

EGEAS Future Outputs

August 17, 2009 OMS CARP Meeting
St. Paul, MN

CARP Futures

Business as Usual (BAU)

- State RPS requirements

- No limitations on capacity to build

- Escalation of costs at 2.91%

- Demand Growth at 0.75%

- Energy Growth at 1.0%

Business as Usual with High Demand and Energy Growth (BAU+High_DE)

- State RPS requirements

- No limitations on capacity to build

- Escalation of costs at 2.91%

- Demand Growth at 1.6%

- Energy Growth at 2.19%

Federal RPS

- State RPS requirements

- Federal RPS of 20% energy to be served by renewables

- No limitations on capacity to build

- Escalation of costs at 2.91%

- Demand Growth at 0.75%

- Energy Growth at 1.0%

CARP Futures continued

Smart Grid (SmartGrid)

- State RPS requirements

- No limitations on capacity to build

- Escalation of costs at 2.91%

- Demand Growth at 0.3%

- Energy Growth at 1.0%

Carbon Tax (Carbon Tax)

- Models a levelized cost of carbon production at \$100/ton

- State RPS requirements

- Allows existing fleet retirements with retro-fit sequestration available

- Escalation of costs at 4.36%

- Demand Growth at 0.3%

- Energy Growth at 0.3%

Carbon Cap (Carbon Cap)

- State RPS requirements

- Applies a declining cap on carbon production that requires a reduction of 39.5% by 2029

- Allows existing fleet retirements with retro-fit sequestration available

- Escalation of costs at 2.91%

- Demand Growth at 0.3%

- Energy Growth at 0.3%

CARP Futures continued

Federal RPS and Smart Grid (Fed RPS+SmartGrid)

- State RPS requirements

- Federal RPS of 20% energy to be served by renewables

- No limitations on capacity to build

- Escalation of costs at 2.91%

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Federal RPS and Carbon Cap (Fed RPS+Carbon Cap)

- State RPS requirements

- Federal RPS of 20% energy to be served by renewables

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CARP Futures Hot off the Presses

Carbon Cap, Smart Grid, and Electric Vehicle

State RPS requirements

Applies a declining cap on carbon production that requires a reduction of 39.5% by 2029

Allows existing fleet retirements with retro-fit sequestration available

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Federal RPS, Carbon Cap, Smart Grid, and Electric Vehicle

State RPS requirements

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Capacity Expansion

Capacity expansions dominated by state or federal RPS requirements in all cases

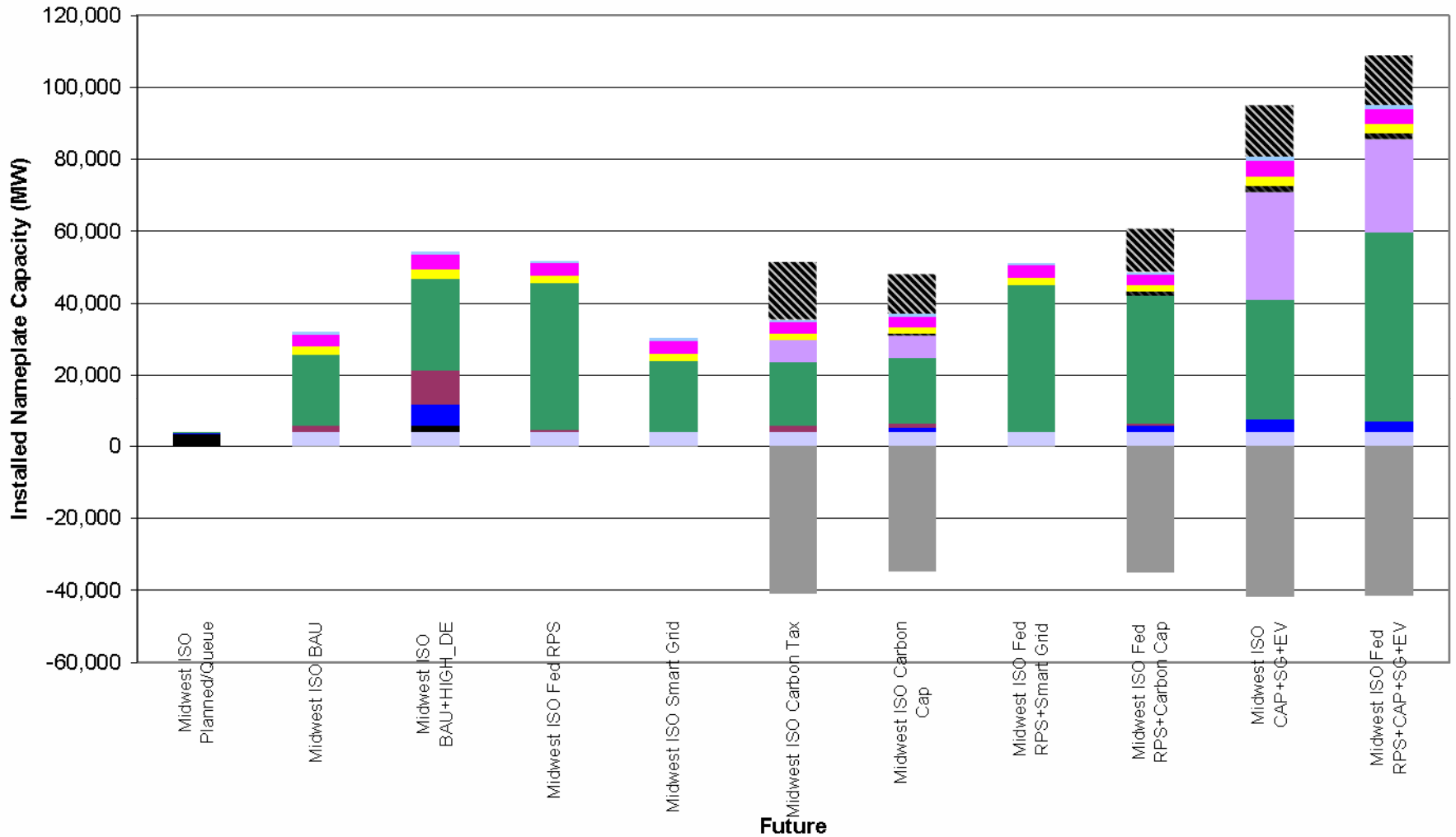
Carbon limitation cases show economic benefit from shifting dependence of fleet away from carbon emitting coal to technology which reduces carbon output of the existing fleet

The Business as Usual with high demand and energy growth and the higher growth carbon cap cases are the only cases that build significant new capacity to meet reliability requirements

All cases start with reserve margins in the 20%-30% range

The Business as Usual case and Federal RPS case build a little capacity for reliability, but not much

2010-2029 Capacity Expansion



■ Planned/Queue
 ■ Coal
 ■ CC
 ■ CT
 ■ Wind
 ■ IGCC w/Seq
 ■ CC w/Seq
 ■ PV
 ■ Biomass
 ■ Hydro
 ■ Sequestration Retro-fit
 ■ Retired Capacity

Total System Costs

Two examples of system costs represented

With allowance credits accounted for at \$50/ton, levelized, which reduces total system production costs

This assumes you can sell credits to your neighbors

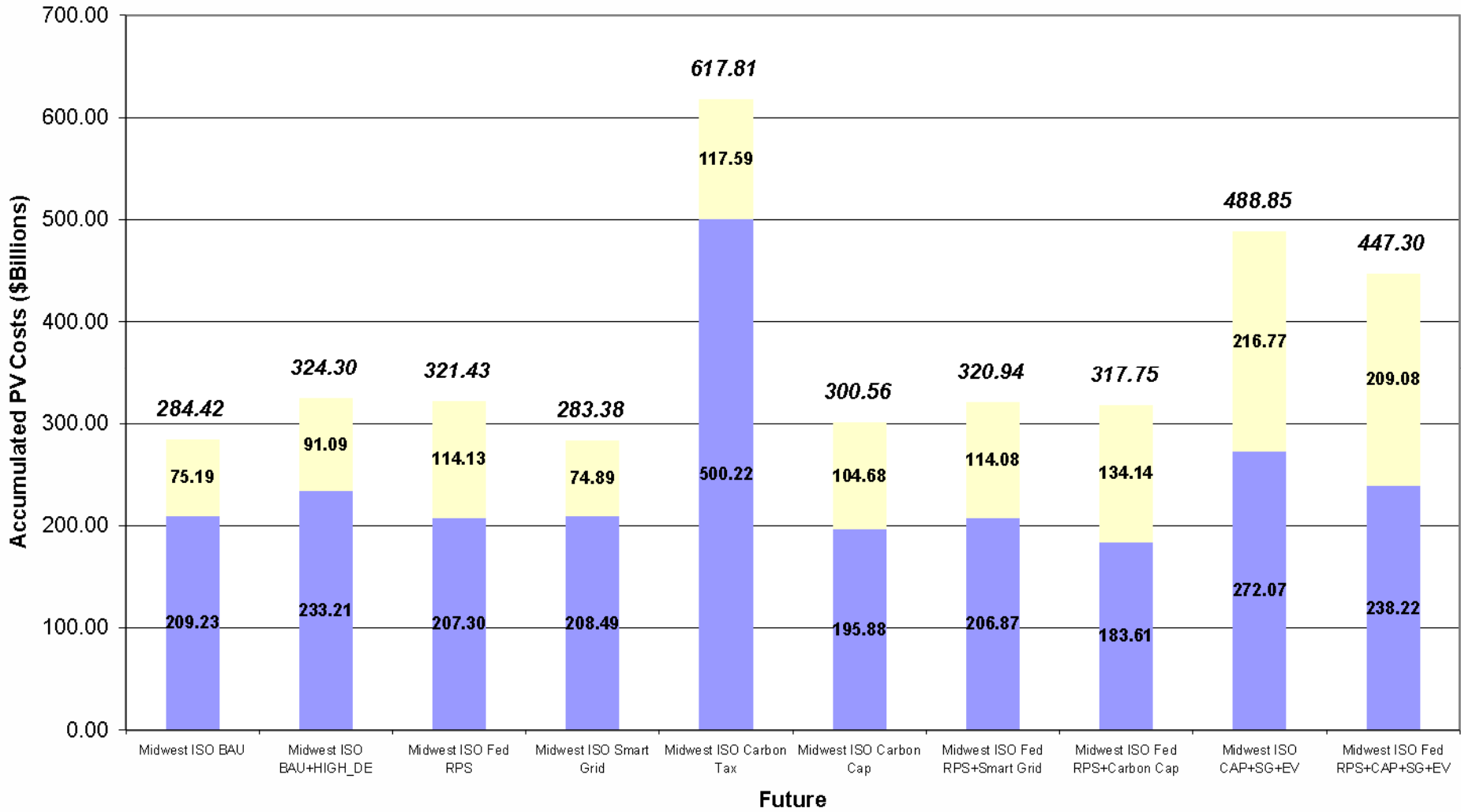
Without allowance credits applied to the reduction of system production costs

System costs are comparable to each other, except for the Carbon Tax case which penalizes the production cost on the system by having the carbon cost adder.

Carbon Cap cases with higher demand and energy growths result in higher overall costs

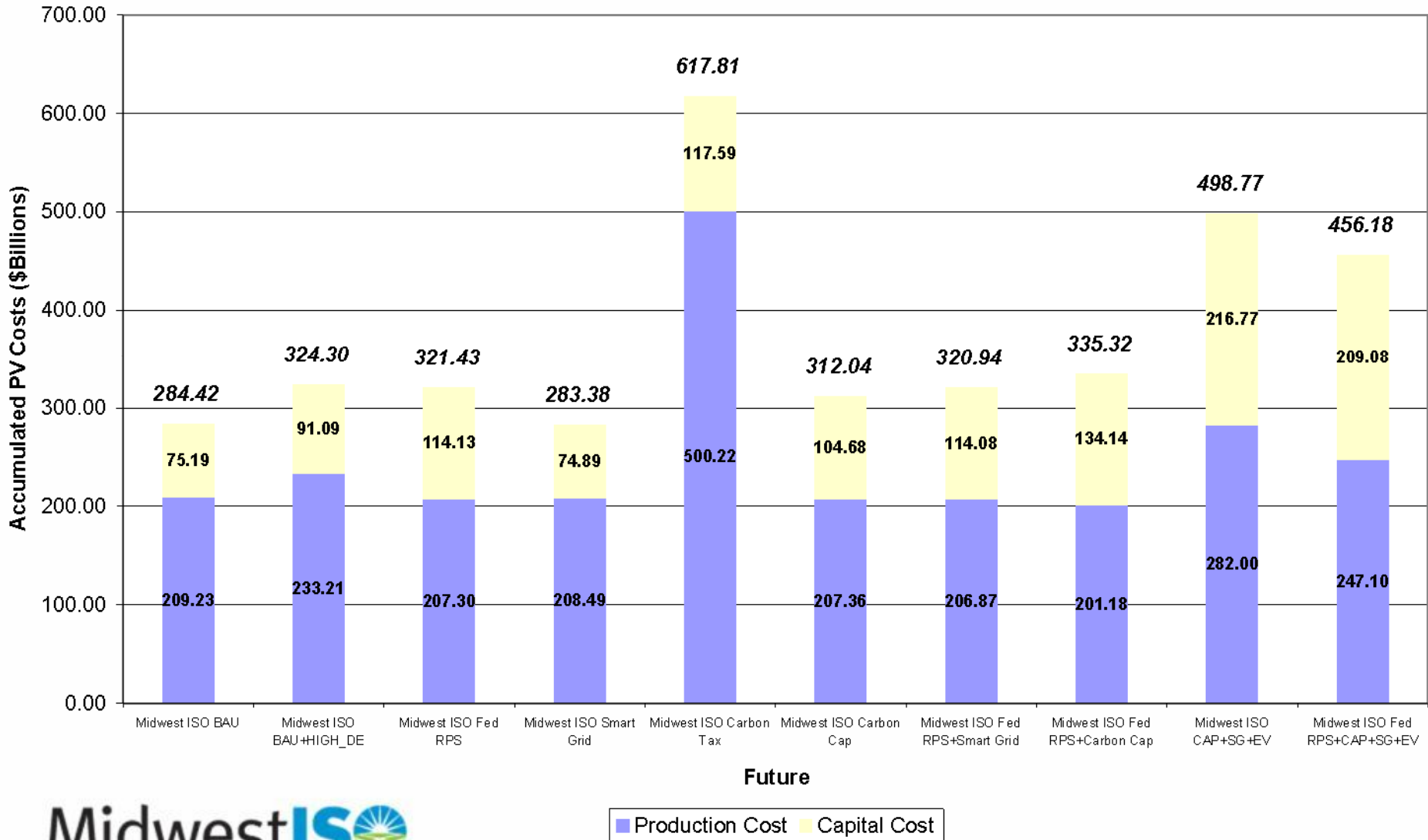
For a comparison of futures it needs to be understood that a difference in demand and energy growths can effect system costs as much as a limitation on carbon or RPS requirements

2010-2029 Present Value Accumulated Costs with Carbon Allowance Credits

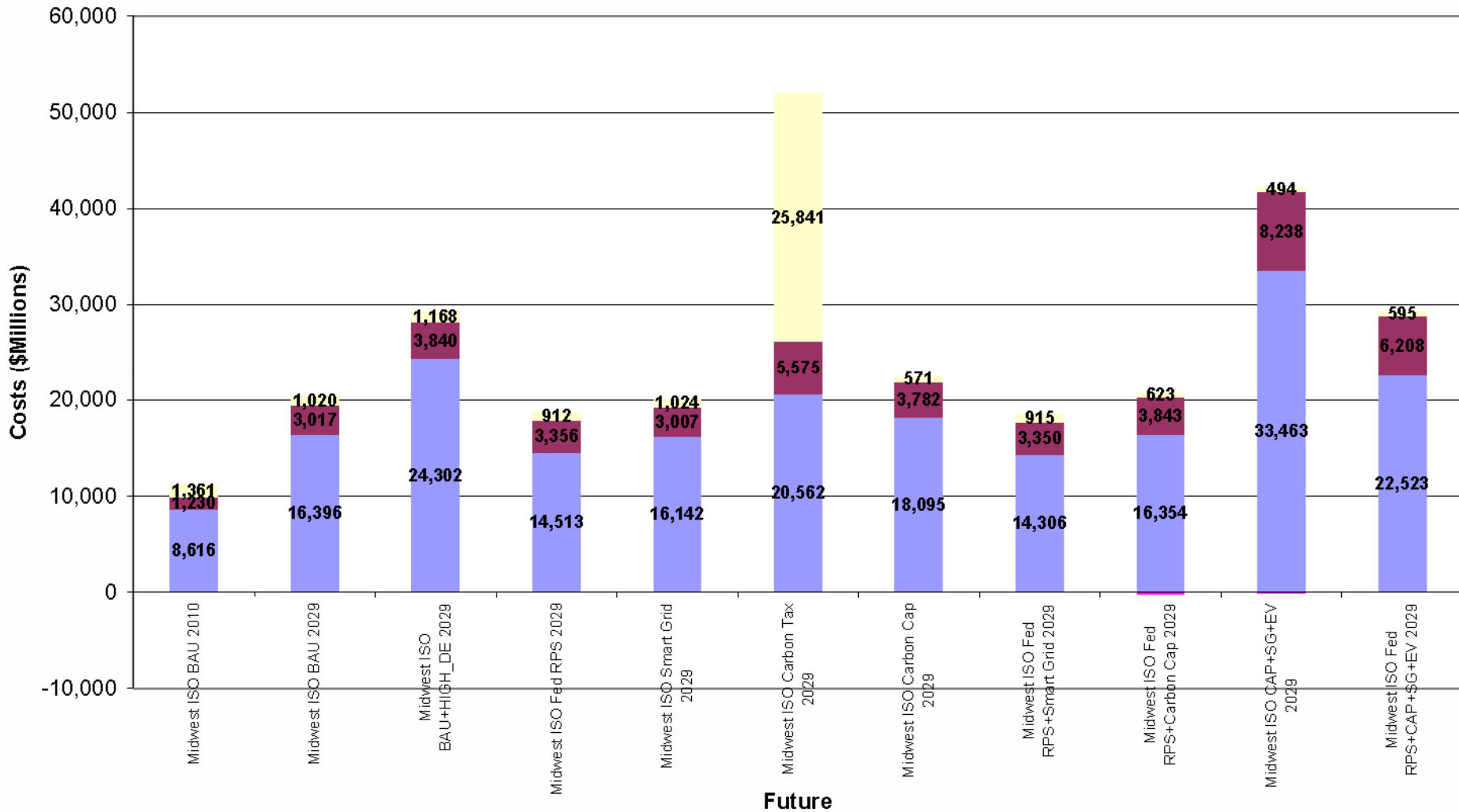


■ Production Cost
 ■ Capital Cost

2010-2029 Present Value Accumulated Costs without Carbon Allowance Credits



Production Cost Breakdown 2029 Data Compared to 2010 Business as Usual Future (Nominal Dollars)

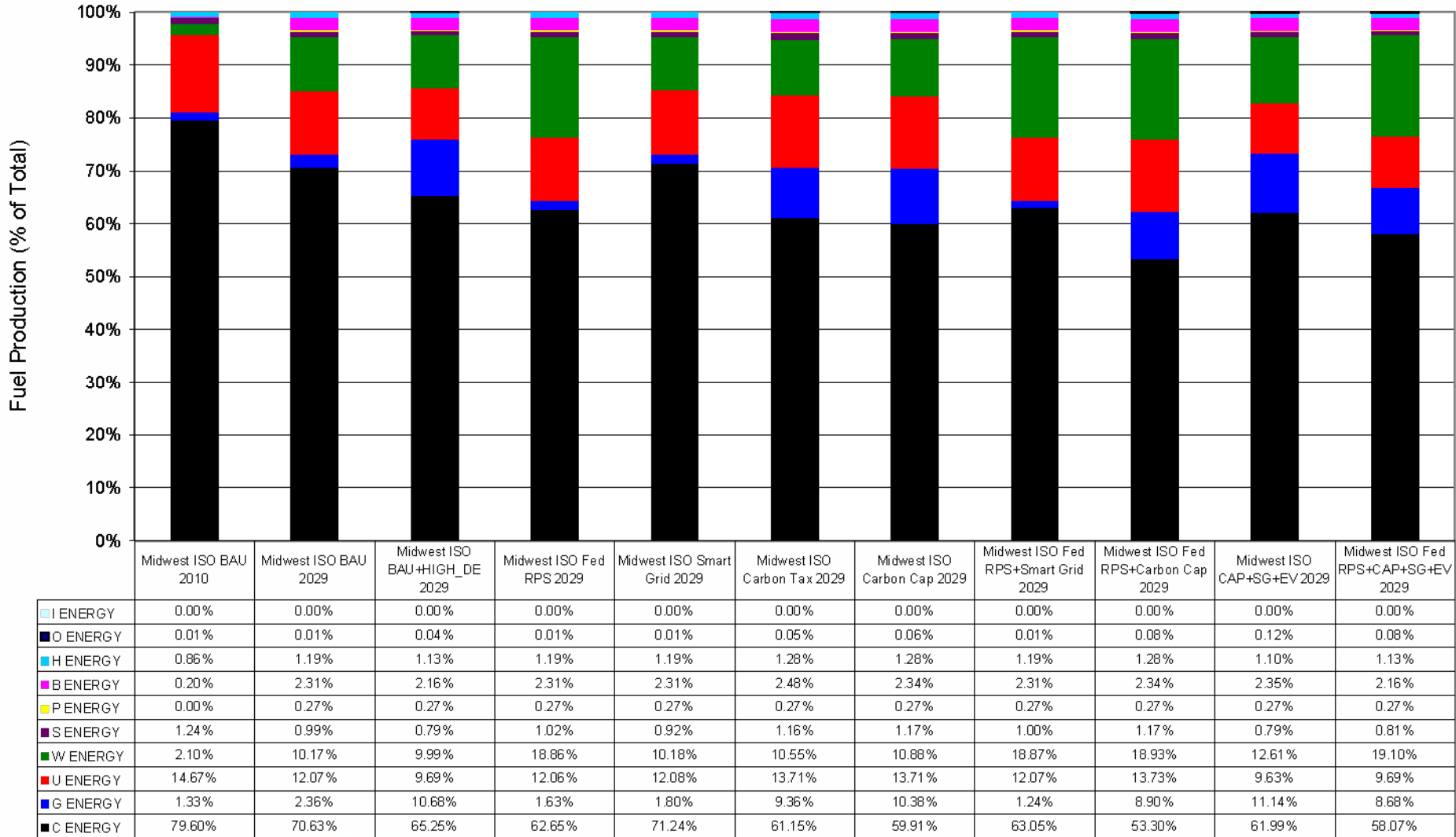


Energy Production by Fuel Type

All Futures show a shift away from coal-fired generation in 2029, compared to the 2010 energy mix

Capacity associated with coal and natural gas fuel sources also include those generated by sequestered units. Therefore, 53% of energy served by the coal fuel source in the Federal RPS+Carbon Cap future is not all carbon producing

Energy Production by Fuel Type



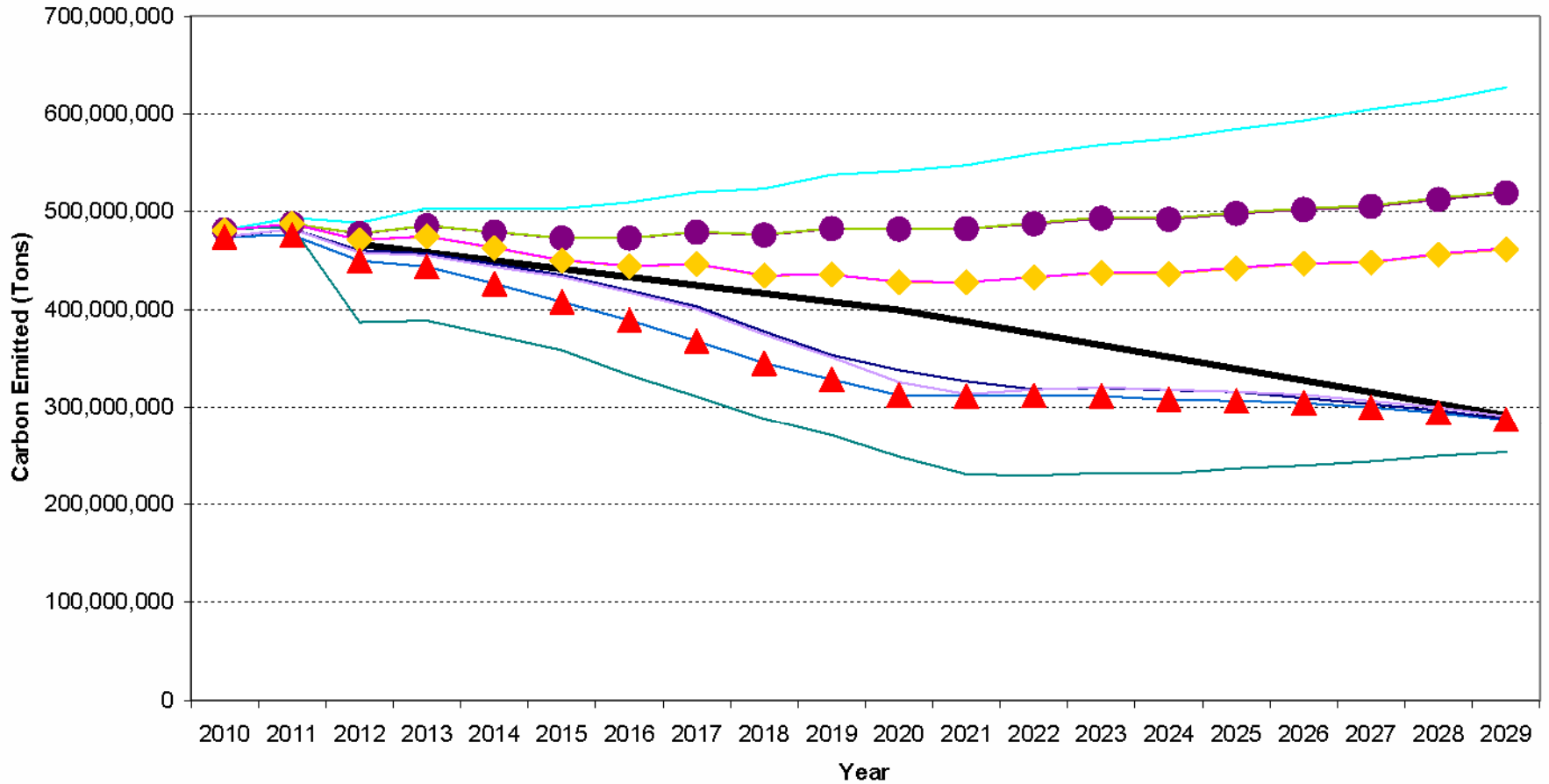
Future

Carbon Outputs

Business as Usual with High Demand and Energy growth shows a significant increase in carbon over the time frame due to meeting current and future energy needs with capacity that is not regulated for carbon production.

Carbon Cap limitation is shown and it should be noted that all carbon limitations, as modeled, stay below cap requirements for the study period

Carbon Outputs



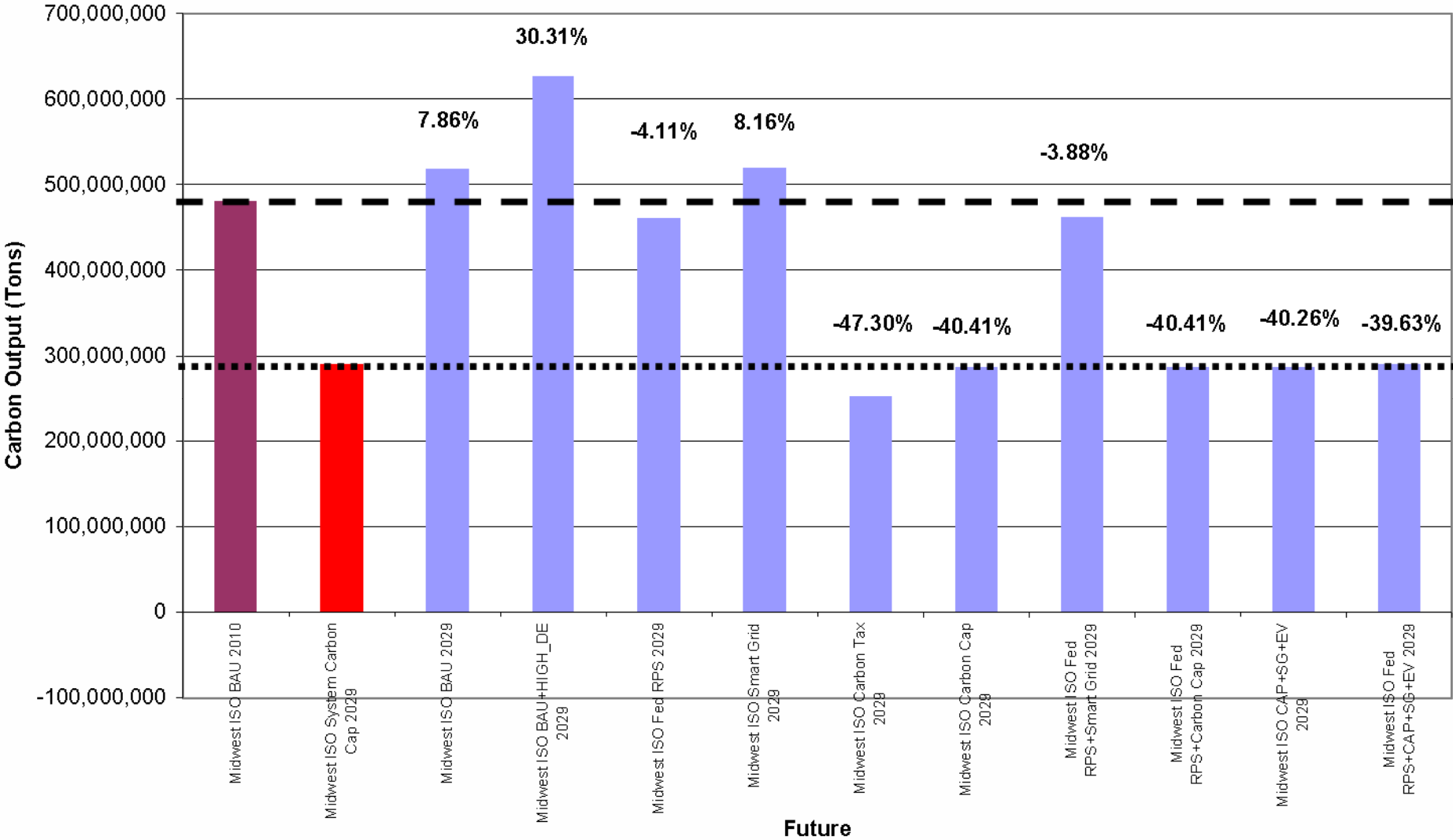
Carbon Reduction %

Carbon limitation cases fall below target carbon reduction objectives (the tax by cost adjustment and the cap cases by meeting the hard constraint)

Federal RPS cases help reduce carbon from 2010 levels

By shifting energy to off-peak production hours, Smart Grid, alone, results in an increase in Carbon production partially because of a greater dependence on an aging, coal-fired fleet

Annual Carbon Production Comparison



Future
Carbon Output



Moving Forward

Midwest ISO Resource Planning staff have a couple of suggestions to move forward.

Selection of 4 futures to carry into PROMOD analysis.

Our recommendations:

Business as Usual with High Demand and Energy

Federal RPS

Carbon Cap

Carbon Cap, Federal RPS, Smart Grid, and Electric Vehicle

Moving Forward continued

Midwest ISO staff would also like to recommend that any carbon limitation future/s chosen would be re-analyzed with a more realistic sequestration penetration date

The models used dates recommended from the EIA Annual Energy Outlook which had 2016 availability

We believe this date should be pushed back to at least 2025 if not further

This will most likely result in outputs that will depend more on a nuclear fleet and perhaps more on the renewable fleet to help meet the carbon objectives modeled

Also, any retirements of existing coal fleet would have a mothballed status applied to it and allow it to be available during summer peak seasons to help reduce capacity build out to meet future resource adequacy needs