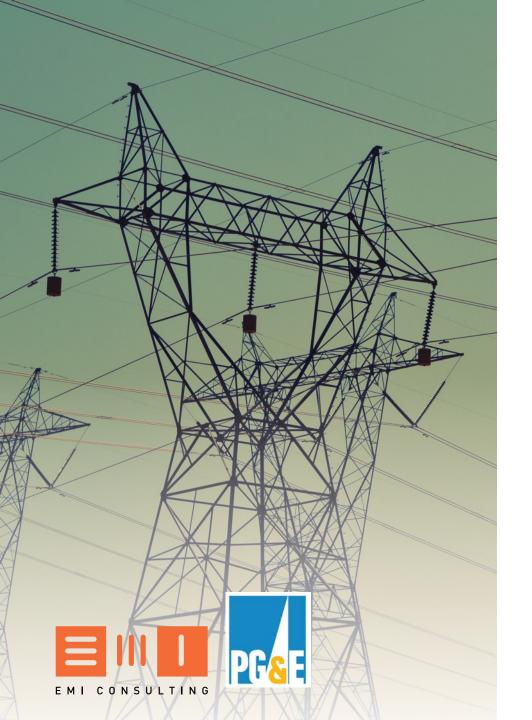
ADVANCED ANALYTICS FOR EVALUATING MARKET TRANSFORMATION



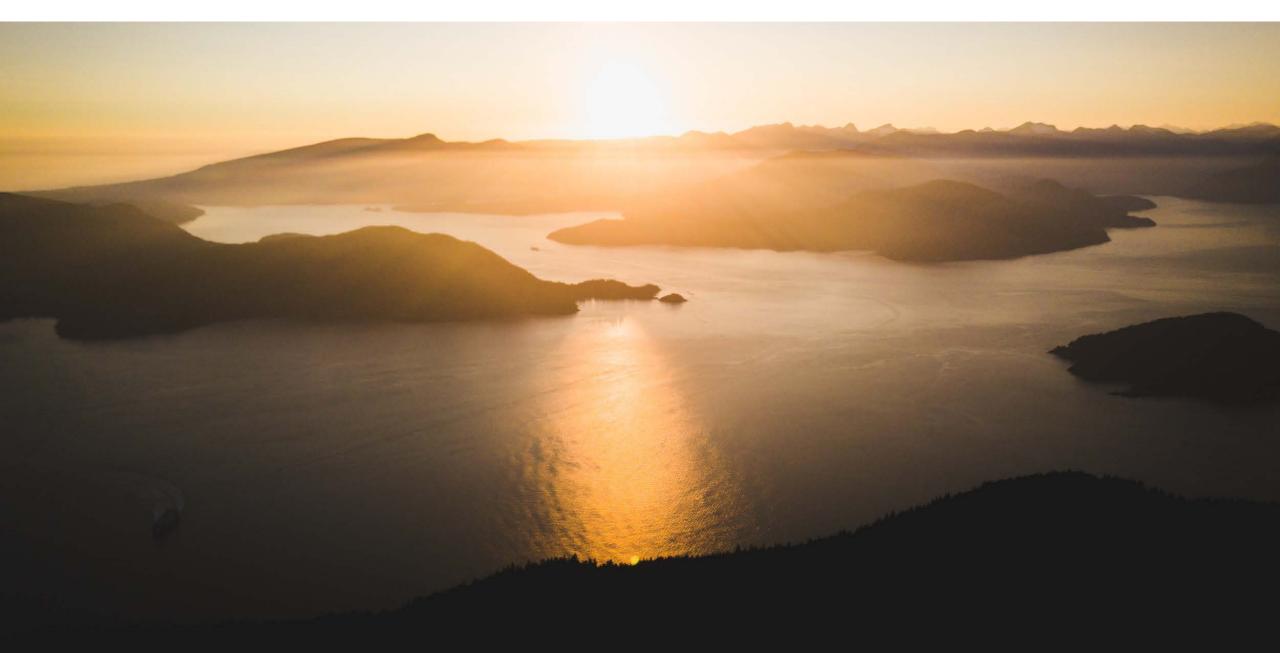


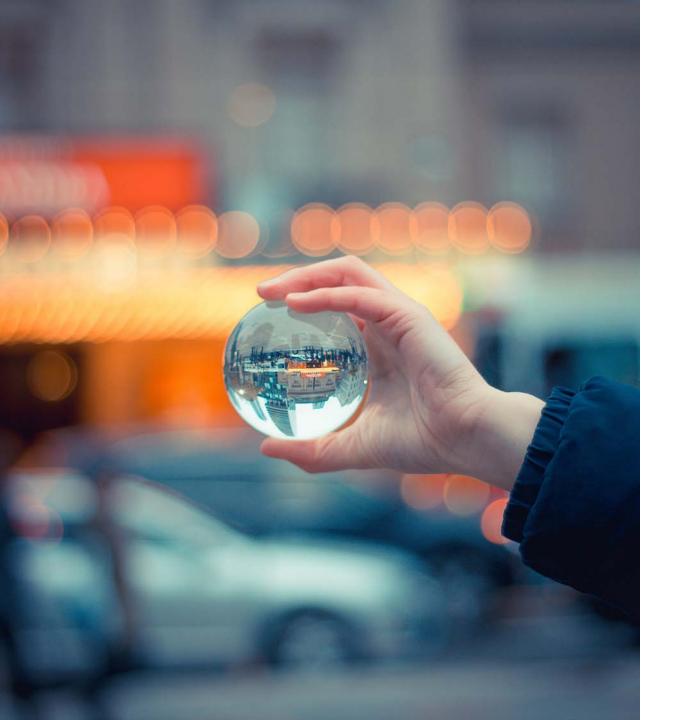
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MARKET TRANSFORMATION IS A DIFFERENT FRAMEWORK

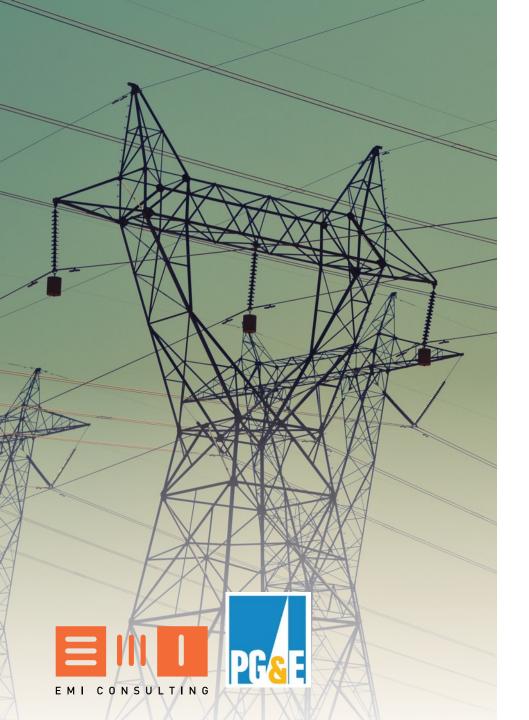




MARKET TRANSFORMATION REQUIRES A DIFFERENT EVALUATION FRAMEWORK

- 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

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

O1.1. Incentives for qualified units

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

02.1. 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

O3.1. Coverage of PAs

O3.2. Optimal set of PRs

O3.3. Product categories

selected and tiers defined

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

standards, product selections, sales data and other sources.

O4. Input on specifications and and tier definitions using retailer

Use sales, data to advance specs, C&S

S1. Increased penetration of gualified 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

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

(feedback loop)

M1.1. PRs increase offering and marketing of qualified models

M1.2. Increase in PQS leads to increases in minimum requirements for RPP product

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

(feedback loop)

KEY: Clear evidence

On the right track

Not assessed

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

L2. Increase in national market RPP product categories

L3. Federal standards increase for RPP product categories

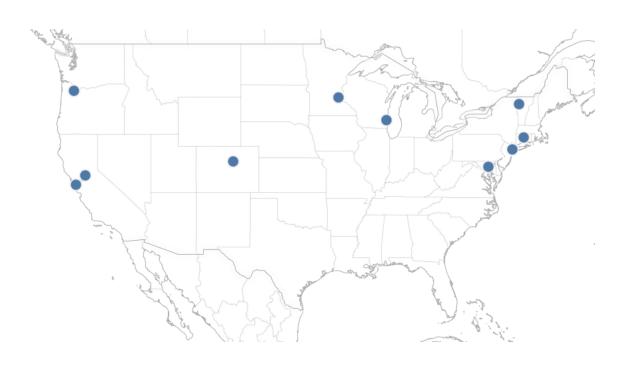
NATIONAL RPP CONTEXT

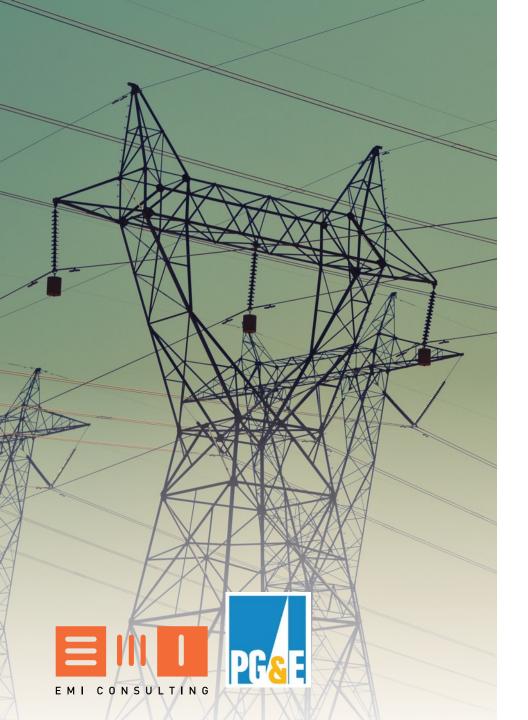
Since March 2016 RPP is a national effort under the auspices of ENERGY STAR

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**.

PY2018 Participating Retailers

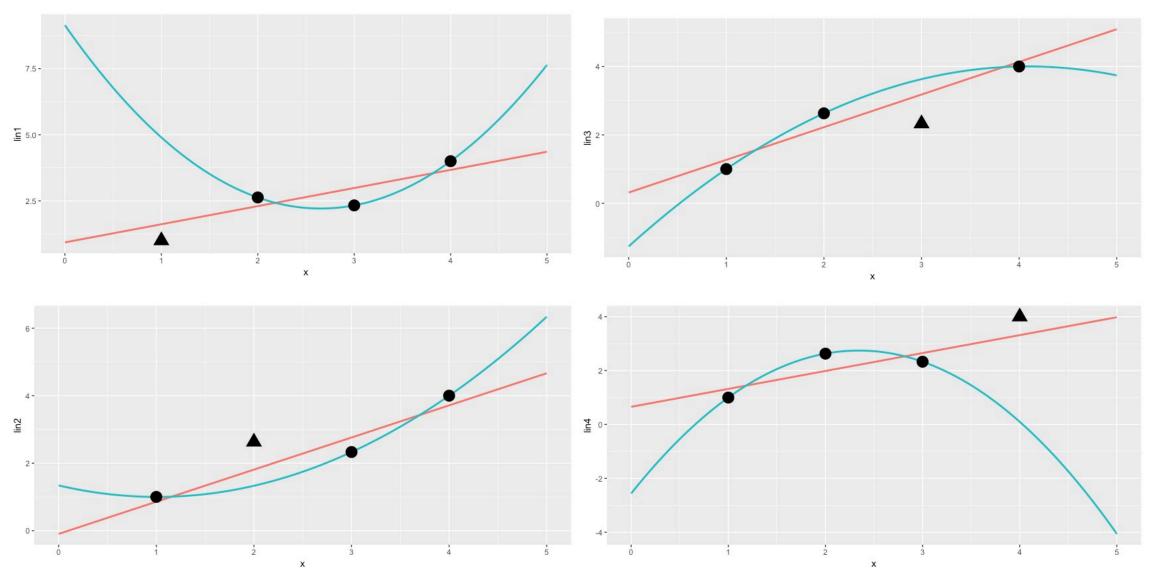




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SIMPLE EXAMPLE: LEAVE-ONE-OUT MODEL FIT

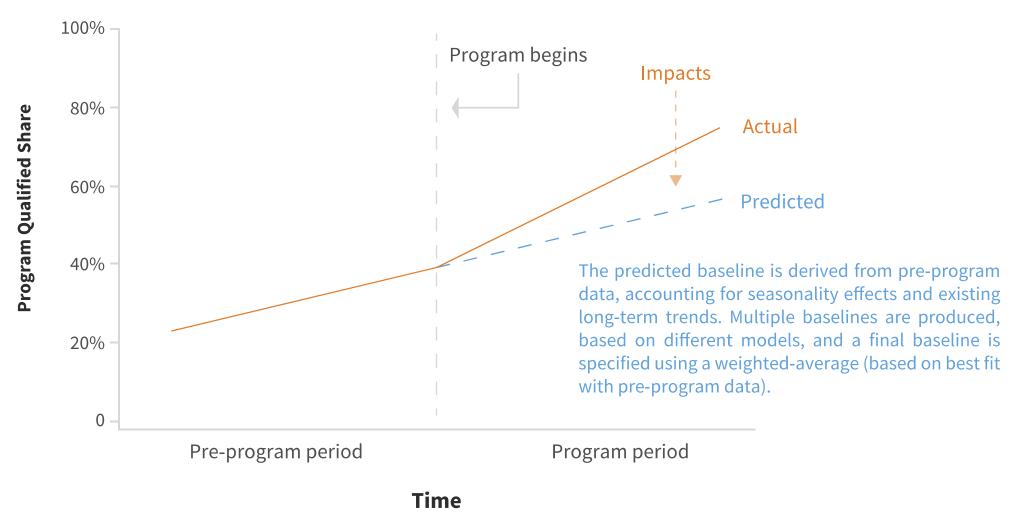




JACKKNIFE MODEL AVERAGING

- 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.

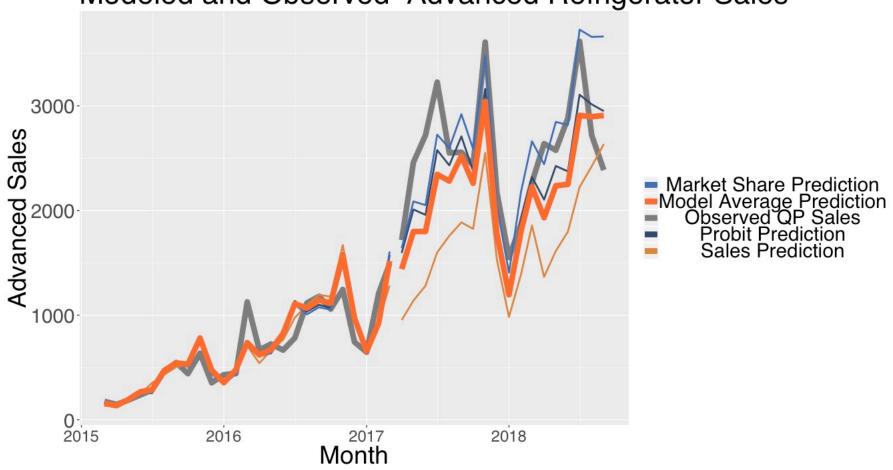
PRE/POST MODEL-AVERAGING FORECAST BASELINE

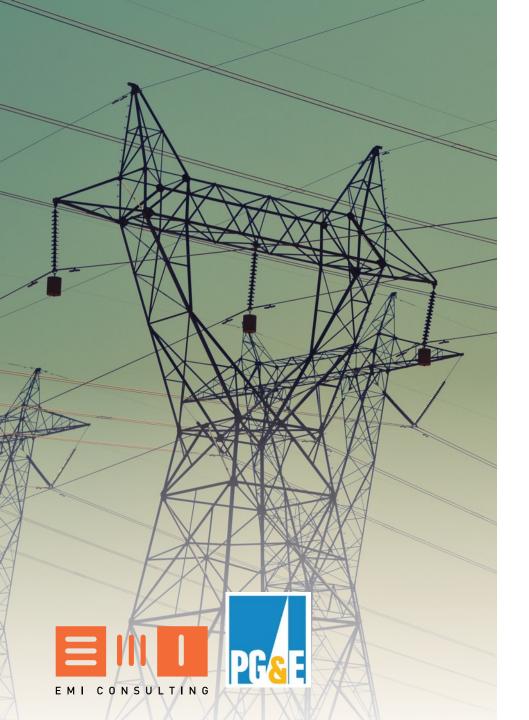


Additional methods supplement the sales analysis to create a holistic picture.

MODEL AVERAGING OF SALES DATA

Modeled and Observed Advanced Refrigerator Sales





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SALES DATA MODELING RESULTS

Over two-year period

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

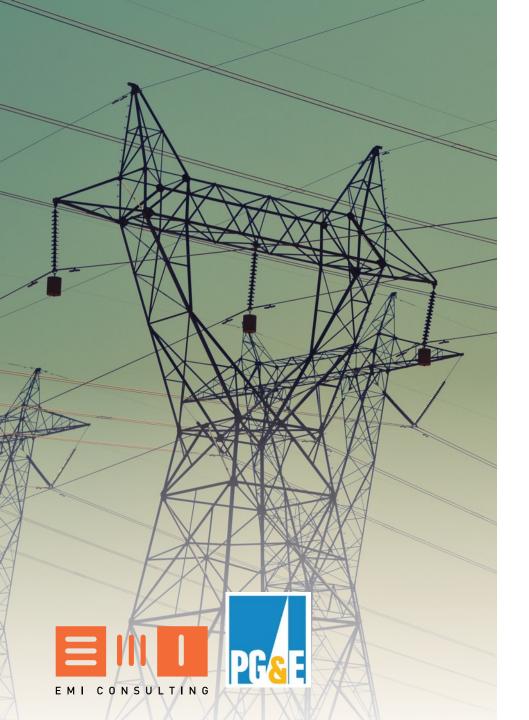
PG&E stopped incenting basic tier soundbars in April 2017.

COMPARISON OF SALES DATA + SHELF ASSORTMENT DATA

A comparison shows general alignment, though soundbars shows opposite trend, and room AC trend is not significant.

Product Category	Program-Qualified Sales Increase?	Program-Qualified Shelf Assortment Increase?		
Air Cleaners	No	No		
Dryers	Yes**	Slight increase**		
Freezers	Yes (basic tier only)**	Slight increase**		
Refrigerators	Yes (advanced tier only)**	Slight increase**		
Room ACs	Indeterminate	Slight increase**		
Soundbars	Yes (advanced tier only)**	No		
Washers	No	Slight increase**		

^{**} 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, statisticallyfounded manner
- With PG&E's RPP program, this approach lined up well with other sources of information

