Analysis of EPA's Proposal to Reduce CO_2 Emissions from Existing Units

November 12, 2014

The generation fleet in MISO is being affected by fuel prices, energy policies and multiple environmental regulations

	MATS	CSAPR & CWIS	Draft Clean Power Plan 111 (b) & (d)	NAAQS & Coal Ash
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) Beginning in 2020 (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; base load capacity options reduced • Significant coal retirements • Increased dependence on gas and CO_2 neutral resources	• Increased costs • Other potential impacts depend on regulations

MISO Mission

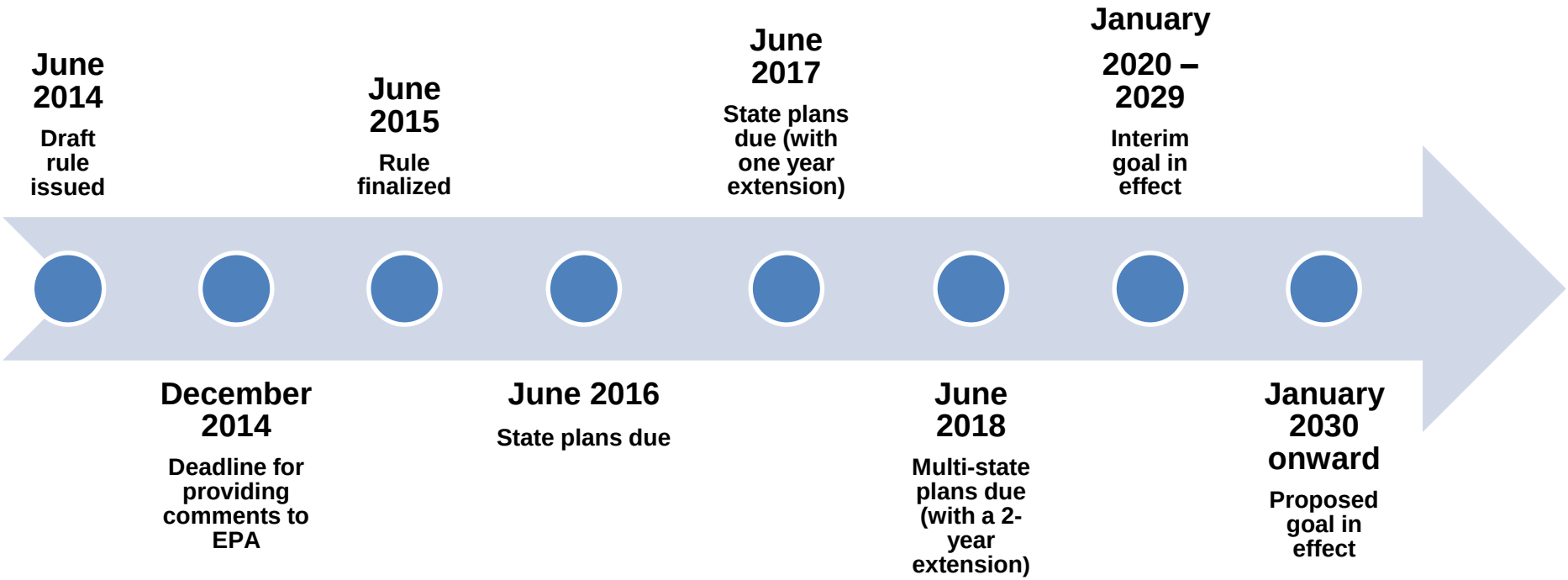
- Drive value creation through efficient reliability / market operations, planning and innovation.
- Ensure reliable, least-cost delivered energy for all electricity consumers.

Disclaimer

- The studies referenced in this presentation show predictions of potential future costs. These costs are indicative based on the assumptions used in the modeling. Capital, fixed operating and maintenance and production cost increases are only captured.
- These do not include additional costs related to:
  - Electric transmission expansion
  - Gas infrastructure expansion
  - Stranded generation facilities

The purpose of MISO's analysis…

…is to inform stakeholders of potential impacts on the generation fleet and load resulting from the EPA's proposal to reduce CO_2 emissions from existing electric generating units.



Key Findings (All costs shown are indicative)

- Compliance costs vary based on the reduction strategy.
  - ~$90B net present value for EPA's Four Building Blocks
  - ~$55B net present value for regional optimization
- Regional compliance is approximately 40% less expensive.
  - $55B (regional) vs $83B (sub-regional) CO_2 emissions reduction
- Entities subject to the rule may need to take action by 2020, which may challenge their ability to implement least-cost compliance strategies.

EGEAS, a strategic assessment model was used to study the impacts of the draft CO_2 emissions reduction rule

OPTIMIZATION CONSTRAINTS

- Planning Reserve Margin
- CO_2 emission constraint (mass-based)
- Resource availability

INPUT DATA ASSUMPTIONS

- Demand and energy forecast
- Fuel forecasts
- Retirements
- CO_2 costs
- RPS requirements

EXISTING RESOURCES DATA

- Unit capacity
- Heat rate
- Outage rate
- Emissions rate
- Fuel and O&M costs

EGEAS

NEW RESOURCES DATA

- Capital cost
- Construction cash flow
- Fixed charge data
- Years of availability

OPTIMIZED RESOURCE PLAN

- 20-year resource expansion forecast
- Amount, type and timing of new resources
- Total system Net Present Value (NPV) of costs
- Annual production costs for system
- Annual fixed charges for new units
- Annual tonnage for each emissions type
- Annual energy generated by fuel type
- Annual system capacity reserves and generation system reliability

EGEAS stands for Electric Generation Expansion Analysis System

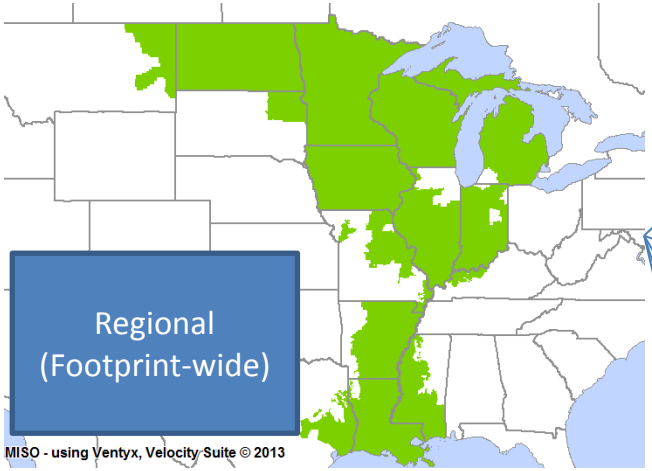
Total System Costs = Sum of Production Cost + Fixed O&M Cost + Capital Carrying Costs.

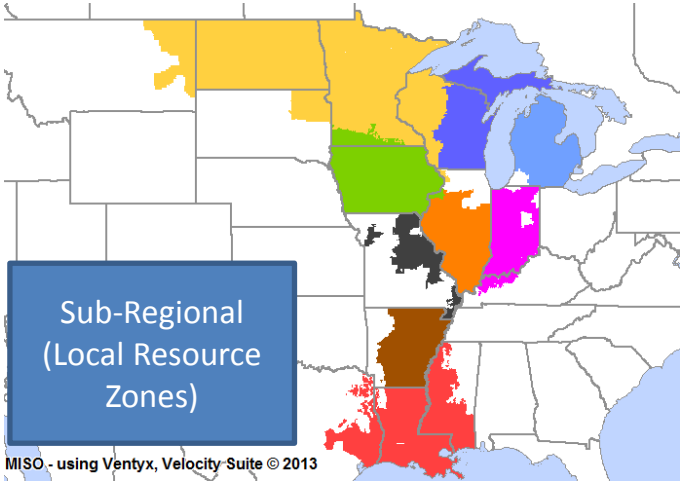
Each state has a proposed interim and final state-wide CO_2 emissions rate goal calculated as:

$$\text{Rate (lbs/MWh)} = \frac{\textit{Statewide } CO_2 \textit{ emissions from covered fossil fuel-fired power plants (lbs)}}{\textit{State electricity generation from covered fossil plants + renewable energy + nuclear (at-risk portion and New) + energy efficiency (EE) (MWh)}}$$

- Numerator – sum of CO_2 emissions from existing generating units
- Denominator – electricity generation in the state excludes existing hydro and new thermal resources
- Every state is assigned a different proposed rate goal (lbs/MWh) for the interim (2020-2029) and the final (2030 onward) periods
- For modeling purposes, rate-to-MISO-equivalent mass was calculated:
  - Emissions in tons = (2012 generation from covered fossil plants + renewable and EE mandate-driven energy forecast) * (proposed state CO_2 emission rate goal)
  - Only the MISO portion of the state was modeled

An assessment of EPA's proposed building blocks to calculate their costs and emissions reduction potential





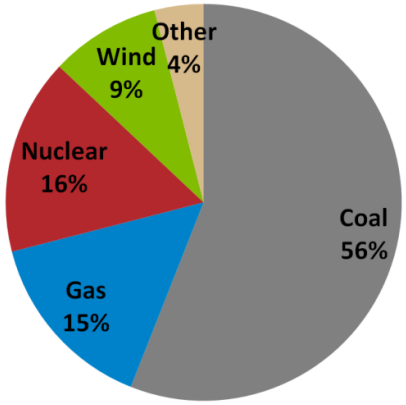
- Building Block 1
  - Cost of Compliance
  - Emissions Reduction Achieved
- Building Block 2
  - Cost of Compliance
  - Emissions Reduction Achieved
- Building Block 3
  - Cost of Compliance
  - Emissions Reduction Achieved
- Building Block 4
  - Cost of Compliance
  - Emissions Reduction Achieved
- All Building Blocks
  - Cost of Compliance
  - Emissions Reduction Achieved

EPA's Technical Support Documents provided modeling assumptions for the Four Building Blocks

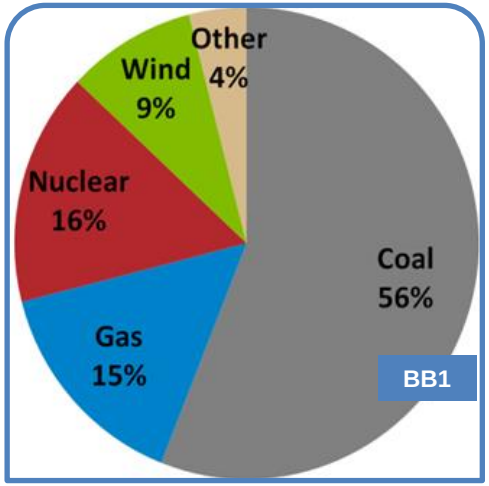
Scenario	Modeling Assumptions (per EPA's Clean Power Plan) and Methodology
Reference Case	MISO's MTEP-15 Business As Usual future assumptions*
Building Block 1	In 2020, apply a 6% heat rate improvement to all the coal-fired units at a capital cost of $100/kW (amortized over 10 years).
Building Block 2	Calculate and enforce, starting in 2020, a minimum fuel burn for existing CC units to yield an annual 70% capacity factor.
Building Block 3	Calculate and add the equivalent amount of wind MWs to meet the incremental regional non-hydro renewable target.
Building Block 4	Calculate the amount of energy savings for the MISO footprint and incorporate it as a 20-year EE program in the model.
All Building Blocks	Application of all building blocks.

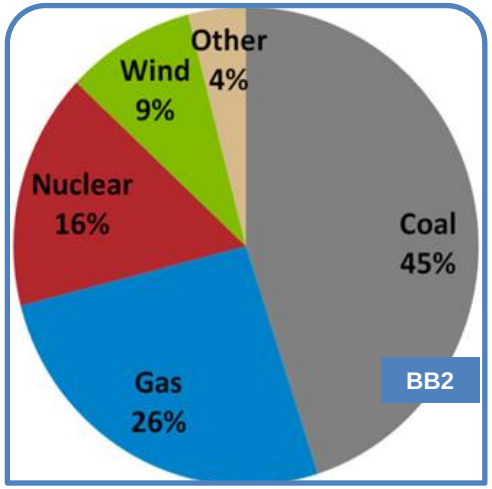
* Assumptions matrix is available at https://www.misoenergy.org/Events/Pages/PAC20140820.aspx

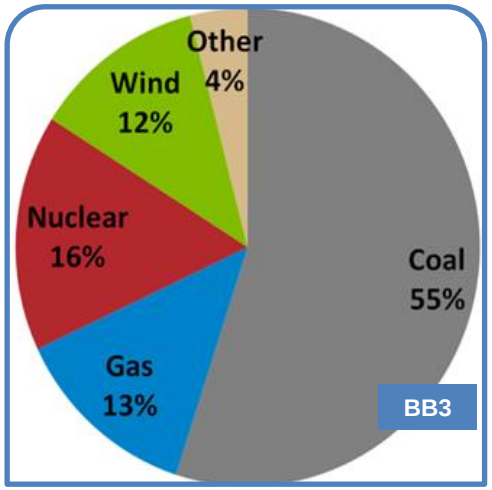
Implementing the EPA's building blocks changes the energy mix of the system, and…

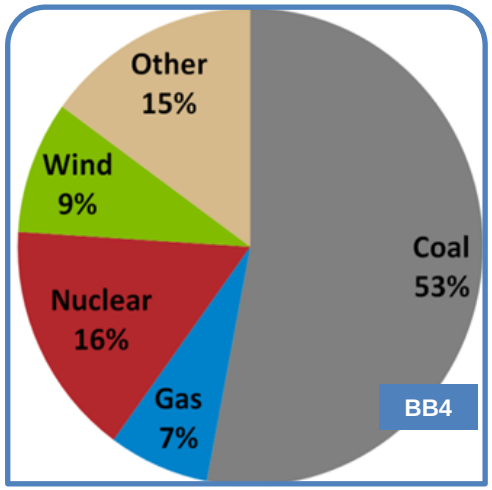


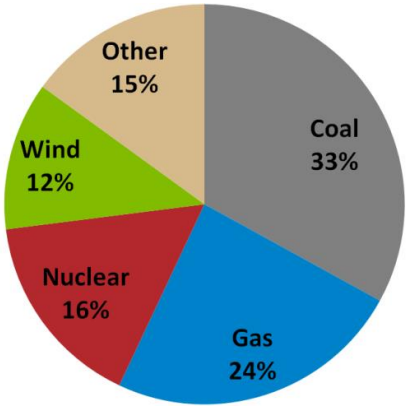
Reference Case









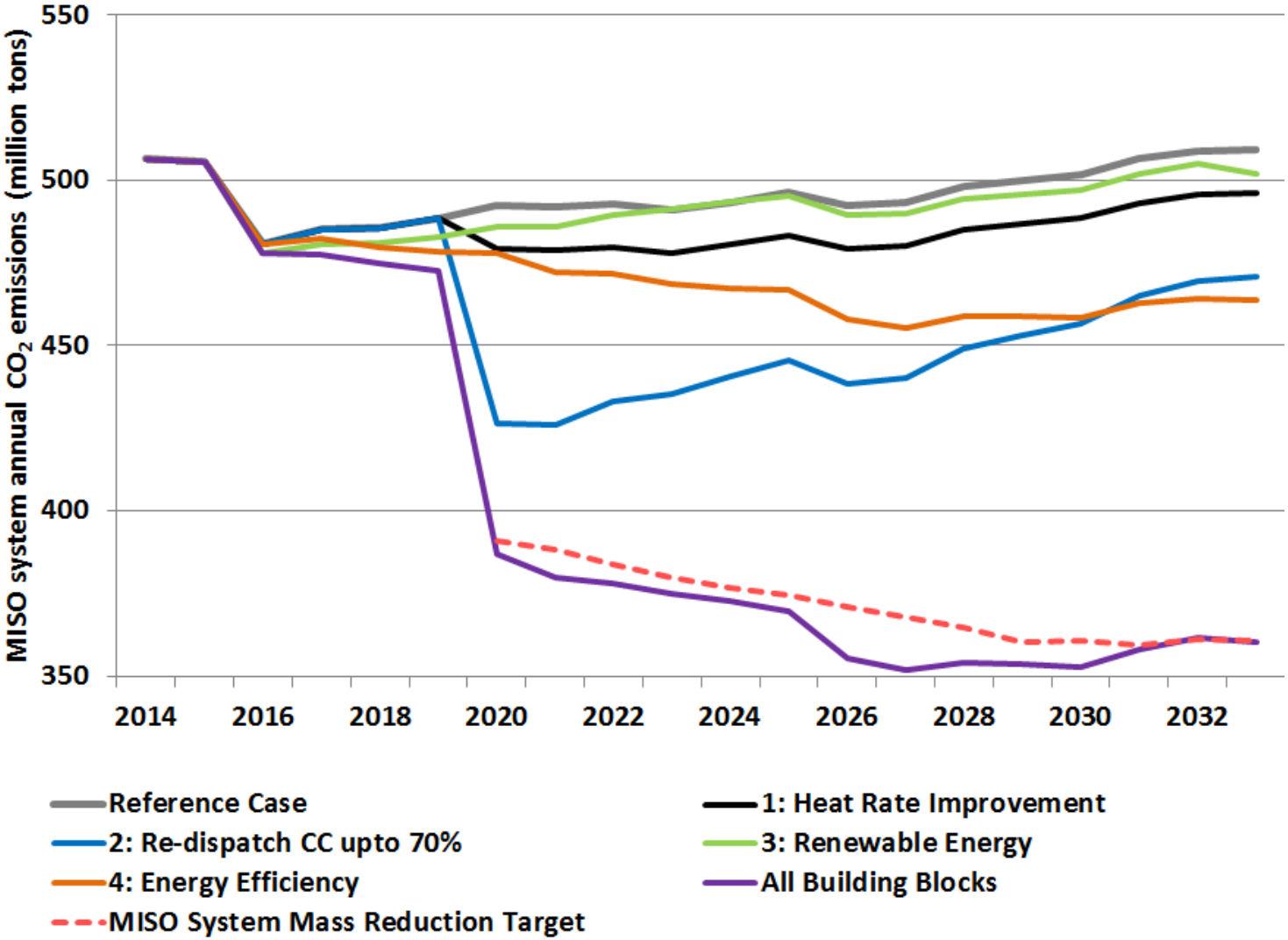


All Building Blocks

All charts show MISO system 2030 energy production by fuel type.

Energy production from new gas is less than 2.3% in all the scenarios.
"Other" category includes energy from biomass, hydro, demand response, energy efficiency and solar.

…the application of all four building blocks achieves the required CO_2 emissions reduction for the MISO footprint



Thinking outside the blocks

Alternative compliance options achieve the proposed level of CO_2 reduction at a lower cost than the EPA Building Blocks by approximately $3.5B annually.

The difference in the "Other" category is due to modeling assumptions: EPA assumes 1.5% annual growth in energy efficiency as a % of energy sales; MISO assumes continuation of existing energy efficiency programs.

MODELING ASSUMPTIONS

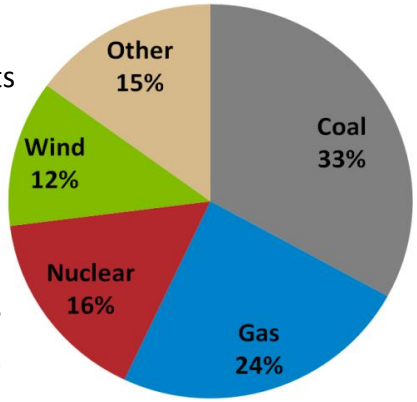
Building Blocks

BB1 = Efficiency improvements for existing coal units

BB2 = Increased CC dispatch

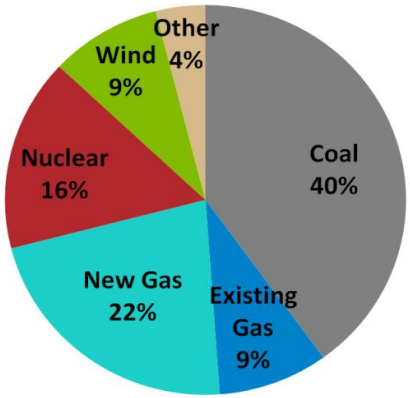
BB3 = Expanded renewables and sustained energy production from nuclear units

BB4 = Expanded demand-side energy efficiency



2030 MISO Energy: All Building Blocks

$60/ton



2030 MISO Energy: CO_2 Constraint

$38/ton

CO_2 Constraint Case

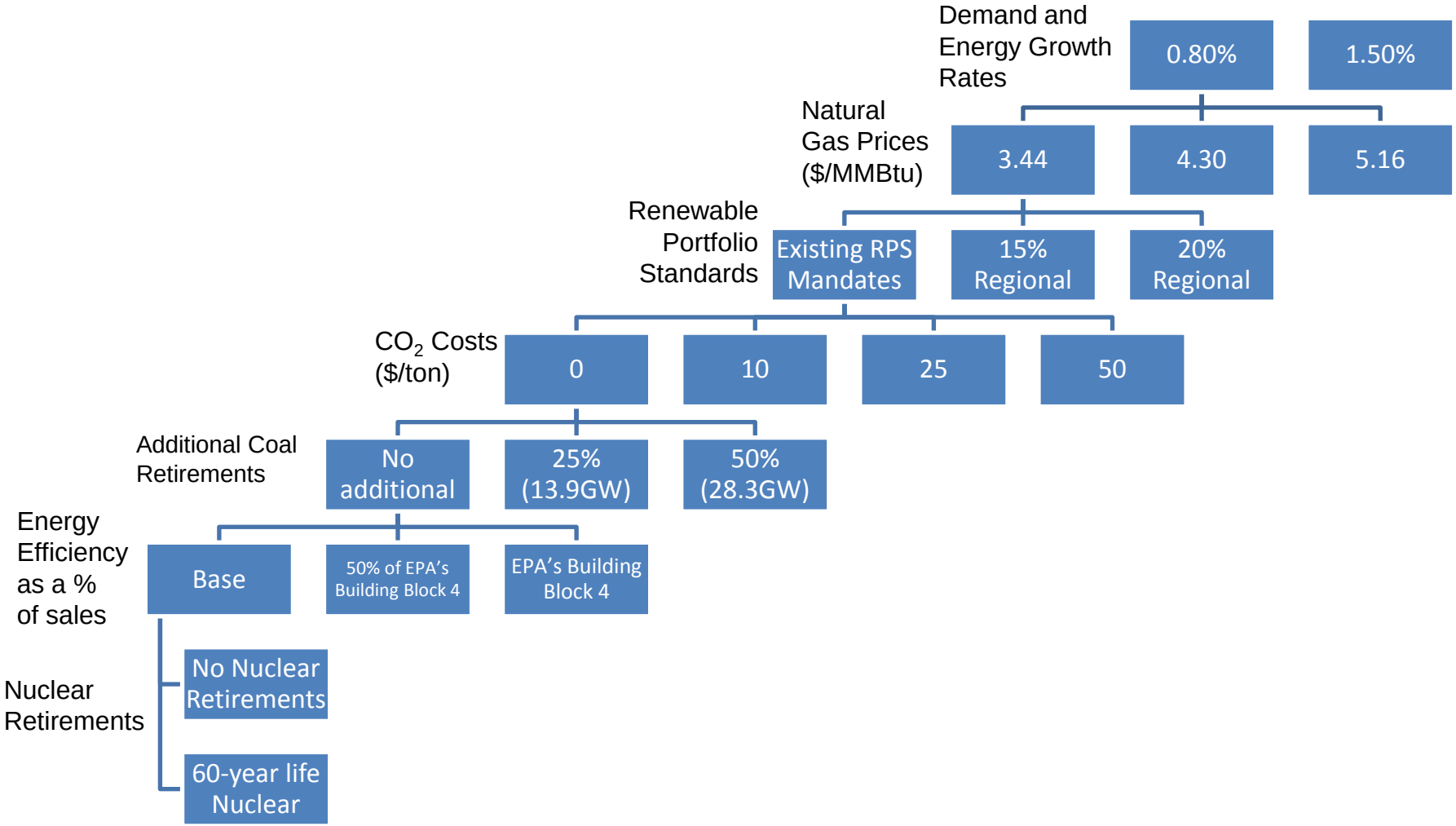
System-wide CO_2 constraint

New gas units more efficient than existing gas units (results in increased dispatch of new CCs/decreased dispatch of higher-CO_2-emitting units)

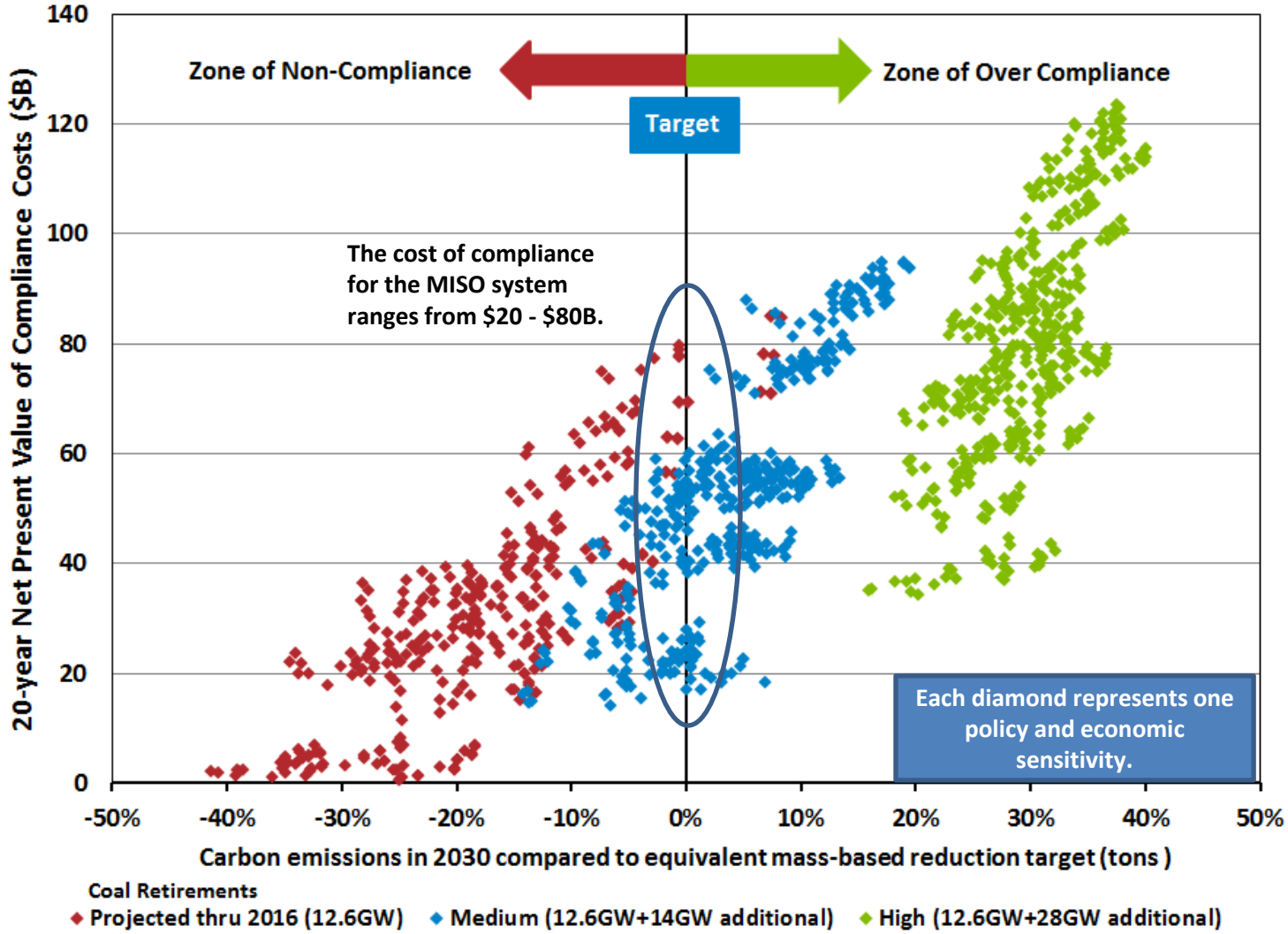
Current Renewable Portfolio Standards & state energy efficiency targets assumed unchanged

In the reference scenario, energy production from new gas is less than 2.3%. "Other" category includes energy from biomass, hydro, demand response, energy efficiency and solar. The results shown for the CO_2 Constraint case are indicative. Further model optimization is required as shown in Phase 2 which indicates potential additional value from increased energy efficiency and coal retirements.

All combinations of the following policy and economic sensitivities were modeled

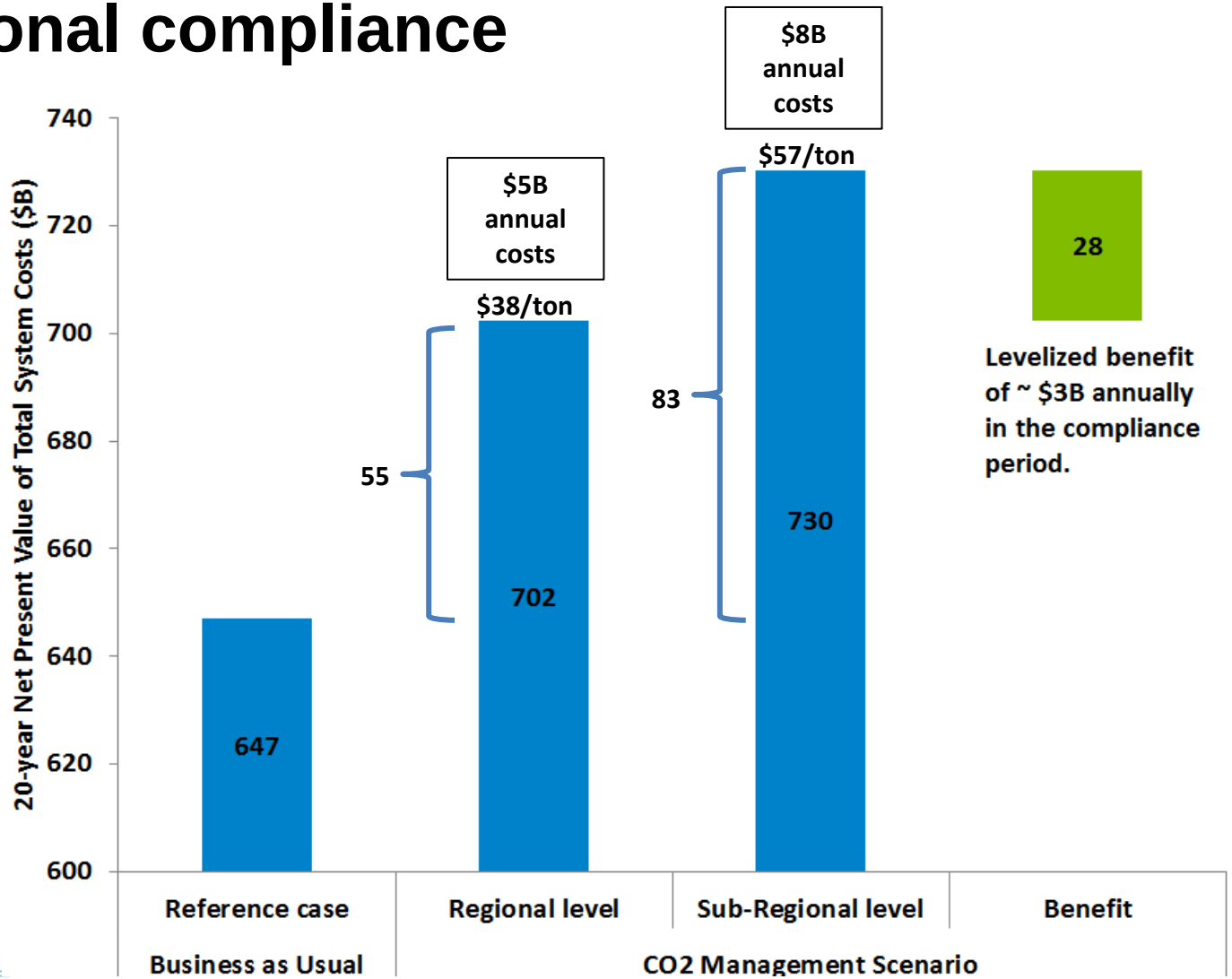


Lower-cost 111(d) compliance strategies retire up to an additional 14GW* of coal capacity

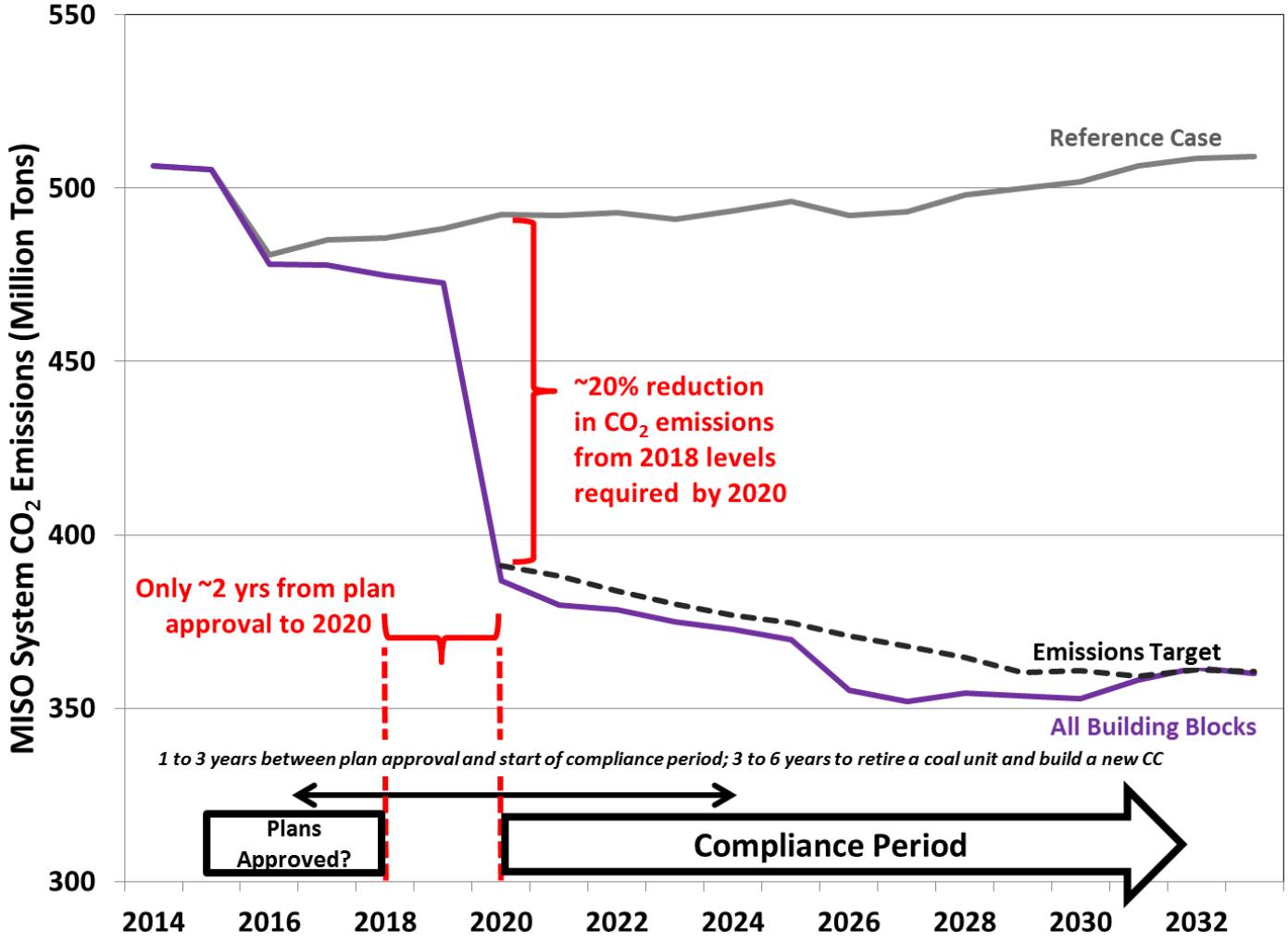


* In addition to the 12.6 GW of capacity already projected to retire.

Regional compliance options avoid costs of approximately $3B annually compared to sub-regional compliance



Is there enough time to reliably implement lower-cost compliance strategies?



Additional Information

- EPA Regulations webpage

  https://www.misoenergy.org/WhatWeDo/EPARegulations/Pages/EPARegulations.aspx

- Planning Advisory Committee: Study Results Presentation

  https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/PAC/2014/20140917/20140917%20PAC%20Item%2002%20GHG%20Regulation%20Impact%20Analysis%20-%20Study%20Results.pdf

- MISO One-Pager on Initial Study Results

  https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/PAC/2014/20140917/20140917%20PAC%20Item%2002%20MISO%20CO2%20Analysis%20One%20Pager.pdf

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