# Joint System Analysis Advisory Committee and Resource Adequacy Advisory Committee Technical

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- Mark Dyson, ROCKY MOUNTAIN INSTITUE
- Tom Chisholm, USACE

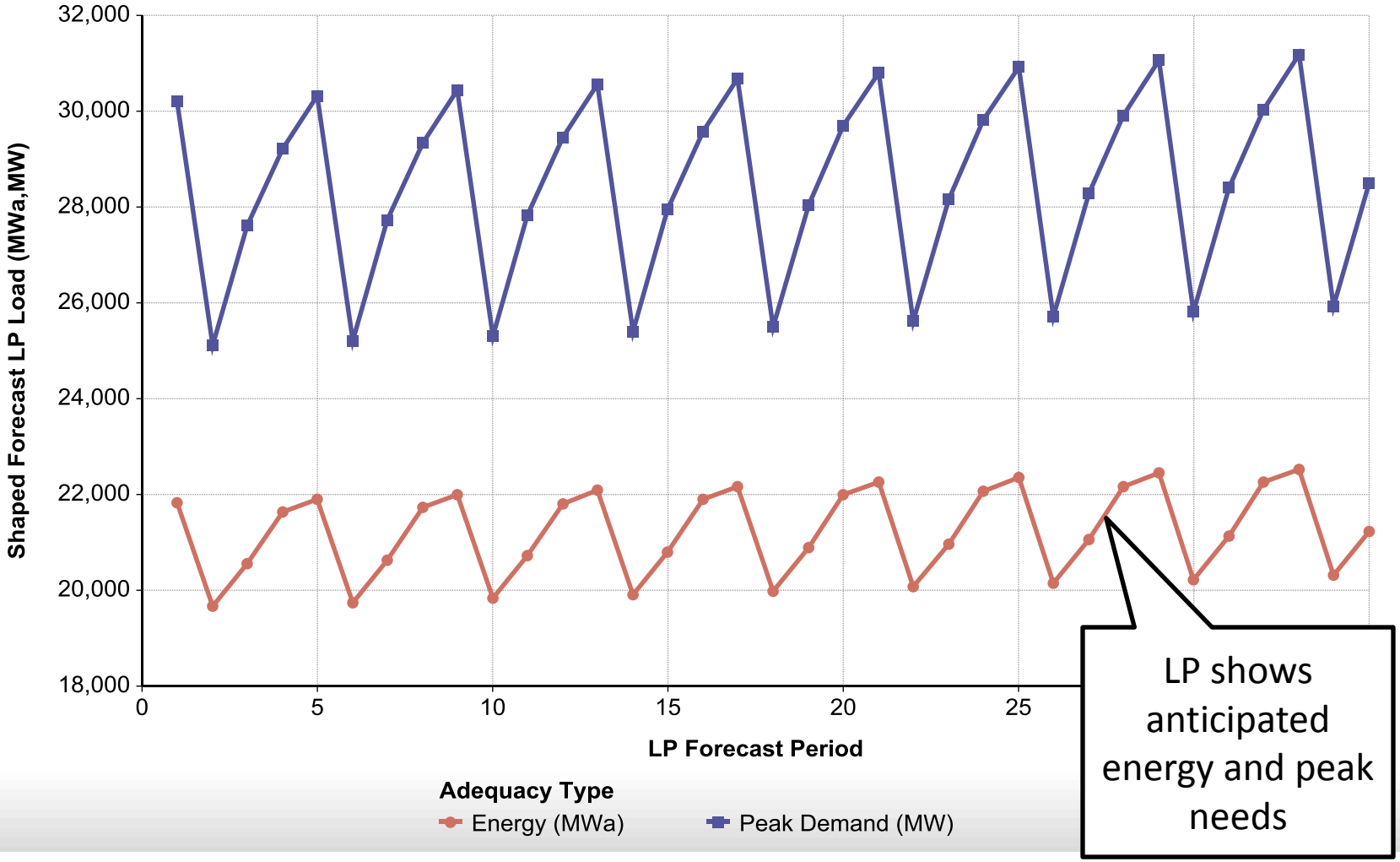
# Adequacy Resource Build Logic

- "Forecasts" Load Net of Conservation
  - To avoid confusion, the LP agent-based "forecast" will be referenced as the look-ahead in subsequent bullets and slides
- Accounts for retirement and resources under construction (all RPS, economic and adequacy driven additions)
- Uses look-ahead load and anticipated resource additions/subtractions to estimate future adequacy needs based on ARMs
- A linear program solves for optimal resource additions and then resources needed for the next decision period are extracted

# LP Look-Ahead Load

- Agent-based internal look-ahead forecast uses historic information to project growth
- Perceptions lag behind actual change
- Look-ahead currently uses 35 periods

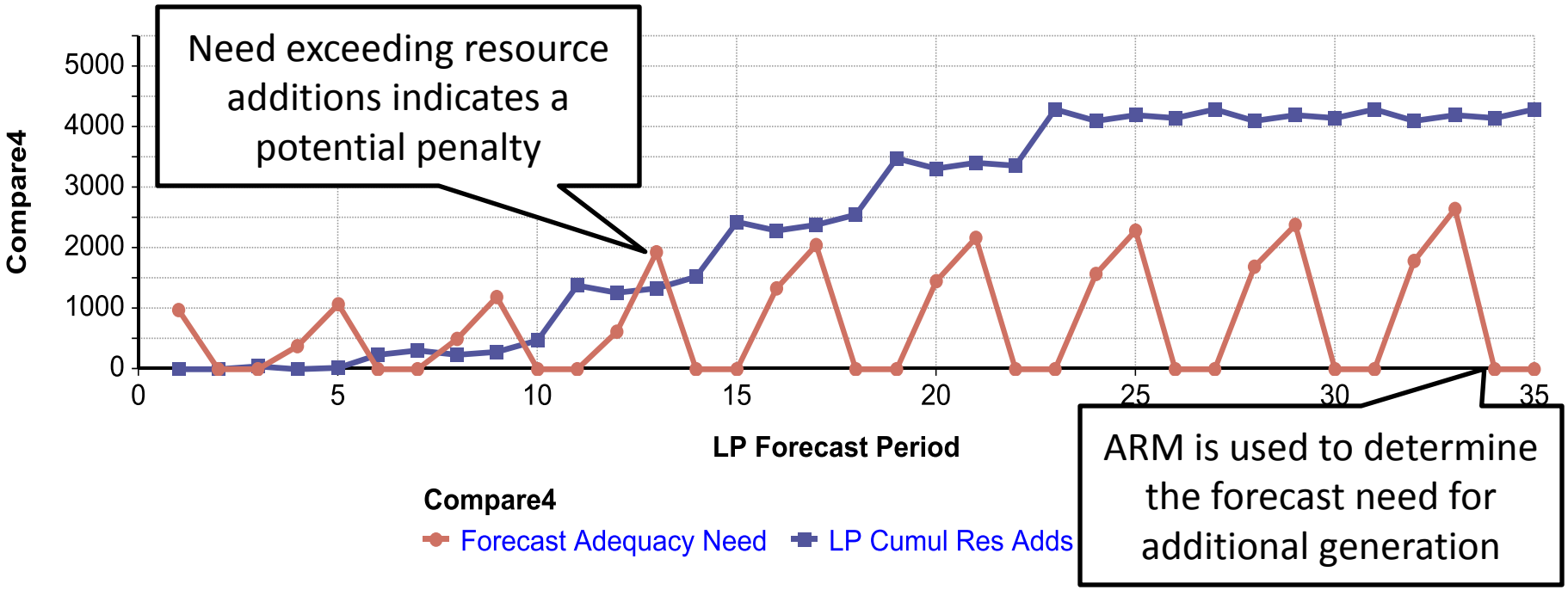
# LP Look-Ahead
# Example Load "Forecast"



# LP Look-Ahead Adequacy Need

- Based on ARMs the LP projects the need for additional resources
- Adequacy need is based on look-ahead load, thus it may not match actual surplus/deficit

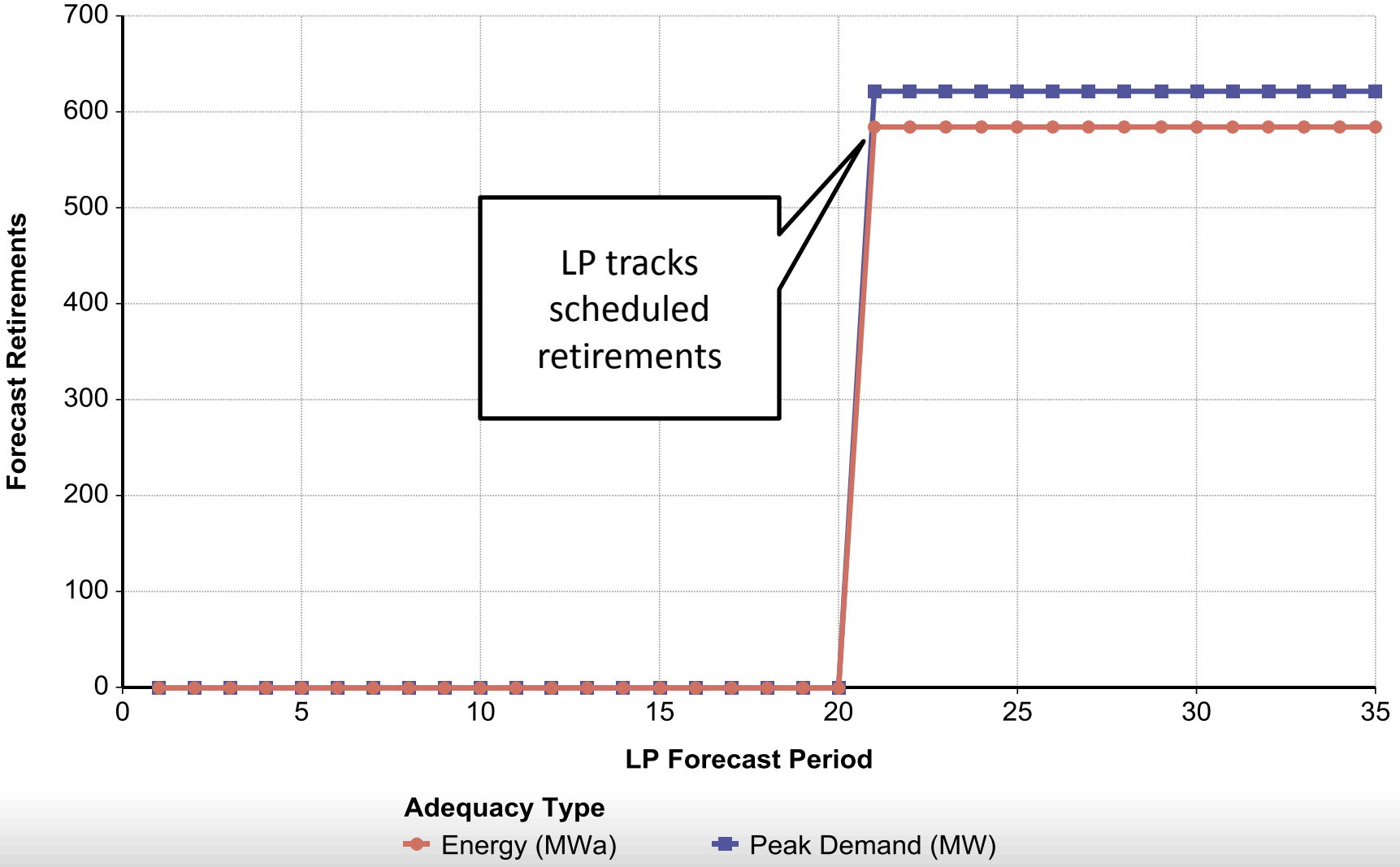
# Peak Resource Additions Vs. Look-Ahead Peak Need



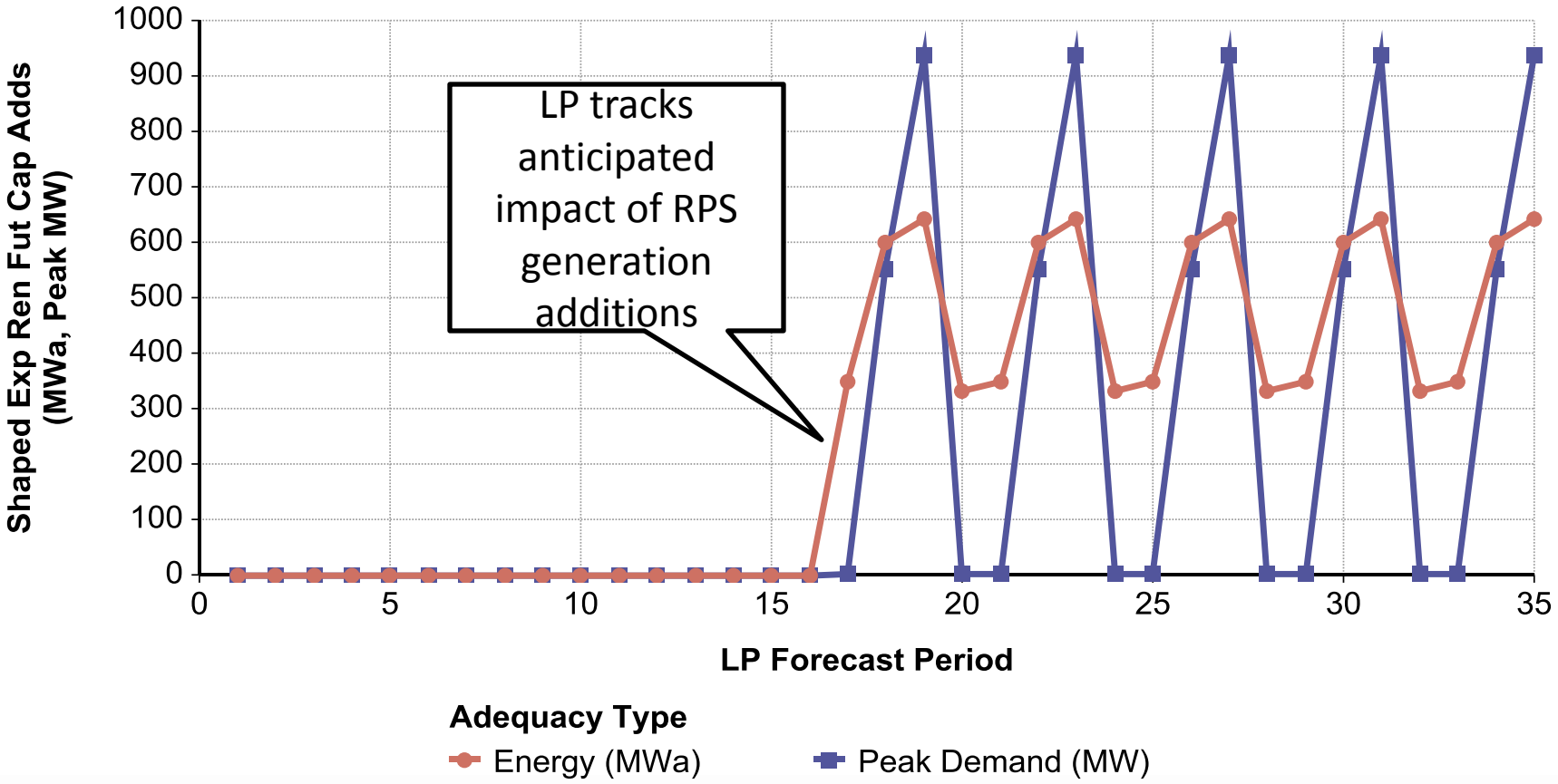
# LP Look-Ahead Retirements and Renewables

- Retirements are accounted for which is an improvement over previous logic
- Renewables added for RPS are also accounted for so the RPM does build when RPS resources will fill in an adequacy need

# LP Look-Ahead Retirements



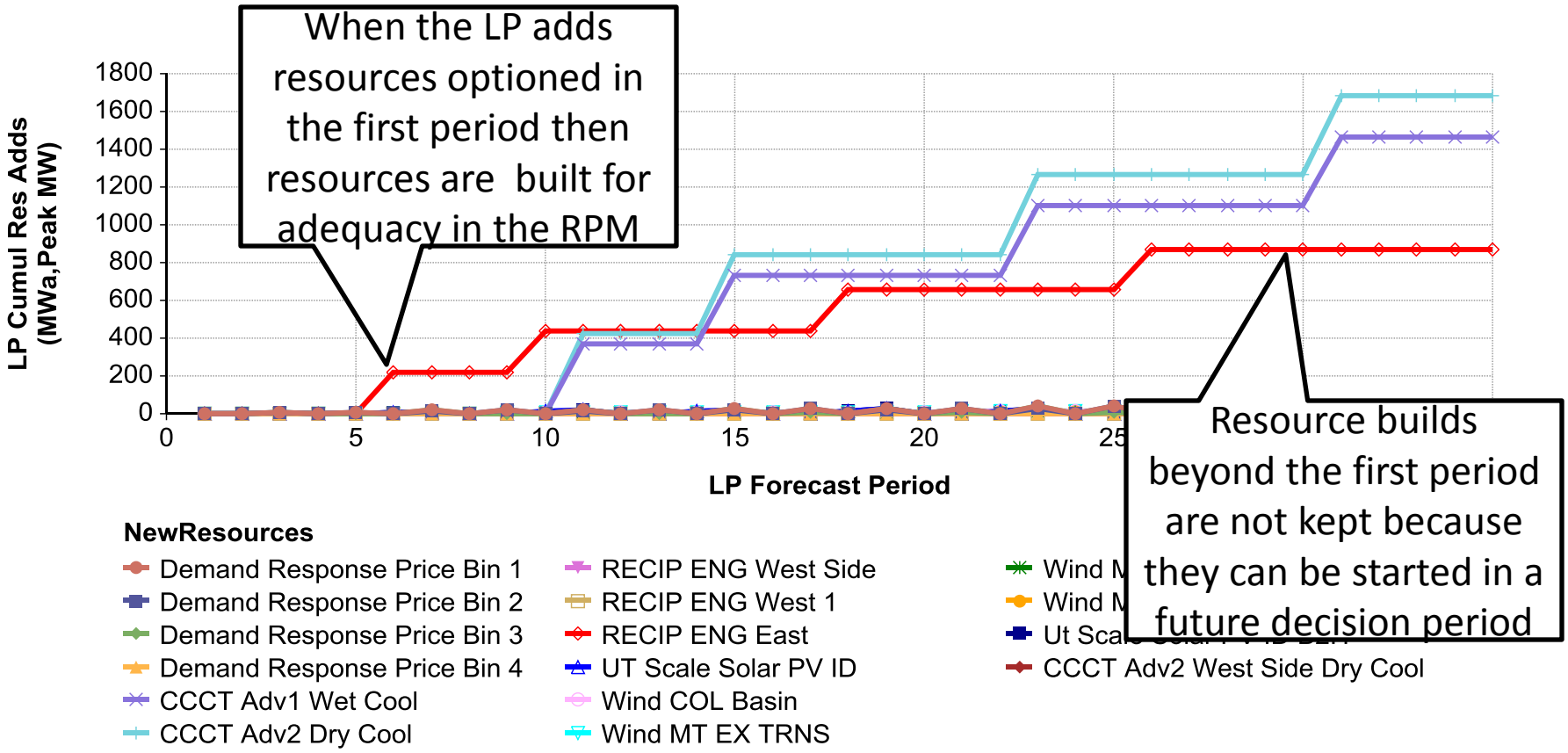
# LP Look-Ahead Renewable Builds



# LP Look-Ahead Projected Resource Additions

- LP projects resource additions to meet future needs so current period is not biased toward building too many resources
- LP minimizes total cost of resources so resources that lead to the least cost are added, which are not necessarily the cheapest resources by $/MW-yr

# LP Look-Ahead Projected Resource Additions



# RPM Economic Resource Build Logic

# Expected Dispatch Value

- Expected costs
  - Fuel price – 2 year "historic" exponentially smoothed
  - CO2 cost – 2 year "historic" exponentially smoothed
- Expected revenue
  - Market price – 2 year "historic" exponentially smoothed
  - REC value – if renewable
  - PTC value – if renewable

# Resource Cost

- Fixed O&M
- Construction Costs
- *Planning Costs*
  - *Planning costs are paid when a resource is optioned and thus are treated as sunk cost in the model, i.e. not part of the "economic" build decision costs*

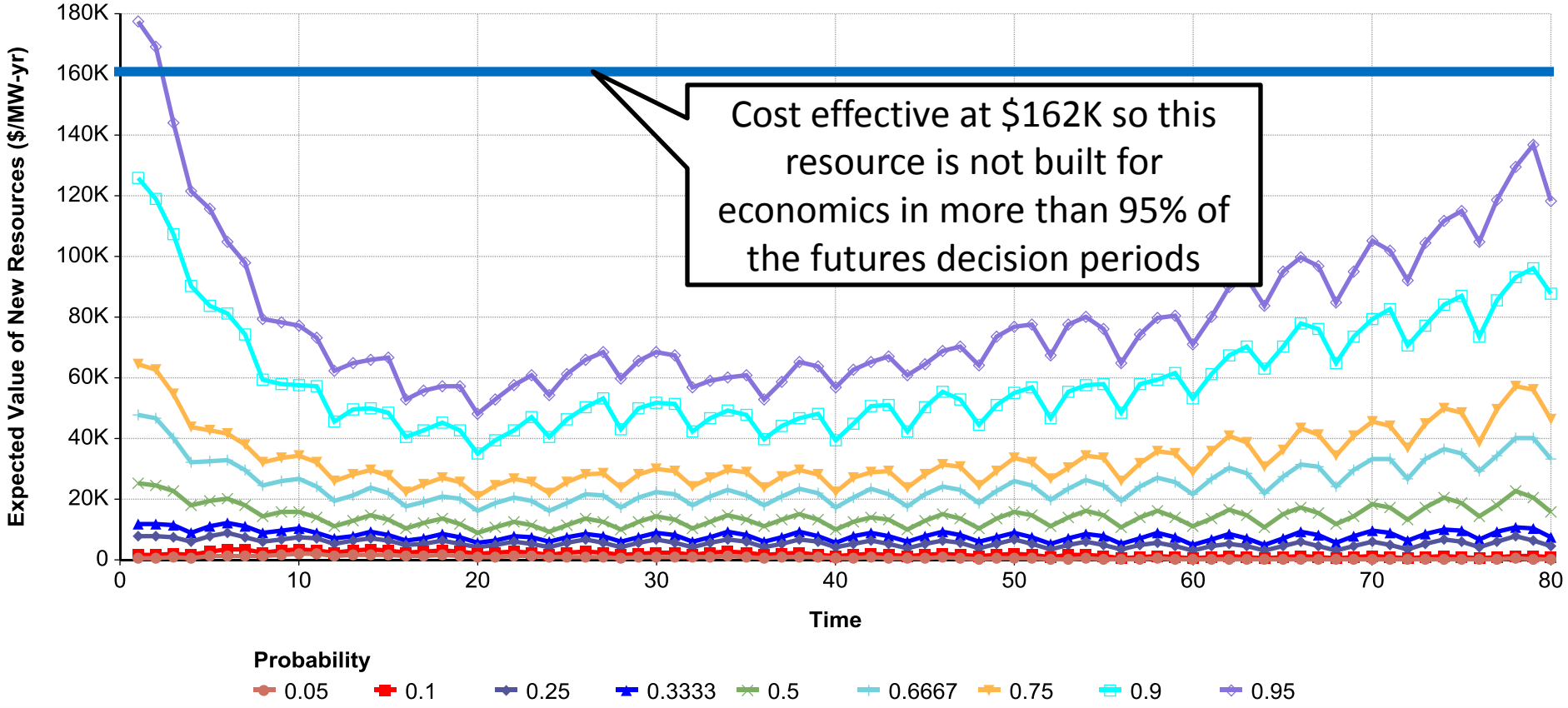
# Resource Cost $/MW-yr

| | | |
|---|---|---|
| Demand Response Price Bin 1 | $ | 22,941.99 |
| Demand Response Price Bin 2 | $ | 49,815.42 |
| Demand Response Price Bin 3 | $ | 71,031.22 |
| Demand Response Price Bin 4 | $ | 174,018.98 |
| CCCT Adv1 Wet Cool | $ | 152,535.75 |
| CCCT Adv2 Dry Cool | $ | 164,940.94 |
| RECIP ENG West Side | $ | 171,388.25 |
| RECIP ENG West 1 | $ | 141,764.85 |
| RECIP ENG East | $ | 162,310.59 |
| UT Scale Solar PV ID | $ | 195,944.29 |
| Wind COL Basin | $ | 263,487.10 |
| Wind MT EX TRNS | $ | 304,479.47 |
| Wind MT New 230kV Line | $ | 314,215.54 |
| Wind MT Path8 Upgrade | $ | 325,504.34 |
| Ut Scale Solar PV ID B2H | $ | 273,611.75 |
| CCCT Adv2 West Side Dry Cool | $ | 161,519.17 |

# Expected Net Value

- Expected net value = expected dispatch value – resource cost
- If expected net value is greater than zero **AND** the model has optioned that resource for the decision period then all optioned units are built
- Units built for economics can increase net system cost when the internal forecast leads to decisions where the costs exceed benefits

# CCCT Expected Net Value Range



# Conservation in the NPV Calculation

# Conservation in the NPV Calculation

- Current NPV calculation based on frozen efficiency load
- An NPV calculation with net load (frozen efficiency load minus conservation) provides the same answer for the total system cost
- Conservation allows for an increase in the revenue of new and existing generation when the market price exceeds the variable cost in addition to reducing the cost of load

# Prospective System Costs

- Existing resource fixed O&M
- Existing resource fuel and variable O&M for native load
- Conservation
- New resource capital & fixed O&M
- New resource fuel and variable O&M for native load
- Market purchases for native load
- **Penalties**

# Prospective System Revenue

- Market sales to loads outside the region

# Value of Conservation Example

- Consider a single hour in a small system with:
  - 10 MW of frozen efficiency load
  - A 10 MW generator with a variable cost of $30
  - A $50 market price
  - 1 MW of potential conservation with a cost of $20

# Value of Conservation Example

- Without conservation:

| | MW | $ Per MW | Total |
|---|---|---|---|
| Market Cost of Frozen Load | 10 MW | -$50 | -$500 |
| Generation Value | 10 MW | $20 | $200 |
| Cost | 10 MW | -$30 | -$300 |
| Revenue | 10 MW | $50 | $500 |
| **Total System Cost** | **10 MW** | | **-$300** |

# Value of Conservation Example

- With conservation, without exports:

| | MW | $ Per MW | Total |
|---|---|---|---|
| Market Cost of Frozen Load | 10 MW | -$50 | -$500 |
| Generation Value | 9 MW | $20 | $180 |
| Cost | 9 MW | -$30 | -$300 |
| Revenue | 9 MW | $50 | $500 |
| Conservation Value | 1 MW | $30 | $30 |
| Cost | 1 MW | -$20 | -$20 |
| Revenue | 1 MW | $50 | $50 |
| **Total System Cost** | **10 MW** | | **-$290** |

# Value of Conservation Example

- Net load perspective:

| | MW | $ Per MW | Total |
|---|---|---|---|
| Net Load | 9 MW | -$50 | -$450 |
| Generation Value | 9 MW | $20 | $180 |
| Cost | 9 MW | -$30 | -$270 |
| Revenue | 9 MW | $50 | $450 |
| *Conservation Cost* | *-1 MW* | -$20 | -$20 |
| **Total System Cost** | **9 MW** | | **-$290** |

# Value of Conservation Example

- With conservation, with exports:

| | MW | $ Per MW | Total |
|---|---|---|---|
| Market Cost of Frozen Load | 10 MW | -$50 | -$500 |
| Generation Value | 10 MW | $20 | $200 |
| Cost | 10 MW | -$30 | -$300 |
| Revenue | 10 MW | $50 | $500 |
| Conservation Value | 1 MW | $30 | $30 |
| Cost | 1 MW | -$20 | -$20 |
| Revenue | 1 MW | $50 | $50 |
| **Net System Cost** | **10 MW** | | **-$270** |

# Value of Conservation Example

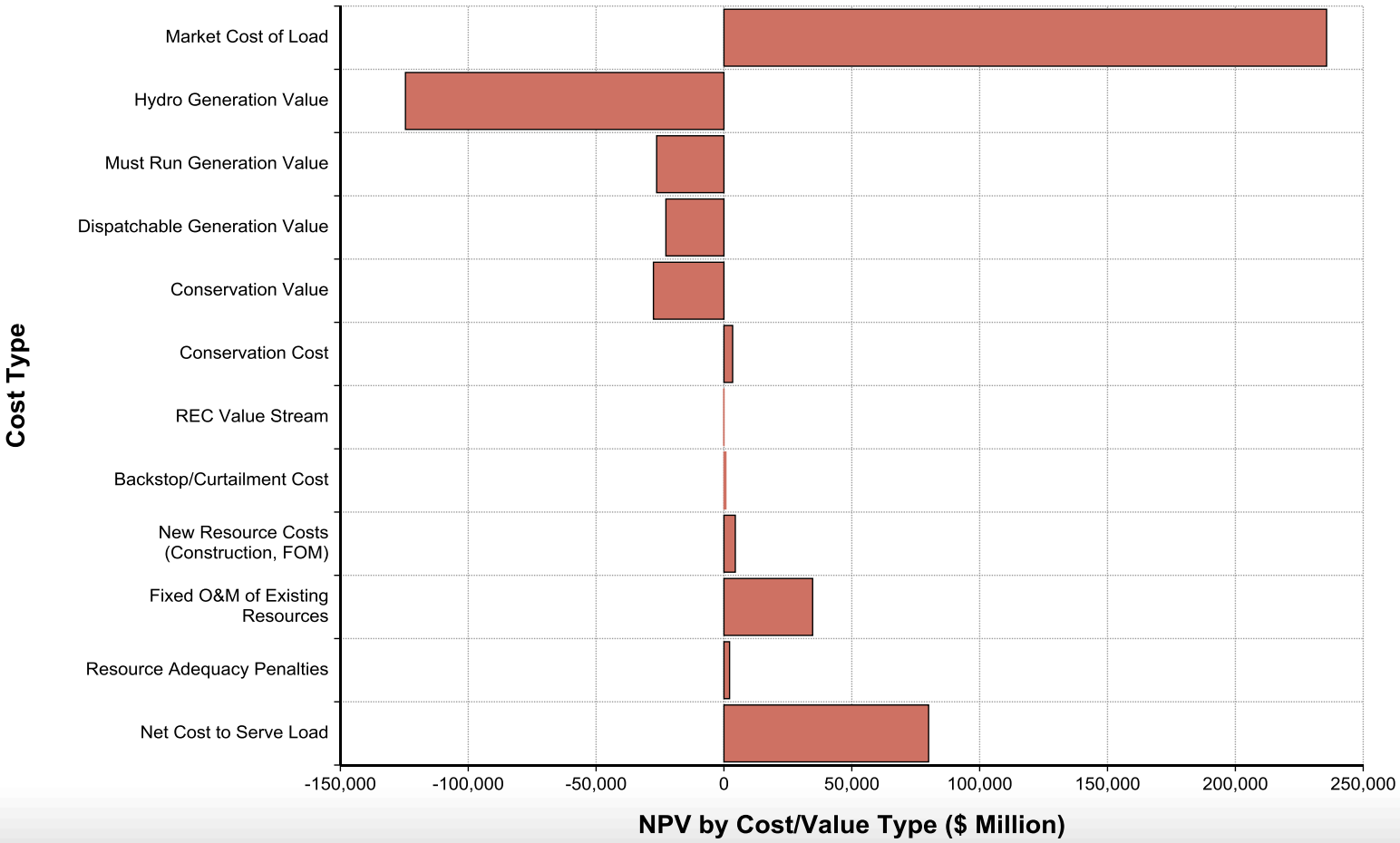
- Net load perspective with exports:

| | MW | $ Per MW | Total |
|---|---|---|---|
| Net Load | 9 MW | -$50 | -$450 |
| Generation Value | 10 MW | $20 | $200 |
| Cost | 10 MW | -$30 | -$300 |
| Revenue | 10 MW | $50 | $500 |
| *Conservation Cost* | *-1 MW* | -$20 | -$20 |
| **Net System Cost** | **9 MW** | | **-$270** |

# Value of Conservation Example

- With exports, conservation reduces total system cost by $30
- Value is counted in both the value of conservation and the value of generation
  - i.e. there is interaction between the conservation and the value of generation so in the absence of conservation the value of generation would likely be lower

# NPV Components in RPM



# Value of Conservation Feedback

- Net load vs. frozen efficiency load give the same system value, is it useful to break out costs from a net load perspective?
- Should we try to track generation value attributable to conservation for an estimate on total conservation value?
- Is there better terminology to avoid confusing this concept of system value with other perspectives?