EXPORT PRICES AND REVENUES RELATING TO THE NEED FOR AND ALTERNATIVES TO (NFAT) MANITOBA HYDRO'S DEVELOPMENT PLAN

Presentation by:

Robert A. Sinclair. Ph.D.

On behalf of
Potomac Economics, Ltd.
Independent Expert Consultant

POTOMAC ECONOMICS

DR. ROBERT A. SINCLAIR

Vice President at Potomac Economics

Credentials

Ph.D. in Economics. University of Pittsburgh. Areas of expertise include industrial organization, antitrust, regulation, statistical analysis, and microeconomic theory.

Energy Consultant since 1993. Provided expert testimony and reports in a number of jurisdictions on matters relating to competition, prices, and market monitoring in the electric utility industry, including monitoring transmission networks.

DR. DAVID B. PATTON

President of Potomac Economics

Credentials

Ph.D. in Economics George Mason University. Areas of expertise include industrial organization, antitrust, regulation, statistical analysis, and microeconomic theory.

Energy Expert since 1990, including Senior Economist at the Federal Energy Regulatory Commission. Extensive experience as a testifying expert matters relating to competition, prices, and market monitoring in the electric utility industry.

Potomac Economics

- Potomac Economics is a leader in the field of Market Monitoring.

- We perform Market Monitoring functions in the following multi-lateral wholesale electricity markets:

  Midcontinent ISO;

  NYISO;

  ISO-NE; and

  ERCOT (Texas);

Summary of Scope

- We were asked by PUB to examine export market conditions.
- This primarily involves forecast of MISO prices, because the Company's exports are predominantly to MISO.

Issues Addressed in our Presentation:

Forecast of MISO Prices

Other, related export market issues

Certain points raised by MH on rebuttal

Key Project Relationships

Development Costs (Construction)

Extra Development Costs

⇒ Serve Load

Create Export Market Capacity

Development Costs (Construction)

Extra Development Costs

− Export Market Revenues

=

Total Costs to Manitoba

Key Project Relationships

Development Costs (Construction) ⇒ Serve Load

Extra Development Costs ⇒ Create Export Market Capacity

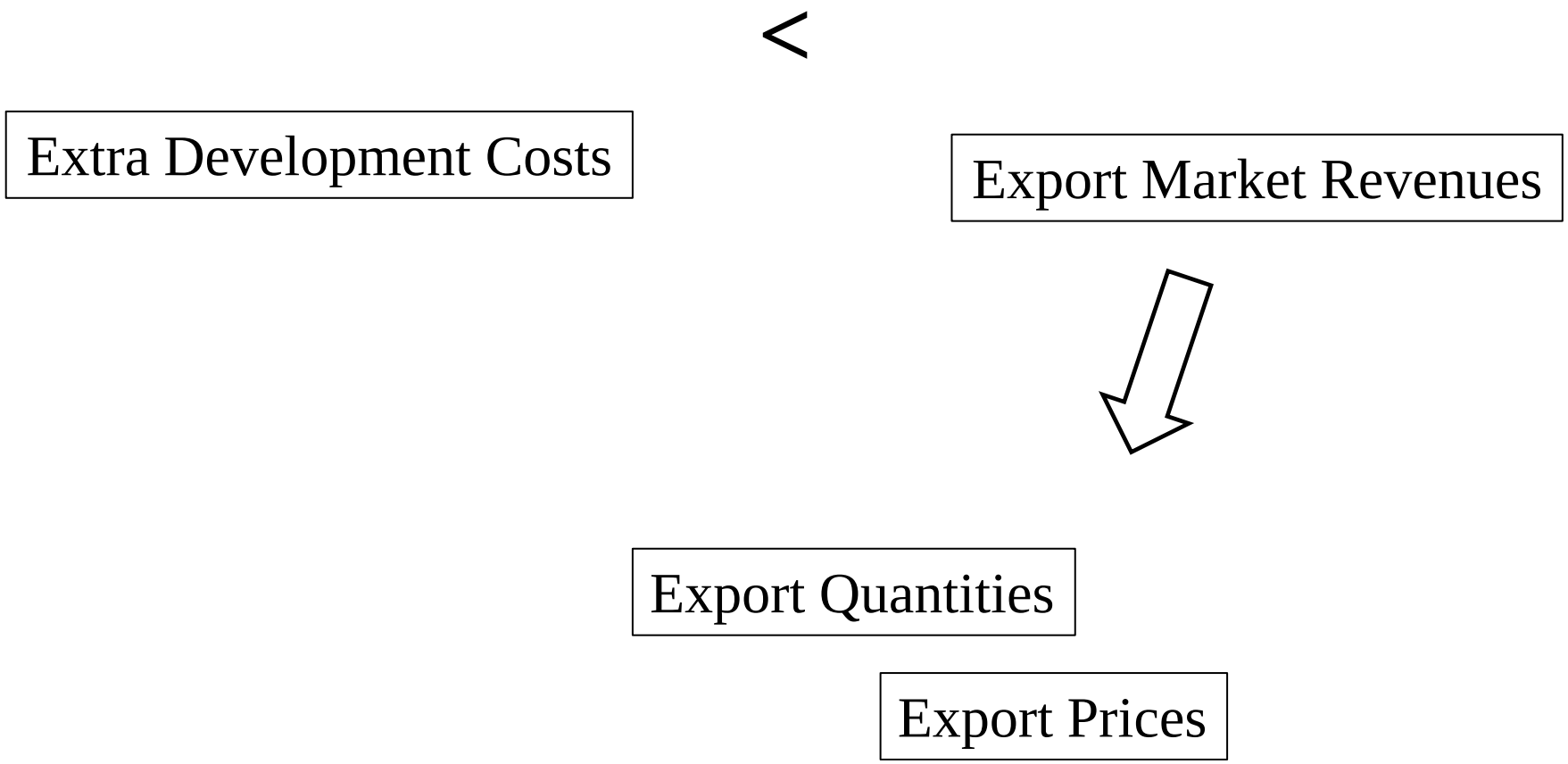
Development Costs (Construction) − Export Market Revenues

Extra Development Costs

=

Total Costs to Manitoba

Key Project Relationships



Export Revenues

Quantities are based on excess capacity and water optimization

We found minor issues, but generally find the quantity forecast to be reasonable

We developed our own forecast to assess the Company's Forecasts

Export Quantities

Export Prices

Manitoba Export Prices

- Manitoba uses the results of six consultants to establish estimates of MISO export prices.
- The forecasts include three products
  - ✓ On-Peak Energy
  - ✓ Off-Peak Energy
  - ✓ Capacity
- The availability of the underlying data for the forecasts was restricted.
  - ✓ As a result, we developed our own forecasts that would enable us to assess the Company's forecasts.

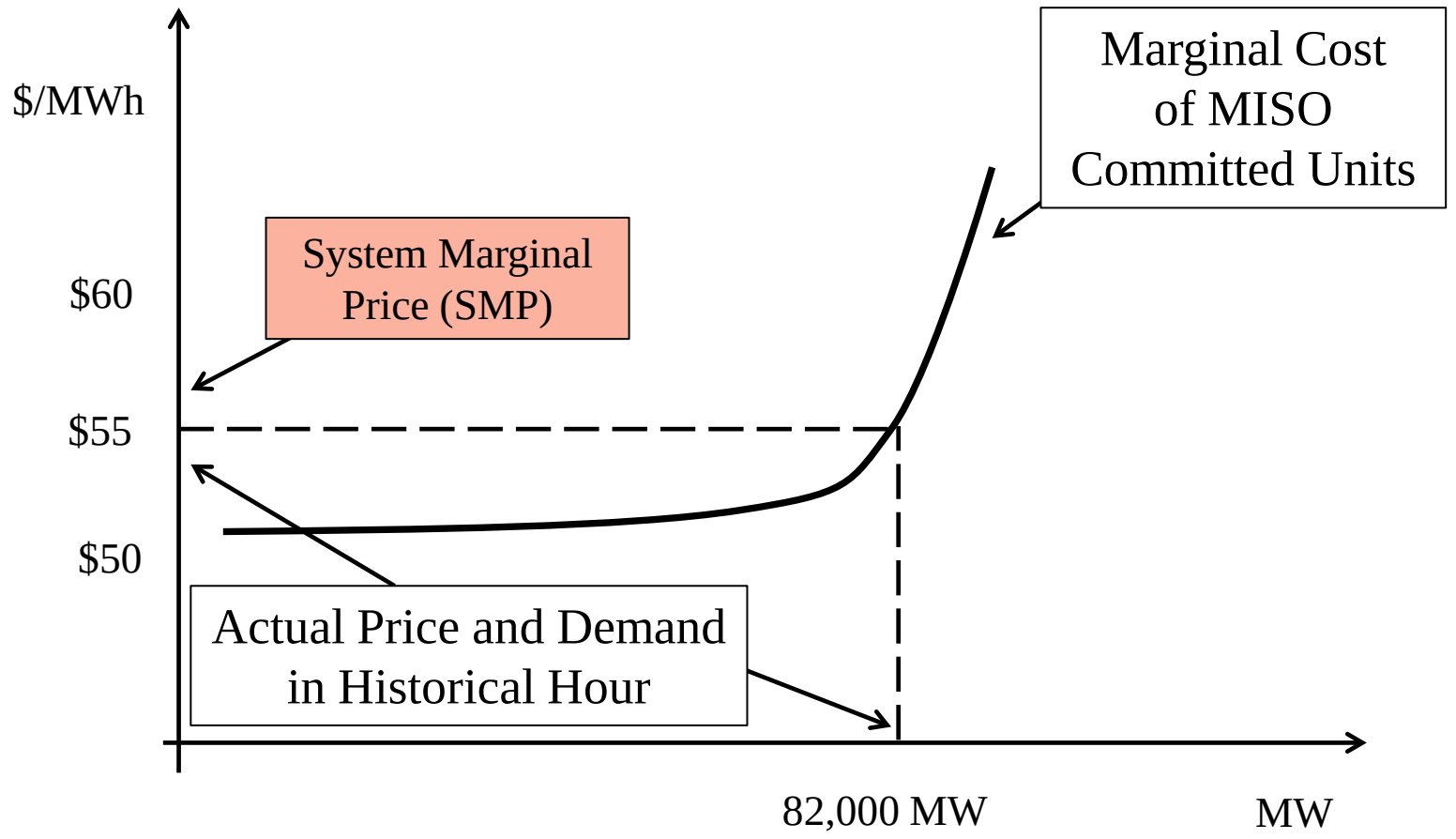
On-Peak and Off-Peak Energy Price Forecasts

POTOMAC ECONOMICS

Potomac Economics Energy Prices

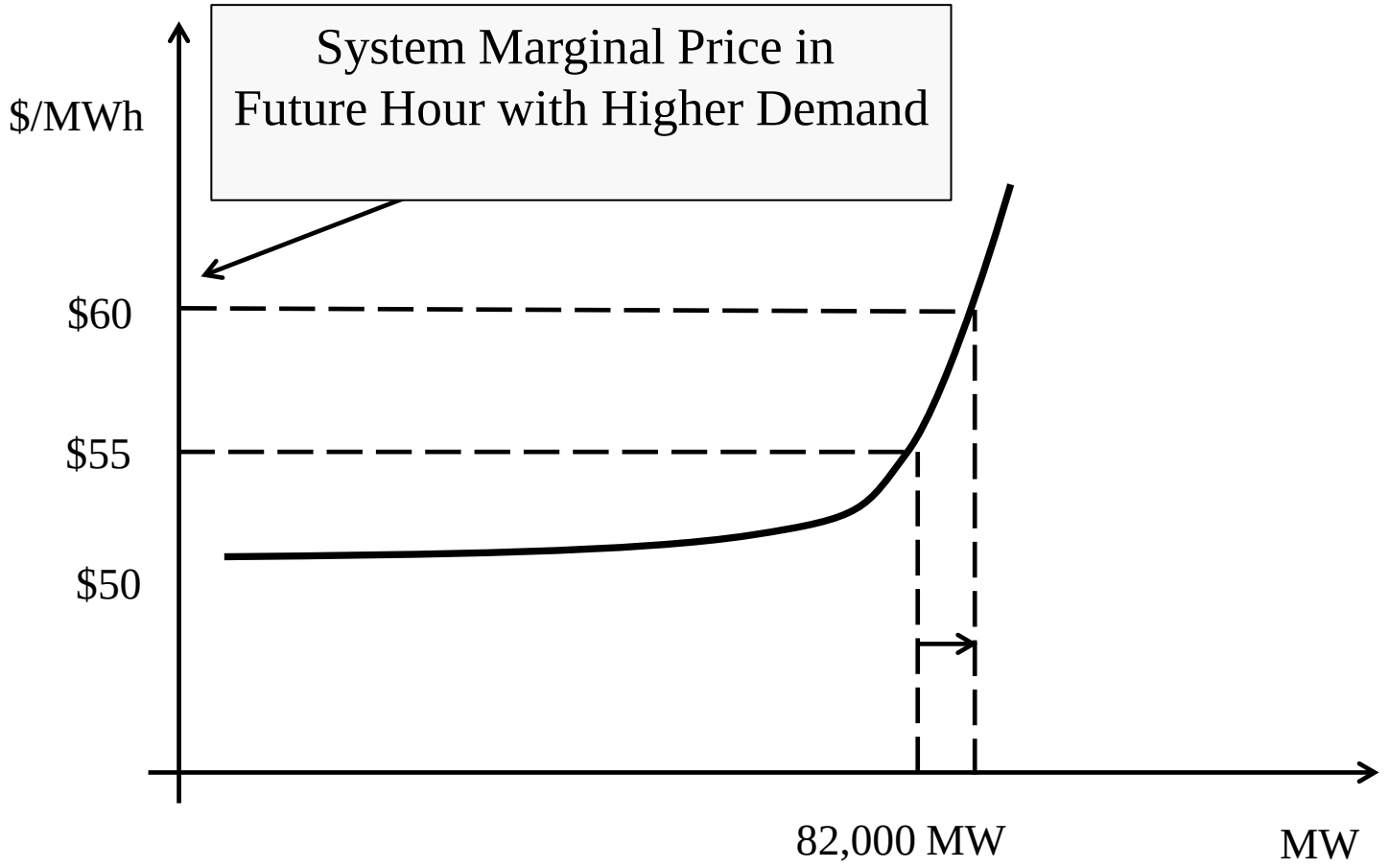
- Our forecast includes 20 years -- 2015-2034
- We use the day-ahead market as the basis of the forecast.
- Our forecasts are based on MISO supply curves from the two most recently available years (2011 and 2012).
  - ✓ We have supply curves from each hour of the two years.
- For each hour, we observe:
  - ✓ The as-offered marginal cost of MISO units committed in that hour;
  - ✓ MISO demand;
  - ✓ Actual clearing price.

Hourly MISO Supply Curve (Illustration)



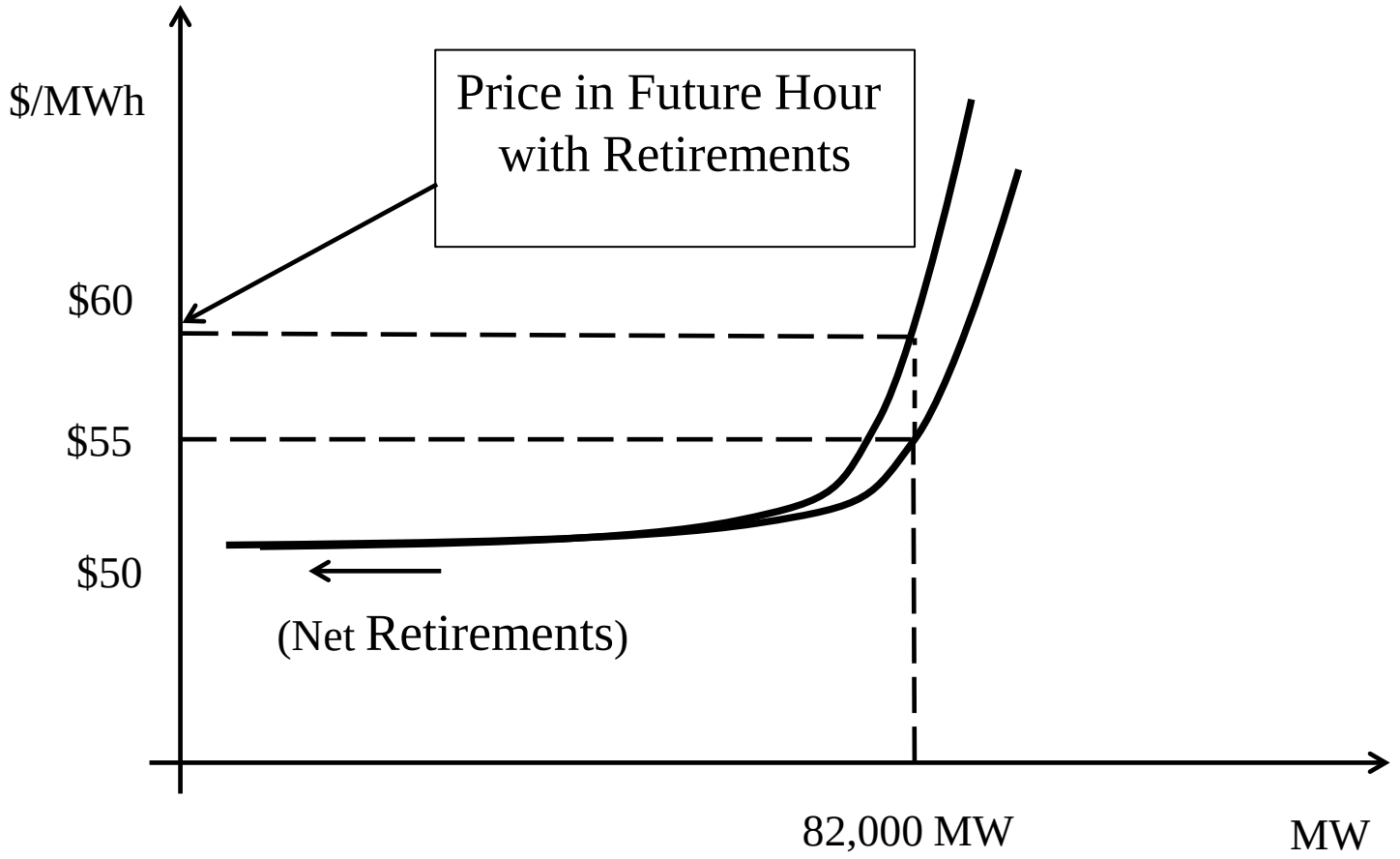
POTOMAC ECONOMICS

Hourly MISO Supply Curve (Future Hour w/ Higher Demand)



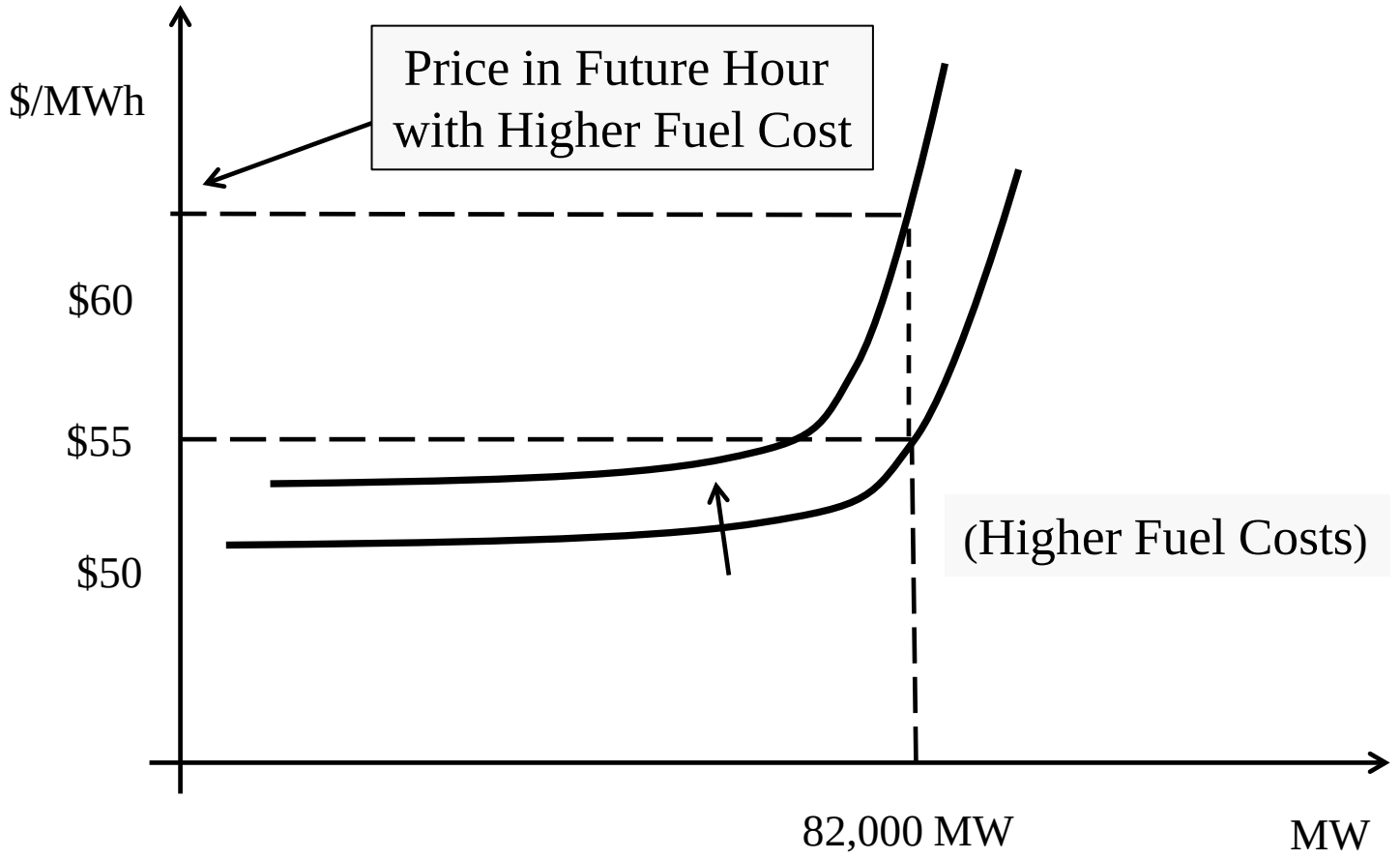
POTOMAC ECONOMICS

Hourly MISO Supply Curve (Future Hour w Retirements)



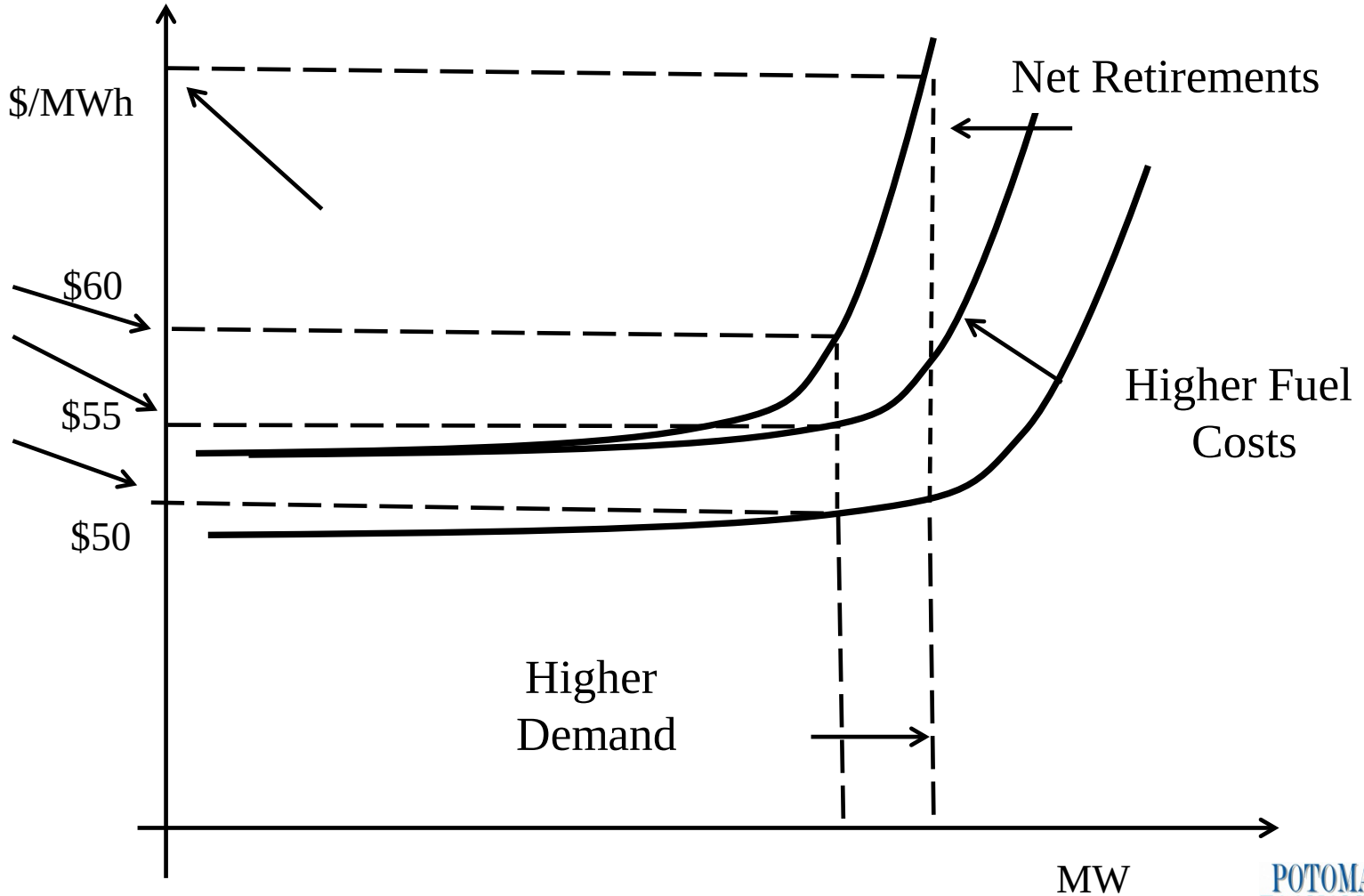
POTOMAC ECONOMICS

Hourly MISO Supply Curve (Future Hour Higher Fuel Costs)



POTOMAC ECONOMICS

Hourly MISO Supply Curve (Multiple Effects)



POTOMAC ECONOMICS

Forecast of MISO Energy Prices (Main Determinants)

1. **Capacity Additions and Retirements**

Net Retirements

2. **Fuel Costs (Coal, Natural Gas and Carbon)**

3. **Load Growth**

Higher Fuel Costs

Higher Demand

Forecast of MISO Energy Prices (Main Determinants)

1. **Capacity Additions and Retirements**

2. **Fuel Costs (Coal, Natural Gas and Carbon)**

3. **Load Growth**

We make a range of assumptions regarding these main determinants. This results in four alternative cases:

1.-2. Reference Case (with and without Carbon costs)

3. High Growth Case

4. Low Fuel Price Case.

Reference Case

1. Capacity Additions and Retirements

- Our capacity additions and retirements over the 20-year forecast period are based on U.S. Energy Information Agency (EIA) reference case.
  - ✓ 7,700 MW of Retirements
    - – 6,100 MW are coal retirements
  - ✓ 9,200 MW of Additions
    - – 4,000 MW of Wind (most of it de-rated).
  - ✓ We also balance the system in any year there is a capacity deficit by adding natural gas capacity.
    - – In reference case we add 4,000 MW over 20 years.

Reference Case

2. Fuel Costs

- Our fuel costs are based on U.S. Energy Information Agency reference case.
  - ✓ Natural gas costs increase from $3.26/MMBTU in 2015 to $6.31/MMBTU in 2034
  - ✓ Coal costs increase from $0.94/ MMBTU in 2015 to $1.55/MMBTU in 2034
  - ✓ Carbon prices start at $13.14 in 2021 and increase to $24.78 in 2034
    - – This is not an EIA assumption. EIA assumes no carbon prices.
    - – Our value comes from Independent Expert Consultant Mr. Sabine of MNP

Reference case

3. Load Growth

- Our load growth is based on U.S. Energy Information Agency reference case, although we adjust it for Carbon price.
  - ✓ Our load growth projections result in a cumulative 10 percent growth over the 20-year period.
  - ✓ We use the EIA reference case from 2015 to 2021, but reduce the growth rate thereafter to reflect carbon costs.
    - – For years starting in 2022, we use the load growth rate from EIA's $10 carbon price case.

Alternative Forecasts

- Besides our reference case forecast, we produced three alternatives to cover what we view as the large range of potential outcomes.
  - ✓ Reference Case No Carbon
  - ✓ High Resource Production case (Low Fuel Price Case)
    - US Production of natural gas is assumed to be higher (affecting both natural gas and coal prices).
    - Electricity Demand is lower.
  - ✓ High Growth Case
    - Economic growth is higher, leading to higher fuel prices and higher demand.

Congestion and Losses

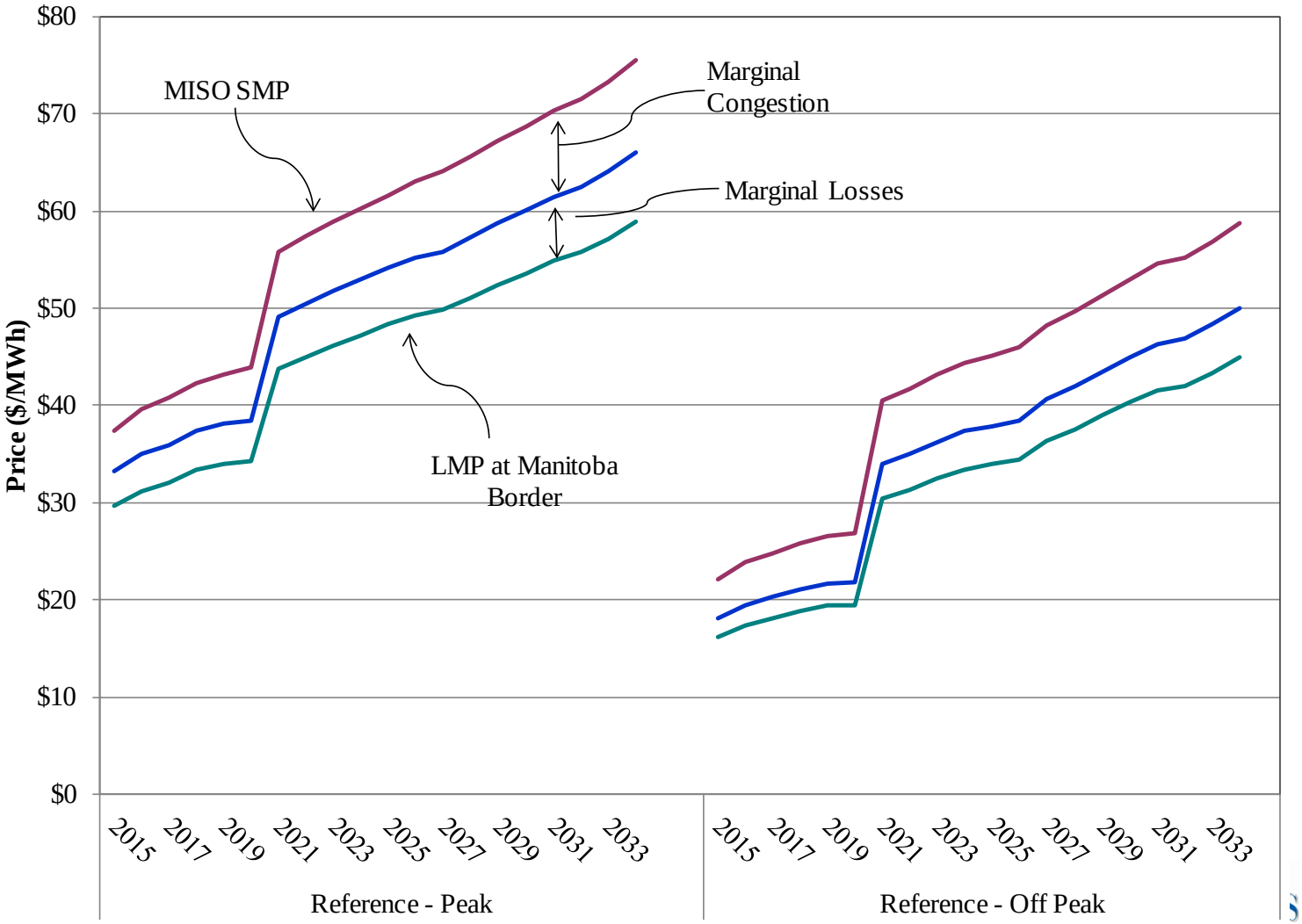
- The price estimated by the process described above is the MISO System Marginal Price (SMP).
  - ✓ It is based on all MISO units and MISO demand
- SMP is the cost of the meeting load in MISO ignoring losses and congestion.
- We are interested in the Locational Marginal Price (LMP) at the Manitoba Border.
  - ✓ This is the price MH would receive in MISO

LMP = SMP – LOSSES – CONGESTION

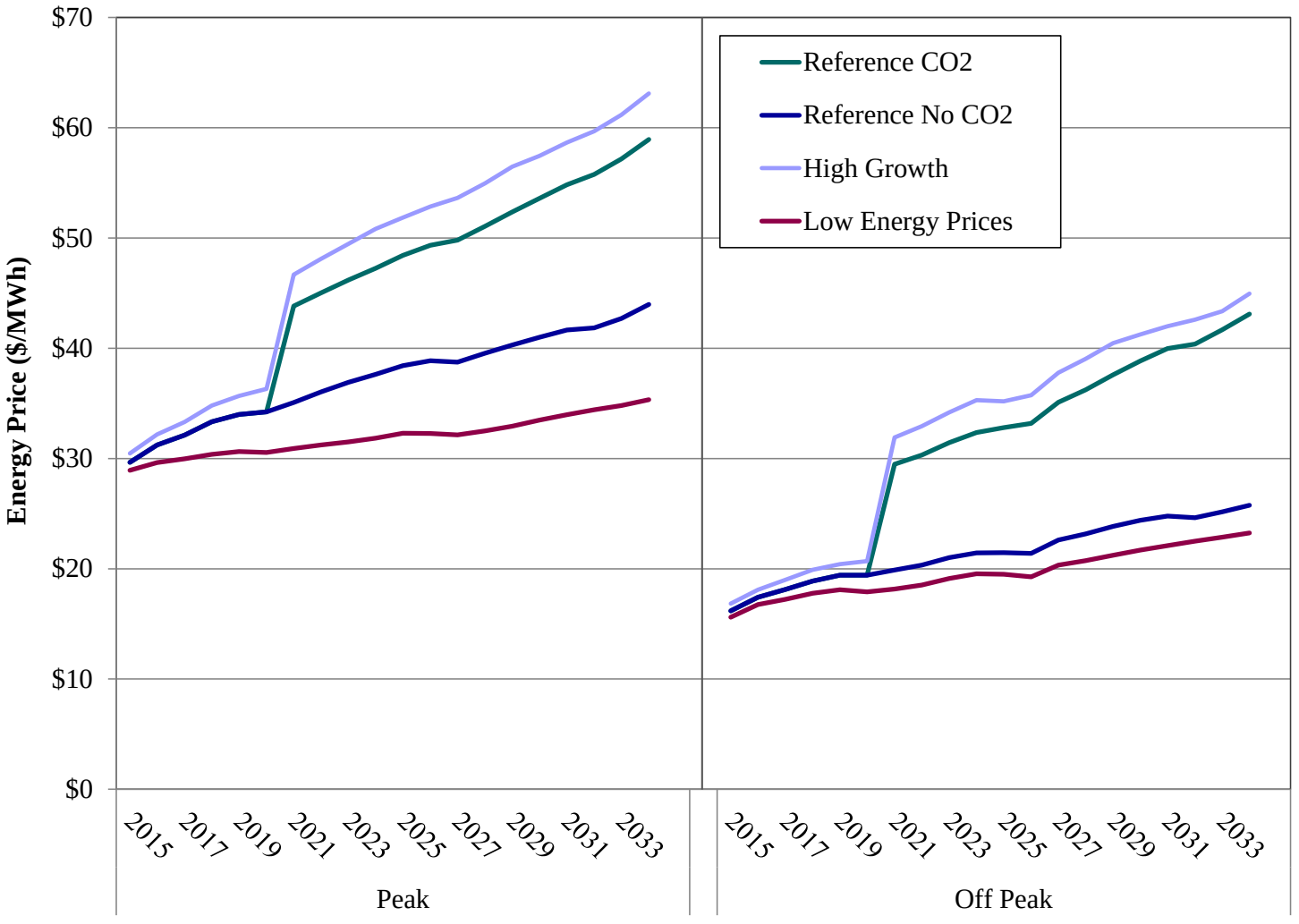
Congestion and Losses

- We used average losses over the years 2011-2012 as the basis for the loss component of the LMP at the Manitoba Border.
  - ✓ This was about 9 percent.
- We estimated congestion cost using linear regression techniques.
  - ✓ We hypothesized that congestion was determined by various market and operating factors.
  - ✓ Our estimates indicate that average congestion was
    - 12 percent in on-peak hours and
    - 16 percent in off-peak hours.
- The following Chart shows our reference forecasts.

Potomac Economics Energy Price Components Reference Forecast with Carbon



Potomac Economics Energy Price Forecasts



CAPACITY PRICE FORECAST

POTOMAC ECONOMICS

Potomac Economics Capacity Price Forecast

- Our capacity price is based on the net Cost of New Entry or "net-CONE."
- The net-CONE of a resource is
  - ✓ the annual carrying cost and other fixed cost of a new combustion turbine

  NET OF
  - ✓ the variable profits earned in the MISO energy and ancillary services markets.

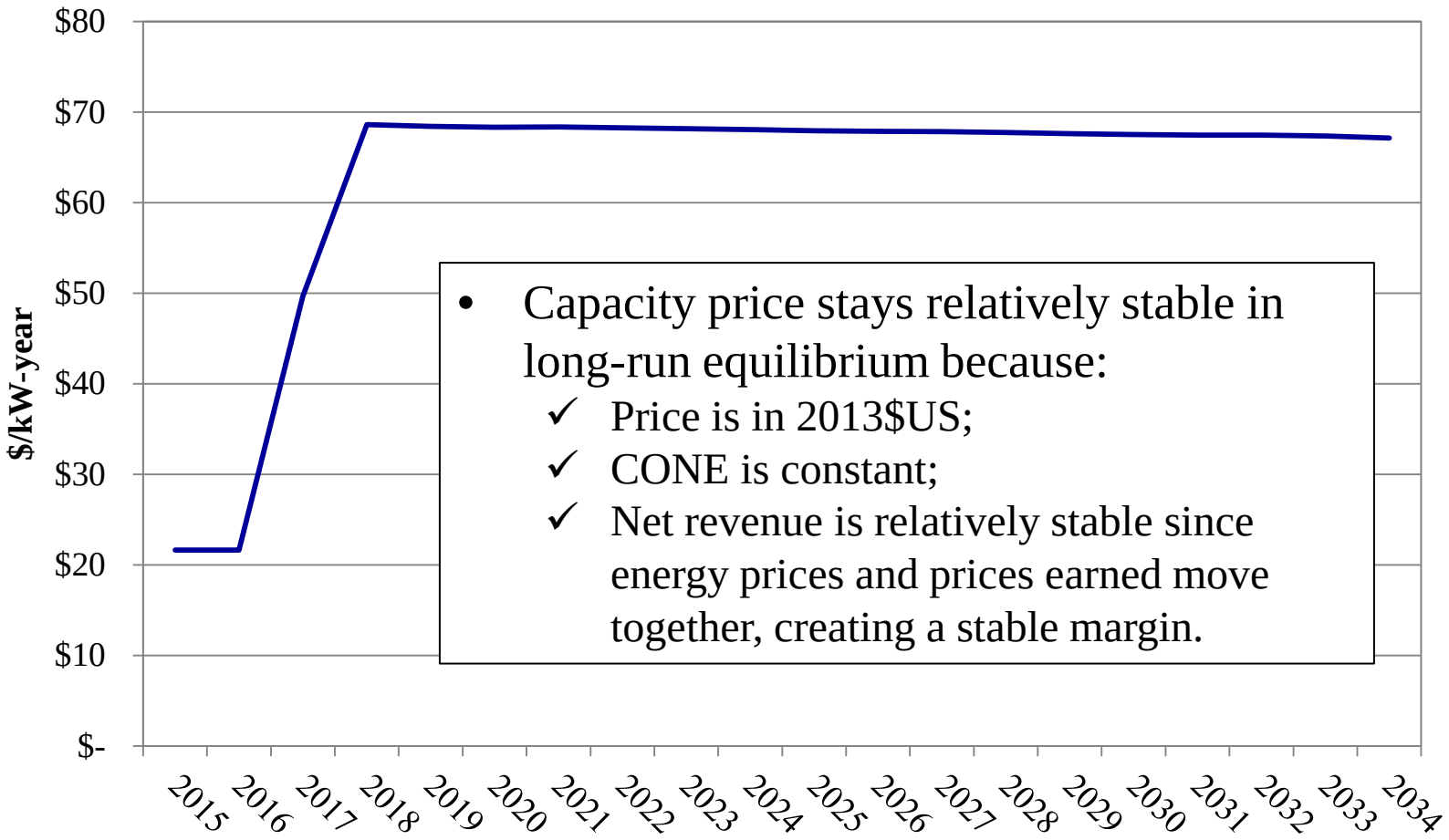
Potomac Economics Capacity Price Forecast

- The net-CONE approach recognizes that suppliers need a capacity price high enough to make entry profitable.
- A capacity price too high will cause excess entry and depress energy prices, leading to lower net revenue and excess planning reserves.
- A capacity price too low will defer entry and increase energy prices and lead to insufficient planning margins.

Potomac Economics Capacity Price Forecast

- We estimate the CONE of a natural gas Combustion Turbine to be $89.95/kW.
  - ✓ This is based on EIA assumptions for an advanced CT
- Hence net CONE would be the CONE minus the annual per-kW net revenue earned by a CT in the energy and ancillary service markets.
  - ✓ Net revenues are the variable profit based on our price forecast for each year.
- We expect MISO will begin to need new resources in 2018. Until then, capacity prices will be lower than net-CONE due to excess capacity.

Potomac Economics Capacity Price Forecast



- Capacity price stays relatively stable in long-run equilibrium because:
  - ✓ Price is in 2013$US;
  - ✓ CONE is constant;
  - ✓ Net revenue is relatively stable since energy prices and prices earned move together, creating a stable margin.

Capacity Price Forecast

- Capacity Price should be interpreted with three caveats:

1. MH will likely have to rely on bilateral contracts and face possible preference for self-building inherent in integrated utility resource development.
2. Over the long time frame of the forecast, generation technology may become cheaper and reduce the cost of new entry and, thus, the capacity price.
3. Net revenues are based on the MISO SMP. In congested locations, (most likely in the east), these areas will have a lower net CONE value and set the capacity price.

Other Export Market Issues

POTOMAC ECONOMICS

Export Market Issues

- Overall, we conclude that Manitoba will likely be able to sell the volumes it assumes in its plans.

Some qualifications:

- We believe recent historical data should be the basis for assuming the portion of dependable energy sold at long-term firm contracts.

CSI

ISSUES RAISED ON REBUTTAL

POTOMAC ECONOMICS

Rebuttal Issues

- MH Rebuttal p. 95-97, *Potomac Economics Forecast energy prices generally within range of MH experts*.
  - ✓ Our effort was to establish the best forecast possible, not necessarily to establish one higher or lower than MH consultants.
  - ✓ However, our forecast is generally lower than the MH composite.
- MH Rebuttal at p. 98: *Potomac Economics has improperly dismissed MH forecasts*.
  - ✓ The underlying data for 5 of the 6 consultants was not available for analysis.
  - ✓ Only Brattle was available for further analysis.

Rebuttal Issues

- MH Rebuttal Evidence at p. 98*: Potomac Economics improperly interpreted Consultants' Capacity analysis*.
  - ✓ Without the underlying data, we could not fully determine the method used by the various consultants.
  - ✓ Accordingly, we had to infer based on the level of the final capacity prices.
- MH Rebuttal p. 101, *Potomac Economics misunderstood Brattle Capacity analysis inputs.*
  - ✓ We read the Brattle report to be using a $1200/kW Combustion Turbine. We were misinformed.
  - ✓ Based on the MH rebuttal, we understand they used the lower value.

Rebuttal Issues

- MH Rebuttal Evidence at p. 105: *Potomac Economics coal retirements assumption is outside of the mainstream*.
  - ✓ We based our assumption on EIA projections, which we do not believe are outside of the mainstream.
    - EIA work is a careful evaluation that has been ongoing for many years.
  - ✓ When carbon costs are included, the marginal retiring coal plant is comparable to the marginal cost of a CCGT. Hence, higher retirements do not result in higher off-peak prices.
    - ✓ The following table illustrates this.

Marginal Cost of Natural Gas and Coal Plants
Reference Case with Carbon 2030

Unit Type	Fuel Delivery (/MMBtu)	Commodity (/MMBtu)	Heat Rate (Btu/KWh)	Fuel Cost (/MWh)	Carbon Cost ($/T)	Carbon Cost (/MWh)	Marginal Cost w/Carbon Price (/MWh)
CCGT-New	$ 0.50	$ 5.64	6500	$ 39.91	$ 20.38	$ 10.52	$ 50.43
CT-New	$ 0.50	$ 5.64	9500	$ 58.33	$ 20.38	$ 10.52	$ 68.85
Coal (1960s)	$ 1.50	$ 1.43	10000	$ 29.30	$ 20.38	$ 20.79	$ 50.09

Rebuttal Issues

- MH Rebuttal Evidence at p. 106: *Potomac Economics Carbon emission rates are simplistic*.
  - ✓ We use a constant emission rate for all coal units and a constant rate for all natural gas units.
  - ✓ Changing the rate to vary by efficiency is not likely to have a significant impact.

Rebuttal Issues

- MH Rebuttal Evidence at p. 107*: Potomac Economics capacity expansion is too simplistic*.
  - ✓ We assume the capacity deficiency in a given year is served one-half by a new CCGT capacity and one-half by CT capacity.
  - ✓ This assumption will have very little impact on prices;
    - ✓ For the reference case, we add 4000 MW of natural gas capacity to meet deficiencies.
    - ✓ This is about 11 percent of CCGT and CT capacity in MISO's north and central region expected by 2034.

Conclusion

- This concludes the public part of my presentation.
- Commercially Sensitive Information to be provided at appropriate time.

Thank you