US Department of Energy, Quadrennial Energy Review Second Installment

Statement of Jennifer Curran, Vice-President of System Planning and Seams Coordination

MISO

May 6, 2016

MISO appreciates the invitation to participate in this discussion on the challenges we are all facing with respect to addressing an evolving generation mix. MISO is an independent, not-for-profit organization responsible for maintaining reliable transmission of power in 15 states and one Canadian province. In 2001, MISO became the first federally-approved Regional Transmission Organization. Every day, MISO works to create value for our stakeholders and operate the electric grid reliably. We administer one of the world's largest energy markets and perform regional scale transmission planning, creating large scale efficiencies in the way the electric grid operates and is planned that didn't exist before. Additionally, given the geographic scope of the MISO footprint, we share borders with a diverse set of entities. These borders are referred to as "seams". MISO coordinates extensively with its seams neighbors to plan and operate the electric grid along the seams reliably and efficiently.

The MISO region spans from Canada to the gulf coast. Within that area are 42 million end use customers that receive the value created by our continuously improving competitive energy markets and a regional approach to planning and operating the system. Demand from those 42 million customers has peaked at 127 GW during our history. To meet that demand, MISO helps to efficiently operate 180 GW of generation capacity and 66,000 miles of transmission.

The nation's energy landscape is changing – driven by factors like technology advancement, regulation, and fuel costs. Cost structure and consumer preferences have an impact on how MISO is responding to those change drivers.

The MISO region has historically received upwards of eighty percent of its energy from coal burning plants. Over the past several years, the generation mix in the MISO footprint began shifting due to a combination of economic, regulatory, environmental and policy drivers at both the state and federal level - affecting reserve margins, grid reliability, transmission infrastructure needs and electric system dispatch and operations.

More recently the U.S. Environmental Protection Agency has added momentum to the changes that were already transforming MISO's generation mix, as efforts to regulate carbon-dioxide emissions from the electric power sector through its Clean Power Plan began to impact the resource portfolio. The EPA says its new rule will continue to reduce carbon emissions. The forces set in motion by these economic, regulatory and policy drivers are expected to continue regardless of whether the EPA's CO_2 rules survive the legal challenges that they currently face. As always, other policy and regulatory changes could encourage further shifts in MISO's generation mix.

Fortunately, MISO has some experience planning for an uncertain future. MISO is not an advocate for specific policy outcomes, but has a responsibility to ensure reliable and efficient outcomes in its operations given a policy direction. After several years of planning primarily for

reliability and market efficiency, it became clear that policy was affecting the resource mix, but that there was also a lack of clarity regarding federal energy policy. Specifically, as states in the Midwest started passing their own Renewable Portfolio Standard requirements and mandates, it was obvious that MISO needed to expand its planning process in order to enable investments to ensure reliable and economic integration of new resources in support of those state requirements. In 2007, MISO began collaborating with stakeholders to enhance its planning process to account for project benefits beyond those driven by reliability and/or market efficiency, including public policy requirements.

Four years of process improvement and analysis work culminated in the first portfolio of Multi-Value Projects - a category of transmission projects which deliver reliability, public policy and economics benefits across the MISO region - being approved by MISO's Board of Directors in MISO's 2011 Transmission Expansion Plan (MTEP11). While construction of much of this approximately $6.5 billion in transmission investment is still underway, this effort gave MISO and its stakeholders experience with defining scenarios that span diverse potential future states and testing projects against those futures under a framework that more comprehensively captures the full transmission project value. Projects that are robust under all futures give no regrets opportunities that will enable value under a broad range of actual future environments.

Today, we don't know specifically what policy and regulation will bring, but MISO recognizes the continuing trends towards carbon reduction and emerging technologies. Many of MISO's members remain focused on changes to their resource portfolios given the fast pace of change in the industry. One example of this is the ongoing integration of renewables. MISO wind penetration, for example has reached an all-time high of more than 14,000 MW. For the bulk power system, there are storage technologies already in the field that may provide value and reliability benefits for consumers. Examples include pumped hydro, compressed air and batteries. As the industry evolves, MISO is monitoring ongoing economics and adoption of technologies such as storage and ensuring we are positioned to enable emerging technology integration. MISO is also working to better understand demand-side options and the impacts those may have on the system. These developments will continue to drive the resource portfolio evolution that has been underway and lead to a continued tightening of reserve margins, more reliance on gas-fired and renewable generation and changes in how the system is used and operated.

These realities are helping to shape MISO's current efforts to develop a new broad set of future scenarios that capture a range of outcomes. Within those future scenarios MISO will determine what generation build is needed to enable the various future outcomes, including fuel type and location. From there, transmission expansion opportunities will then be developed and evaluated for reliability and robustness.

Starting in 2017, MISO will replicate the process that was undertaken to identify the last set of Multi Value Projects. MISO and its stakeholders will be focused on development of possible transmission overlays for the region under a variety of scenarios. From this, MISO will be able to identify, and build the business case for specific transmission solutions that support the needs of the changing resource mix and provide benefits under a wide range of resource mix outcomes. As in the past, we can't stand pat and wait for more clarity. The transmission development process takes a long time, so as the regional reliability and transmission planner, MISO must keep moving forward in a prudent manner. It will take another multi-year effort to get to the end result, but MISO has been down this path before and is confident we will be

prepared with appropriate transmission infrastructure for a future state that will likely be very different from our current environment.

Thus far I have focused primarily on MISO's work in transmission planning within our footprint, but planning and operations along the borders also takes on increased importance with the evolving resource portfolio. As reserve margins tighten, entities collectively maximizing existing resources will help us ensure the needs of consumers broadly continue to be met. The differences in the way each respective transmission system is planned and operated can significantly affect the efficiency with which the larger system delivers electricity. Effective coordination between entities and the ability of each entity to reach agreements that facilitate the most efficient use of our generation and transmission resources is the best mechanism to deliver the value associated with lowest-cost delivered electricity for consumers through a reliable transmission system. MISO will continue to be engaged with our neighbors to identify and seize opportunities that further improve our approaches and processes to planning and operating the system.

MISO appreciates the opportunity to participate in such an important discussion about our nation's evolving energy landscape. While there are many challenges in front of us, the industry has always been effective in working collaboratively through big issues without compromising the reliability of the system. We look forward to continuing to work collectively with all parties to ensure we continue to meet the needs of customers.

Transmission Development with an Evolving Generation Mix

Department of Energy Quadrennial Energy Review – Second Installment

Jennifer Curran, Vice-President System Planning & Seams Coordination

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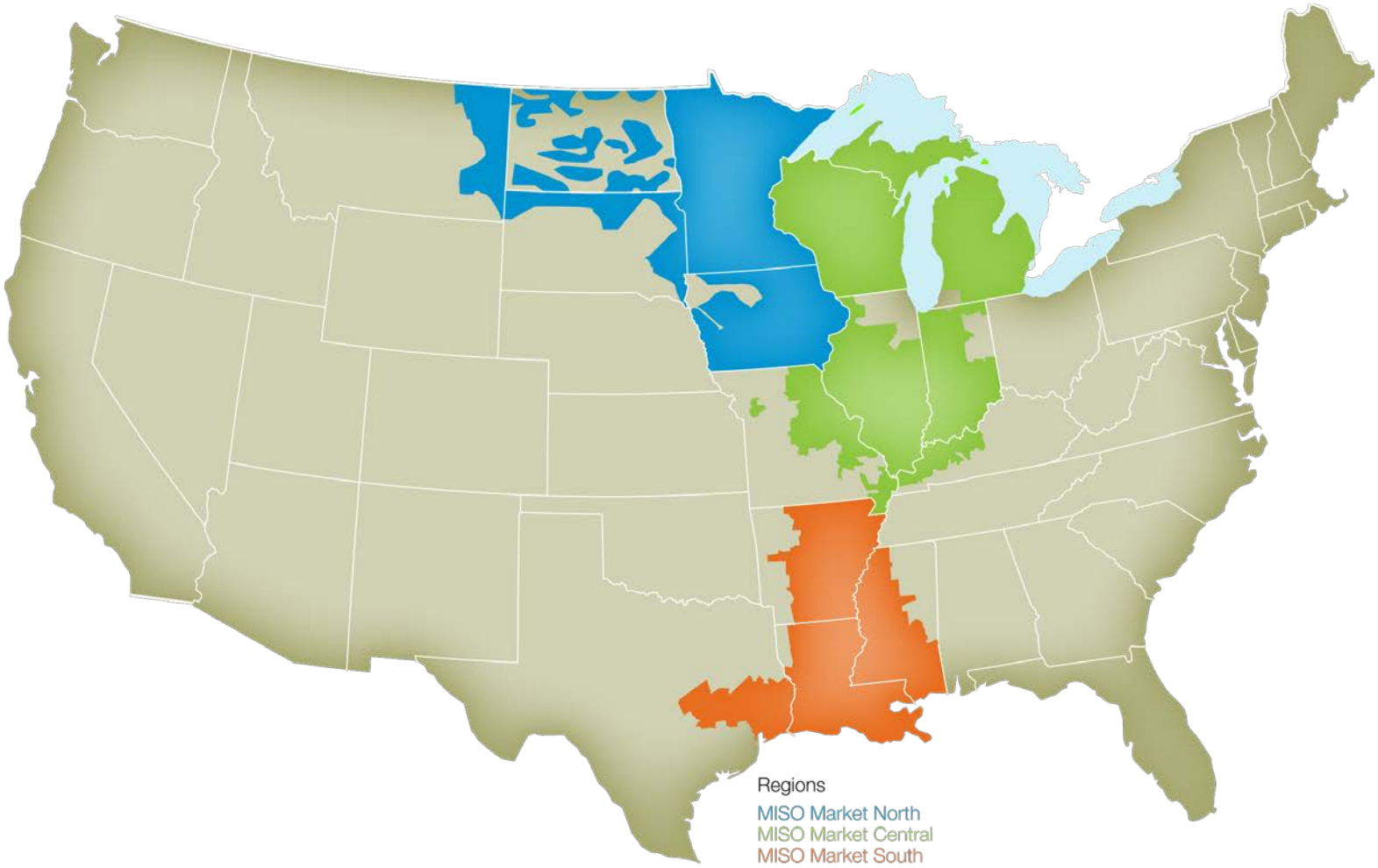
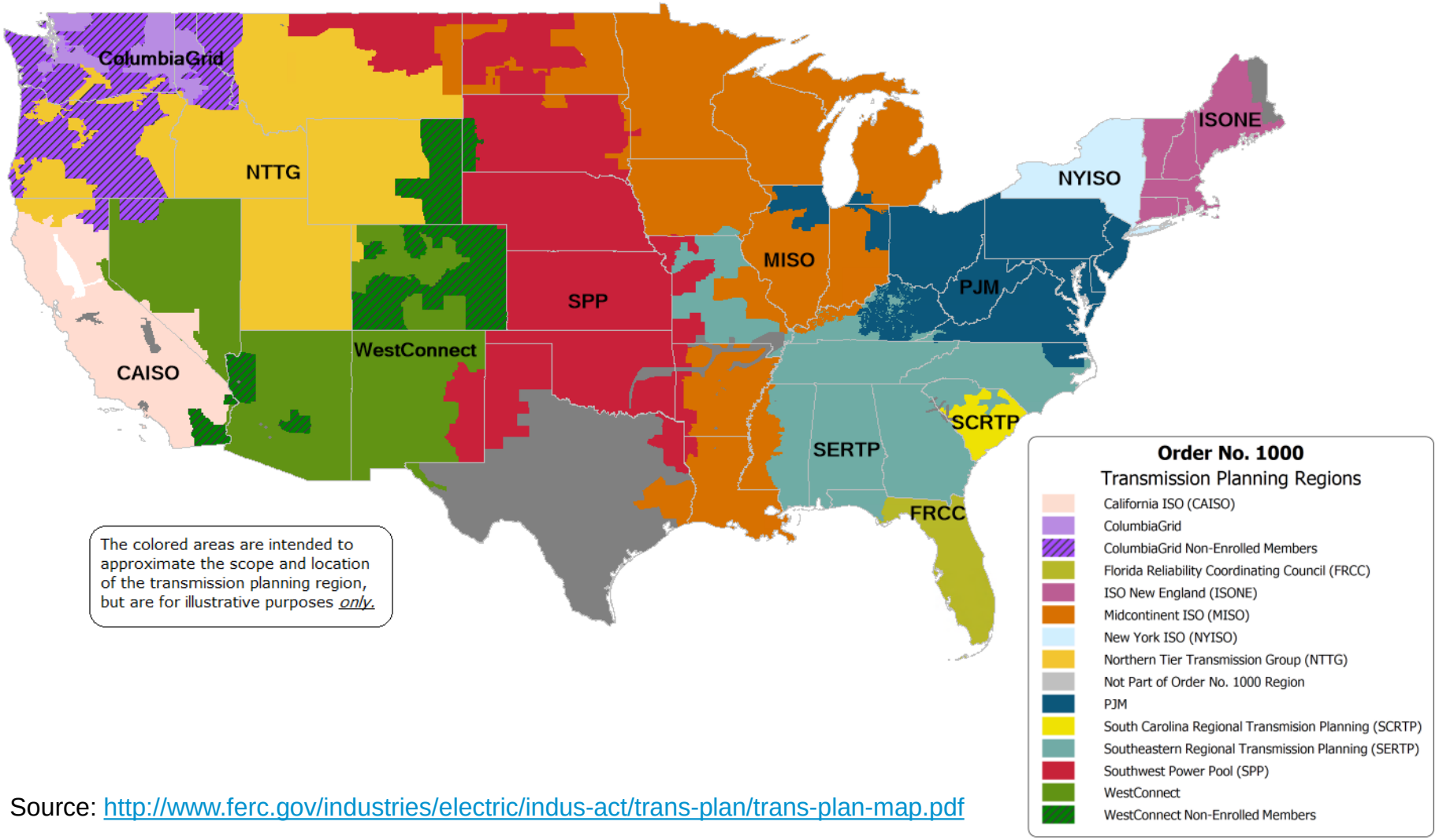
MISO Market Footprint



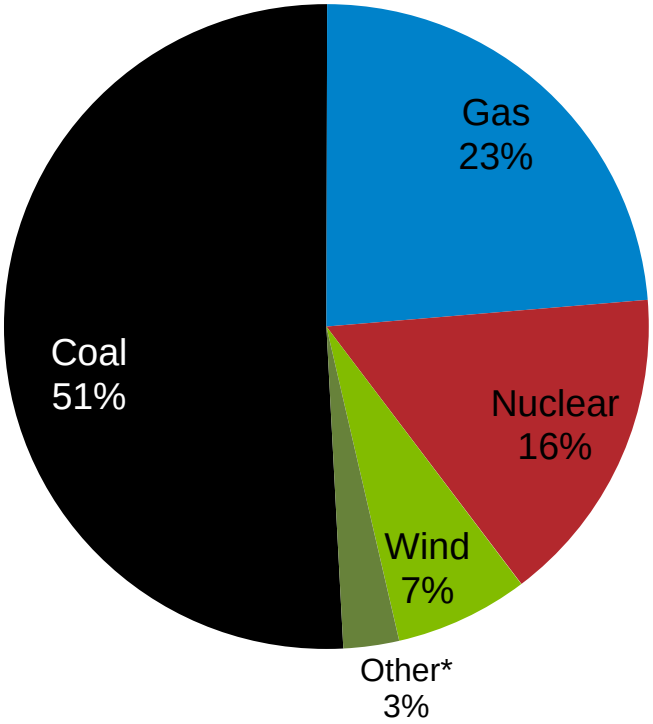
Order 1000 Transmission Planning Regions give us numerous seams neighbors to coordinate with…



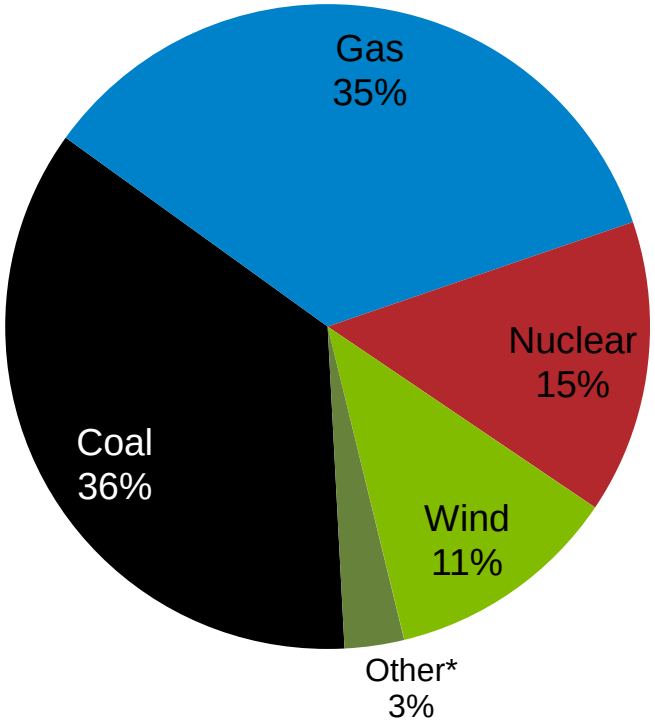
Source: http://www.ferc.gov/industries/electric/indus-act/trans-plan/trans-plan-map.pdf

The gas share of MISO generation will increase significantly in the future as coal retirements continue and renewables gain ground

2015
(Actuals)



2030
Projection[1]



[1] Source: Projection based on MISO CPP mid-term analysis (assumes 16 GW coal retirement, 11+ GW new gas-fired capacity, regional mass-based trading, solar and wind include an economic maturity curve to reflect declining costs over time, Henry Hub gas price at ~$5.65/MMBtu nominal)
* "Other" includes hydro, pumped hydro, oil, solar, other

Multi Value Project Portfolio