Energy efficiency in resource planning

Natalie Mims Frick, Berkeley Lab
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I don’t always write power plans, but when I do they rely on efficiency.

Stay efficient my friends!

Many thanks to Tom Eckman for significant contributions to this presentation, the underlying research and thought leadership on this topic.

Additional contributions by Alan Sanstad, Lisa Schwartz and Greg Leventis.
Topics to cover

Three Principles to Consider in Resource Planning

- Co-optimization
- Consistency
- Characteristics

Four Phases of Resource Planning

1. Risk and uncertainty analysis
2. Resource potential assessments
3. Capacity expansion modeling
4. Load forecasting

Examples
Three principles to consider

- **Co-optimization**: Efficiency is selected in the capacity expansion modeling on par with generating resources, rather than simply reducing load forecast inputs.

- **Characteristics**: Efficiency is compared directly to generating resources based on economic and other resource characteristics (e.g., construction lead times and schedule flexibility, load shape, dispatchability, reliability, forced-outage rates, emissions, fuel and market price risks).

- **Consistency**: Efficiency levels and realistic achievable potential are based on paying up to the full incremental cost of measures, similar to funding generating or transmission and distribution facilities.
Four phases of resource planning

- Load forecasting
- Resource potential assessments
- Capacity expansion modeling
- Risk and uncertainty analysis

- Treating efficiency as a resource alters the methods, models and practices in resource planning
Role of load forecasting

- Load forecasts are the foundation of resource planning.
- Electricity load forecasts predict electricity consumption and peak load.
- They are used by planners as a basis for understanding future electricity needs and developing plans to meet the demand.
Changes to load forecast

**Typical current practice**
- Focus on a single forecast
- Rely on historic forecast to capture the impacts existing policy going forward
- Use inconsistent inputs in planning processes

**Potential improvement**
- Establish a range of future states
- Incorporate the impact of known policies (e.g., standards and codes)
- Align load forecast and resource assessment inputs (e.g., number and type of buildings)
- Use load forecast outputs as inputs to efficiency potential assessment and capacity expansion model
Load forecast **before** adding new efficiency acquisition

Source: 7th Northwest Power Plan – Baseline load forecast range without new efficiency
Role of efficiency resource potential assessment

- The objective of efficiency resource potential assessments is to provide accurate and reliable information on:
  - Quantity available
  - Timing of availability (e.g., new construction, stock turnover)
  - Cost
  - Load shape
Changes to resource potential assessment

Typical current practice

- Reduce load forecast to account for efficiency
- Limit efficiency incentives to a portion of incremental cost
- Determine economic potential independently of capacity expansion model

Potential improvement

- Develop efficiency supply curves using the same types of economic and other resource characteristics
- Acquire efficiency up to a cost equal to their value in the electricity system.
- Economic potential determined using resource optimization modeling process
PacifiCorp 2017 IRP energy efficiency supply curves

20 year technical achievable potential:
- 85% of retrofit
- 73% of new construction

The bundle price is the average levelized cost for the group of measures in the cost range, weighted by the potential of the measures.

Narrow cost ranges

$/MWh
Role of capacity expansion models

**What they do**

- Test alternative resource mixes and development timing (a.k.a., *Resource Strategies*) against a range of future conditions (e.g., load growth, natural gas prices, emissions costs/limits, etc.)
- Identify the “least cost” *Resource Strategy* and may or may not account for “risk”

**What they don’t do**

- Determine what is an acceptable level of “cost”
- Determine what is an acceptable level of “risk”
- Decide which *Resource Strategy* is “Preferred”
Changes to capacity expansion modeling

**Typical current practice**
- Determine economic levels of efficiency outside capacity expansion model
- Do not allow for efficiency potential to change based on economic growth
- Cannot stop and restart efficiency programs
- Does not test ability of efficiency to cost-effectively meet future load (with a longer-term view, additional efficiency may be cost-effective)

**Potential improvement**
- Use efficiency supply curves to allow model to select efficiency as a resource
- Consider lost opportunity resources and economic growth
- Assume programs delivery is flexible
- Acquire efficiency in advance of need
Price Taker versus Price Maker

- Wide-scale deployment of efficiency will alter the type, timing and development of other types of resources.
- When EE is a resource, it is a "price maker," not "price taker."

Impact of demand response and efficiency acquisition on the timing and amount of natural gas combined cycle capacity development in the Northwest
Risk and uncertainty analysis

**Typical current practice**

- Use perfect foresight in capacity expansion modeling
- Do not consider intrinsic resource characteristics
- Do not consider inherent uncertainty in future conditions

**Potential improvement**

- Use stochastic analysis* to consider resource risk and uncertainty
- Consider efficiency characteristics when evaluating risk
- Consider multiple futures in risk analysis

*Stochastic analysis uses random changes in key variables to simulate possible future conditions to test alternative resource portfolios. The process identifies the *most likely* outcomes and a *range* of possible outcomes.

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Commodity Pricing Conditions</th>
<th>Load Conditions</th>
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<tr>
<td><strong>Group 1</strong></td>
<td><strong>Commodity Pricing Scenarios</strong></td>
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<tr>
<td>1.</td>
<td>Base - (RP1 Retires 12/2028; RP2 Lease Expires 12/2022)</td>
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<tr>
<td>2.</td>
<td>High Band - (RP1 Retires 12/2028; RP2 Lease Expires 12/2022)</td>
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<td>3.</td>
<td>Low Band - (RP1 Retires 12/2028; RP2 Lease Expires 12/2022)</td>
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<td>4.</td>
<td>No Carbon - (RP1 Retires 12/2028; RP2 Lease Expires 12/2022)</td>
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<td><strong>Group 2</strong></td>
<td><strong>Group 2 &amp; 2A Scenarios</strong></td>
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<td>Case 5 &amp; 5A (RP1 Retires 12/2028; RP2 Lease Expires 12/2022)</td>
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<td>6.</td>
<td>Case 6 &amp; 6A (RP1 FGD 1/2026 &amp; Retires 12/2044; RP2 Lease Expires 12/2022)</td>
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<td>Case 7 &amp; 7A (RP1 FGD 1/2029 &amp; Retires 12/2044; RP2 Lease Expires 12/2022)</td>
<td>Base/No Carbon (A)</td>
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<td>8.</td>
<td>Case 8 &amp; 8A (RP1 Retires 1/2025; RP2 Lease Extended, FGD 1/2029, &amp; Retires 12/2048)</td>
<td>Base/No Carbon (A)</td>
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<td>9.</td>
<td>Transitional (RP2 Lease End 2022, RP1 Retire 12/2028)</td>
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<td>10.</td>
<td>12 - Year Peaking (Post RP2 Lease End)</td>
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<td>11.</td>
<td>15 - Year Peaking (Post RP2 Lease End)</td>
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<td>Case 12 &amp; 12a</td>
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<td><strong>Load Scenarios</strong></td>
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<td>High Load</td>
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<td>16.</td>
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<td>High Band</td>
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<td><strong>Group 5</strong></td>
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<td>EE Decrement Method</td>
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<td>19.</td>
<td>Reserve Margin Constraint with unconstrained Renewables</td>
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- **PJM on-peak energy prices** (nominal $/MWh)
- **PJM capacity prices** (nominal $/MW-day)
- **Delivered natural gas price** (nominal $/mmBTU)
- **Carbon dioxide prices** (nominal $/short ton)
Select resources and related research

- End-Use Load Profiles for the U.S. Building Stock
- Electricity Markets and Policy energy efficiency research
- Time and locational sensitive value of efficiency
  - Time-varying value of electric energy efficiency (2017)
  - Time-varying value of energy efficiency in Michigan (2018)
  - No Time to Lose: Recent research on the time-sensitive value of efficiency (webinar)
  - Locational Value of Distributed Energy Resources (forthcoming)
- Peak Demand Impacts from Electricity Efficiency Programs (forthcoming)
- Energy Efficiency in Electricity Resource Planning (forthcoming)
Natalie Mims Frick
nfrick@lbl.gov
510-486-7584

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