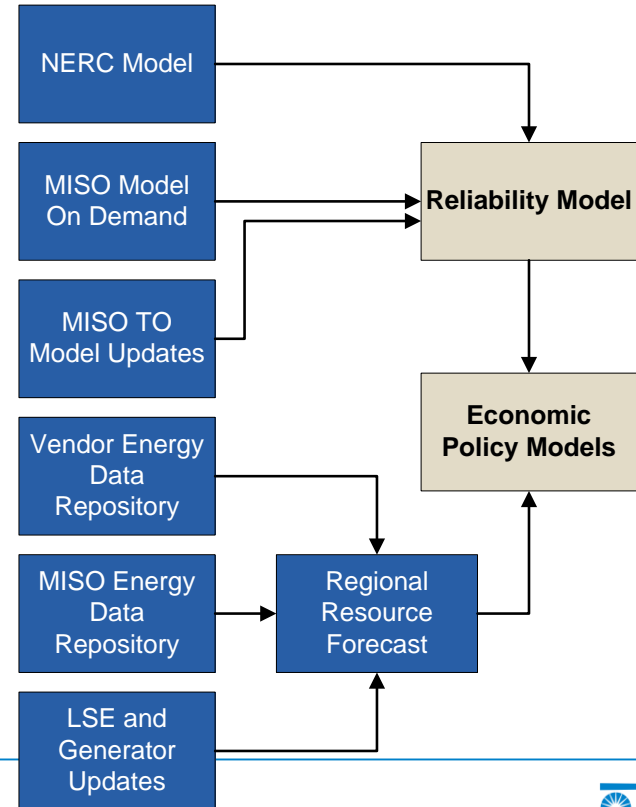
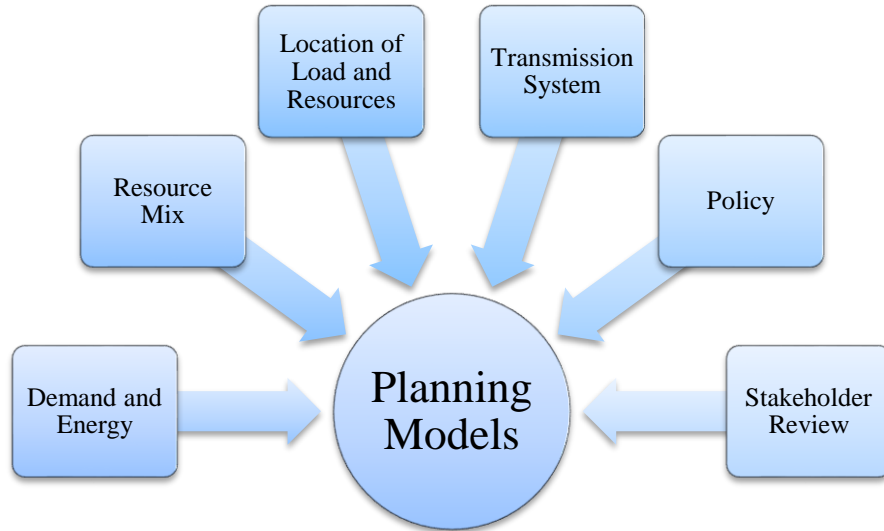
Used to meet requirements established in MISO's planning tariff

## PLEXOS

- Can produce both hourly and sub-hourly production simulations
- Objective function is least cost dispatch constrained by transmission system capabilities
- Robust capability to constrain optimization by emissions or other dispatch requirements
- Represents full transmission system capabilities

Generally used in research to support other planning processes

# The models used in the planning processes are only as good as the data inputs, so we spend a lot of time on data





# In summary, to get to good planning outcomes, MISO relies on a suite of tools that leverage a significant amount of data

## Inputs

- Demand and Energy
- Resource Mix
- Location of Load and Resources
- Transmission System
- Policy
- Stakeholder Review



## Planning Models (Tool)

- Probabilistic (SERVM)
- Resources Expansion (EGEAS)
- Production Cost (PROMOD and PLEXOS)
- Reliability (PSS/E, TARA, POM, TSAT, VSAT)



## Outputs

- Identification of solutions that provide:
  - **Reliability,**
  - **Economic,**
  - **and**
  - **Policy benefits**