Riding the Momentum:

Driving Efficiency Beyond Programmes

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Abstract

The typical paradigm for energy efficiency programmes in North America is that utilities implement programmes, analyse the energy efficiency savings directly attributable to the programme, and have limited visibility into how the market is transforming as a result of the programme and other market effects. The Pacific Northwest region of the U.S. is turning this paradigm upside down with a new model called "Momentum Savings."

Momentum Savings encompass all cost-effective savings that occur above established baselines that are not incented by programmes—and utilities in the Northwest can count them towards their targets. Why? The idea is to shift the focus of market research and evaluation from attribution of savings to understanding the actual savings occurring in the market. This allows utilities or other programme administrators to dynamically adapt and continuously improve their programme offerings in sync with the momentum of the market. Programmes can then invest in technologies that need investment, choose the right point in the supply chain to invest, and course correct as needed.

This method relies on market-wide data collection and on-the-ground understanding of market movement. And it can result in significant savings—for example, initial estimates suggest that momentum savings account for between one-third and one-half of the total energy efficiency savings in the Northwest. This paper discusses how momentum savings are determined; lessons learned from Momentum Savings projects in lighting, appliances, HVAC, and other end use areas; how Momentum Savings are becoming well-understood and respected as a viable savings mechanism within the Northwest; and how this approach can be valuable in evaluating true energy efficiency impacts in markets anywhere in the world.

What are Momentum Savings?

Momentum Savings result when an end-user chooses an efficient option without receiving a financial incentive from a programme. Many factors may drive such choices, including the "momentum" generated by past efficiency programmes, corporate sustainability policies, and technology trends.

Momentum Savings are energy savings that meet the following criteria:

- Not directly paid for by utilities
- Cost-effective[1]
- Not part of any other regional market transformation initiatives[2]
- Above established baselines[3]

1 Momentum Savings analysis leverages the cost-effectiveness research conducted throughout the region (e.g., by the Regional Technical Forum) rather than conducting new research.
2 In the Northwest, this includes the Northwest Energy Efficiency Alliance's (NEEA) Net Market Effects.
3 In the Northwest, this is the Northwest Power and Conservation Council's Power Plan frozen efficiency baseline (Council baseline).

What is the Role of Momentum Savings in the Northwest?

Energy efficiency is the power resource of choice in the Northwest United States. Every five years, the Northwest Power and Conservation Council (the Council) prepares a regional power supply plan (referred to as "the Power Plan") for Oregon, Washington, Idaho, and Western Montana. The Council's assessment of conservation potential includes all achievable and cost-effective energy efficiency available now to reduce future demand. This cost-effective efficiency resource is a better value for the Northwest than new power generation and forms the regional conservation target for each five-year planning period.

The Council is indifferent to how the region achieves conservation. Two types of savings comprise the conservation resource:

- **Programmatic energy savings**, resources directly paid for by utility programmes or part of the net market effects of the Northwest Energy Efficiency Alliance (NEEA),[4] are the most familiar component of the region's resource acquisition strategy.
- **Momentum Savings** represent all other energy savings, regardless of cause. Any purchase of an efficient product outside of a utility programme can result in Momentum Savings. Momentum Savings build on and enhance programmatic savings, as discussed more in the sections below.

The Bonneville Power Authority (BPA) first addressed the challenge of quantifying Momentum Savings in 2011.[5] Since that time, BPA has conducted several market studies that have shed additional light on the scope and scale of Momentum Savings. In a short time, BPA's view of Momentum Savings has shifted from an ancillary phenomenon—on the periphery of programmatic activity—to a key component of resource acquisition.

Momentum Savings require a fundamentally different quantification approach than programmatic savings, because there is no centralized record of them. A rich body of work exists documenting the approaches to, limitations of, and results of quantifying programmatic savings. Evaluators have sought to refine these approaches and results over 30 years, and continue to advance their methodologies. The methodologies for calculating Momentum Savings build upon, but diverge from, these approaches.[6]

A BPA Momentum Savings analysis typically targets a specific, carefully defined market, usually defined by an end use or measure category within a specific sector. Recent and ongoing projects include residential lighting, weatherization, agricultural irrigation, residential and commercial HVAC, non-residential lighting, and others.[7] For each analysis, BPA first develops a research plan, which includes four basic steps:

- Characterize the market
- Draft the Momentum Savings methodology
- Collect data
- Calculate Momentum Savings

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4 NEEA's net market effects are savings associated with the market transformation efforts of specific NEEA initiatives and programs. These savings are separate from other utility incented savings.

5 Bonneville Power Administration. *Methodology for Quantifying Market-Induced, Non-Programmatic Savings.* Prepared by The Cadmus Group, Inc. April 1, 2011. http://www.bpa.gov/EE/Utility/research-archive/Documents/Market_Induced_Savings_Report.pdf.

6 There are precedents for estimating savings that occur outside of programmes, as evidenced by market effects studies conducted across the country. See, for example, the recent LED market effects studied completed in Massachusetts (DNV-GL, 2015). http://ma-eeac.org/wordpress/wp-content/uploads/LED-Market-Effects-Baseline-Characterization-Final-Draft.pdf. Momentum Savings studies differ from market effects studies in that the Momentum Savings analytical focus is on the change in average unit energy consumption of all products within a given market over time, compared to a frozen baseline.

7 A list of projects and associated reports can be found here: www.bpa.gov/goto/Momentumsavings.

The qualitative research—including extensive interviews with a wide variety of market actors—conducted in the "characterize the market" step provides rich contextual information that enables the research team to develop the Momentum Savings methodology, collect sales data from the right market actors, and offer market intelligence to programme designers to improve future programmes. This paper focuses on the "Calculate Momentum Savings" step to show how Momentum Savings research projects lead to regional estimates of Momentum Savings.[8]

How are Momentum Savings Measured?

Momentum Savings occur only when markets change. More specifically, Momentum Savings occur when, on average, the choices consumers and businesses make in a given market change between two points in time. If there is no change, there can be no Momentum Savings. Measuring Momentum Savings is about measuring this change in the entire market over time. The average unit energy consumption in a market can change for a variety of reasons[9]:

- Underlying technologies change
- Codes and standards change
- Prices change
- The economy changes
- Consumer priorities and preferences change

Sales data are crucial for understanding how the market has changed over time. Sales data are the best source for estimating the mix of efficiencies sold in the market. Unfortunately, sales data are often incomplete due to the sensitivity of the data, their proprietary nature, and wide dispersal across competitors within a market. Efficiency programmes may collect sales data on the products they incentivize, but they rarely collect more than a limited subset of the total market. A series of data gaps is the inevitable result.

Data gaps would not be so problematic if all sellers sold the same mix of products and efficiencies. Real-world variation among products sold by market actors means an analyst cannot simply assume the average efficiency mix found in incomplete sales data represents the total market.

To address these problems, BPA applies a Chain Logic Method of extrapolating sales data to estimate the efficiency mix of the entire market.[10] Key lessons learned through this process include:

- Sales data can be representative of the entire market, even when incomplete11
- Market segmentation can inform whether or not sales data are representative
- Establishing average efficiencies using full year data can account for seasonal variations

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8 For more information on the other steps, see: Bonneville Power Administration. *Overview of Momentum Savings.* Prepared by Navigant Consulting, Inc. and Cadeo Group. October 2015. https://www.bpa.gov/EE/Utility/research-archive/Documents/Momentum-Savings-Resources/Overview_on_Momentum_Savings_white_paper.pdf.

9 Utility programs can and do influence many of these reasons; for example, utilities that engage in mass marketing to educate consumers about the benefits of energy-efficient lighting may contribute to a shift in consumer preferences toward LED lighting.

10 For more information on the Chain Logic Method, see: Bonneville Power Administration. *Methodologies for Calculating Momentum Savings*, Prepared by Navigant Consulting, Inc., 2016.

11 For example, in the residential HVAC Momentum Savings analysis, the research team found that the efficiency mix evident in an incomplete sales data set (i.e., data collected from major market actors comprising approximately 45-60% of the air source heat pumps in the region) closely matched the efficiency mix found in a more comprehensive data source compiled by the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) which covers 95% of the market.

The Momentum Savings Analysis Framework

At the highest level, the calculation of Momentum Savings in a given market follows this equation:

*Total **Market** Savings - Total **Programme** Savings = **Momentum** Savings*

The analyst measures each of these terms against a consistent baseline tied to the Council's Power Plan.

The framework requires the analyst to answer the following four core questions to quantify Momentum Savings for any market:

1. What is the market?
2. How big is the market?
3. What are the total market savings?
4. What are the programme savings?

The answers to these questions provide the analyst with all of the data necessary to estimate Momentum Savings—the cost-effective savings that occur above the frozen baseline and that are not directly incented by programmes or claimed as part of NEEA's net market effects. Figure 1 summarizes how the questions fit together to enable the estimation of Momentum Savings.

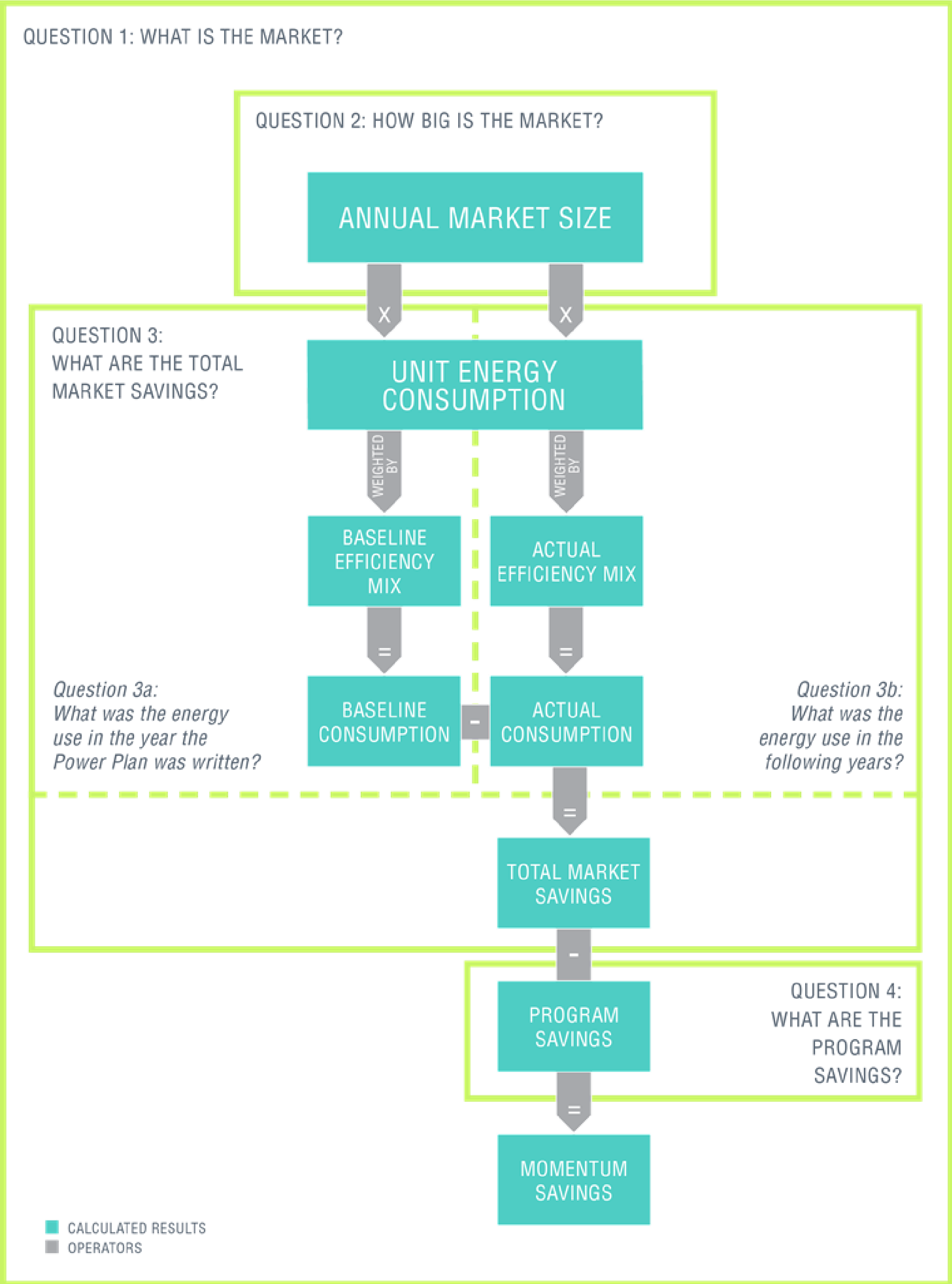

Figure 1. Overview of the Momentum Savings Analysis Framework
Source: Bonneville Power Administration. *Methodologies for Calculating Momentum Savings*, Prepared by Navigant Consulting, Inc. and Cadeo Group, 2016.

To calculate Momentum Savings, the analyst's perspective must include all activity in a given market, not just programmatic. Therefore, the natural starting point for the analysis is to define the market.

Question 1: What is the market?

The definition of the market establishes the boundaries of the analysis. It requires the analyst to consider the market along many dimensions:

- Which sectors does the market include?
- Which product types or measures does the market include?
- Does the market include applications in new construction, early retirement, and replace-on-burnout, or just some subset of those scenarios?
- What geographic territory does the analysis cover?
- How could reviewers misinterpret the terms of the chosen market definition? For example, does residential lighting include multi-family homes and common areas? Does the HVAC market include tune-ups and duct sealing or just the equipment?

Definitional clarity leads to analytical clarity. The analyst will explicitly state which sectors, product types, applications, and geographies the analysis will include, as well as the rationale for any exclusions, if applicable. These foundational decisions will make the analysis easier to communicate and understand.

Note that if the analysis includes multiple product types which are not interchangeable (e.g., both dishwashers and clothes washers), each is considered an individual market for the purposes of Questions 2 through 4.

Question 2: How big is the market?

The total number of units sold in a given calendar year – the product flow – defines the size of the market from Question 1. The total number of units includes units of all efficiency levels. This market is separate from existing installations—or stock—that resulted from decisions made in the past. This distinction is most critical in rapidly changing markets where new technologies offer the potential for change. In such cases, product flow can look very different from the product stock in the field. In the parlance of the Northwest efficiency community:

- **Flow** is current market sales. Flow represents the decisions consumers are making in the present, under current market conditions (e.g., new lightbulbs being sold into the market this year).
- **Stock**, on the other hand, is the installed stock of products and equipment out in the field at a single point in time. Stock represents the decisions consumers made in the past and, therefore, may not reveal current trends in the market. (e.g., lightbulbs already installed in homes and businesses in past years).

Sales data provide the best indicator of product flow. Ideally, the analyst could collect sales data from all sellers in the market and simply add up the total units sold to calculate market size. In reality, such a complete data set is rarely available. The analyst may need to use several common methods for estimating market size given incomplete data, including:

1. **Stock turnover approach.** This method begins with the estimated installed stock for the market of interest (e.g., the number of air source heat pumps (ASHPs) installed in homes in the Northwest). NEEA's commercial[12] and residential[13] building stock assessments produce this kind of data for the Northwest. The analyst assumes that, on average, the replacement market in any given year is equal to the total existing stock divided by the typical lifetime of the

12 Northwest Energy Efficiency Alliance. "Commercial Building Stock Assessment." http://neea.org/resource-center/regional-data-resources/commercial-building-stock-assessment (accessed July 31, 2015).
13 Northwest Energy Efficiency Alliance. "Residential Building Stock Assessment." http://neea.org/resource-center/regional-data-resources/residential-building-stock-assessment (accessed July 31, 2015).

technology (in years). New shipments must replace these failed units. Next, the analyst estimates the shipments for new construction applications by multiplying an estimated saturation rate[14] of the relevant product(s) in new homes by the number of new homes built each year. The sum of the shipments for new construction applications and the shipments replacing failed units are a reasonable representation of the total annual market size.

2. **Bottom-up analysis**. In this method, the analyst extrapolates, or scales up, sales data covering some portion of the market to estimate total market sales. This extrapolation can take on many forms. The most basic approach is to extrapolate sales data based on the data provider's estimated market share. For example, if a retailer with a 10% regional market share reports sales of 100 lamps in 2014, the analyst estimates a total market size of 1,000 lamps. The analyst can provide several market size estimates when the analyst has sales data from several market actor groups (e.g., retailers and distributors). These estimates could either be averaged to arrive at one market size estimate or the analyst may, depending on the data quality from each market actor group, judge one of the estimates as more credible than the others. Using this simple method in concert with other approaches helps alleviate the effects of the varying reliability of market share estimates.
3. **Top-down analysis.** A typical top-down analysis starts at a broader market level and scales down to the market of interest to the analysis. For example, the analyst might scale the size of the national lighting market to the regional level based on the ratio of regional residential square footage to national residential square footage.

As a best practice, analysts should develop market size estimates using multiple approaches to ensure robust estimates, whenever possible. The most appropriate approaches for a given analysis will depend on the quantity and quality of the data available to the analyst.

Question 3: What are the total market savings?

Total market savings are the difference between baseline energy consumption and actual energy consumption, which corresponds to the change in the market over time. For the purposes of Momentum Savings, we are measuring changes in the *average unit energy consumption* (UEC) in the market over time. The average UEC is the energy consumed by an "average" unit sold in the market in a given year.[15] Energy savings materialize when the average energy use of a product type (e.g., light bulb) decreases. Figure 2 demonstrates how energy savings materialize when the average UEC in a market decreases over time, relative to the baseline.

14 These estimates may be obtained from the regional stock assessments conducted by NEEA or developed based on primary research with market actors.
15 The average UEC for a product is developed using the best regional data sources available (e.g., hours of use).

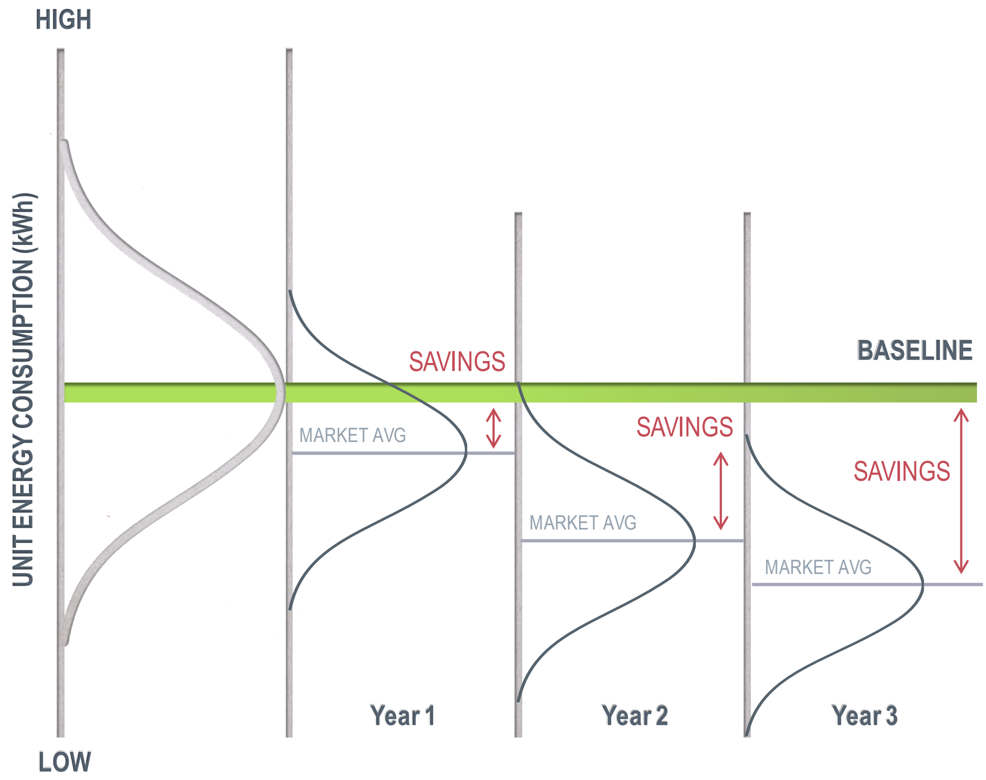

Figure 2. Momentum Savings Correspond to the Changes in Energy Consumption over Time
Source: Bonneville Power Administration. *The FUNdamentals of Momentum Savings*, Prepared by Navigant Consulting, Inc. and Cadeo Group, February 2016.

To measure this change over time, weighted average UECs are estimated for the baseline year (Question 3a) and in each subsequent year of the analysis period (Question 3b). If the weighted average UEC did not change over time, there would be zero energy savings. The weighted average UEC is the average UEC for each product weighted by the efficiency mix (i.e., the percentage of sales at each efficiency level in a given market in a given year). It includes *all* units in a market, not just efficient ones. The sales data from retailers and distributors help provide understanding of the efficiency mix of units sold into those markets.

For example, the efficiency mix for residential light bulbs may have changed substantially from the baseline year, in which incandescents dominated sales, to the analysis, as shown in Table 1. The average UECs for incandescents, compact fluorescents, and light emitting diodes would then be weighted by these efficiency mixes to estimate the weighted average UEC in each year.

Table 1. Efficiency Mix Example

Bulb Type	Efficiency Mix in Baseline Year	Efficiency Mix in Analysis Year
Incandescents	80%	40%
Compact fluorescents	20%	30%
Light emitting diodes	0%	30%

The weighted average UEC is then multiplied by the annual market size to determine the market's total consumption.

Question 3a: What was the energy use in the baseline year?

The first step in measuring a change is deciding what point to measure against. In the Northwest, that point is the baseline established by the Council in their Power Plans. As described above, the baseline for Momentum Savings is the average UEC of all sales within the baseline year. The baseline is calculated with *all* products sold in the market, including efficient and non-efficient units.

This type of baseline is referred to as a *current practice baseline*, which is the average efficiency of new units sold in the market. Figure 5 shows how the current practice baseline reflects a mix of efficiency levels, including some lower efficiency and some higher efficiency units. In this case, Figure 3 shows the current practice baseline for 60-75 Watt-equivalent General Purpose lamps.

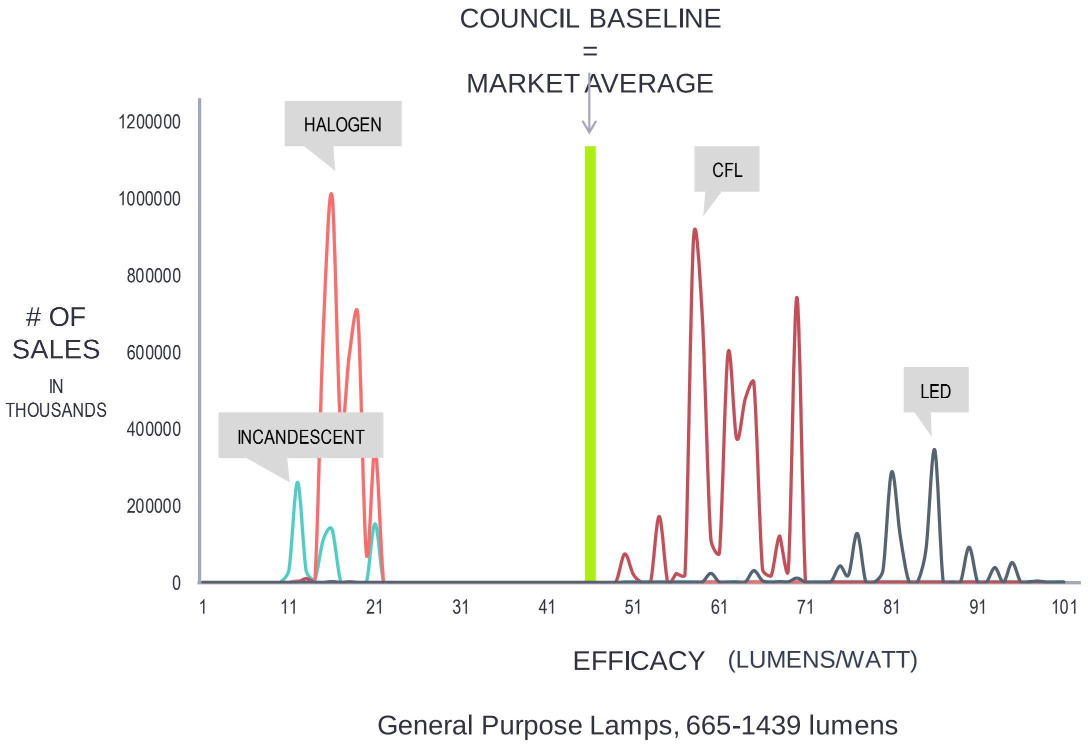

Figure 3. Example of Current Practice Baseline for General Purpose Lamps
Source: Bonneville Power Administration. *The FUNdamentals of Momentum Savings*, prepared by Navigant Consulting, Inc. and Cadeo Group, February 2016.

The baseline average UEC remains frozen for the analysis period. If the actual average UEC decreases over time (Question 3b), it results in energy savings.

Question 3b: What was the energy use in the following years?

Question 3b estimates the actual energy consumption of the market in the years covered by the analysis period. Conceptually, measuring the actual energy consumption (Question 3b) is the same as measuring the baseline energy consumption (Question 3a), but for a different period of time.

To answer this question, the analyst uses as much sales data as possible to estimate the efficiency mix of units actually sold during the analysis period. The Council Plan assumes a frozen efficiency mix over time, but, in general, markets where programmes operate become more efficient over time.

With the new data on actual sales, the analyst determines the actual consumption in the same manner she calculated baseline consumption. She replaces the baseline efficiency mix data with the newly estimated actual efficiency mix to estimate the actual weighted average UEC for each year of the analysis, and multiplies it by the annual market size calculated in Question 2. The difference between actual consumption and baseline consumption in any given year equals the total market savings.

Question 4: What are the programme savings?

Since the actual energy consumption estimated in Question 3b is based on total market sales data that include high efficiency units incentivized by programmes, the analyst must subtract the savings from programme-incented units from total market savings to derive Momentum Savings.

Before doing this, the analyst must assess whether the programmes calculated savings using the same baseline assumed in the Power Plan for that measure or market. Often, the two baselines are not consistent because different baselines serve different purposes. Baseline inconsistency creates inaccuracy in reporting. The analyst, therefore, must adjust programme savings to align with the baseline used in the Momentum Savings analysis.

Why are Momentum Savings Important?

As shown in Figure 4, Momentum Savings can be a powerful tool in assessing energy efficiency resources and directing programme funding to market segments in need. By researching and measuring the effects of past programme influence in the broader market, the region can identify pain points in the market where the next generation of programmes can be most effective. The following points illustrate the cross-benefits of programmes and momentum savings:

- The mass of the region’s programme investments drives the momentum in the market. The region’s historic and current energy efficiency programmes support and maintain Momentum Savings.
- Programme impact estimation improves the estimation of Momentum Savings by providing region-specific verification of operating hours and other inputs into the UEC estimation.
- Momentum Savings analysis “trues up” the entire market to inform where the markets are moving versus stuck. Programme managers can then invest their time and funds into markets or technologies that need more intervention to advance the market for efficiency.
- Market research helps determine the current practice baseline for a given product. In the Northwest, the current practice baseline established through Momentum Savings research can become the new baseline for programmes.
- Momentum Savings research efforts allow utilities or other programme administrators to dynamically adapt and continuously improve their programme offerings in sync with the momentum of the market. Programmes can then invest in technologies that need investment, choose the right point in the supply chain to invest, and course correct as needed.

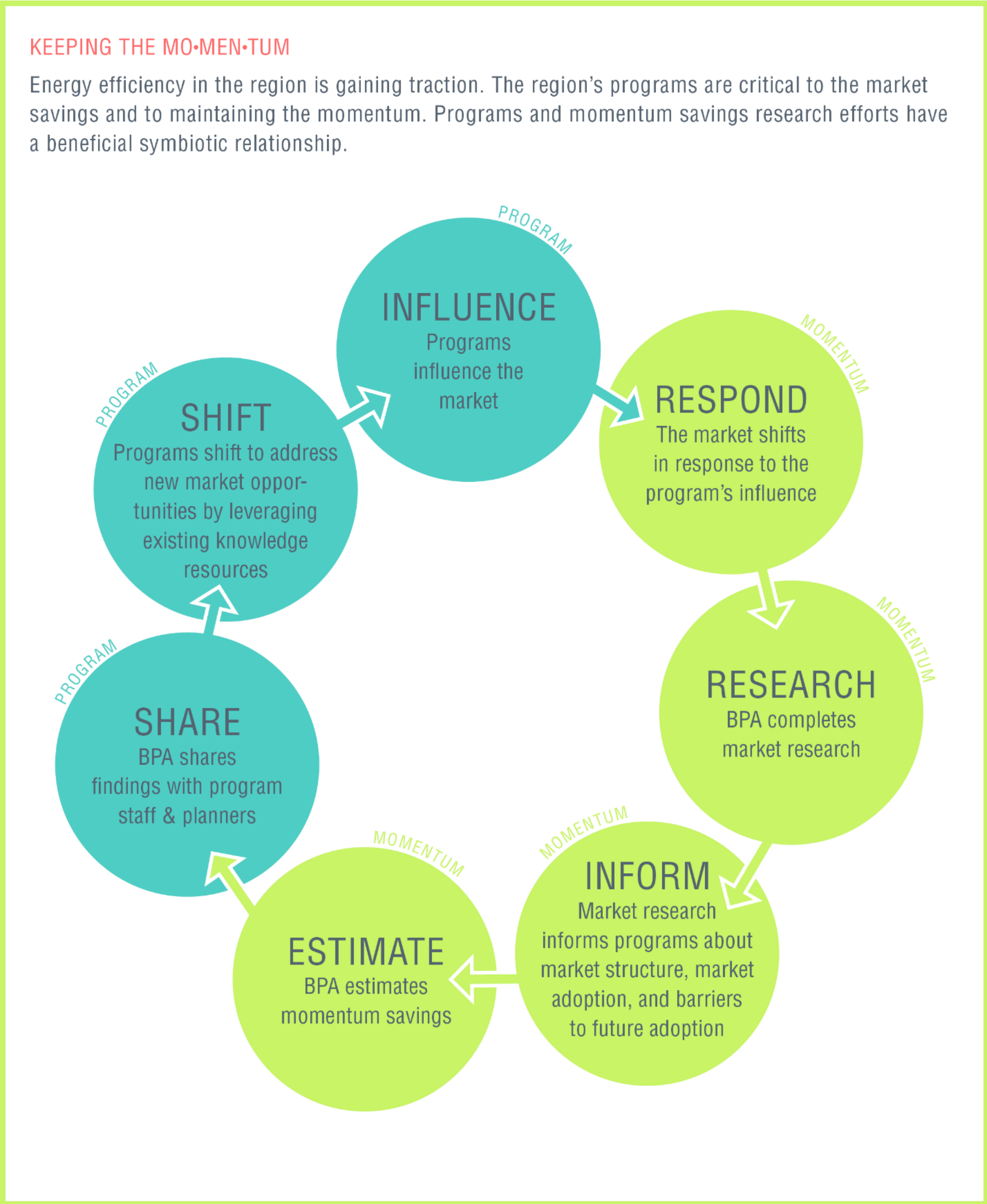

Figure 4. The Symbiotic Relationship between Programmatic and Momentum Savings
Source: Bonneville Power Administration. *Methodologies for Calculating Momentum Savings*, Prepared by Navigant Consulting, Inc. and Cadeo Group, 2016.

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