The Future of Baseload Capacity

Gulf Coast Electricity Transmission Summit

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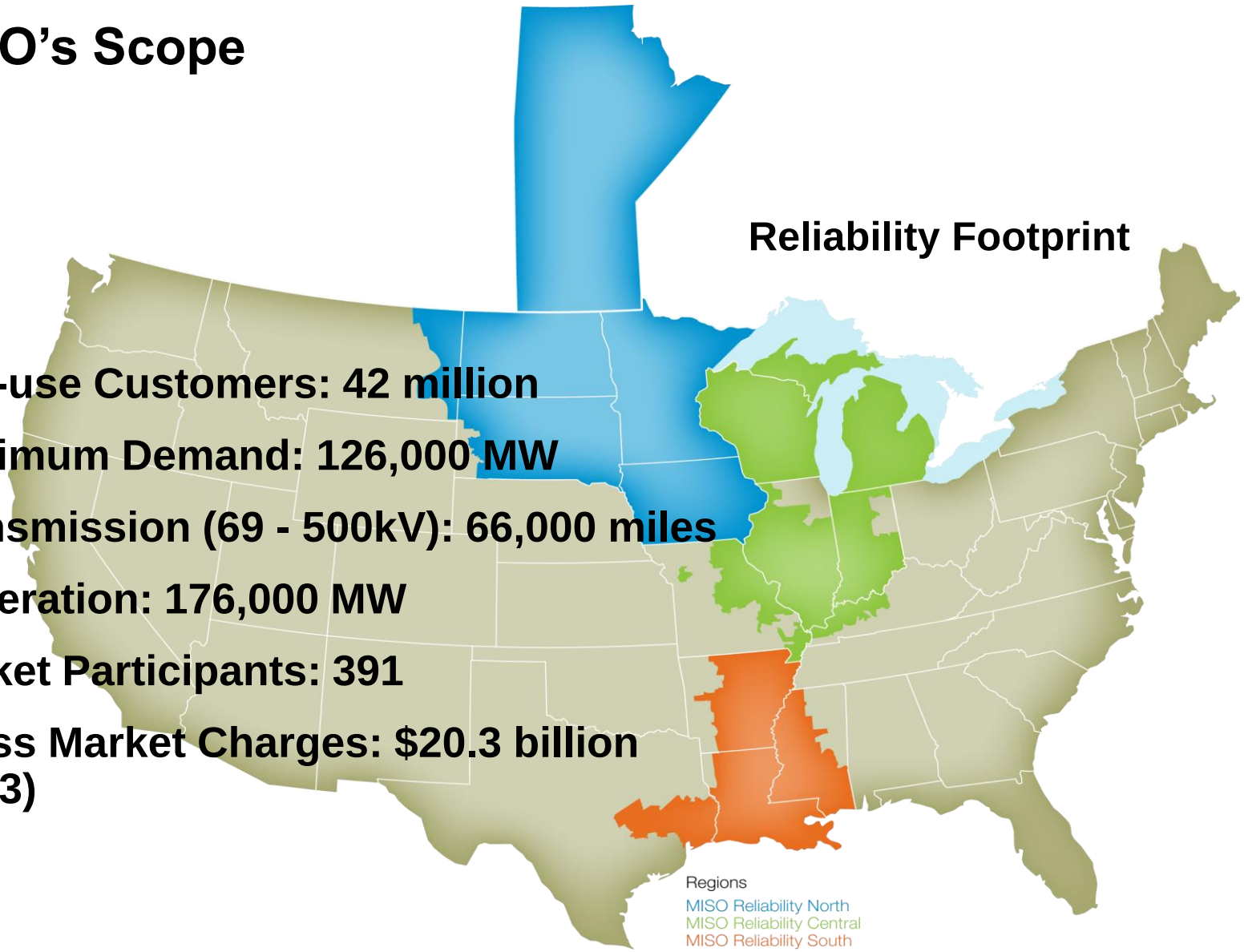
MISO's Scope

- End-use Customers: 42 million
- Maximum Demand: 126,000 MW
- Transmission (69 - 500kV): 66,000 miles
- Generation: 176,000 MW
- Market Participants: 391
- Gross Market Charges: $20.3 billion (2013)



Summary

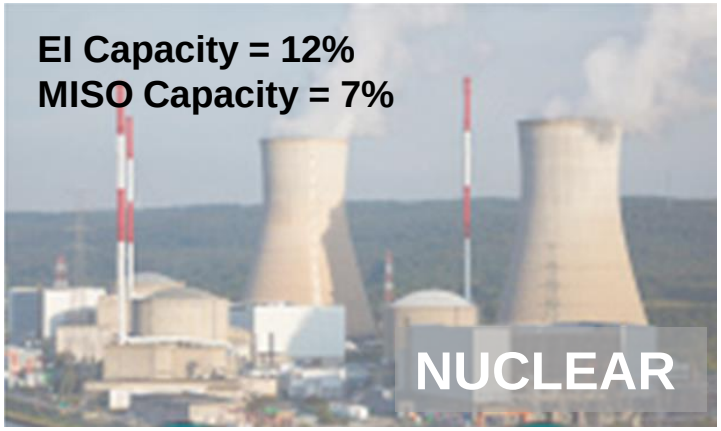
- Of the four major baseload capacity types:
  - Coal capacity is retiring and not being replaced in kind
  - Nuclear can be built in regulated states but not elsewhere
  - Hydro is essentially built-out
  - Gas is the remaining choice

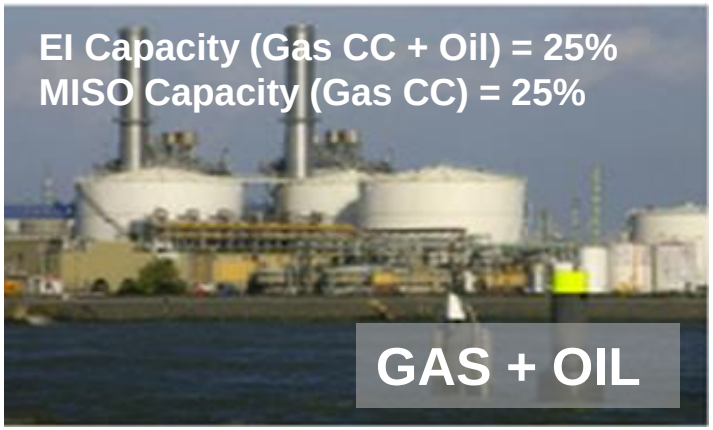
- Renewables are being pushed at the federal and state levels with both policy and financial incentives.

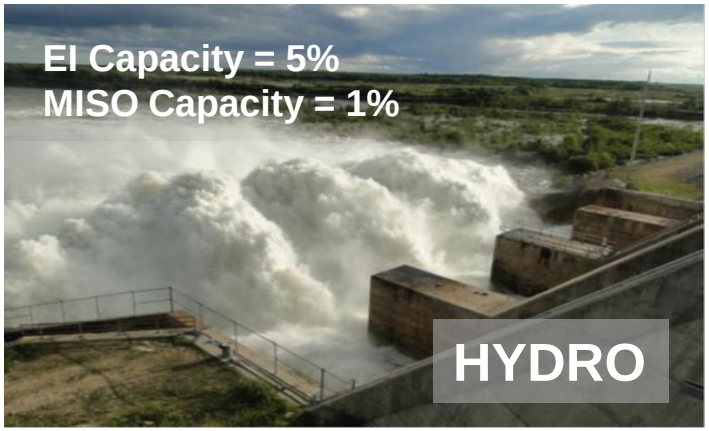
- Renewables are intermittent but can approach baseload status through broad geographic implementation.

- If you can't build traditional resources then non-traditional resources have to be considered…new solutions must be adopted.

Traditional baseload capacity in the Eastern Interconnect (EI) is primarily a mix of coal, gas, oil and nuclear resources…





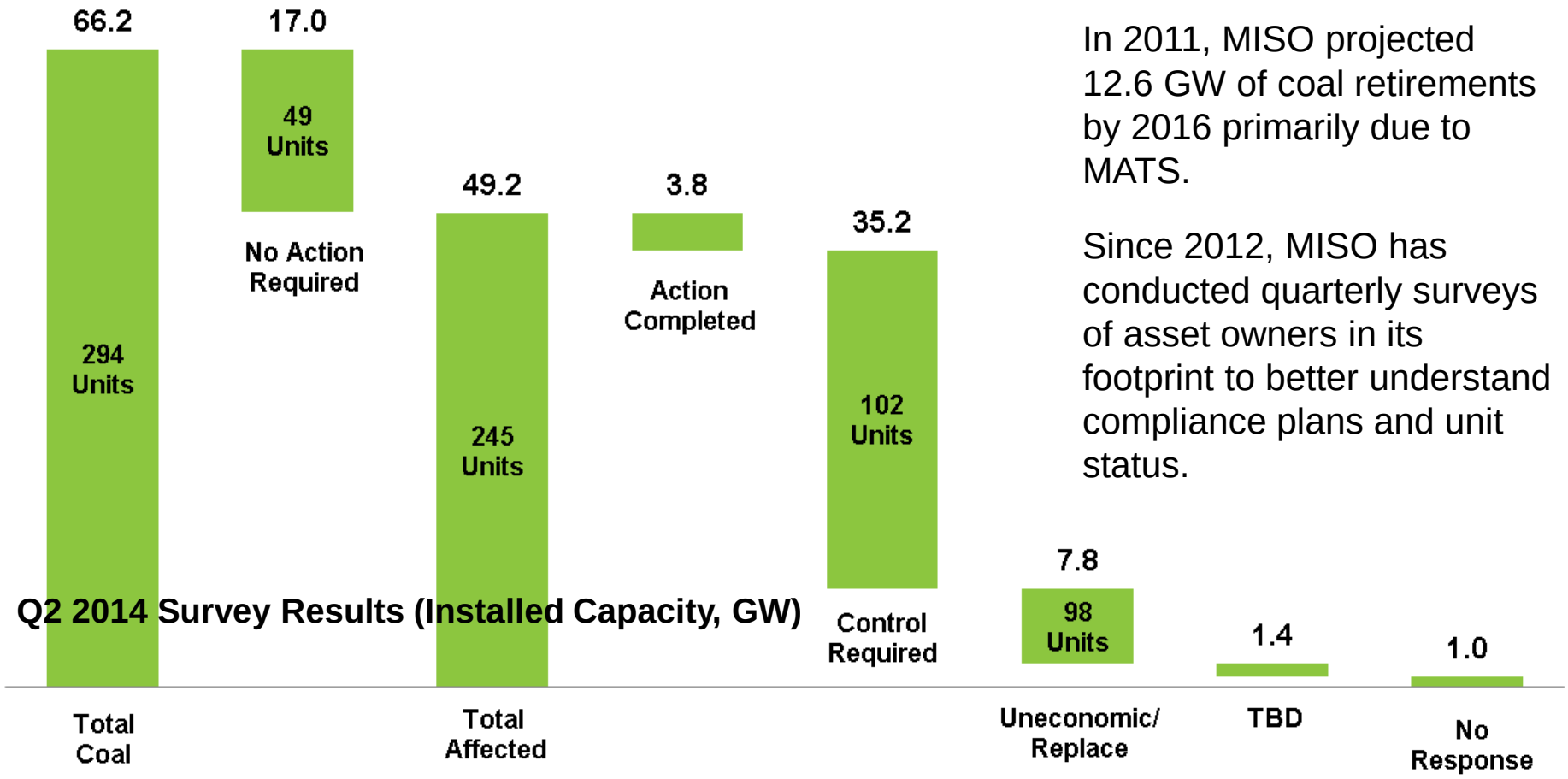


…but the generation fleet in MISO and EI is being affected by fuel prices, energy policies and multiple environmental regulations

	MATS	CSAPR & CWIS	Clean Power Plan 111(b) & (d)	NAAQS & Coal Ash
Nature of Regulation	Mercury and Air Toxics Standards	Cross State Air Pollution Rule and Cooling Water Regulations (316(b))	CO_2 from existing and new power plants	New air quality standards/ Coal ash storage
Compliance Dates	2015 / 2016	As early as 2015	2015/16 (New) 2020 & beyond (Existing)	???
Impacts	• Significant coal retirements • Outage coordination challenges • Shrinking reserve margins around MISO • Growing dependence on natural gas	• NO_x requirements tightened • Higher plant compliance costs influence retirement decisions	• New coal requires CCS; baseload capacity options reduced • Significant coal retirements • Increased dependence on gas and carbon neutral resources	• Increased costs • Other potential impacts depend on regulations

These impacts will change the baseload resource mix, erode reserve margins and increase reliability risk.

Measuring the capacity impacts of MATS



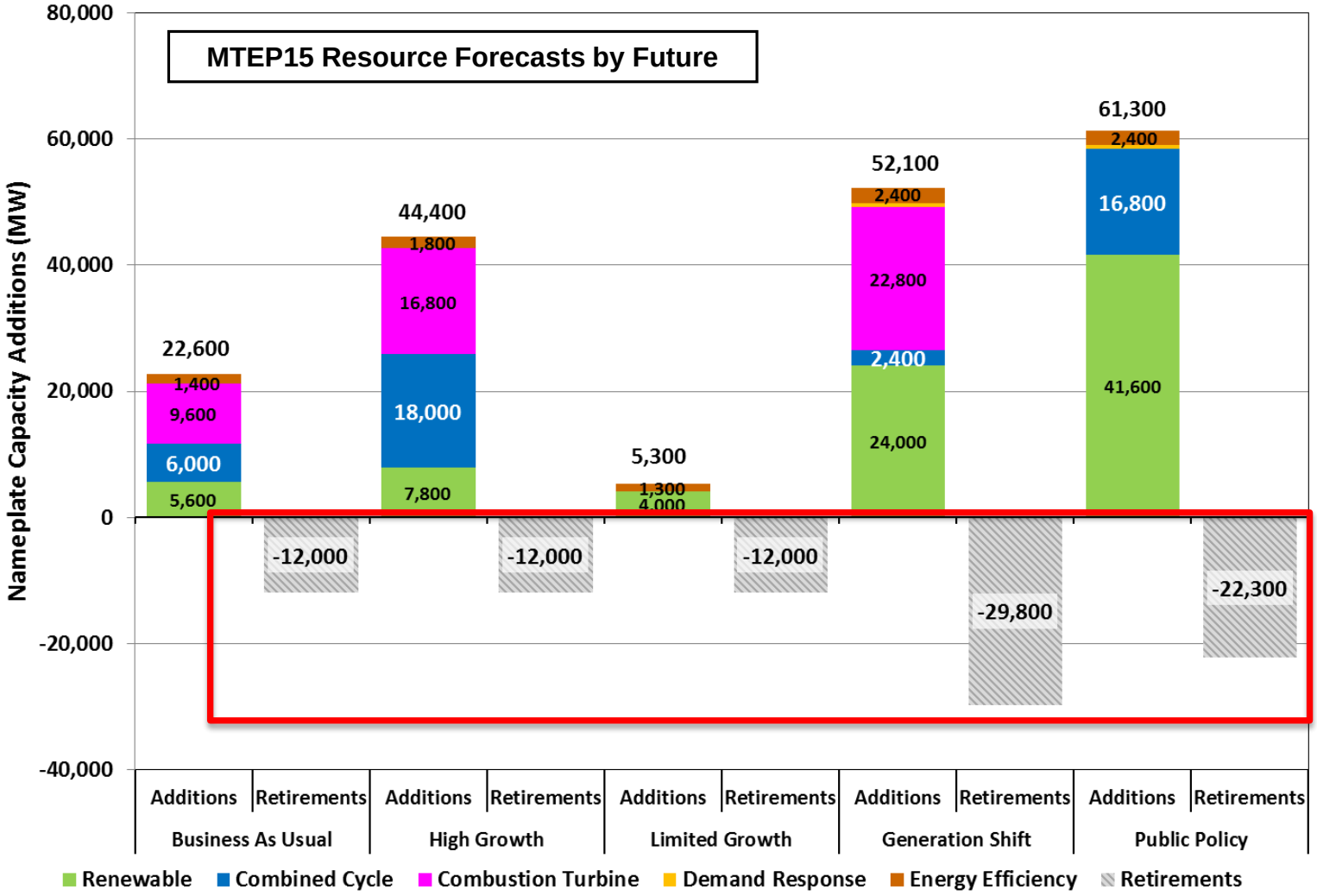
Q2 2014 Survey Results (Installed Capacity, GW)

In 2011, MISO projected 12.6 GW of coal retirements by 2016 primarily due to MATS.

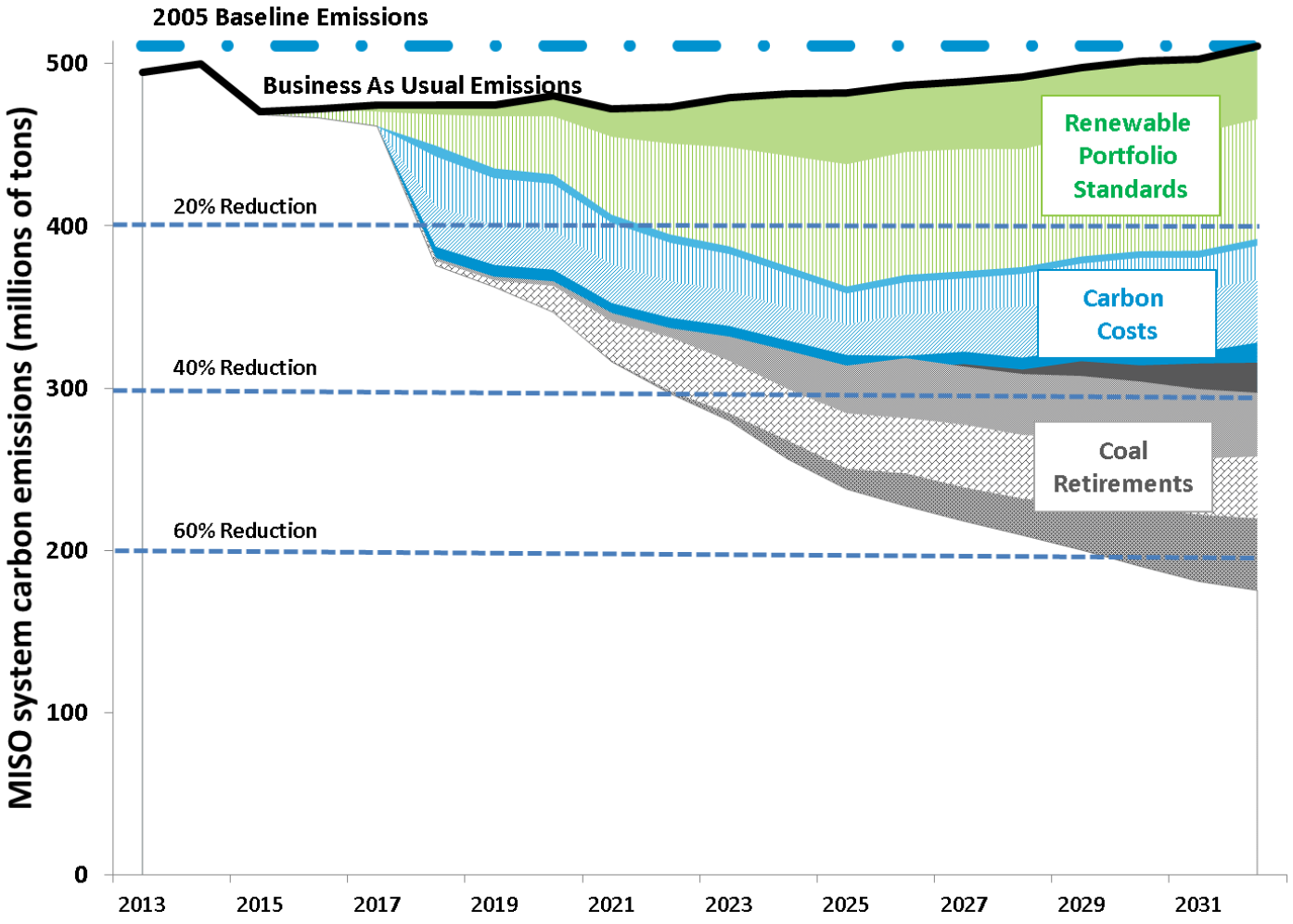
Since 2012, MISO has conducted quarterly surveys of asset owners in its footprint to better understand compliance plans and unit status.

Approximately 15% of coal capacity in the MISO footprint is projected to retire by 2016.

Capacity retirements currently modeled by MISO range from 12 GW to 30 GW

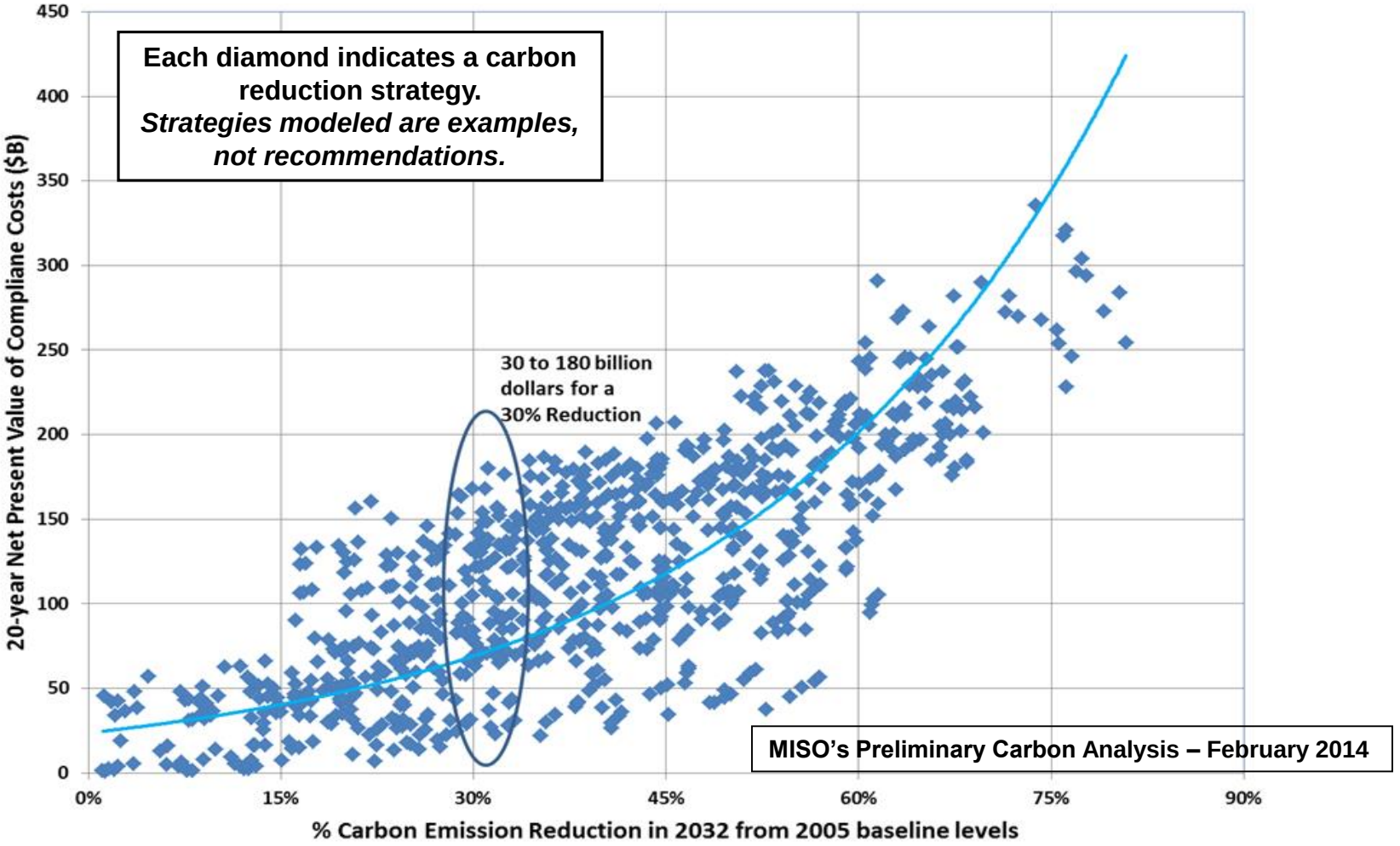


One carbon management strategy alone may not be able to achieve emission reduction targets.



MISO's Preliminary Carbon Analysis – February 2014

MISO performed preliminary analysis on carbon regulations in early 2014



Preliminary results show that, for given policy and economic conditions, certain combinations of carbon reduction strategies are more cost effective than others. Strategies modeled do not represent an exhaustive range of compliance options.

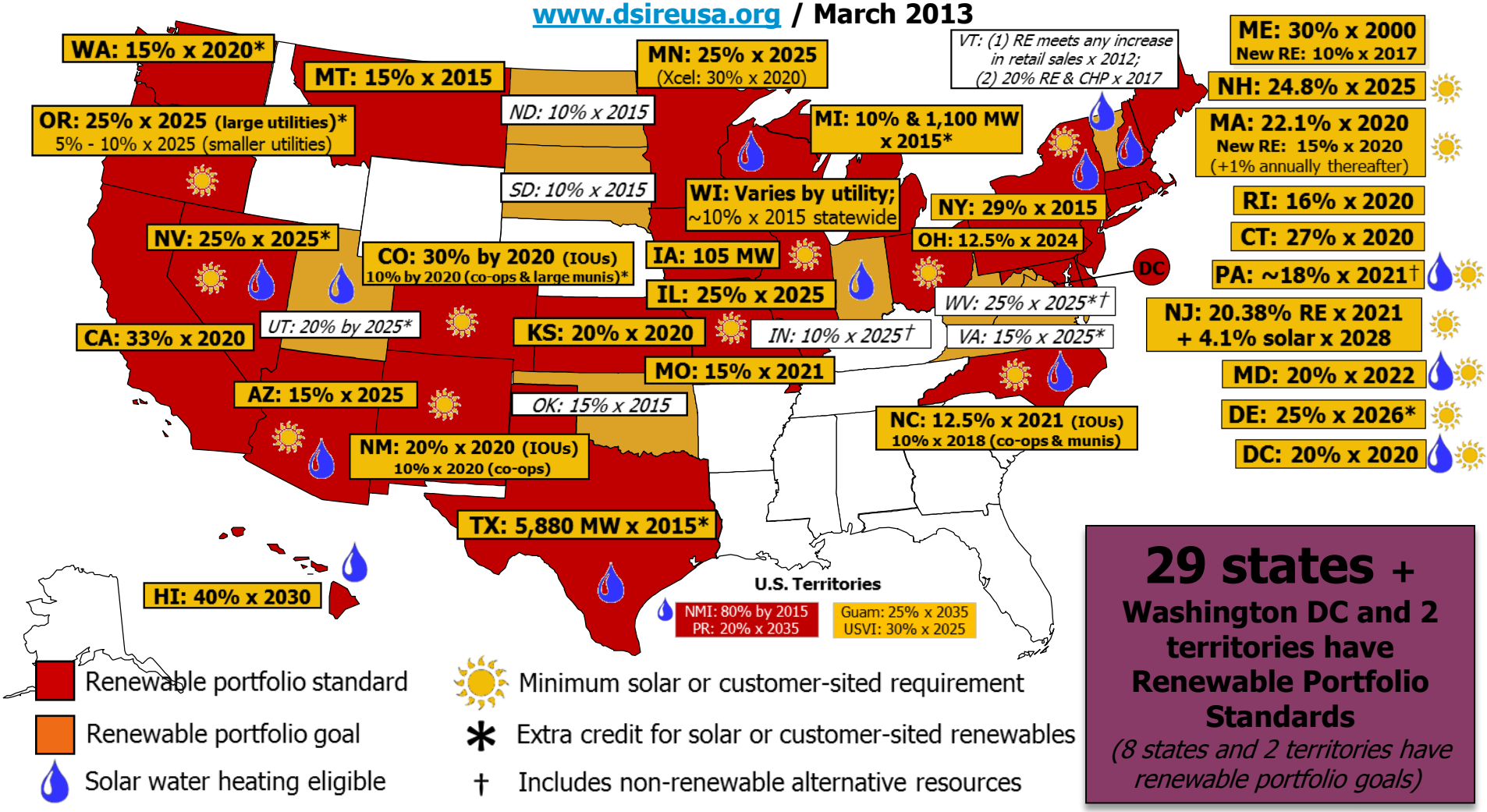
Future baseload capacity may look very different…

+ ENERGY STORAGE OR NEW TECHNOLOGIES ?

If economics and/or regulations prohibit the construction of traditional electric generation baseload resources, non-traditional resources must be considered and new solutions must be adopted.

Renewable Portfolio Standard Policies

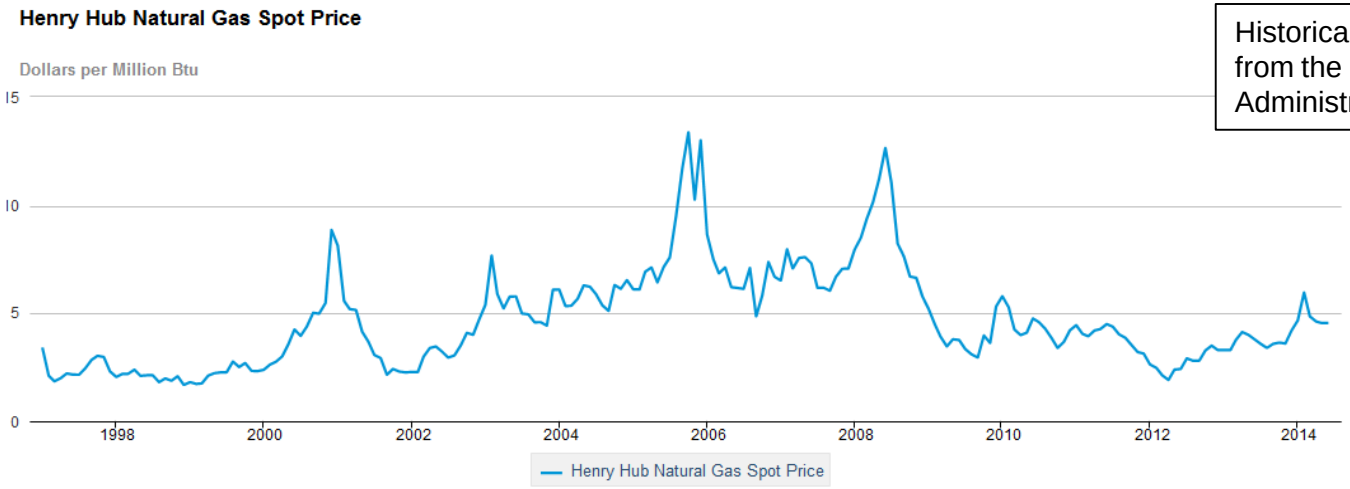
www.dsireusa.org / March 2013



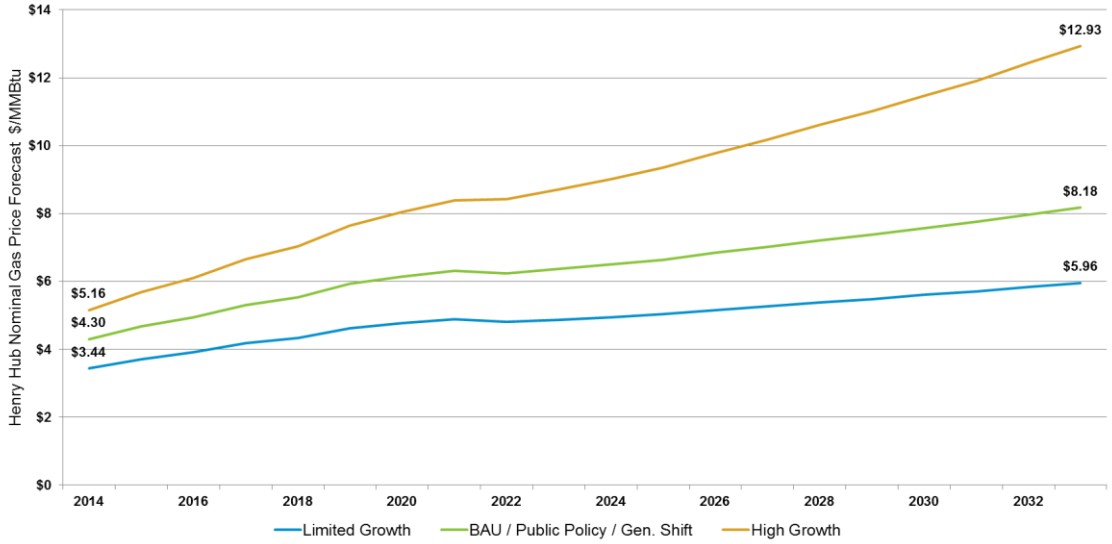
29 states +
Washington DC and 2 territories have Renewable Portfolio Standards
(8 states and 2 territories have renewable portfolio goals)

Source: DSIRE™ - Database of State Incentive For Renewables & Efficiency

Gas prices have historically been volatile; analysts forecast less price volatility

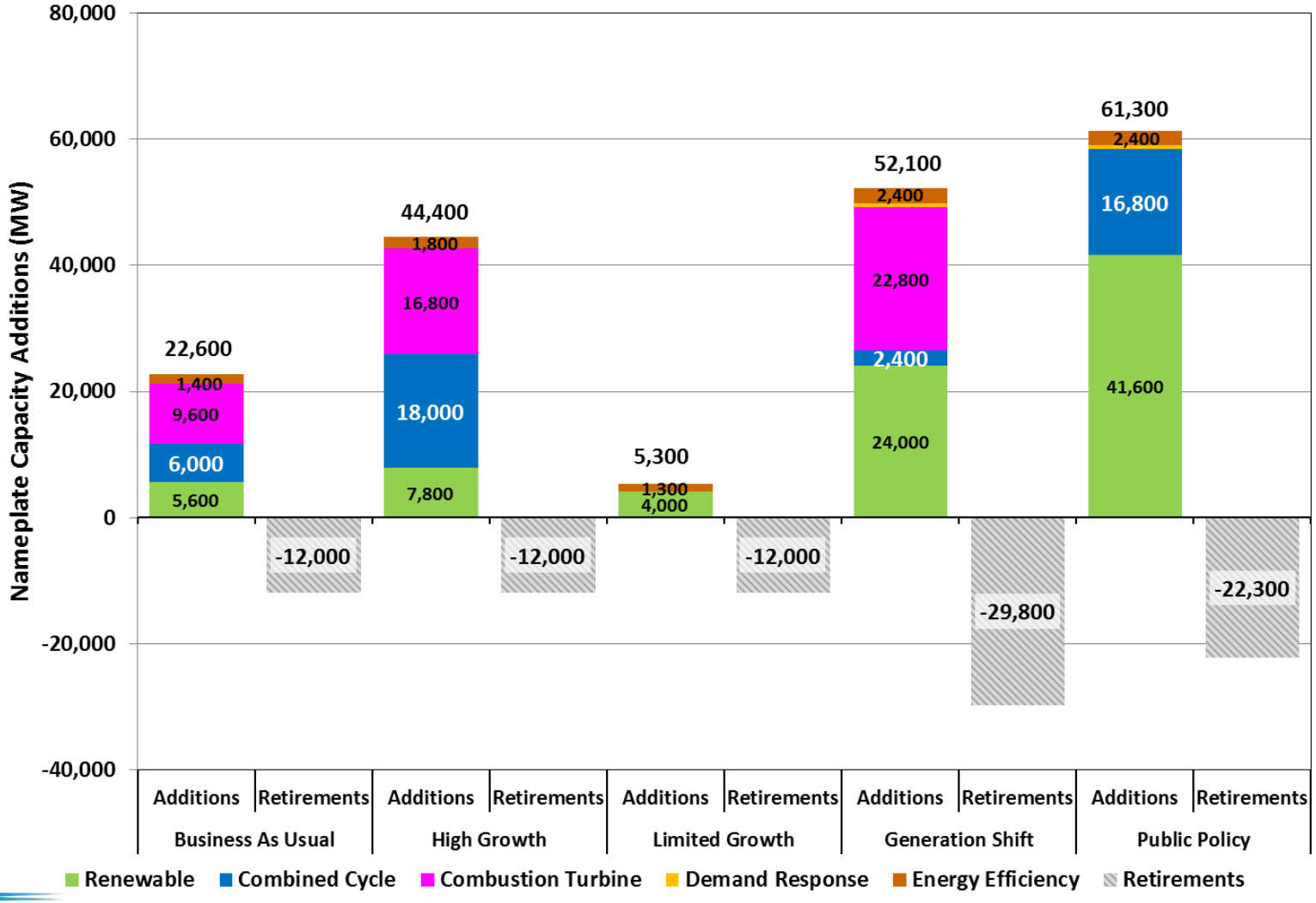


Historical Henry Hub gas price from the Energy Information Administration (8/2014).

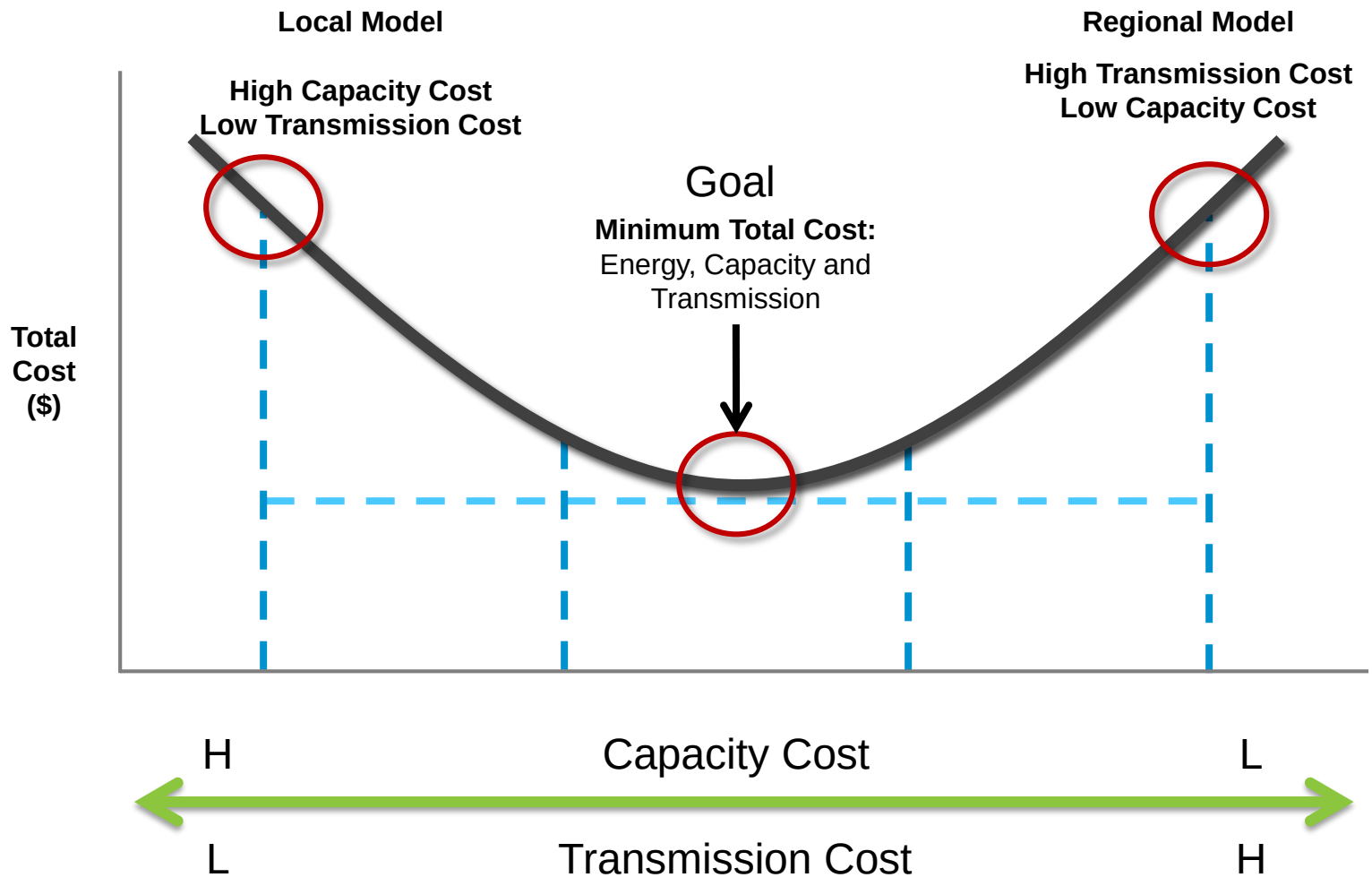


Nominal Henry Hub natural gas price forecasts for MISO's 2015 regional transmission planning process.

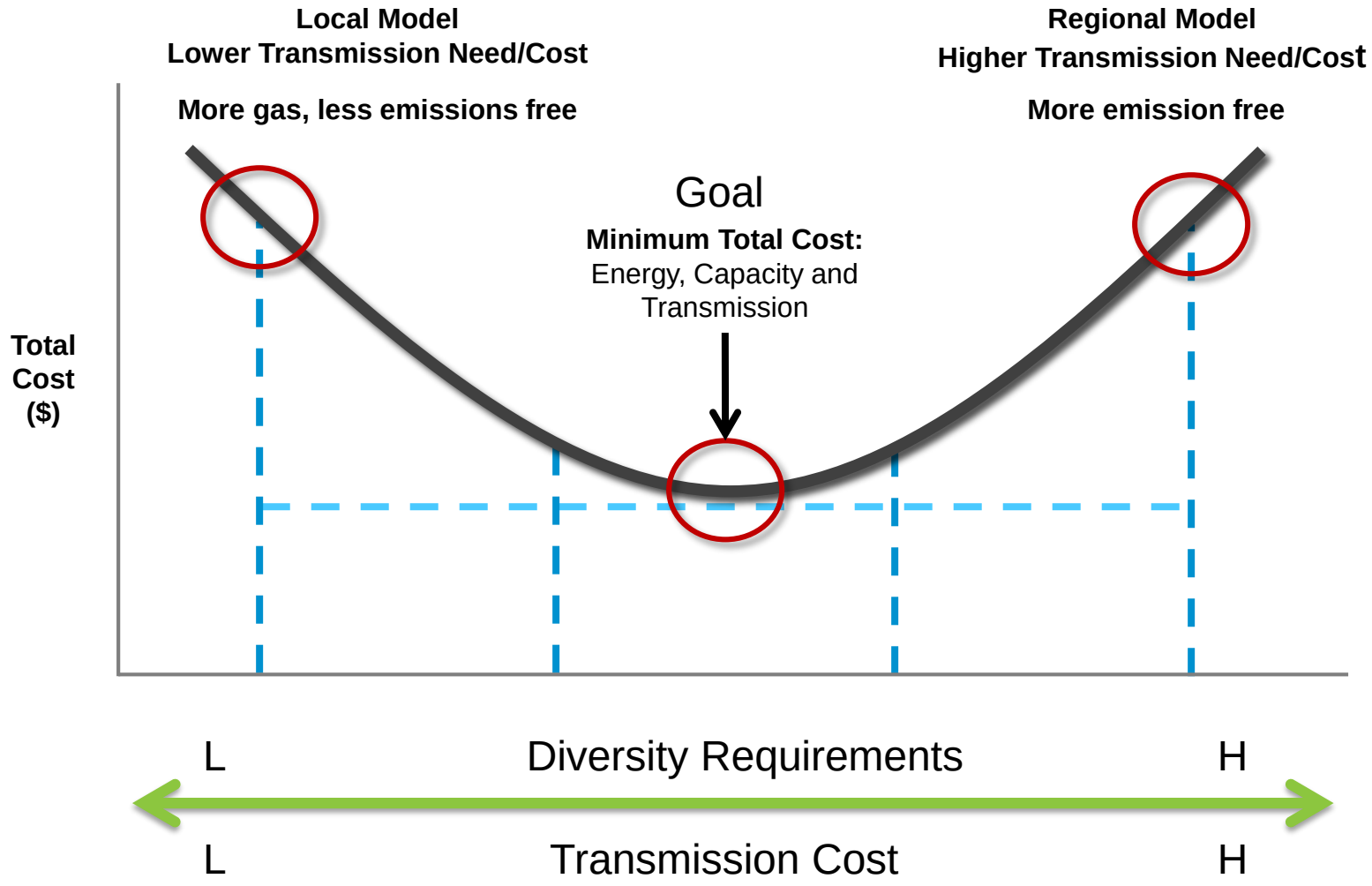
Resource forecasts from MISO's MTEP15 study process project build-out of renewable and gas resources



Current paradigm



Future baseload structure will require a larger regional transmission system to help maintain reliability



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