ADVANCED ANALYTICS FOR EVALUATING MARKET TRANSFORMATION

Brett Close, PhD, EMI Consulting
Tim Michel, PG&E
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AGENDA

1. Introduction
2. RPP Program Overview
3. Methods
4. Results
5. Conclusion
MARKET TRANSFORMATION IS A DIFFERENT FRAMEWORK
MARKET TRANSFORMATION REQUIRES A DIFFERENT EVALUATION FRAMEWORK

- Focus on market changes, rather than individual changes
- Don’t know where the equipment is
- The design is to make the comparison group invalid

Need some way to see an alternate future
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REVISED LOGIC MODEL

Pay incentives to increase PQS and obtain sales data

Sales increases lead manufacturers to improve efficient offerings

KEY:
- Clear evidence
- Evidence
- On the right track
- Not assessed
- Too early to assess

1. PAY INCENTIVES TO INCREASE PQS AND OBTAIN SALES DATA

A1. PG&E provides incentives to participating retailers (PRs) and collects retailer sales data

O1. Incentives for qualified units sold

O1.1. Incentives for qualified units sold

O1.2. Sales data platform with monthly retailer data

A2. PG&E monitors point-of-purchase (POP) materials in PR stores; gathers shelf assortment data; trains store associates; places POP

O2. POP materials in store

O2.1. POP materials in store

O2.2. Promotional activity data / shelf assortment data gathered

O2.3. Store associates trained

A3. PG&E participates in national ENERGY STAR RPP (ESRPP) coordination efforts to recruit new retailers and program administrators, select products and define tiers

O3. Coverage of PAs

O3.1. Coverage of PAs

O3.2. Optimal set of PAs

O3.3. Product categories selected and tiers defined

A4. PG&E participates in voluntary and mandatory codes and standards advocacy and coordinated comment letters. PAs, ESRPP and other market data, and engineering/technical support, and informal networking

O4. Input on specifications and standards, product selections, and tier definitions using retailer sales data and other sources.

O4.1. Input on specifications and standards, product selections, and tier definitions using retailer sales data and other sources.

2. USE SALES DATA TO ADVANCE SPECS, C&S

S1. Increased penetration of qualified models as a result of reduced barriers and increased PR sales of qualified models.

S2. PRs factor ESRPP incentives and increased demand for PQ models into assortment and marketing/promotional decisions

S3. Specifications/codes/standards organizations are able to make more timely and informed decisions based on input and data from PG&E/ESRPP.

S4. ENERGY STAR specification criteria for product categories become more stringent

M1. PRs increase offering and marketing of qualified models

M2. PRs purchase additional types of qualified models and more of each type of qualified model from manufacturers

M3. ESRPP has scale to influence PRs

M4. ENERGY STAR specification criteria for product categories become more stringent

L1. Manufacturers increase number and types of highly efficient models in targeted product categories

L2. Increase in national market share of highly efficient models in ESRPP product categories

L3. Federal standards increase for RPP product categories
Since March 2016 RPP is a national effort under the auspices of ENERGY STAR

The most recent estimates from ENERGY STAR indicate the program covers roughly 18% of the total U.S. residential population.

In 2018, RPP had 9 Program Sponsors.
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SIMPLE EXAMPLE: LEAVE-ONE-OUT MODEL FIT
JACKKNIFE MODEL AVERAGING

• All models are simplifications
• Multiple models may have features that fit the underlying market behavior
• By combining multiple models we can create a better synthetic model

• Jackknife model averaging uses numerical optimization to combine the models to achieve the best leave-one-out fit.
Additional methods supplement the sales analysis to create a holistic picture.
Model Averaging of Sales Data

Modeled and Observed Advanced Refrigerator Sales

Advanced Sales

Month

2015 2016 2017 2018
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SALES DATA MODELING RESULTS

Over two-year period

<table>
<thead>
<tr>
<th>Product</th>
<th>Tier</th>
<th>Increase</th>
<th>SE</th>
<th>Lower Bound (95% CI)</th>
<th>Upper Bound (95% CI)</th>
<th>PQ Sales in the Post Period</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dryers</td>
<td>Basic</td>
<td>10,557</td>
<td>2,482.8</td>
<td>6,347</td>
<td>14,766</td>
<td>135,388</td>
<td>7.8%</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>159</td>
<td>20.0</td>
<td>125</td>
<td>193</td>
<td>279</td>
<td>57.1%</td>
</tr>
<tr>
<td>Freezers</td>
<td>Basic</td>
<td>2,522</td>
<td>352.5</td>
<td>9,849</td>
<td>1,924</td>
<td>3,120</td>
<td>14.8%</td>
</tr>
<tr>
<td>Refrigerators</td>
<td>Advanced</td>
<td>6,933</td>
<td>1,055.7</td>
<td>5,102</td>
<td>8,764</td>
<td>45,948</td>
<td>15.1%</td>
</tr>
<tr>
<td>Soundbars</td>
<td>Basic</td>
<td>(986)</td>
<td>60.8</td>
<td>(1,089)</td>
<td>(883)</td>
<td>421</td>
<td>-234.2%</td>
</tr>
<tr>
<td></td>
<td>Advanced</td>
<td>10,477</td>
<td>115.6</td>
<td>10,281</td>
<td>10,673</td>
<td>15,057</td>
<td>69.6%</td>
</tr>
</tbody>
</table>

PG&E stopped incenting basic tier soundbars in April 2017.
A comparison shows general alignment, though soundbars show opposite trend, and room AC trend is not significant.

<table>
<thead>
<tr>
<th>Product Category</th>
<th>Program-Qualified Sales Increase?</th>
<th>Program-Qualified Shelf Assortment Increase?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Cleaners</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Dryers</td>
<td>Yes**</td>
<td>Slight increase**</td>
</tr>
<tr>
<td>Freezers</td>
<td>Yes (basic tier only)**</td>
<td>Slight increase**</td>
</tr>
<tr>
<td>Refrigerators</td>
<td>Yes (advanced tier only)**</td>
<td>Slight increase**</td>
</tr>
<tr>
<td>Room ACs</td>
<td>Indeterminate</td>
<td>Slight increase**</td>
</tr>
<tr>
<td>Soundbars</td>
<td>Yes (advanced tier only)**</td>
<td>No</td>
</tr>
<tr>
<td>Washers</td>
<td>No</td>
<td>Slight increase**</td>
</tr>
</tbody>
</table>

** denotes statistical significance.
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CONCLUSIONS

• Market transformation efforts like RPP require a different evaluation framework
• Model averaging provides a method to combine competing models of program impact in a data-driven, statistically-founded manner
• With PG&E’s RPP program, this approach lined up well with other sources of information
Questions?

Brett Close
bclose@emiconsulting.com
t. 206.388.0988