

What is a Future?

MISO MTEP futures are forward-looking scenarios of the energy landscape. The futures establish ranges of combined possibilities that produce a representation of what could be. Futures consider economic, political, and technological changes of different rates over time, i.e. natural gas price forecasts, load growth rates, generator retirements, renewable energy levels, carbon policy, and generation capital cost maturities. This information is used to model economic generation capacity expansion, which forecasts the optimal fleet to meet planning reserve margin and any renewable energy or environmental requirements. Using the range of optimal resource mixes across futures, MISO then develops transmission plans that ensure continued reliability and economic energy delivery.

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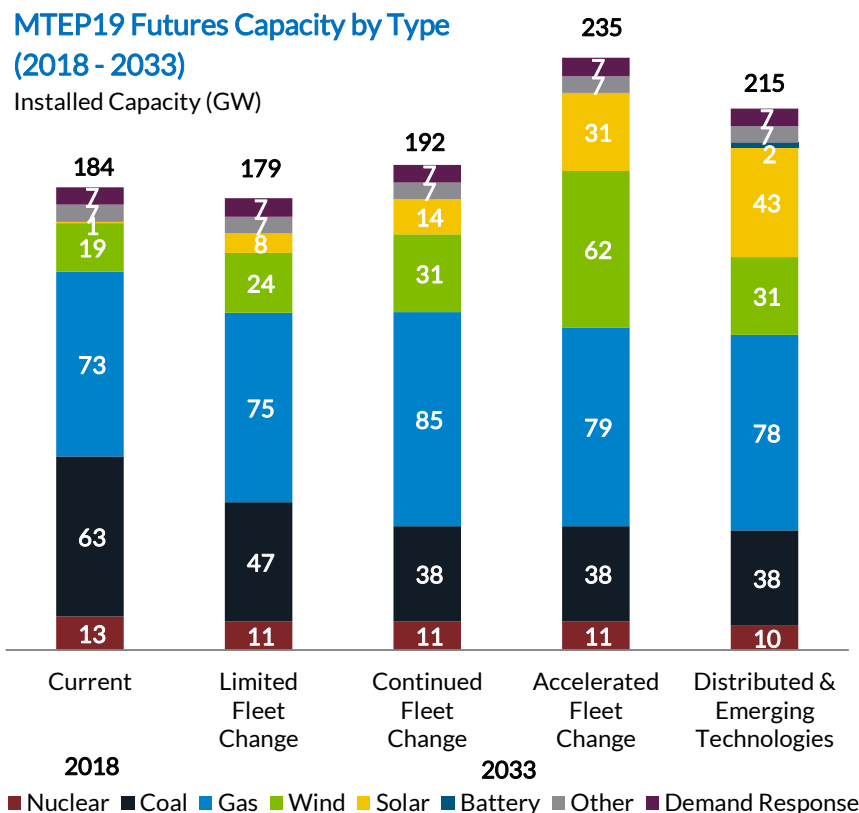
Why does MISO use futures in Transmission Planning?

MISO is not an integrated resource planner; however, robust transmission planning is dependent upon the type and location of future generation. In most cases, effective transmission planning must occur nearly 10 years prior to a significant transmission need. MISO’s Attachment Y generation retirement process requires a minimum six month notice and the Generator Interconnection Queue provides a two to three year outlook for resource additions. This lack of foresight poses a challenge to MISO transmission planning to evaluate future grid needs. Futures are used to bridge the visibility gap by bookending uncertainty. MISO MTEP futures are long-term and consider possible outcomes as well as capture the uncertainty that the electric industry faces over the next 15 years.

The goal of MTEP futures is to bookend uncertainty by defining a wide range of potential plausible outcomes.

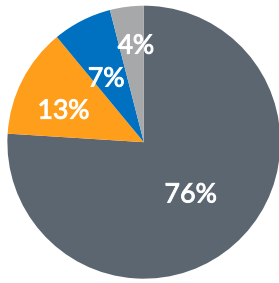
What are the MTEP19 Futures?

Lacking any significant changes in policy and economic conditions, MISO proposed and stakeholders supported using the MTEP18 futures definitions with updated data for MTEP19. Three of the four futures highlight a range of fleet evolution. The fourth future models the impacts of localized emerging technologies - lithium-ion battery storage, electric vehicles, and distributed solar photovoltaics (PV). The generation fleet is shifting from the historical fuel mix to rely on a more balanced mix of coal, natural gas, and renewables. The futures attempt to capture varying rates of change and technologies that drive system changes.

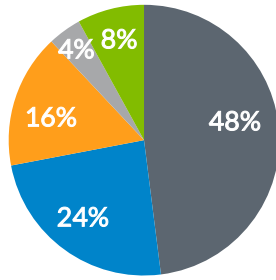


MTEP19 Futures Details and Energy Mix Charts

- Nuclear
- Coal
- Gas
- Wind
- Solar
- Other
- DSM



2005



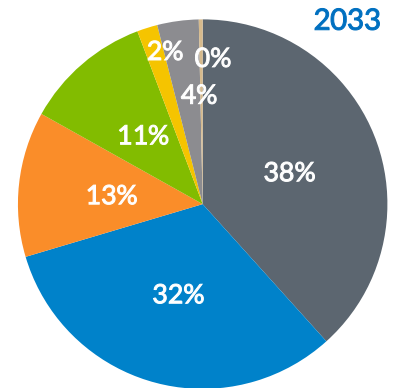
2017

Historical Trends

The MISO footprint has experienced significant changes in its energy mix since 2005. Renewables have entered the market driven by Federal and State policies as well as economics. In addition, low natural gas prices have enabled more gas fired generation.

Limited Fleet Change

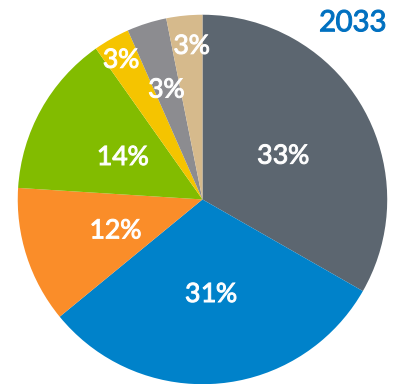
Existing generation does not experience any significant drivers of change. Policy and economic conditions favor thermal generation; thermal generators retire only at the end of their useful life. Renewable additions are primarily driven by existing Renewable Portfolio Standards and near-term additions. Demand and energy remain flat over time due to decreased base forecasts.



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Continued Fleet Change

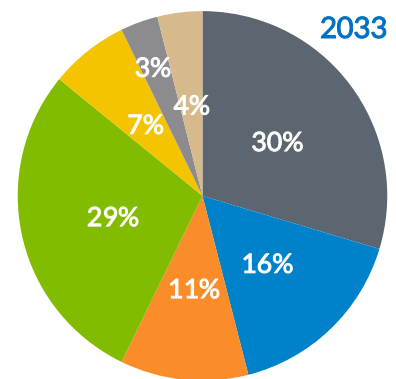
Fleet evolution will follow historical trends. Coal generation will retire at the historical rate, slightly sooner than the end of useful life. Renewable growth will continue to outpace Renewable Portfolio Standards, and natural gas reliance will increase to replace retired coal generation. Demand and energy growth reflects the current base Module E forecast net of energy efficiency.



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Accelerated Fleet Change

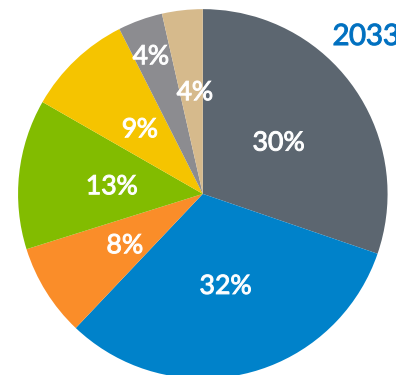
Significant change is driven by a robust economy with increased demand and energy growth rates at twice the Module E forecast as well as favorable economic and policy conditions for renewables. Higher gas prices as well as a 20% carbon emissions reduction from current levels create a favorable landscape for renewable expansion and increased demand-side management programs. Coal generation retires at the historical rate and operates only in peak season.



2033

Distributed & Emerging Technologies

Characterized by the addition of emerging technologies, this future models 2 GW of lithium-ion battery storage and increased distributed solar PV. Demand and energy rates are higher due to electric vehicle adoption, with energy growing faster than demand to simulate smart off-peak charging. Coal generation retires at the historical rate and nuclear generation retires as licenses expire. Renewable additions grow due to favorable economics, particularly for solar PV.



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