Modifying California's Traditional Resource Acquisition Benefit-Cost Analysis to Accommodate Market Transformation Programs

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ABSTRACT

Pacific Gas and Electric Company (PG&E) has recently launched the Retail Plug Load Portfolio (RPP) Program, a market transformation (MT) program, in which utilities provide retailers with incentives on a portfolio of consumer-facing energy efficiency (EE) measures - primarily white goods and consumer electronics - with the objective of permanently altering the behavior of key market actors throughout the supply chain. What distinguishes this design from the typical-resource acquisition program is that savings are achieved primarily *at a market level.*

One of the challenges confronted by the RPP Program in moving to a full program is how to assess its cost effectiveness. Because the current California benefit-cost framework is primarily oriented towards the more immediate savings of resource acquisition (RA) programs, it is not well-adapted to MT programs. The current benefit-cost framework assumes a one- to three-year program period during which the net-to-gross ratio (NTGR), gross savings, incremental costs, and administrative and marketing costs are assumed to be fixed. MT programs typically require a 10- to 15-year period to affect the market-level changes during which all of these key parameters will change.

This paper describes a case study of how to adapt a benefit-cost (B-C) policy framework that is primarily oriented to RA programs in order to more fairly and consistently assess the efficacy of MT Programs. Many jurisdictions, which have a B-C policy framework similar to California's, have yet to address these issues and could therefore benefit from the results of this case study.

Introduction

Because plug loads represent a significant and growing proportion of residential electricity consumption, reducing plug load energy consumption is a critical step on the path towards achieving California's residential Zero Net Energy (ZNE) goals. The 2012 ZNE Technical Feasibility Report states that "…minimizing plug loads will be critical to meeting ZNE goals",[1] and recommended that utilities "continue equipment efficiency incentive programs" and "aggressively promote equipment efficiency regulations at the state and federal level".[2]

In response, PG&E has developed and launched the Retail Plug-Load Portfolio (RPP) Program. The RPP Program uses a mid-stream design to influence retailers to stock and sell more energy efficient models of home appliances and consumer electronics in targeted product categories. Retailers are paid per-unit incentives for every program-qualified model that they sell during the program period. Program-qualified models are typically models that meet or exceed the minimum ENERGY STAR

[1] Arup, Davis Energy Group, Sun Light & Power, New Buildings Institute, Engineering 350, and Sustainable Design + Behavior. 2012. *The Technical Feasibility of Zero Net Energy Buildings in California.* Page 8. Developed on behalf of Pacific Gas and Electric Company. Retrieved from: http://www.energydataweb.com/cpucFiles/pdaDocs/904/California_ZNE_Technical_Feasibility_Report_Final.pdf

[2] Ibid. p. 51.

specification in each product category. By increasing the sales of energy efficient models over less efficient models, the RPP Program is intended to generate gross energy and demand savings in the short- and mid-term through participating retailers while transforming the overall market towards higher efficiency in the long-term. The broader RPP Program strategy is discussed in detail in the PG&E document *Retail Plug-Load Portfolio Trial Plan.*[3]

The first phase of the RPP Program included a single participating retailer in a limited number of stores in the PG&E service territory and took place from November 2013 through December 2014. This phase incented six product categories, including: (1) air cleaners, (2) DVD/Blu-Ray players, (3) home theaters-in-a-box (HTIBs), (4) freezers, (5) refrigerators, and (6) room air conditioners. The second phase will include additional retailers and is scheduled to launch in 2016. This phase will include incentives for six targeted product categories including: (1) air cleaners, (2) sound bars, (3) home theaters-in-a-box (HTIBs), (4) freezers, (5) electric clothes dryers and (6) gas clothes dryers. The third phase, slated to launch in 2017 or beyond, may add other measures such as room air conditioners and refrigerators.

In the short-term, the RPP Program is intended to motivate participating retailers to promote and sell more efficient models. However, over the longer-term, other retailers, utilities, and program administrators outside of PG&E's service territory (e.g., other California investor-owned utilities (e.g., Southern California Edison), municipal utilities (e.g., the Sacramento Municipal Utility District), and regional bodies (e.g., Northwest Energy Efficiency Alliance (NEEA) and the Northeast Energy Efficiency Partnerships (NEEP)) will collaborate in this effort to get retailers to regularly demand, assort, and promote the most efficient models available. At the same time, the California Investor-Owned Utilities (IOUs) and their partners will be working with ENERGY STAR and others to advance voluntary and mandatory standards in order to propel the broader marketplace towards greater efficiency and with manufacturers to meet this expected increase in demand. This broader scale will be necessary because the markets for consumer electronics and home appliances are complex and world-wide and it may be difficult for a single utility or state to significantly influence the market forces to affect how manufacturers and mid-stream players act. Because the RPP Program is intended to work with these market actors across multiple regions to cause beneficial, lasting changes in the structure and functioning of the market leading to increases in the adoption of energy efficient products, it is considered to be a market transformation (MT) program.

Policy Framework

The question is how to adapt the California B-C policy framework that is primarily oriented to RA programs in order to more fairly assess the efficacy of MT Programs. One answer to this question was provided by Prahl and Keating (2014) who address, among other things, the benefit-cost issues that are unique to MT programs. They noted that most RA programs are implemented over a relatively short period of time (e.g., two to three years) during which key parameters such as the net-to-gross ratio (NTGR), gross savings, rebates, incremental costs, and administrative and marketing costs are assumed to be fixed.[4] However, for MT programs, the timeframe for costs and benefits is much longer *and* dynamic. They point out that the initial program design and implementation costs for MT programs can be significant but are expected to decrease over time. Prahl and Keating also point out that incremental cost for a variety of reasons will decline over time, citing CFLs, rooftop PVs and LEDs as prime examples. They go on to note that the magnitude of the benefits while relatively small in the short-run

[3] Navitas Partners. 2013. *PG&E Retail Plug-Load Portfolio (RPP) Trial Plan*. Prepared for PG&E.

[4] This is not to imply that all RA programs cease after a short period of time, but that the primary objective is short-term energy savings. RA programs are often extended using updated parameters.

are expected to grow over time as the program increases the market share of program-qualified measures in the broader market. Thus, to base the benefit-cost ratio of a MT program on these short-term costs, which are likely quite significant, and the short-term benefits, which are likely quite small, would be misleading. Rather, one must consider the benefits and costs over the full program period which can be 10 to 15 years.

Another issue that Prahl and Keating highlight is the NTGR that is entered into the E3 Calculator[5]. They point out that gross savings observed in a MT program are not all due to the program; some of it is naturally occurring. To address this issue, the naturally occurring savings must be forecasted and subtracted from the gross savings observed in the MT program. They also observed that some stakeholders

> . . . were concerned about the need to change the way that current CPUC cost-effectiveness criteria are applied to market transformation initiatives. Our view is that it is not necessary to change the overall framework of the existing tests to consider market transformation initiatives. Inputs into current tests may need to be provided differently, however, from the way inputs are treated for resource acquisition programs. (p. 21)

One of their key recommendations was:

> Avoid seeking a fundamentally different cost-benefit analysis approach for market transformation initiatives than for resource acquisition programs. Rather, recognize the need for limited changes in the way the CPUC's TRC test and cost-effectiveness calculator handle some inputs. The single most important change would be a lengthening of the time-frame covered by the analysis, specifically the handling of up-front costs and delayed benefits. (p. 6)

Consistent with these recommendations, PG&E has conducted a case study to address: 1) the fact that benefits occur over a longer period of time, 2) the fact that costs occur over a longer period of time and decline for most costs including PG&E marketing costs, incentives, incremental costs and market development funds, and 3) the need to modify the calculation of the NTGR based on a long-term forecast of savings *with* and *without* the RPP Program.

Since all of the jurisdictions of which we are aware have not yet attempted to address these issues with respect to their existing or planned MT programs, it is hoped that the results of this California case study will provide some useful guidance in the fair and consistent treatment of such programs across these jurisdictions.

Before discussing the details of this case study, we describe the current California benefit-cost framework. In this paper, we focus on the Total Resource Cost (TRC) Test given the complexity of the issues that arise in its use.

Current E3 Calculator

The *California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects* (CPUC, 2001) (SPM) was updated twice, once in 2007 and again in 2012. The purpose of the first update (2007 SPM Clarification Memo (D.07-09-043, Mimeo pages 154-158) was to clarify that a transfer incentive (rebate) recapture quantity should be added to the TRC cost equation as presented in Equation 1.

[5] The E3 Calculator is the official spreadsheet tool for evaluating all energy efficiency programs for the California investor-owned utilities since 2006. The E3 Calculator is also used by third party providers to design and submit their programs to the utilities as well as by the CPUC Energy Division to track and evaluate programs ex-post.

$$Costs_{trc} = \sum_{t=1}^{N} \frac{Admin_t + (NTGR * Meas\$_t) + (1 - NTGR) * Rebate_t}{(1+d)^t} \quad (1)$$

where

Admin= Program administrative costs
NTGR= Net-to-gross ratio
Meas$= Incremental costs (*before* Rebate is received)

Rebate= Incentive costs, restricted to include only dollar benefits such as rebates or rate incentives (bill credits) to end users.

Adding this term ((*1-NTGR)*Rebate*)) to the TRC cost formulation ensured that the removal of free rider costs does not also remove program costs that become ratepayer revenue requirements, consistent with the intent and purpose of this test.

In 2012, two further adjustments were made to the E3 Calculator, some of which are directly relevant to the calculation of the TRC for the RPP Program. The first is based on the recognition that there are several types of incentives including incentives paid directly to end users (e.g., downstream rebates) and incentives paid to third parties (e.g., "midstream" or "upstream" payments made directly to manufacturers, distributors, or retailers; or direct installation payments made to third parties who install equipment on a customer's site). These payments are *not* transferred from nonparticipating to participating customers, and per the SPM definition, they are not even technically incentives – they are part of the program administrator costs. The solution was to add an incentive cost adjustment to ensure that incentives to others and Direct Install costs that are in excess of the incremental measure cost are fully captured in the TRC cost (see Equation 2).

$$Costs_{trc} = \sum_{t=1}^{N} \frac{Admin_t + NTGR * (Meas\$_t + Excess_t) + (1 - NTGR) * (Rebate_t + Incent_t + DI_t)}{(1+d)^t} \quad (2)$$

where

$Admin_t$= Program administrative costs
NTGR= Net-to-gross ratio
$Meas\$_t$= Incremental costs (*before* Rebate is received)
$Excess_t$= Max(0,Incentives to others + Direct Install materials and labor costs - Measure Cost).
$Rebate_t$= Rebate to end users
$Incent_t$= Incentive to others
DI_t= Direct installation costs

The second adjustment to E3 Calculator addressed market effects. The revised E3 Calculator includes the ability to separately adjust measure benefits and measure TRC costs for market effects such as spillover. Market effects for benefits are applied to all benefit components. Market effects for costs, however, are applied only to (Meas$ + Excess). They are not applied to rebates or incentives. This market effects component is incorporated into Equation 3.

$$Costs_{trc} = \sum_{t=1}^{N} \frac{Admin_t + (NTGR+MEA)*(Meas\$_t + Excess_t) + (1-NTGR)*(Rebate_t + Incent_t + DI_t)}{(1+d)^t} \quad (3)$$

where

MEA = Market effects adjustment.

We refer to the term (NTGR+MEA) as the market-effects-adjusted net-to-gross ratio (MEA_NTGR). Note that the variable *Excess* was added by the Energy Division to adjust for cases in which the incentives to others were not treated as administrative costs. How we addressed the Excess variable is discussed later. Also note that the variable *DI* drops out since there are no direct installation costs in the RPP Program.

The TRC benefits are calculated using Equation 4.

$$Benefits_{trc} = \sum_{t=1}^{N} \frac{UAC_t}{(1+d)^t} \quad (4)$$

where

UAC_t= Utility avoided costs in year *t* (based on *net* program savings (i.e., gross kWh, kW, and therms savings, which have been adjusted using the MEA_NTGR)

d= Discount rate

t= The number of periods over which future values are discounted

Modified B-C Calculator Framework

Consistent with the recommendations of Prahl and Keating (2015) noted earlier, we made only one change to the current E3 calculator, which was to lengthen the forecast of avoided costs through 2045 to account for the fact that the RPP Program is designed to run 10 years. All the other modifications involved the development of different ways of calculating key parameters such as incentives, incremental cost and PG&E administrative costs before they are entered into the E3 Calculator. Separate Excel workbooks were developed to generate these inputs. In all of the tables that follow, the values are only illustrative.

Benefits

For each product category, the benefits are based on a forecast of the sales of program-qualified products using the Generalized Bass Diffusion Model (Boehner and Gold, 2012) implemented in a series of Excel spreadsheets. Illustrative forecasts of the annual gross sales in the PG&E service territory of program-qualified models for the six product categories are presented in Table 1.

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Table 1. Forecasted Annual Gross Sales of Program-Qualified Products in the PG&E Service Territory, by Product Category

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Electric Clothes Dryers	12,628	17,059	22,246	28,006	34,056	40,066	45,720	50,851	55,410	59,448
Air Cleaners	6,403	8,261	10,026	11,682	13,227	14,642	15,960	17,239	18,514	19,806
Sound Bars	28,181	33,742	39,136	44,256	49,100	53,733	58,219	62,648	67,078	71,555
HTIB	1,071	1,697	2,554	3,666	5,024	6,582	8,261	9,978	11,667	13,295
Freezers	14,773	17,514	20,126	22,501	24,592	26,404	27,967	29,340	30,573	31,706
Gas Clothes Dryers	9,132	14,373	21,489	30,656	41,722	54,090	66,763	78,749	89,402	98,593

Each of these forecasts is then entered into the E3 calculator. The volume of sales for each year for each product category is then multiplied by the associated Unit Energy Savings (UES)[6]. Finally, this product is multiplied by the stream of avoided costs associated with the load shape assigned to each product category over the period of time defined by the effective useful life (EUL).

Costs

The way in which TRC costs are currently addressed in the E3 Calculator was presented earlier in Equation 3. How each cost term was modified in a separate Excel workbook, the E3 Input Calculator (E3IC), to accommodate MT programs is presented in the following sections.

PG&E Administrative, Marketing and Implementer Costs. The cost calculation addresses the fact that PG&E's administrative, marketing and implementer costs for the RPP Program continue for the ten years of program operation and are assumed to decline somewhat over time as program operations become more efficient. Table 2 presents the *PGE Costs* Worksheet in the E3IC. The dollar amounts are only illustrative. The rates of decline in Table 2 are only examples and can be set to any value based on the best judgment of the RPP Program manager as to how these costs are expected to decline over time.

Table 2. PG&E Administrative and Marketing Costs, by Year

Rate of Decline PG&E Administration Costs	5%
Rate of Decline PG&E Marketing Costs	20%
Rate of Decline Implementer Costs	20%

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
PG&E Administration Costs	$400,000	$380,000	$361,000	$342,950	$325,803	$309,512	$294,037	$279,335	$265,368	$252,100
PG&E Marketing Costs	$350,000	$280,000	$224,000	$179,200	$143,360	$114,688	$91,750	$73,400	$58,720	$46,976
Implementer Costs	$450,000	$360,000	$288,000	$230,400	$184,320	$147,456	$117,965	$94,372	$75,497	$60,398
Total	$1,200,000	$1,020,000	$873,000	$752,550	$653,483	$571,656	$503,752	$447,107	$399,586	$359,474

The present value of the stream of total PG&E costs is entered into the *PGE Costs* Worksheet of the E3IC as an administrative cost which is linked to the E3 Calculator.

Retailer Market Development Payments. In the first year of the RPP Program, PG&E is considering providing each retailer with an annual payment of $5,000 per participating store for market development, which includes such things as in-store advertising, displays, etc. If PG&E were to provide such a payment in the first year, the expectation is that this payment would be decreased at a specified rate over the next nine years since retailers are expected to build these costs into their regular in-store advertising/display budgets as it becomes clear that profits can be made by selling these efficient

[6] See Energy Solutions and EMI Consulting. (2015). *Calculation Methodology for Unit Energy Consumption (UEC) and Unit Energy Savings (UES) for the Retail Plug-Load Portfolio (RPP) Program.* Prepared for the Pacific Gas and Electric Company.

products. This annual payment would be treated as an *administrative cost*. Table 3 presents the *Retailer Payment* Worksheet in the E3IC.

Table 3. Retailer Market Development Payments for All Participating Stores, by Year

Rate of Decline	10%

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
# Stores	214	214	214	214	214	214	214	214	214	214
Payment per Store	$5,000	$4,500	$4,050	$3,645	$3,281	$2,952	$2,657	$2,391	$2,152	$1,937
Total Payments	$1,070,000	$963,000	$866,700	$780,030	$702,027	$631,824	$568,642	$511,778	$460,600	$414,540

The payments and their rate of decline of 10% in Table 3 are only examples and could be set to any values based on the best judgment of the RPP Program manager. The present value of this stream of market development costs is entered as an *administrative cost* into the E3IC which is linked to the E3 Calculator.

Incremental Measure Costs (IMC) and Retailer Incentives. In the E3IC, we have created a worksheet, *Levelized Cost IMC & Rebate*, to address the fact that both the IMCs and the initial retailer incentives extend over ten years and decline over time.

Table 4 shows that the initial incremental cost is set for the first year (2015) of the RPP Program and declines at a specified rate over the next nine years simply due to natural technological advances, manufacturing efficiencies and economies of scale. In the first year of the RPP Program (2015), each product category is assigned an IMC value[7]. Note that these IMC values are only examples.

Table 4. Incremental Measure Costs, by Year and Product Category

Description	Unit of Measure	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Electric Dryers	Widget	$80.00	$72.00	$64.80	$58.32	$52.49	$47.24	$42.52	$38.26	$34.44	$30.99
Air Cleaners	Widget	$109.00	$98.10	$88.29	$79.46	$71.51	$64.36	$57.93	$52.13	$46.92	$42.23
Sound Bars	Widget	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
HTIB	Widget	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Freezers	Widget	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Gas Dryers	Widget	$80.00	$72.00	$64.80	$58.32	$52.49	$47.24	$42.52	$38.26	$34.44	$30.99

Table 5 shows the initial retailer incentive for each product category over the life of the RPP Program. The initial retailer incentive is currently set to remain constant for the first three program years in order to keep the retailers engaged. However, beginning in the fourth year, incentives are adjusted for an annual rate of decline over the next seven years. This is done to reflect the fact that the incentive is hypothesized to become less important over time as retailers shift their buying practices and learn that sufficient profits can be earned by selling these more efficient models (i.e., the assorting, advertising and promotion of these products is incorporated into their business-as-usual plans) and as the proportion of energy-efficient products offered by manufacturers increases in response to the intervention and naturally-occurring forces.

[7] Using a web harvester, Energy Solutions collects retail sales data from major sites selling the product categories promoted by the Program and estimates IMC values using hedonic price modeling.

Table 5. Initial Retailer Incentive, by Year and Product Category

Description	Unit of Measure	Entire Retailer Incentive in 2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Electric Clothes Dryers	Widget	$50.00	$50.00	$50.00	$45.00	$40.50	$36.45	$32.81	$29.52	$26.57	$23.91
Air Cleaners	Widget	$20.00	$20.00	$20.00	$18.00	$16.20	$14.58	$13.12	$11.81	$10.63	$9.57
Sound Bars	Widget	$15.00	$15.00	$15.00	$13.50	$12.15	$10.94	$9.84	$8.86	$7.97	$7.17
HTIB	Widget	$15.00	$15.00	$15.00	$13.50	$12.15	$10.94	$9.84	$8.86	$7.97	$7.17
Freezers	Widget	$20.00	$20.00	$20.00	$18.00	$16.20	$14.58	$13.12	$11.81	$10.63	$9.57
Gas Clothes Dryers	Widget	$50.00	$50.00	$50.00	$45.00	$40.50	$36.45	$32.81	$29.52	$26.57	$23.91

Examples of the rates of decline for IMCs and initial retailer incentives for each product category are shown in Table 6. The annual rate of decline for the initial retailer incentive is set based on the professional judgment of the Program staff while the annual rate of decline for the IMC is based on the best available evidence (Desroches, 2013). The annual rate of decline for IMC should match that used in the Generalized Bass Diffusion Model that is used to estimate the gross sales of program-qualified models, MEA_NTGR, the NTGR and the TRC of the ten-year Program[8].

Table 6. Annual Rates of Decline for IMC and Rebate, by Product Category

Electric ClothesDryers	IMC Annual Rate of Decline	10.00%
	Rebate Annual Rate of Decline	10.00%
Air Cleaners	IMC Annual Rate of Decline	10.00%
	Rebate Annual Rate of Decline	10.00%
Sound Bars	IMC Annual Rate of Decline	10.00%
	Rebate Annual Rate of Decline	10.00%
HTiB	IMC Annual Rate of Decline	10.00%
	Rebate Annual Rate of Decline	10.00%
Freezers	IMC Annual Rate of Decline	10.00%
	Rebate Annual Rate of Decline	10.00%
Gas Clothes Dryers	IMC Annual Rate of Decline	10.00%
	Rebate Annual Rate of Decline	10.00%

Another factor addressed by the E3IC is that the retailers who receive the initial incentives may not always pass them along to their customers. The portion of the incentive that is retained by the retailer must be treated as an additional cost while the portion that is passed along to the customer in the form of a price reduction should be treated as a customer buy-down. Table 7 specifies the portion of the initial retailer incentive that is, on average, expected to be passed along to the customers as a buy-down. The 30% value is only an example.

[8] See PG&E. (2015). *Estimation of Net-To-Gross Ratios for the PG&E RPP Programs*. Prepared for the California Technical Forum.

Table 7. Share of Initial Retailer Incentive as Customer Buy-Down, by Product Category

Description	% Passed Along to Customer
Electric Clothes Dryers	30%
Air Cleaners	30%
Sound Bars	30%
HTIBs	30%
Freezers	30%
Gas Clothes Dryers	30%

For each year and each product category, the portion of the initial retailer incentive rebate passed along to the customer as a buy-down is multiplied by the number of purchases.

While the IMC and the customer buy-downs extend over the life of the Program, the E3 Calculator accepts for each measure only one incremental cost value and one customer buy-down value. To accommodate the E3 Calculator, the levelized cost for each of these two parameters are calculated in the *Levelized Cost IMC & Rebate worksheet* of the E3IC, using Equations 5 and 6, based on the stream of values over the ten-year life of the Program.

$$Levelized\ Cost_{IMC} = \frac{PV(IMC_i \times Annual\_Purchases_i)}{PV(Annual\_Purchases_i)} \quad (5)$$

$$Levelized\ Cost_{Customer\ Buy\_Down} = \frac{PV(Customer\_Buy\_Down_i \times Annual\ \_Purchases_i)}{PV(Annual\_Purchases_i)} \quad (6)$$

These levelized IMCs and the customer buy-downs are then entered into the E3 Calculator.

Next, for each year and product category, we created a table that takes one minus the portion of the initial retailer incentive passed along to customers as a buy-down (i.e., the portion retained by the retailer), multiplies it by the initial retailer incentive, and then multiplies the resulting product by the number of purchases. The present value of this stream of costs divided by the present value of the number of purchases yields the levelized cost of retained retailer incentives, which is added to the utility incentives *and* the incremental cost of the measure for each measure in the E3IC which is linked to the E3 Calculator. By including the retained retailer incentive in the customer buy-down and the incremental measure cost, the net cost to participants correctly reflects the fact that the retained retailer incentives will not lower the expected costs to consumers. This treatment increases the TRC cost of the measure and effectively increases the total cost of delivering the program.

NTGR

In a separate series of Excel workbooks, MEA_NTGRs, NTGRs (i.e., 1-FR) and nonparticipant spillover (NPSO) rates (see Equation 7)[9] were estimated for each product category using the same Generalized Bass Diffusion Model mentioned earlier. Note that the NPSO rate represents the MEA (the market effects adjustment) in Equation 3. For the purposes of this paper, it is not necessary to understand all of the methodological details of how these three parameters were estimated for each

[9] Currently, the California Public Utilities Commission (CPUC) allows the investor-owned utilities to claim a 5% spillover factor. Impact evaluations, led by the Energy Division of the CPUC, will eventually provide estimates of any spillover (ISO, OSO and NPSO), which could be larger or small than this 5%.

product category. The important thing to understand is that these parameters were estimated based on long-term forecasts of the market share[10] of program-qualified products under two scenarios, one *with* the RPP Program and one *without* it.

$$\text{MEA\_NTGR} = ((1\text{-FR}) + \text{ISO Rate} + \text{OSO Rate}) + \text{NPSO Rate} \quad (7)$$

where

FR= Freeridership
ISO Rate= Inside spillover rate for participants
OSO Rate= Outside spillover rate for participants
NPSO Rate= Nonparticipant spillover rate

While the NTGR can be adjusted using a participant inside spillover rate and/or a participant outside spillover rate, the *with RPP Program* forecast does not attempt to model either of these two types of participant spillover. Thus, the NTGR is simply the present value of the monetized[11] participant net savings divided by the present value of the monetized participant gross savings (see Equation 8).

$$NTGR = \frac{PV(Participant_{Net})}{PV(Participant_{Gross})} \quad (8)$$

The NPSO rate is calculated in Equation 9 as the present value of the monetized nonparticipant net savings divided by the present value of the monetized participant gross savings.

$$NPSO\ Rate = \frac{PV(Nonparticipant_{Net})}{PV(Participant_{Gross})} \quad (9)$$

From Equation 7, we can see that the final MEA_NTGR is simply the sum of the NTGR and the NPSO Rate (i.e., the MEA in Equation 3). From Equation 3, we can also see that the NTGR + MEA (i.e., the MEA_NTGR) is then applied to the levelized incremental costs in the E3 Calculator for each product category. In the E3 Calculator, the term (1-NTGR) is applied to the *Levelized Cost*$_{Buy\text{-}Down}$ and the *Levelized Cost*$_{Retained\_Retailer\_Incentive}$ in order to account for payments to freeriders (i.e., customers who would have purchased program-qualified products in the absence of the RPP Program and retailers who would have sold program-qualified products in the absence of the RPP Program). From Equation 4, we can see that the utility avoided costs are based on *net* program savings (i.e., gross savings that have been adjusted using the MEA_NTGR). The NTGR and the MEA_NTGR are assumed to be the same for kWh, kW, and therms.

Conclusions

This paper has demonstrated one way in which the inputs to the existing E3 Calculator can be modified to address the unique benefits and costs of MT programs in California. Because there is always a great deal of uncertainty regarding the gross sales of program-qualified models, the MEA_NTGR, the NTGR and the TRC of a MT program prior to its launch, they should be recalculated annually using the most recent results of the theory-driven evaluation along with recorded sales, recorded customer buy-downs and retained retailer incentives, recorded administrative costs, the most recent estimates of

[10] Market share is defined as the percent of program qualified models in a given year that meet or exceed the RPP Program specification as it was defined in 2015 when phase two launched.
[11] kWh savings are monetized using the avoided costs.

incremental measure cost, and the results of the on-going literature review. Using these data, revised forecasts of sales *with* and *without* the program will be made resulting in revised estimates of the MEA_NTGR, the NTGR and the TRC. Only by regularly updating these key parameters can program administrators, regulators, and other stakeholders begin to effectively manage their respective risks.

As noted in the introduction, many jurisdictions are similar to California in that, while they have historically relied primarily on RA programs, they also have begun implementing or are considering implementing a number of MT programs. To assess the cost-effectiveness of these MT programs, these other jurisdictions must eventually address the same issues that have arisen in California. As far as we know, most, if not all, of these jurisdictions have not yet attempted to address these issues. It is hoped that the results of this California-based case study will provide some useful guidance in the fair and consistent treatment of MT programs across these jurisdictions.

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