Capacity: The Hidden Treasure in Energy Efficiency

Jennifer Light & Lakin Garth

EE as a Resource

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CADMUS

Northwest **Power** and **Conservation** Council

Overview

Share a project the Regional Technical Forum is doing to support systematic review of the quality of capacity savings benefits estimated from energy efficiency

- Background and context
- Project goals
- Work to date and plans for completion

BACKGROUND

Northwest Power and Conservation Council

Interstate compact agency formed in 1980 by the Northwest Power Act

Core Roles:

- Conduct regional power plan to ensure "an adequate, efficient, economical, and reliable power supply"
- Work to protect, mitigate, and enhance fish and wildlife resources associated with the BPA system
- Work through a public stakeholder process

Funded by the Bonneville Power Administration

Regional Technical Forum

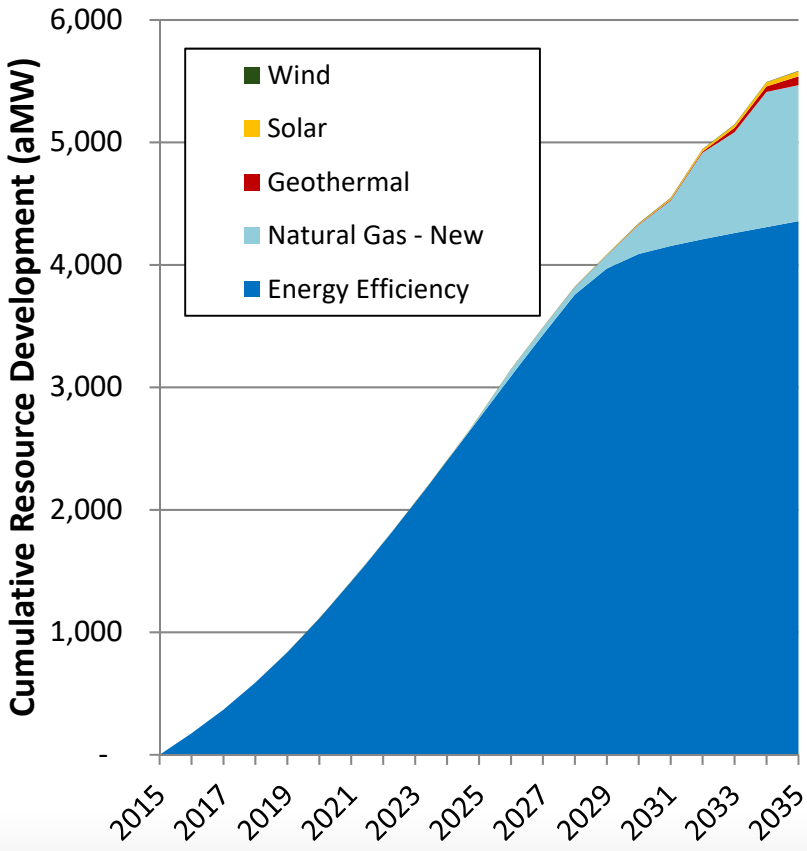
Advisory Committee to the Council established in 1999

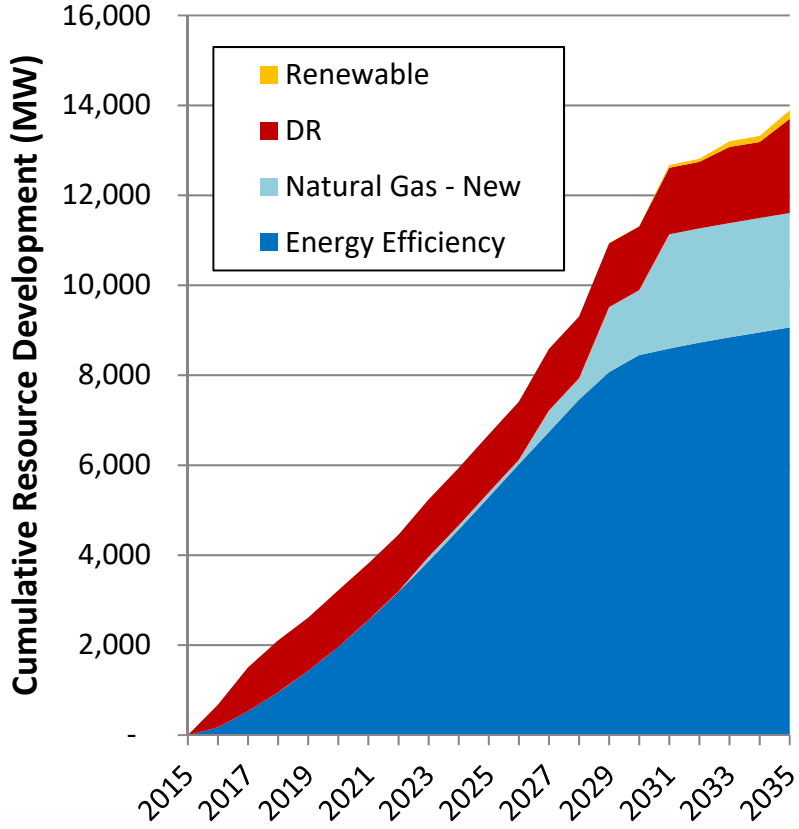
Core roles:

- Develop standard methods for estimating and verifying energy savings
- Help region meets the Council's targets for cost-effective efficiency, and track progress
- Publicly available materials

Funded by regional utilities

Seventh Plan Resource Portfolio





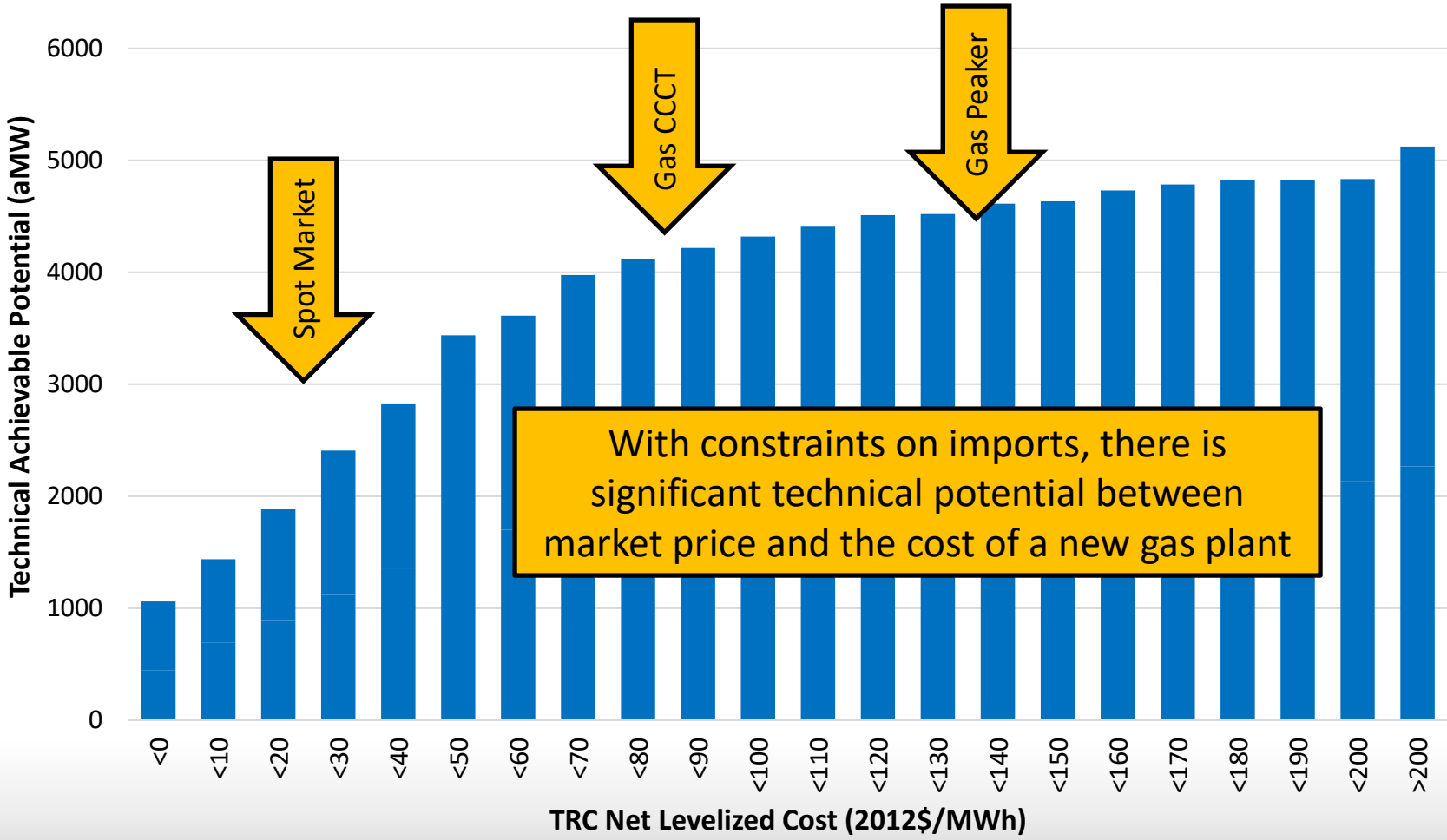
Mean resource build for least-cost resource portfolio

Seventh Power Plan Key Findings

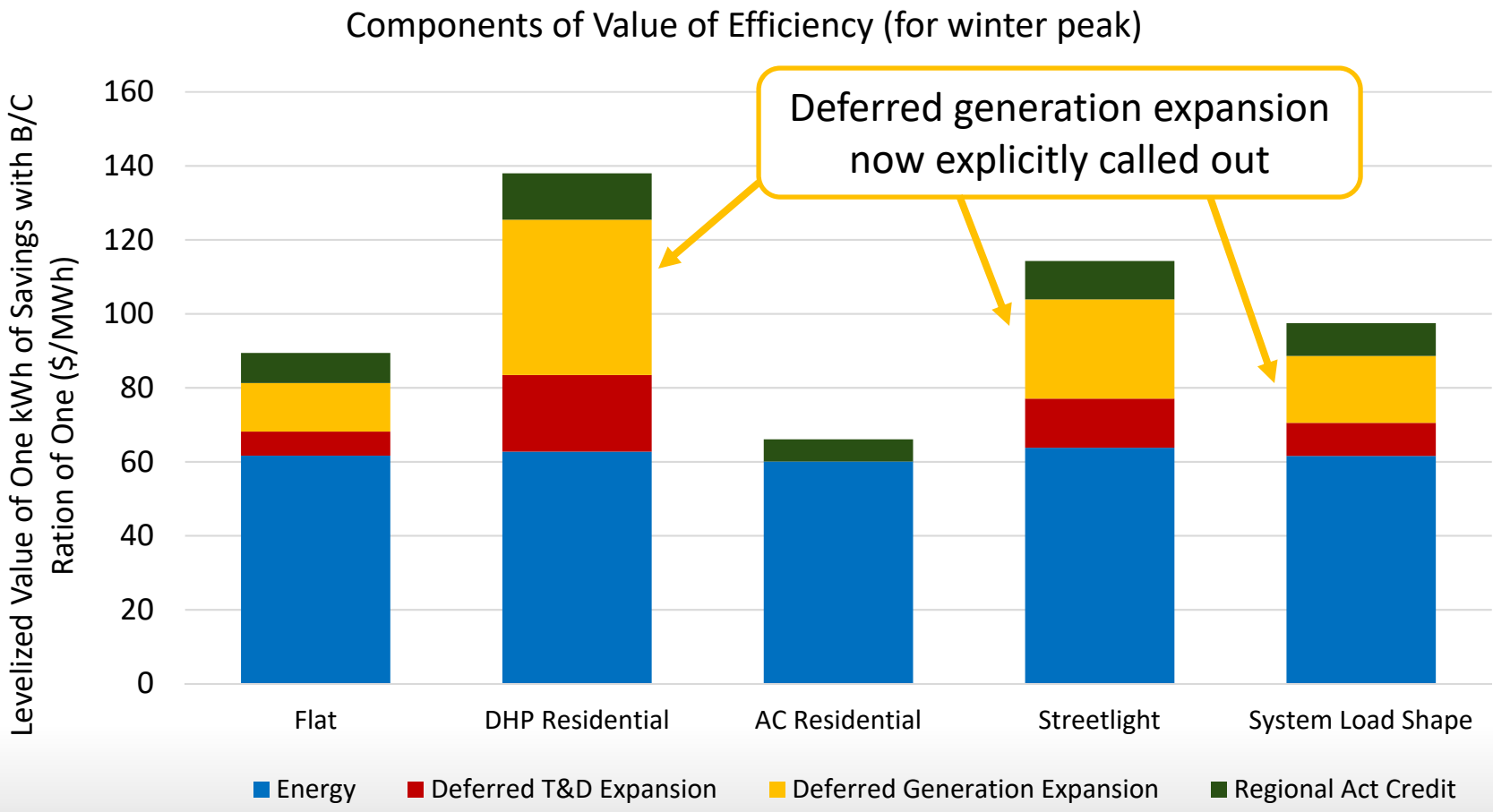
- Region has a need for energy and capacity now
- Efficiency and demand response are the least-cost resources to meet nearly all forecast growth
- Minimal variance in efficiency builds across many futures and scenarios tested
- **Low-cost efficiency was built for economy** when it is cheaper than the market of energy
- **Higher-Cost efficiency was built for capacity** right away, capacity needs drive the pace of efficiency build

  Note: import assumptions impact the efficiency build for adequacy
- Building efficiency above the spot market price of electricity is critical for a least-cost path

Efficiency is Cheaper than New Generation



Cost-Effectiveness More Fully Accounts for Capacity Contribution



RTF PROJECT ON CAPACITY BENEFITS

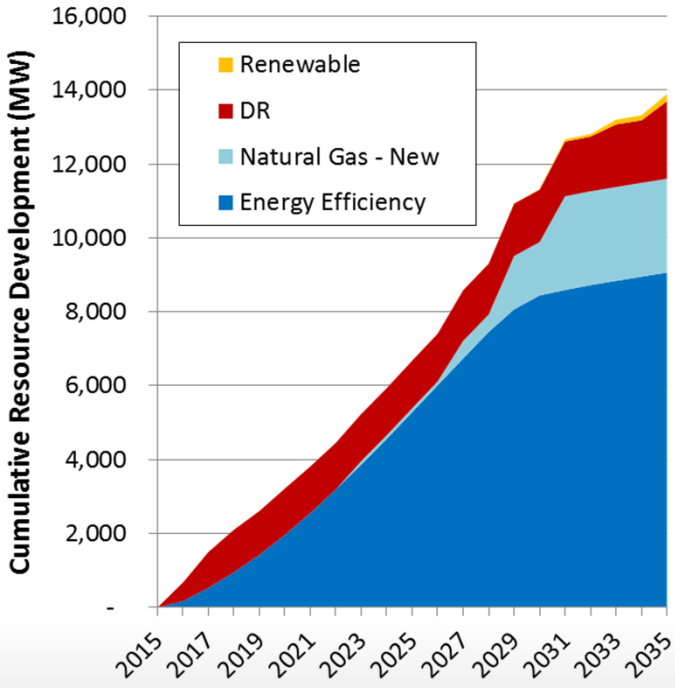
Reliability Standards for Capacity Benefits

Council directed the RTF to:

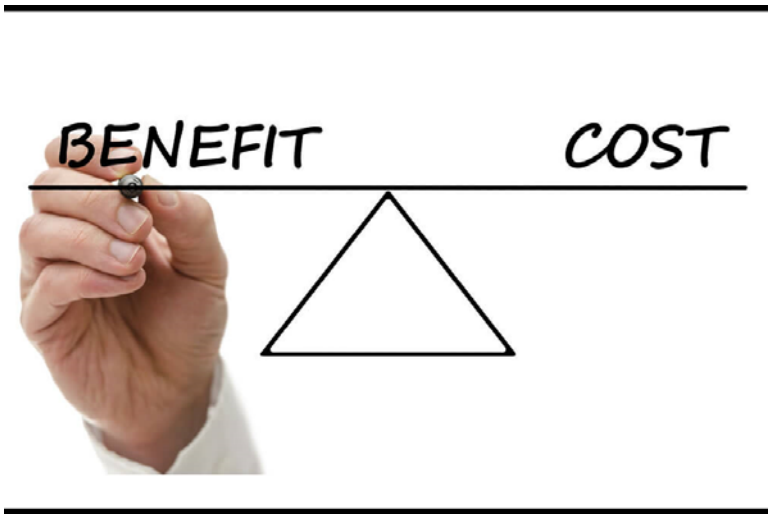
- Develop reliability requirements for estimation of capacity impacts associated with efficiency measures
- Review all measures against those guidelines and provide recommendations to the region for improving reliability

Why Do Quality Capacity Estimates Matter?

1. Need to know we can rely on this resource for adequacy



2. Cost-effectiveness depends in part on capacity impact



Project Goals

Project expected to:

- Expand existing Operational Guidelines to include capacity
- Support transparent and consistent qualification of these capacity impacts
- Provide insight into future load research to improve our understanding of these impacts

CAPACITY BENEFITS PROJECT: PHASE 1

Project Scope

Out of Scope: RTF already has quality standards for energy savings estimate and methodology for estimating capacity savings

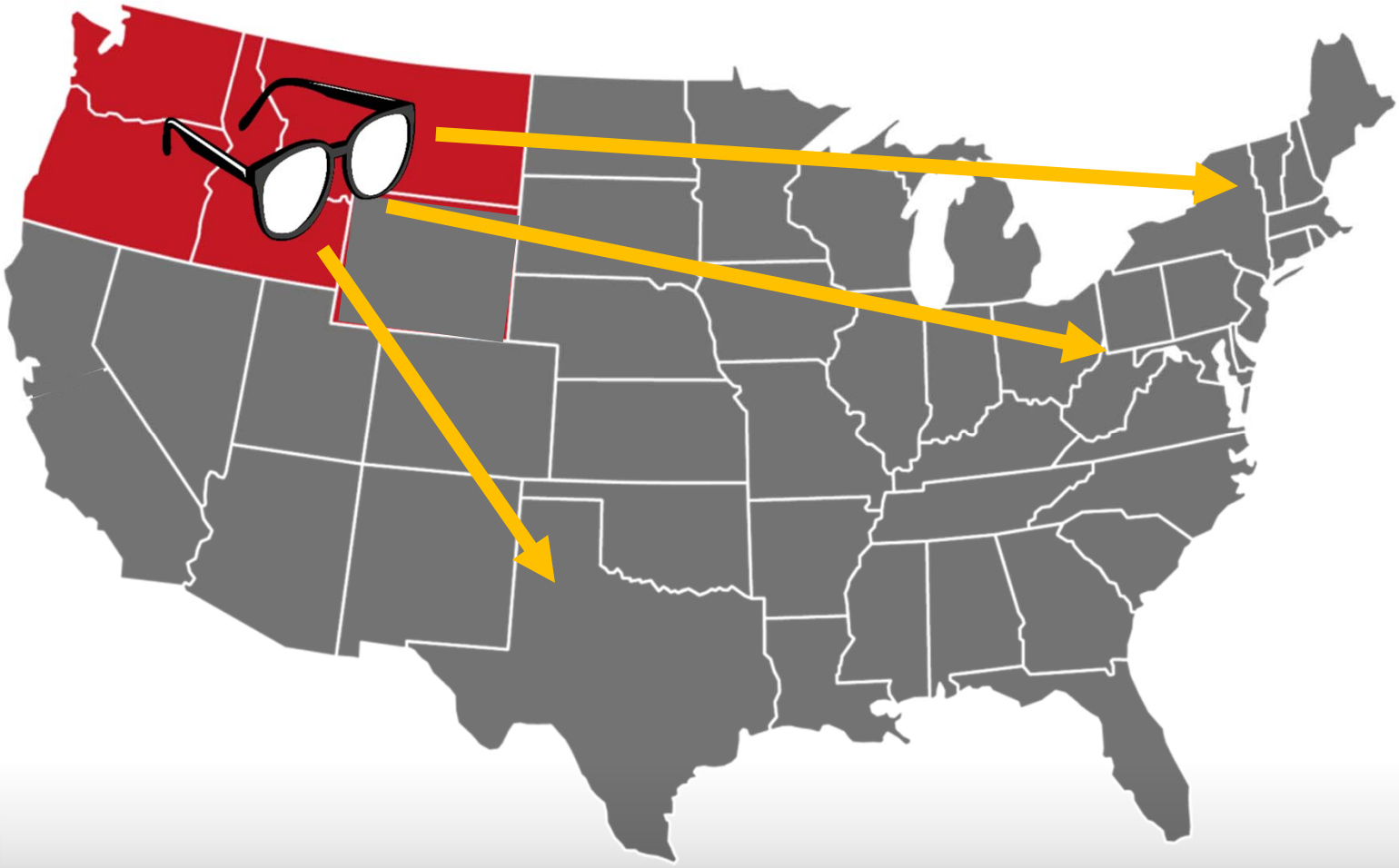
RTF Unit Energy Savings

In Scope: Developing Guidelines for assessing reliability of hourly profile

Hourly Profile Coincident Factor

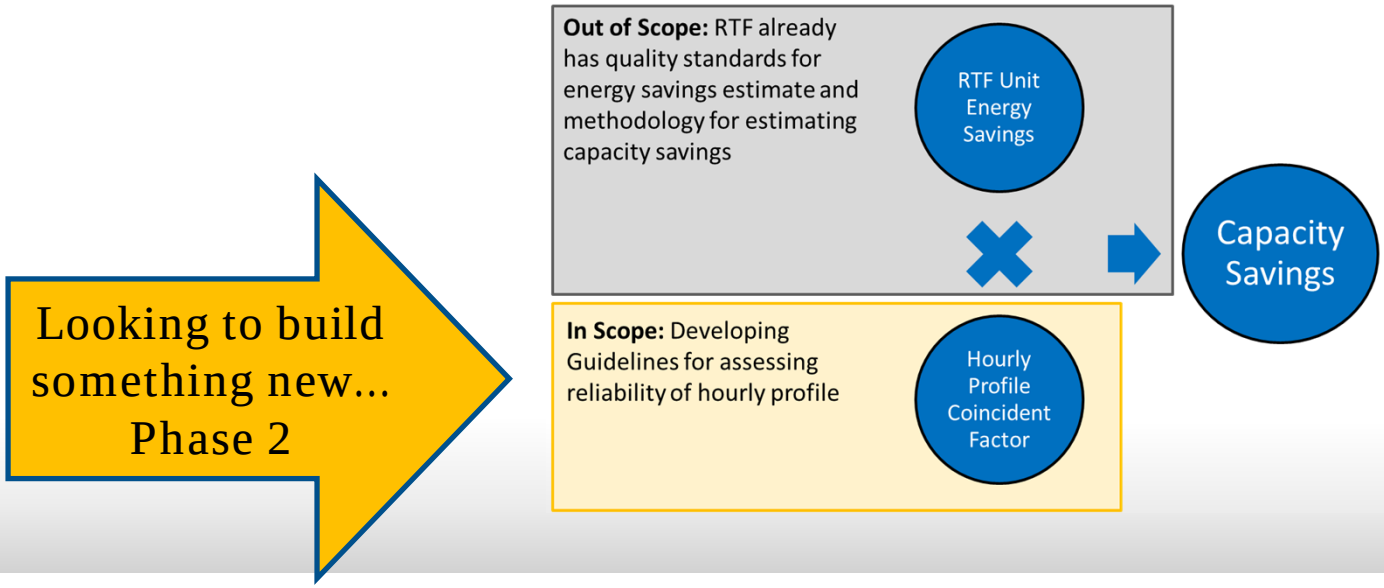
Capacity Savings

Scanned for Existing Standards



Phase 1 Findings

- Guidelines and methodologies exist for verifying energy savings and calculating capacity impacts
- No specific guidance on assessing the reliability of hourly profile or resulting capacity impacts



CAPACITY BENEFITS PROJECT: PHASE 2

Developing the Rating

Draft guidelines provide **decision rules** for how the RTF determines the **quality of capacity savings** determined from **hourly profiles**

Defining Quality

How well do the hourly profiles represent the diversity of their constituent loads?

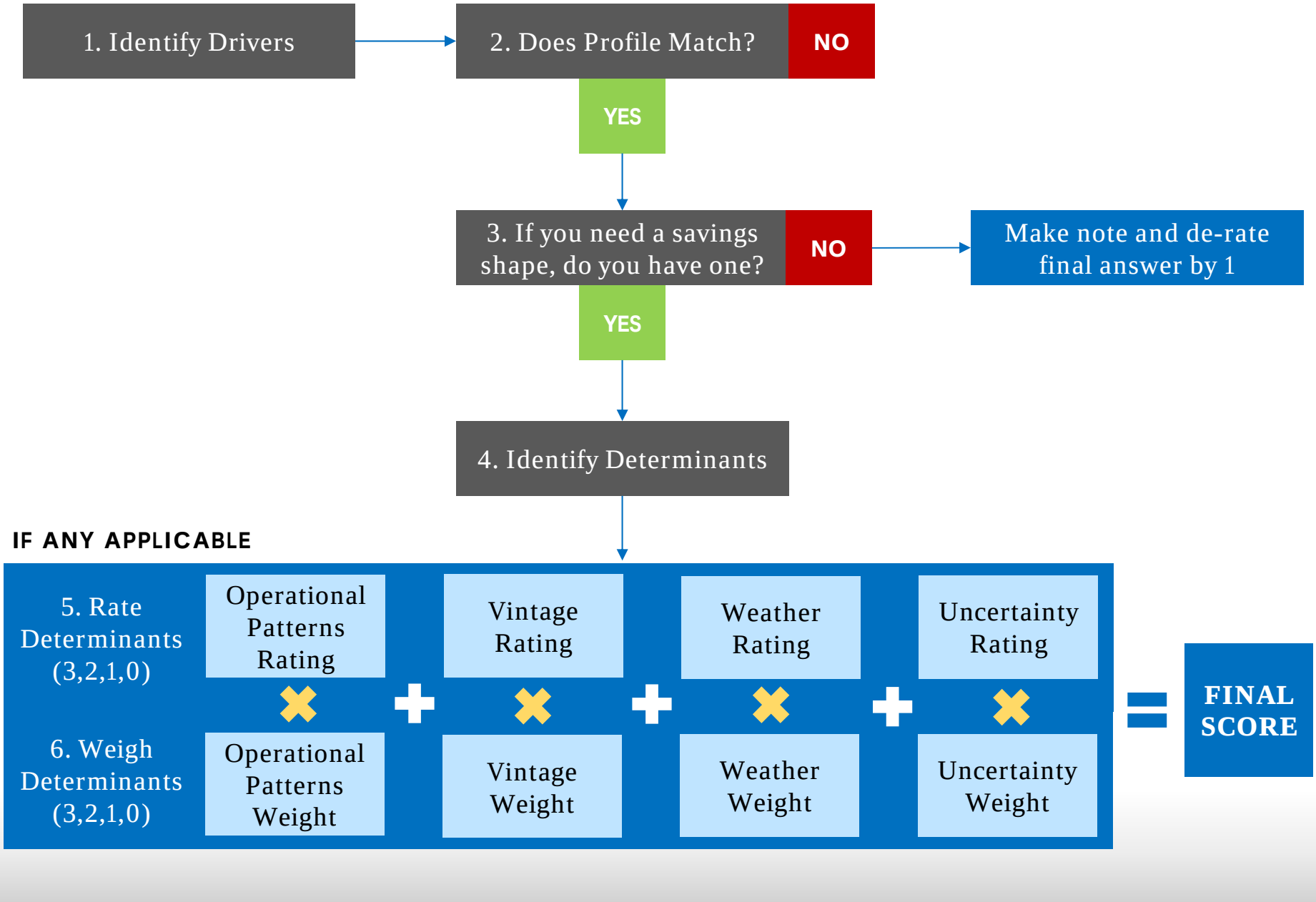
Are we selecting the hourly profile that gives the least amount of uncertainty?

Quantitative vs. Qualitative

For profiles developed from a set of 8760-hourly observations of sample of homes/buildings, we can glean **quantitative** information including the variance, uncertainty, and confidence interval of the **mean** at **each hour** or by **groups of hours**.

This quantitative information does not address the **possible biases** in the **sample data** relative to the population. Considering the challenges of quantitative bias estimation, we seek to develop a **qualitative process** of evaluating the "determinants" of hourly profile quality.

Determinants
The primary factors that determine the quality of an hourly profile and its application to energy efficiency measures are referred to as "determinants."


1. Identify Drivers
2. Does Profile Match?
NO
YES
3. If you need a savings shape, do you have one?
NO
Make note and de-rate final answer by 1
YES
4. Identify Determinants
IF ANY APPLICABLE
5. Rate Determinants (3,2,1,0)
Operational Patterns Rating
Vintage Rating
Weather Rating
Uncertainty Rating
6. Weigh Determinants (3,2,1,0)
Operational Patterns Weight
Vintage Weight
Weather Weight
Uncertainty Weight
FINAL SCORE

Developing the Rating

Preliminary Assessment Considerations

- Identify which measure component provides the most significant savings and its related end use
- For this measure component, consider the primary drivers of energy savings

First Order Considerations

- Determine if an available hourly profile matches the measure's primary savings component's end use
- Determine the measure's type of load impact
  - Usage profile vs. savings profile

Determinants

The profile needs to represent the end use's variance in **operational patterns**. These are human-driven factors.

Residential Lighting

- Drivers of savings: LEDs, hours of use, room distribution
- Sample: avg. hourly N = 91 single family homes, metered data for an entire year,
- Future research considerations: greater geographic distribution, additional housing types, rural vs. urban

Water Heating

- Drivers of savings: number of occupants, water draw patterns, water heater location
- Sample: avg. hourly N = 100 SF homes, metered data for an entire year
- Future research considerations: new technologies, including Tier 4 HPWH

Determinants

The profile should represent the measure end use's current **vintage** (e.g., building and equipment stock).

Weatherization

- Savings result from lower primary heating system loads
- Most of the electric heating profiles are very old (from 1988-89)
- Heating equipment and housing stock have changed since then
- Older data might better reflect usage patterns in uninsulated homes, while newer data should better reflect newer heating equipment, especially heat pumps

Lighting

- Technology has changed rapidly
- Most recent metered lighting data (RBSA 2012-13) reflects newer housing stock and a more diverse range of lighting technologies than ELCAP (1988-89)
- Both the level of load and shape have changed

Determinants

The profile should represent the measure's end use **temperature or weather sensitivity**.

ASHP Upgrades

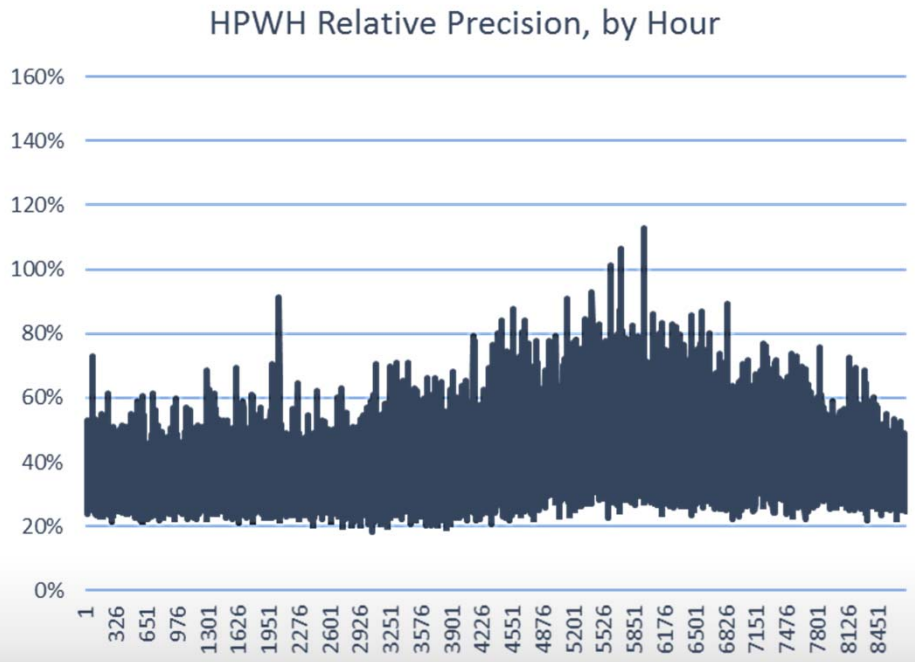
- Energy savings result from increased heat pump efficiency
- Energy savings differentiate by NW heating zone
- Metered sample data from 1988-89, include 26 observations and do not differ across heating zones

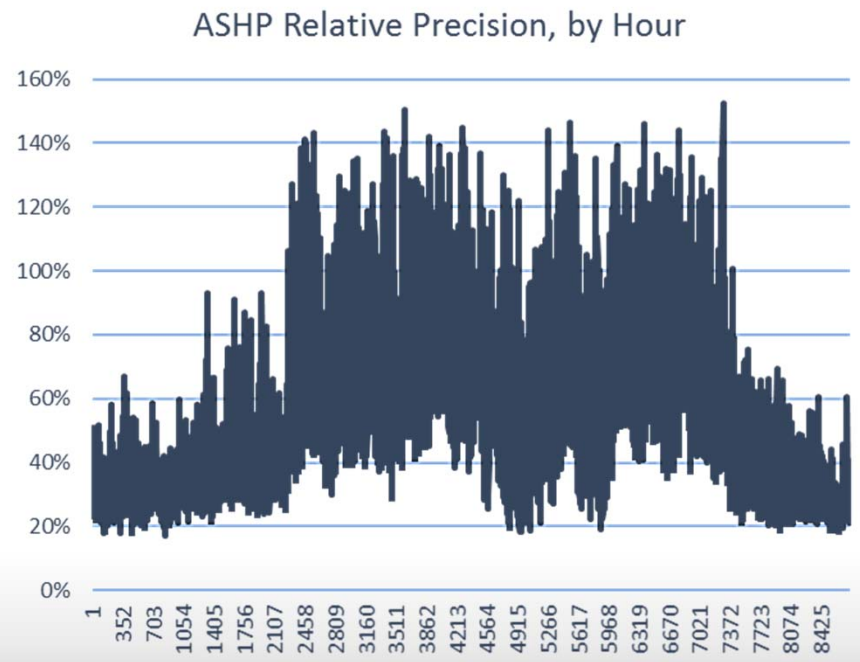
Ductless Heat Pumps

- Energy savings result from displacing/supplementing electric resistance heating
- Energy savings differentiate by NW heating zone
- Metered sample data is more recent and the sample design included SF homes with DHPs in each of the three heating zones

Determinants

The profile's **uncertainty** at the Northwest system peak should be estimated. Requires 8760-hourly observations for all sample observations. Relative precision provides an estimate of uncertainty of the sample mean.





Next Steps

- Finalize draft guidelines
- Apply those guidelines to the full RTF measure suite and develop recommendation memos that provide:
  - Recommendations for quality rating
  - Suggestions for future end use load research and load profile development
- Refine guidelines as needed