The Regulatory Relationship between Free Ridership and Equity for Public Goods Programs

Robert M Wirtshafter, Wirtshafter Associates, Inc.
Stephen Grover. Evergreen Economics, Inc.
Chris Ann Dickerson, CAD Consulting, Inc.
Rob Rubin, Sempra Utilities, Inc.
Wendy Takanishi and John Cole, Hawaii Public Utilities Commission

ABSTRACT

Concerns about the equitable distribution of public benefit funds (PBF) or public goods charges (PGC) collected by utilities as part of their standard tariff structures and distributed by utilities and other program administrators to firms and individuals who install energy-efficiency and renewable measures, have been raised repeatedly over the years, but there has been limited quantification of how fund distribution is spread out amongst contributors. Small surveys suggest that certain groups of residential customers, called hard-to-reach, have not participated in programs as frequently as have other sectors of the community. This has raised a few states to issue policies to encourage hard-to-reach customer participation, but efforts have been limited and results have never been measured. New techniques described in this paper use geographic information system (GIS) to measure the distribution of program participation and to identify the likely characteristics of each participant. Using this method, we can determine winners and losers (equity) in the distribution of PBF funding across the utility.

This paper argues that tracking equity and developing policies that encourage a broader distribution of program incentives are not just a matter of fairness. This paper draws comparisons between efforts to encourage the equitable distribution of PBF benefits and efforts to reduce the level of free-ridership that occurs in energy efficiency efforts. An argument is made to encourage more attention to equity as a better means to broaden program reach and increase program savings. Policies that can increase reach to underserved customers and also reduce free ridership are discussed.

Background on Equity Regulation in Energy Efficiency Programs

The calculation of free ridership rates, the degree to which energy-efficiency program participants take incentives for projects that would have been installed without the program, has become a major focus of energy efficiency programs' regulatory oversight for most state in the country.[1] One state, Hawaii, has implemented its energy efficiency programs without requiring extensive quantification of free-rider rates. Instead, a stipulated net-to-gross ratio of .73 is used., In addition, the Hawaii Public Utilities Commission ("HPUC") has established an equity performance metric that gives its program administrator a performance incentive if they can achieve a balance in program activity across the three island counties in which the program is offered, see SAIC (2012).

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[1] An ACEEE study, Kushler et. a. (2012, p. 25) notes that 71% of the states calculate net savings when reporting savings from their rate-payer funded energy efficiency programs.

This paper explores the concept of using equity as a performance indicator, including its relationship to free ridership. We first provide a short history of equity as a regulatory concern in energy efficiency programs. We then describe two case studies that demonstrate how equity can be monitored. These case studies use customer data and a geographic information system to examine the rebate program portfolio in order to establish participant characteristics and estimate the degree to which programs are achieving an equitable distribution of public goods funds. Finally, the paper addresses how equity regulation can address the free rider concerns of regulators, and how attention to equity may offer an alternative to costly free ridership quantification.

Equity has been defined in several different ways as applied to rate-payer funded energy efficiency programs. In a broad sense all equity discussions examine the distribution of program benefits; however, the definition of benefits and the ways the distribution has been measured have varied widely. Conceptually, PBF legislation has been enacted because states wish to encourage individual investments in energy efficiency and renewable in order to delay the need for construction of centralized electric-generation plants. Thus, the large benefits given to participants also generate benefits to non-participants. The early justifications of utility investments in solar energy and energy efficiency were based on a no-losers rule; see (Feldman and Wirtshafter 1980). The no-losers rule established that as long as the utility contribution required to implement the energy reduction was less than the marginal cost to supply the energy, non-participant customers were better off even though they did not receive any of the incentive payments.

As programs developed, challenges emerged as to the fairness of programs. Post-program surveys of participants found that wealthier and better educated customers were more represented in participation samples than they were in the population of eligible rate-payers. Wirtshafter (1985), noted that while non-participants were generally not harmed by payments to participants in properly costed and operated programs, they were not really helped either. He argued that programs should refocus their attention to deliberately seek out those customers who are not participating.

The creation of public benefit funding and the associated charges that appeared on every customer's monthly bill raised the concerns about fairness. The California Public Utility (CPUC) initiated studies to determine what populations of customers were hard-to-reach (HTR). The CPUC established a list of residential customer types who, based on post-program surveys, were under-represented in utility programs. This list cited low-income, rural, non-white, non-English speaking households, and those living in rental properties as characteristics correlated with being hard-to-reach. TecMrkt Works (2001) provided zip code maps of areas of the state that had high concentrations of these customers, and the CPUC required that utilities report on their efforts to serve these zip codes. As a result, modifications, such as expansion of services to underserved areas, were made to existing programs. In addition, new programs, such as third-party programs targeted to renters and non-English households, were added. In later years the concept of hard-to-reach was expanded to develop programs for small businesses.

Let us note here that fairness is a term loaded with political and legal overtones. Utility rate regulations do not require that rates paid by each individual match the costs of serving that individual, nor should individual PBF contributions match PBF withdrawals. As we have noted above, the reduction in the use of electricity often has benefits that extend beyond the specific energy saver. For this reason, it is not essential that rebate levels perfectly track contributions. For measures that are not yet commercialized, those investing in the early stages are benefiting non-participants, who will see improved and cheaper products when they are ready to purchase. In the long-run such rebates, even though they are unequally distributed, encourage market transformation; and therefore generate large overall benefits. In these cases, the unequal distribution of program benefits may be an appropriate and efficient objective.

The opposite may be the case for technologies and services that are more commercially available. In these cases, the distribution of funds does not generate the same market transformation benefits. Since most programs serve all customers on a first-come first-serve basis, these programs favor those with the greatest ability to take advantage of the rebates, and as such these programs tend to have large numbers of free-riders; participants who would have taken the energy-saving action in the absence of the program. Jurisdictions concerned about quantifying the net effects of their program interventions adjust the gross energy saved by the rate of free-ridership.

Thus we come to the central theme of this paper, that efforts to monitor and encourage broader distributions of program incentives are a means of addressing the free-ridership problems confronting most rate-payer funded programs. The authors believe that regulators should spend more time monitoring PBF distributions, and develop strategies that encourage broader distribution of resources across potential customers. In the next section we describe efforts to monitor distribution and how it can be used to improve programs.

Portfolio Analysis of Participation

Two case studies with Hawaii and San Diego Gas and Electric (SDG&E) are described below. In both, program distribution is calculated using a geographic information system (GIS) to combine actual participation data, customer information, and census data. This analysis provides a deeper perspective on equity by determining what areas are being served by the programs and what are the characteristics of the people in those areas.

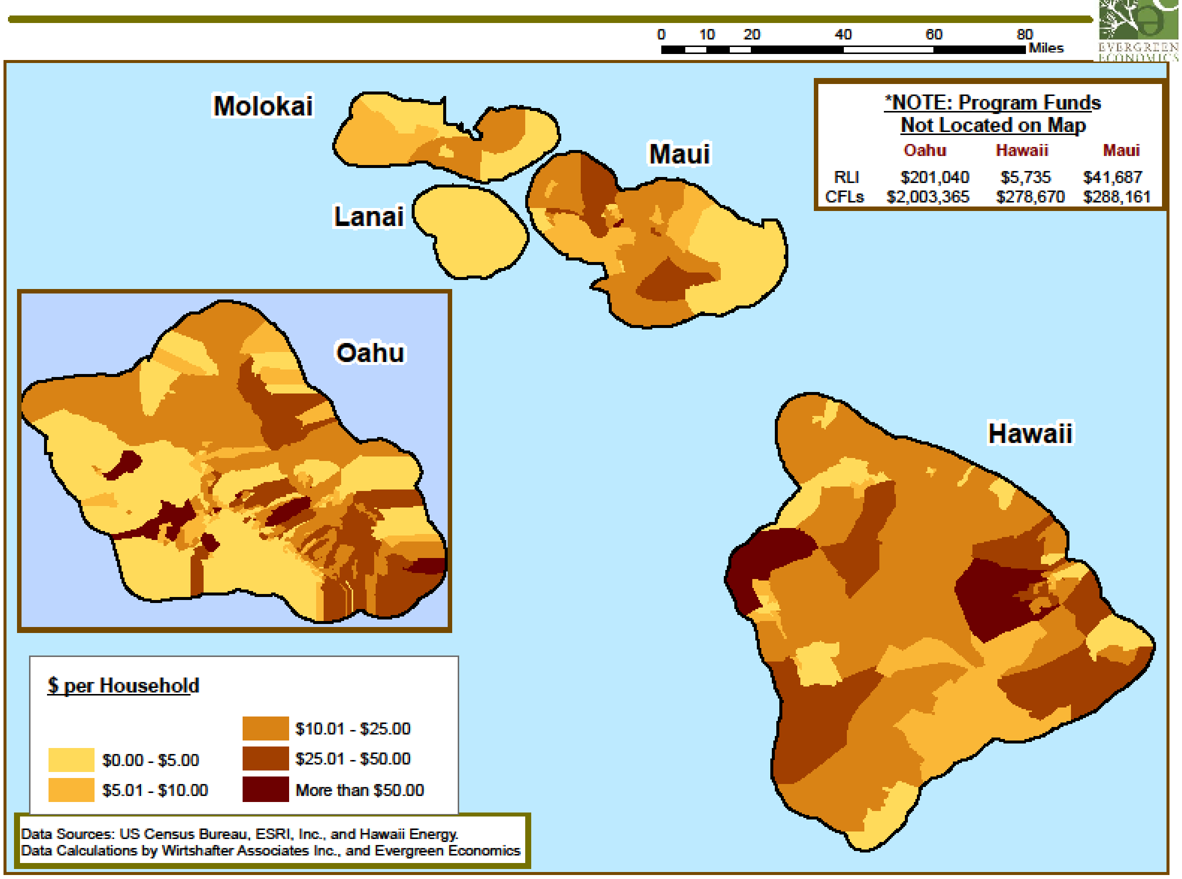
Case Study 1: Hawaii Energy

The Hawaii Public Utility Commission (HPUC) recently restructured their energy efficiency programs so that they are now managed by a third-party administrator, rather than under direct utility control. In setting up the new program called Hawaii Energy, one of the performance incentives, Island Equity, requires that the distribution of kWh savings achieved by the three island counties be proportional to the kWh consumption of the three counties. Because most of the program infrastructure was located in Oahu, it was feared that most of the activity would be concentrated there. Indeed, this was the case in the first year of operation, and the program administrator did not meet the equity metric. Subsequently significant resources were moved to the other two counties, and the metric was achieved in the second year. Our study looks at the current distribution of program contributions and distributions to see if the metric idea could be refined to encourage additional efforts to reach areas not already served.

Using geocoding software that locates the precise longitude and latitude of each program participant, we are able to place each participant into a US 2000 Census Block Group. Once the participant is assigned a block-group, the activity within each block-group is averaged over households. This assigns a Rebate dollar per household value for each block-group. The analysis can only locate those program measures and incentives where an exact address is known. For the solar water heater and appliance rebates the addresses of those receiving are known and locatable. Expenditures for other residential programs, particularly the upstream CFL incentives and most of the residential low income CFL distributions are not locatable.

01 provides a map of the area covered by Hawaii Energy's programs and shows the distribution of its locatable portfolio of residential rebates associated with Hawaii's PBF and the American Recovery and Reinvestment Act of 2009 (ARRA) money. In 2010, the Hawaii Energy residential programs distributed $3,118,747 in program rebates to identifiable households. (That is: this analysis excludes $2.8 million in upstream lighting and $250,000 in low income lighting giveaways where a specific location was not identifiable.) In addition, Hawaii Energy distributed $3,403,915 in ARRA funds to residential households. Together, a total of $6,522,662 rebates were distributed to the 383,239 households identified in the 2000 Census data for an average of $17.14 per household. As Figure 1 illustrates, the distribution of funds varies significantly across the State's block-groups. Many of the block-groups received less than $5/household in rebates in 2010 (1/3 the state average), while others averaged more than $50/household (three times the overall state average).

Figure 1. Total residential and ARRA rebates per household



The GIS allows us to overlay different maps and to produce composite pictures and data tables based on their intersections. In the Hawaii case, we used the average values from the 2000 US Census and American Community Survey results to characterize the households in each block-group. For example, for each block-group, we determined the percentage of households that are below the 150 percent of poverty level. We partitioned the 439 block-groups into quintiles based on the percentage of households that were below the 150 percent of poverty level. We then calculated the mean Rebate and ARRA funds spent per household for each of the quintiles. These results are shown in Table 1.

Table 1. Distribution of rebate dollars by percentage below 150% poverty quintile

	Residential $/HH		
Block-Group Quintiles	**$Program Rebate/HH**	**$ARRA Rebate/HH**	**$Program and ARRA rebates/HH**
Wealthiest (less than 7% below 150% poverty)	$22.71	$13.92	$36.62
Next Wealthiest (7% to 28% below 150% poverty)	$9.64	$10.07	$19.71
Middle (28 to 35% below 150% poverty)	$5.22	$7.74	$12.96
Next Poorest (35 to 46% below poverty)	$2.71	$3.90	$6.61
Poorest (more than 46% below poverty)	$6.97	$4.46	$11.43
Average	$9.21	$7.93	$17.14

The results show that rebate dollars are not distributed equally across household incomes. On average the program provided $17.14 in rebates per household. However, households in block-groups with the lowest percentages of low-income households received four times the rebate amounts as households in the block-groups with the highest percentage of low-income households received. An alternative measure of fairness balances the distribution of rebates to the contributions made to the PBF funds. In Hawaii, wealthier households consume more electricity, so they contribute more to the PBF fund. When rebates are compared to contributions, the gap between the quintiles is reduced, however, the wealthiest quintile still receives twice the $Rebate/$PBF contribution that the least wealthy quintile receives.

The reason that lower income households tend to participate less frequently is likely because they cannot afford to upgrade to high efficiency products, particularly solar water heating systems. These households probably hang on to their old appliances longer, and when they upgrade they often buy the cheapest product available. Because energy efficient features are typically bundled with the higher end models, they cannot afford the extra expense. Because many of these households rent, the split incentive prevents them from investing in their landlord's property, and gives little incentive to the landlord who does not pay the energy bill to upgrade.

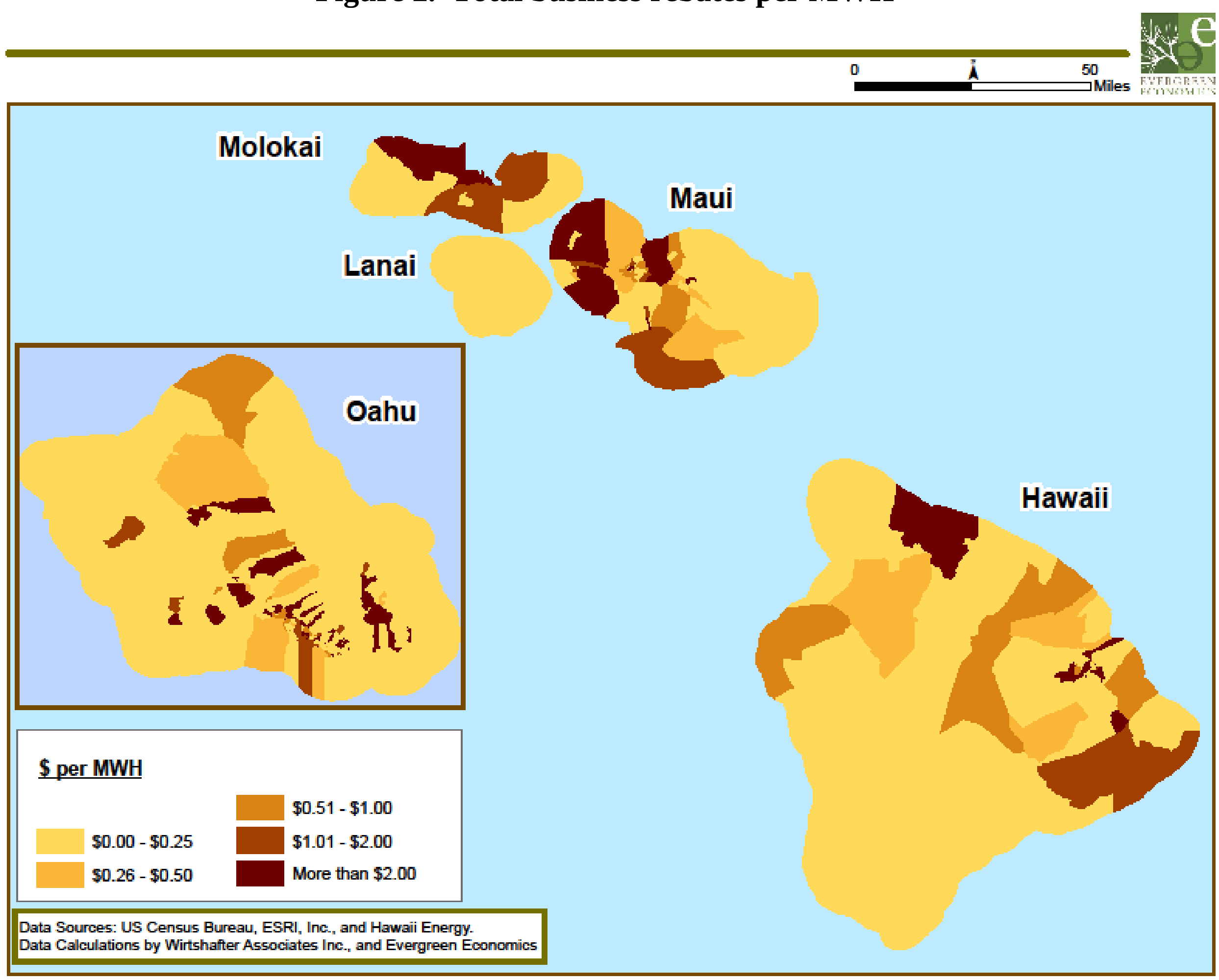
The distribution of business rebates in Hawaii was also examined. Table 2 indicates that Oahu accounts for 75 percent of the electricity consumed by businesses, and receives 81 percent of the rebates. Hawaii consumes 11 percent of the electricity and only receives five percent of the rebates.

Table 2. Comparison of business rebates to PBF contributions

	Total	Oahu	Maui	Hawaii
Program Rebates	$7,311,431	$5,918,348	$999,188	$393,895
KWhs Used	4,594,089,657	3,431,256,635	632,345,721	530,487,301
Percent of Electricity Consumed		75%	14%	11%
PBF (kWh *$0.003125/kWh)	$14,356,530	$10,722,677	$1,976,080	$1,657,773
Ratio PBF Contributions to Rebate Distributions	50.9%	55.2%	50.6%	23.8%

Figure 2 shows the distribution of rebates to the commercial and industrial sectors. This result shows that 81 percent of all business rebates are distributed to Oahu business locations.

Figure 2. Total business rebates per MWH



A similar analysis is done using the business type designation contained in the billing records. This designation is somewhat inconsistent. For example, there are some military accounts that are listed under another category. As **Error! Reference source not found.**indicates, the military account receives more rebates than its equitable portion based on PBF contribution. Some sectors such as restaurants, retail foods retail non-foods, cold storage, and services are underserved. Interestingly hotels are underserved; however, this may be because hotels have used the rebates in previous years.

Table 3. Business rebates to PBF contributions by business type

	Program Rebates	mWh Consumption	Ratio Rebate Distributions to mWhs Consumed
Total	$7,311,482	4,601,137	1.59
Office Buildings	$1,591,302	626,548	2.54
Military Bases	$982,649	69,373	14.16
Education	$898,126	151,416	5.93
Retail -Nonfood	$503,383	637,462	0.79
Health	$279,584	241,693	1.16
Hotels	$245,458	603,886	0.41
Wholesale	$161,833	109,930	1.47
Services	$120,443	253,731	0.47
Retail -Food	$45,342	286,017	0.16
Restaurants	$18,512	317,906	0.06
Cold Storage	$4,256	31,694	0.13
Not Classified	$2,460,596	631,561	3.90
Other Sectors with No Rebates*	$0	624,106	0

*includes air transport, agricultural pumping, manufacturing, communications, food processing, amusement, temp power, other pumping, farming, water/sewer, street lighting

The Island Equity metric has proven to be a successful means of shifting the distribution of the program activity so that it more closely matches PBF contributions. In moving forward, the HPUC may want to consider adding additional metrics that encourage Hawaii Energy to focus on underserved sectors where free ridership is low. The HPUC should consider new metrics that reward HE for increasing program participation among low-income households and renters.[2] For businesses, metrics should focus on increasing participation of smaller businesses and opening up participation in industries such as food services and restaurants. For the military, Hawaii Energy can either limit the military's participation or encourage the military to de-emphasize rebates for standard products and instead apply for less developed technologies that can have spillover effects for the rest of Hawaii. Hawaii Energy is already pushing the military to incorporate efficiency measures that would produce this type of spillover.

In developing these metrics, the HPUC must recognize that reaching new participants is necessarily harder and more costly than is merely offering rebates on a first-come-first served basis. Such a strategy runs counter to the existing primary contracted performance metric that focuses on achieving a kWh savings target on a fixed amount of program resources. Programs targeted to renters and low-income households are likely to cost more per kWh/saved, yet if successful these efforts should result in lower free-ridership and development of more infrastructure that are essential to meeting Hawaii's stringent long-term energy reduction goals.

[2] Hawaii Energy is currently required to spend a protected portion of its budget on residential low-income projects. Most of this involves distribution of free-CFLs; the precise distribution of which is not currently tracked.

Case Study 2: San Diego Gas and Electric

A similar GIS-based study was done for SDG&E (Evergreen Economics 2012, B). In this case, we were able to include almost all of the program's residential portfolio and funds spent on delivering direct-install programs to low income households. Table 4 shows the distribution of program dollars by 150% of poverty quintiles. The results show a similar difference in Rebates$/household between the wealthiest and least wealthy block-groups as was seen in the in Hawaii case study; though the gap is less pronounced. California requires that utilities maintain separate administration for programs serving low-income households. This reflects the original intention of the Public Goods Charge (PGC) legislation in California, which set aside a portion of the funds to serve low income households. When the low income dollars are included, the distribution of funds heavily favors the less wealthy block-groups.

Table 4. Residential and low income rebates and measure costs by income

Percent Below 150% of Poverty (Quintiles)	Residential Programs (Rebate $/Household)	Low Income (Measure Cost $/Household)	Residential Programs and Low Income (Rebates + Measure Cost $/Household)
Least poor (< 6% below poverty)	$10.08	$9.69	$19.77
Next least poor (6-11% below poverty)	$6.62	$13.90	$20.52
Middle (11-19% below poverty)	$6.98	$21.49	$28.46
Next most poor (19-31% below poverty)	$6.47	$31.25	$37.72
Most poor (>31% below poverty)	$4.28	$45.45	$49.78
Average	**$6.81**	**$24.88**	**$31.69**

The value of the GIS analysis is that it can assess equity on a number of levels and pinpoint areas not effectively reached by portfolios or programs. For example, Table 5 shows the distribution of funds across a number of HTR categories. In this table, we compare the block-groups with the very highest concentrations of HTR characteristics to the average for all block-groups. As can be seen, these areas are less represented by the regular programs, but the low income efforts compensate for this so that these areas are receiving a higher than average amount of PGC.

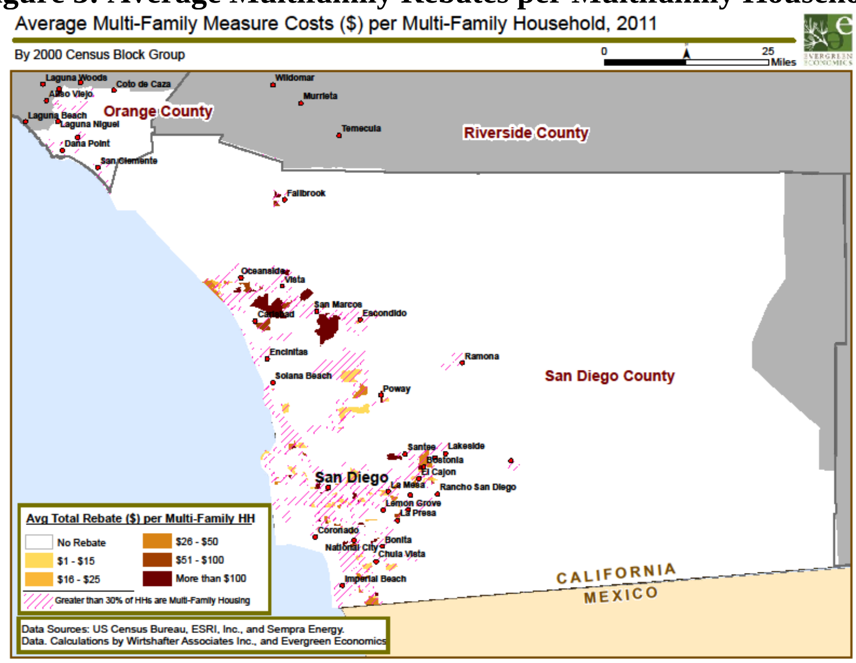
The value of the GIS is that it can if data are available pinpoint both areas where a particular type of customer live, and areas where the program has reached. Figure 3 shows the distribution of the SDG&E's multifamily program and the areas where the concentration of multifamily units is highest. This map shows that the program is concentrated in a few areas, and that large portions of the service territory with high concentrations of multifamily units were not served in the 18 month period analyzed. The multifamily program has been around for a long time so this map does not take into account which buildings were previously served. Using a longer time period of analysis would help clarify this.

Table 5. Distribution of funds in areas with highest concentration of HTR characteristics

	Average all Block-groups(	Highest Poverty	Most African-American	Most Asian	Most Renters
	(n=1946)	Greater than 70% of households under 200% of poverty level (n=96)	Greater than 20% of households African-American (n=82)	Greater than 40% of households Asian (n=42)	Greater than 90% of households rent (n=95)
Rebate dollars per household*	$6.81	$4.41	$3.23	$4.55	$15.17
Low Income Program Costs	$24.88	$49.01	$47.28	$23.23	$32.80
Total for Rebate and Low-income programs	$31.69	$53.68	$50.51	$27.80	$48.07

*excludes residential upstream programs

Figure 3: Average Multifamily Rebates per Multifamily Household



Limits of GIS Analysis

As with all methodologies, there are issues with this application of GIS. The analysis does not include any money spent that was not directly attributable to a residential address. In particular, upstream programs such as lighting and appliance rebates, and outreach efforts such as training, are not included. For Hawaii, the upstream lighting program and other lighting giveaways represents almost half of the residential effort measured on a dollar basis. A second issue with the results is that the analysis is at the block-group, and not the individual residence, level. This means that we are assuming that the average characteristics of the block-group apply to all participants in that block-group. We cannot be sure that distribution within the block-group is proportional to the average characteristics. The analysis can only look across all block-groups to see trends that exist in the distribution. This point can be illustrated by looking at the low income program distribution in Table 4. That table shows that block-groups with higher percentages of poor households receive on average more low income program support. Still, the wealthiest quintile also receives a substantial amount of low income program support. That support in this case is known to be distributed only to low income households. So in this case, the money shown as an average per household is not evenly divided per every household in the block-group. It is likely that other differences in distribution exist that we cannot so easily identify. In San Diego, we suspect that household just above the low income program income-threshold are not receiving a proportional share of the program dollars, but we have no way to isolate that group from other non-low-income households.

Policies to Address Equity

The emphasis in this paper on equity is not just a plea for fairness. The interesting element is that there is a parallel between high free ridership and under-served customers. The characteristics that drive free-ridership: familiarity with technologies and programs, motivation to save, access to information and money, are the elements missing from those that are not participating. Efforts that successfully reach underserved customers will almost certainly also reduce free-ridership levels.

To be successful in reaching hard-to-reach households will require a larger commitment to market research. To some extent those funds are not available because programs are required to commit large amounts of their evaluation dollars to documenting free-ridership. All of the attention on free-ridership quantification means fewer funds are available for market research.

Regulators need to establish policies that encourage program administrators to enroll those customers not generally involved in programs. To accomplish this, regulators must first identify who the underserved are. The methods described provide the needed tools. The GIS tool is a powerful new way for regulators to monitor program performance. As new data sources become available, such as the new 2010 Census and maps of property values, new applications will become possible.

Once identified, regulators can establish metrics similar to Hawaii's that reward program administrators that achieve geographic or income equity. Alternatively, they can stipulate low free-ridership levels for these types of participants. Some states stipulate that low income programs have zero free-ridership. Extending that further, states could stipulate that portions of a program's participants, such as renters, first-time participants, non-English speakers, etc. have a low free-ridership value. Armed with these incentives, program administrators can pursue policies that are better able to identify and attract underserved customers. Truly bold regulators could follow Hawaii's leadership and reject the free-rider/spillover quantification approach, and use metrics that measure market share instead.

As Hawaii has demonstrated, establishing the Island Equity metric can encourage program administrators to develop strategies that reach into new markets. Establishing supportable hard-to-reach (HTR) goals encourage programs to spend funds identifying their HTR customers and developing approaches to serve them. Policy makers should consider these metrics or other incentives because reaching new segments of the population creates a fairer distribution of PBFs, lowers free-ridership, and builds market share.

Regulators will need to recognize that moving away from first-come first-serve to strategies that target underserved populations will require more than just monitoring to be successful. Efforts to attract new, hard-to-reach customers will be more expensive to implement. Policies that set kWh savings goals or reward program administrators for having lowest $/per kWh saved will stand as barriers to successful adoption of these strategies.

Fundamentally, programs designed to attract underserved customers have a very different philosophy from the standard programs offerings. Unfortunately, there are few examples of energy efficiency programs that have made this transition in program design. On the other hand, commercial product campaigns model this approach, and can be a guide for the design of energy efficiency programs.

Practical Steps to Achieving Broader Distribution

The standard energy efficiency approach is to identify a technology that warrants development, offer rebates to all customers, and process rebates on a first-come, first-serve basis. In contrast, product developers first do market research to identify different sub-markets, and develop different strategies to build market share in every sector. A product developer who uses most of their research budget to retroactively query people who have already bought the product (our industry's current focus on free-ridership studies) would likely not be around for long.

Market research is needed that focuses on understanding the differences that exist in the marketplace. Marketers know that there is not one homogeneous market. Some buyers are looking for quality, while others are shopping on price. Some are deciding on style while others chose performance. The more one is able to differentiate the market the more one can design programs to optimize participation.

In addition to more market research, there are two approaches that are not regularly employed by energy efficiency programs that should be used much more often. These are targeted marketing and differential incentives. The value of the GIS analysis is that it provides a means to identify and target sub-groups of customers. Because the case studies described above link into the CIS customer information system, the programs can identify actual customers in the low participation areas and send them targeted mailing. The GIS analysis at the block-group level means more precise targeting; which is more effective and less costly than current efforts done at the zip code level.

The biggest tool in a marketer's arsenal may be differential incentives; and energy efficiency programs almost never use them. The one application that has gained traction is graduated incentives—the more you do the higher the incentive rate. This application does not necessarily address the underserved, but it can mitigate free-ridership by encouraging participants to go deeper than they may have originally intended. Similar approaches can be designed to reach the underserved. The simplest application of this approach would be higher incentive rates, or bonus rebates for first-time customers and trade-allies. We also recommend having higher rates for measures installed in tenant spaces than for those in common areas for multifamily and commercial properties.

Conclusions

There is good reason for utilities and regulators to pay more attention to the equity metrics applied to their rebate and other public benefit funds programs. The general idea is that a broader distribution of program participation, particularly to those customers that have not traditionally participated in energy efficiency programs, will result in less free-ridership and greater market share. Advances in GIS systems and the availability of census and customer information data make it possible to identify spatial areas and demographic characteristics of the underserved. Programs can use this information to design programs that use targeted marketing and differential incentives to attract underserved customers. This is something that states will need to do if they want to reach their aggressive energy reduction goals.

In the end, the onus is on regulators and policy makers to shift their concerns from quantification of free-ridership to one that encourages broader distribution of benefits. This will mean less emphasis on historic quantification of existing participants and greater attention to those not yet participating. It will also mean a shift from tracking and awarding incentives on $/kWh saved to tracking and incentivizing gains in market share.

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