Resource Efficiency: Opportunities for Greenhouse Gas Emission Reduction in Sonoma County

Community Climate Action Plan

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Climate Protection Campaign
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Community Climate Action Plan

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Ned Orrett, PE · February 2008[1]

Executive Summary

This report, which focuses on resource efficiency in the electricity and natural gas sectors, makes the following key points:

- Sound public policy dictates investing in resource efficiency as the highest priority in the energy portfolio, above new supply, even Green supply.
- Currently planned PG&E programs will not achieve Sonoma County's greenhouse gas (GHG) emission reduction goal of 25% below 1990 levels by 2015: even if all PG&E's announced efficiency and supply-side improvements are successful, Sonoma County GHG emissions for electricity and natural gas will exceed the target by ~50 percent.
- Even if the most aggressive utility efficiency scenario currently being discussed in California were implemented ("Full" incentives per Itron's 2006 *Potential Study* discussed below), emissions due to electricity and natural gas use in Sonoma County will be reduced by only an additional seven percent.
- National studies indicate that efficiency measures should be able to reduce electrical and gas usage by more than 20 percent.
- A program building upon the PAYS® system, if implemented as recommended in this report, will enable savings of this magnitude for less cost than any utility program currently operational in the US.
- A program adapting the PAYS® system in conjunction with Community Choice Aggregation (CCA) electricity and natural gas energy services, as recommended in this report, is both sound energy policy, and one that will result in the lowest rates and the lowest bills for customers.
- A CCA program that incorporates the PAYS® system can be used to reduce GHG levels by enabling individual customers to buy energy efficiency, and also to support purchase of renewable Green energy for on-site application.
- Total cost and GHG emissions will be minimized to the extent that resource supply is planned in an integrated way, tariffs emphasize variable over fixed charges, and when the portion of electrical supply potentially avoided by efficiency is secured with flexible commitments. These practices will support individual purchase of efficiency services that will also continuously improve the well-being of the entire customer base.
- Work must start on designing the PAYS® system in 2008 for efficiency to be integrated with the CCA supply and demand-side planning for greatest effectiveness.

[1] President, Resource Performance Partners, Inc. RPP wishes to thank Harlan Lachman, President of Energy Efficiency Institute, Inc. for his significant assistance in developing this report.

Design Context

The Community Climate Action Plan (CCAP) responds to the bold climate goal set by Sonoma's nine cities and the County. They committed to reducing GHG emissions to an amount 25% below the emissions level in Sonoma County in 1990 by 2015. The significant reduction in GHG sought is a design condition that requires a fresh vision to enable an appropriate response. This goal truly calls for nothing less than beginning to shift our society from an industrial to an ecological basis. To stop short of that is to miss the underlying message of climate change and risk an even greater, unimaginable challenge.

As will become apparent below, the role of resource efficiency in meeting this goal must be central. Just as some beetles have developed the ability to slake thirst from fog in the desert, spiders extrude filaments stronger than steel, and termites build self-cooling structures, so may we use elegant design to reduce energy use. As we learn to do this, our economy, environment, and society will become more resilient.

This approach is increasingly recognized by public policy. The California Energy Action Plan places energy efficiency and demand response first in the loading order of an energy procurement portfolio.[2] The follow-up resource choices, in order, are Renewable Resources, Distributed Generation, and Conventional Resources. In other words, sound public policy dictates that resource efficiency be given the highest priority in the energy portfolio. This paper outlines how to do this in an unusually effective manner.

This "efficiency first" criterion is vital both for meeting Sonoma's 2015 GHG goal, and exceeding it over the long-term to meet the scientific imperative for climate change. This is because the "25 by 15" target will not be achieved by either the current scenario being explored in California for gas and electric efficiency, or that coupled with any low carbon emission electricity portfolio that does not include efficiency as a core element.

There is also the issue of rate impacts. California and other states with efficiency programs base their investment decisions on a societal cost test. This test ignores where the costs for efficiency are allocated and simply considers all savings and all costs, regardless of who pays for the costs. The most aggressive (and popular) of efficiency programs offered in these states assign 100% of participants' incremental costs and all associated program costs to all ratepayers.[3] Were this model followed by the Sonoma to achieve the unprecedented level of savings required to meet its goal, the rates may prove unbearably high. However, with the new system recommended in this report, rates and customers' usage will be lower than if efficiency improvements were charged to all customers. This will allow more efficiency to be implemented at negligible public costs when compared to current efficiency programs or investments in green energy.

Energy-saving technologies, green design and construction practices available in Sonoma County make possible a significant reduction in local energy use, and therefore GHG emissions. However, as previously noted and discussed below, current state level plans for dissemination of these technologies and practices, at least as projected by key planning documents, will be too slow and costly to achieve our 25 by 15 climate goal. There is a large opportunity for local, state, and federal government to act more aggressively while improving overall constituent benefits. Accordingly, this portion of the Community Climate Action Plan focuses on a different approach for accelerating the dissemination and cost reduction of resource efficiency improvements for electricity and natural gas throughout Sonoma County.

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[2] As identified in the first edition of this plan, and reaffirmed in the second (and most recent), at page 2: http://www.energy.ca.gov/energy_action_plan/2005-09-21_EAP2_FINAL.PDF

[3] Ironically, this can result in ratepayers paying far more than the cost for participants to install measures as opposed to just reimbursing these costs; a practice with a significant impact on rates.

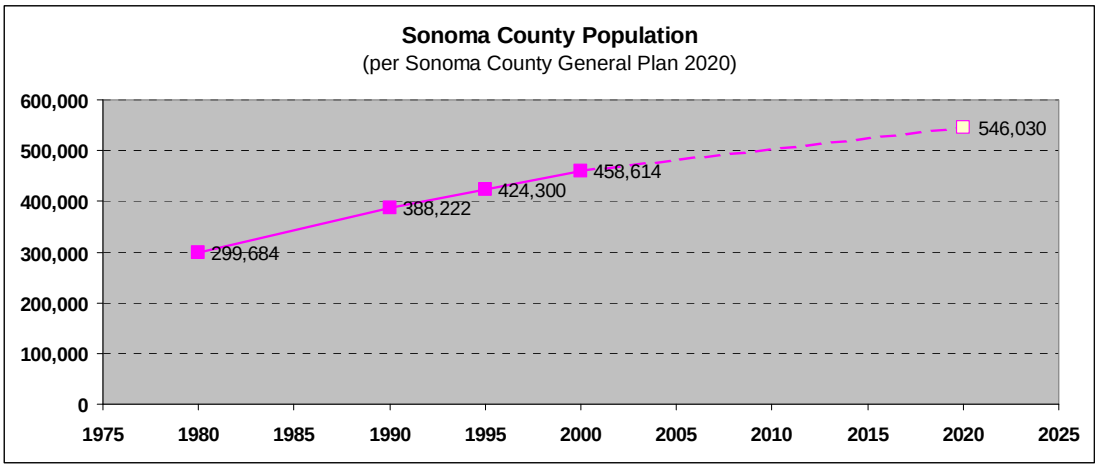
Baseline Trend

How are GHG emissions related to electricity and natural gas use expected to change through the CCAP planning period (through 2015) according to current plans? This can be answered by reviewing key projections.[4]

Key projections about future energy use and emissions relevant for Sonoma County have been made by the California Energy Commission, Pacific Gas & Electric Company, and various consultants. These generally refer either to the whole of PG&E's planning or service areas, statewide assumptions about building codes and appliance standards, and related demographic and economic estimates. For the purpose of this plan, per capita usage and emissions are expected to change within our planning period by the same percentage in Sonoma County as projected for PG&E's entire service area.

The most recent General Plans that cover all of Sonoma County project an average population growth rate of approximately 0.9%/annum for the period 2000-2020 (Fig. 1 below).

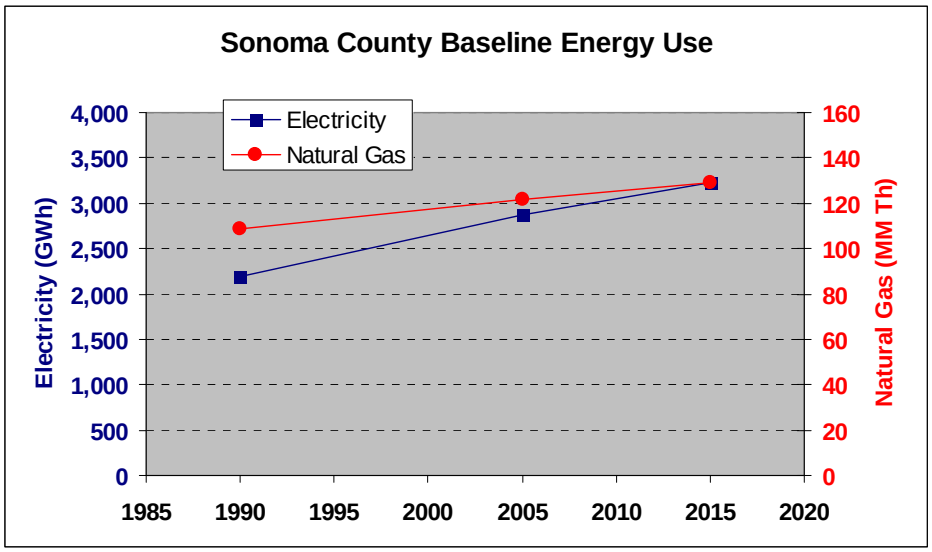
Figure 1



By combining Sonoma County's projected population growth with per capita energy use projections by the California Energy Commission staff for the PG&E Planning Area (*2008 Draft California Energy Demand*), electricity and natural gas usage may be estimated for Sonoma County (Fig. 2). These estimates are net of PG&E's commitments to energy efficiency through 2008, and the effects of building code and appliance standards. Electrical energy consumption in Sonoma County between 2005 and 2015 is expected to increase at the same rate as population growth (~1.2%/yr); while total natural gas consumption, due to higher price hikes, is likely to rise less rapidly (~0.6%/yr).

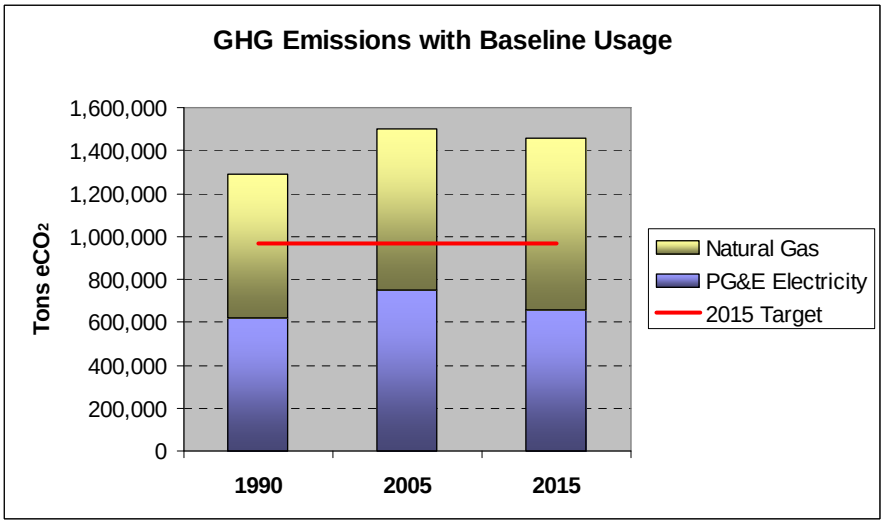
[4] Appendix A presents the data and assumptions used to develop this baseline

Figure 2



With these data, and PG&E's proposed programs that purport to reduce GHG emissions by 2016 to between 17.7 and 20.9 million metric tons/yr (for system-wide PG&E electricity deliveries), it is reasonable to expect total GHG emissions related to use of electricity and natural gas in Sonoma County will total at least 1,460,000 tons in 2015 (Fig. 2). This total exceeds the nominal "25% less than 1990" target by approximately 500,000 tons/yr, or 50 percent (Fig. 3).[5]

Figure 3

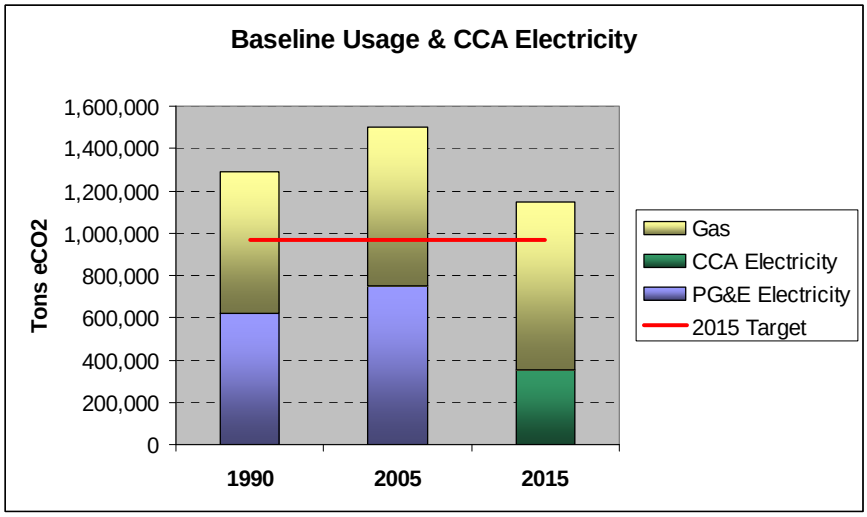


[5] Given the relative ease for reducing emissions related to electricity and natural gas compared to the challenges and costs associated with GHG reductions from transportation fuels, it is likely that GHG from 1990 levels in electricity and gas use must be reduced by even more than 25 percent. In other words, to enable success in adequately reducing GHG emissions across the entire Sonoma County economy, performance in this sector should exceed the nominal 25% reduction target.

Inability to Meet GHG Goal with Low Carbon Electric Power Alone

Current Community Choice Aggregation (CCA) plans propose a significant investment in renewable power to both meet Sonoma County's energy needs and to help achieve the CCAP's GHG reduction target. When the baseline usage data above are recast by replacing PG&E's anticipated 2016 electricity emission coefficient for that proposed for the CCA in 2015, emissions due to electricity supplied from cost-effective, climate-friendly sources drop by approximately 300,000 tons/yr. This significant reduction, however, will still overshoot the nominal target for total GHG emissions for electricity and gas in Sonoma County by nearly 20 percent.

Figure 4



Accordingly, the current CCA plan at the time of this writing proposes to procure an additional 200,000 ton/yr of emission reductions via efficiency services to be propelled by rebate programs funded in an integral manner with its power procurement services.

Rebate-based efficiency programs are well understood, for they have long been the workhorse in the utility world. However, given their cost and limited reach, we must seek more powerful solutions for producing significant GHG reductions. Accordingly, this paper is focused upon how to maximize the ability to reduce GHG emissions via cost-effective purchase of energy efficiency.

The above theme is addressed in three steps:

1. The capacity of the energy efficiency programs already being explored for Sonoma County energy customers;
2. The inherent limitations of rebate-base efficiency programs, and how they may be overcome; and
3. An outline for how more effective efficiency services may be offered synergistically within a CCA[6] to improve overall GHG and financial performance.

[6] This system can also be offered through local water utilities or through PG&E, although either would represent a significant change from present operations.

"Full" Efficiency Utility Programs: Unable to Meet the GHG Goal

Energy efficiency is being discussed as never before in California as the first step in developing a supply portfolio. A principal design question now asks: How much energy may be saved, and at what cost? *The answer depends primarily on the system used to effect investment in efficiency*; and secondarily upon the effectiveness and scope of measures employed.

The most thorough study addressing the effectiveness and scope of efficiency measures in California is referred to as the *Itron Potential Study*.[7] This was prepared by a group of consulting firms that is highly experienced in modeling energy efficiency programs. The study was managed by PG&E, and the consulting team was advised by representatives of California's major Investor-Owned Utilities, the CPUC, CEC, and NRDC.

The most aggressive energy efficiency scenario developed by this study that could be feasibly implemented is based upon offering rebates equal to the full incremental cost of installed measures. Called "Full" (incentive), this model requires no incremental cost by the participants who will realize energy savings from better equipment or services. Instead, all ratepayers would pay the full incremental cost for efficiency measures, and also installation and program costs. The Full incentive model, if successfully implemented as proposed, is expected to reduce projected baseline electrical and gas energy use within PG&E's service area by approximately 10% and 5%, respectively, by 2016 (details are summarized in Appendix A). These reductions are net of planned improvements in appliance standards and building codes, and end use efficiency improvements already committed to by PG&E through 2008.

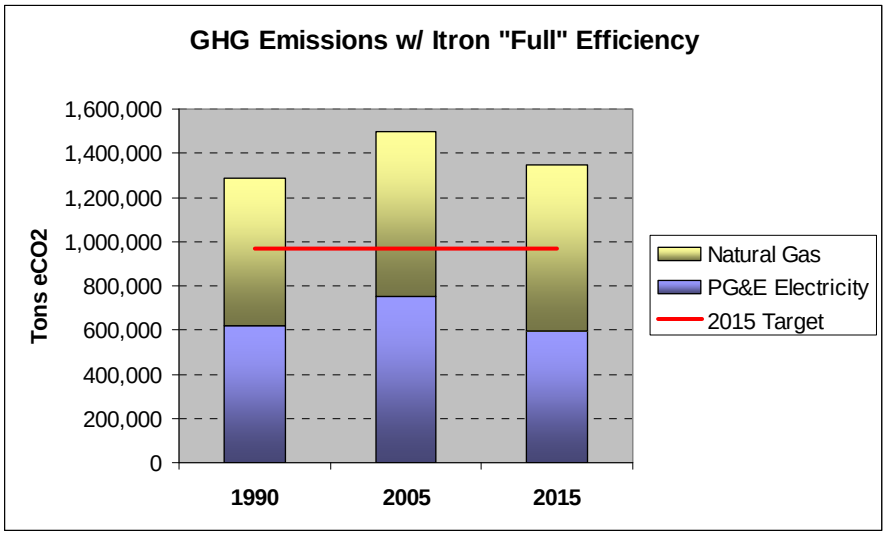
As one example of the above scenario, the efficiency improvements indicated for new construction are insignificant in relation to Sonoma's climate goal (e.g., the energy savings target for new residential units addressed within PG&E's service area is at best only 15% better than the Title 24 building code; a goal that is equivalent to the mandatory green building code recently adopted by Rohnert Park, and one that other Sonoma County cities are preparing to replicate). Failure to aggressively pursue "green" opportunities in new construction will have long-term consequences, for the future improvements inevitably required will be difficult to develop. It is much more costly to retrofit green measures later that than it is to build them into a building in the first place.

Were PG&E to successfully implement Full incentives, total emissions for electricity and gas used in Sonoma County would still exceed Sonoma's 25 by 15 target by approximately 40% (Figure 5).[8] In other words, despite what is potentially California's most heroic utility efficiency effort to date, a massive investment will produce little progress toward Sonoma's emission reduction target.

[7] Itron, Inc., *California Energy Efficiency Potential Study*, 24 May 2006

[8] In other words, a further reduction of only 10%. Figure 5 illustrates these savings.

Figure 5



The Real Potential for Resource Efficiency

The potential value offered by efficiency is widely understood but narrowly practiced. Consider the following:

Electricity: When expensive rooftop photovoltaic systems represent the marginal cost for "green" electricity, economic analysis recommends investing first in things that reduce energy demand at less cost. For example, to make the point with lighting:

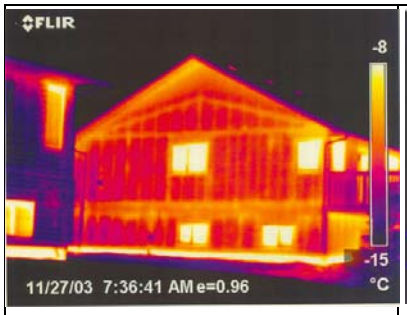
No! *Avoid energy hogs!*

Better: *9 watt task lamp with optically tuned LEDs*

Best: *Daylight delivered deep into a building without glare or heat*

Natural Gas: The next big supply of natural gas anticipated for California is from Asian and Middle Eastern sources delivered in liquid form by tanker. Due to extra energy used for refrigeration and transport, this has ~25% more embedded GHG emissions than gas delivered by pipeline from North American fields.

Heating is the primary end use for direct use of natural gas in Sonoma County. Improvements in the thermal integrity of building shells, and the efficiency of practices that use hot water, will reduce the need for natural gas.

		
No! *Severe heat loss across framing, windows, and foundation*	***Good:*** *Much less heat loss; most thermal bridging eliminated*	***Better:*** *Heating system eliminated (**in Sweden!**) via passive solar design, insulation, and heat recovery ventilation; same cost as standard housing*

Best Practices: Two of the best examples that demonstrate the value of efficiency are located in Sonoma County. With these, Petaluma architect George Beeler (www.aimgreen.com), demonstrates how meticulous attention to high performance design in terms of site selection (to minimize transportation), building orientation (to fully utilize solar opportunities), and efficient equipment enables large reductions in energy demand (see Figure below). When the design proceeds in this order, and the structure of a Community Choice Aggregation enables payment for excess generation of onsite power, the concept of achieving or exceeding a "carbon neutral" standard for buildings becomes feasible, if not highly attractive as a matter of standard practice.[9]

Such is the power of efficiency: an extremely potent resource which the State of California recognizes in its Energy Action Plan, but which has yet to be engaged at a level anywhere near its potential. This plan proposes to bring the power of efficiency to the fore with another kind of power: market power.

[9] "Zero Carbon" homes are more than a concept: The UK Government announced in December of 2006 its proposal for "*Zero Carbon and Sustainable Homes*." This calls for all new homes in UK to be zero carbon by 2016, with a 25% improvement on energy use on current building regulations by 2010, and a 44% improvement by 2013.

NEW CONSTRUCTION Environmental Technology Center Sonoma State University	**RENOVATION** 1940-era Residence Petaluma, CA
	
*Designed for 80% less energy use than the Building Code, this 2,200 sq ft building, with its roof-integrated photovoltaic system, achieved net energy use of **-1.34** kBtu/ft^2-yr for 2001-2003: it is a net energy provider. Energy saving features include passive solar, natural ventilation, smart building controls, and superior daylight design. Source: US DOE High Performance Building Database.*	*This home was extensively retrofitted with additional insulation, exterior shading for windows, high performance windows, wind-powered ventilation; and an efficient heating system, lighting, and appliances. It was then possible to install sufficient solar PV (with air heating) to exceed internal loads and offset most carbon emissions from household natural gas. Additional solar heating capacity for water/space is planned. With this, all GHG emissions related to residential electricity and natural gas will be offset.*

A Proposed Target for Resource Efficiency

Obtaining and evaluating the data required to directly estimate the GHG savings potential of our recommended approach was beyond the scope of this study.[10] However, it is still appropriate to develop reasonable targets for Sonoma's efficiency effort. A method that can be used within the scope of this report is to cite studies by other experts and use them to develop the local goal.

In 2004, the American Council for an Energy Efficient Economy (ACEEE) performed a meta-study[11] (an analysis of eleven contemporary studies) that estimated an achievable potential for a 24% reduction in electric usage through efficiency efforts.[12] Earlier, in 2000, a working group of the National Laboratories also estimated the potential for a 24% reduction in electricity usage through efficiency programs.[13] Finally, in another state renowned for its previous resource efficiency efforts, the New York State Energy Research

[10] Technical studies that attempt to quantify the resource efficiency acquisition potential, none of which embody the approach recommended in next section of this report, typically command budgets in excess of $1 million.

[11] http://www.aceee.org/conf/04ss/04ssindex.htm

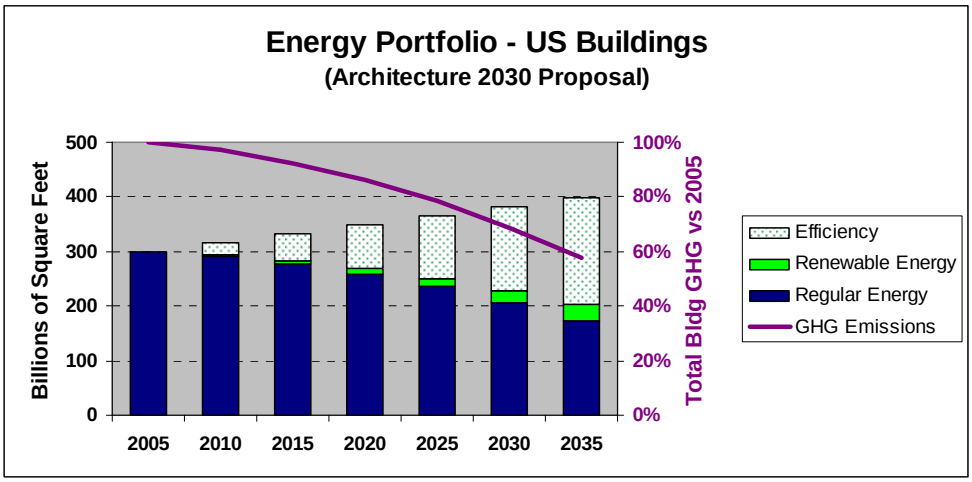
[12] All of these analyses likely underestimated savings potential by assuming a traditional program design that fails to reach rental markets or customers without significant resources.

[13] http://www.ornl.gov/sci/eere/cef/

and Development Authority (NYSERDA), in two studies (2003 and 2006)[14] estimated electricity savings of 16.1% from continuation of existing programs at a cost below $0.03 per kWh and potential savings of 28% of forecasted gas use from a new efficiency effort. New York currently has opened a Pubic Service Commission investigation into what other programs might achieve.

Within California, Itron's 2006 *Potential Study* indicates the Economic Potential for efficiency to provide savings of 24% and 14% in electrical and gas use, respectively, by 2016 (see Appendix A). This level of savings assumes the delivery of all measures that individually pass the Total Resource Cost Test (that is, are cost-effective from PG&E's perspective).

Yet another perspective is offered by Architecture 2030, a non-profit organization advancing a vision of GHG emission reductions in buildings of a magnitude commensurate with climate stability.[15] They emphasize efficiency – particularly via skillful building design (new construction and major renovations) – as the most cost-effective tool for achieving large reductions in GHG emissions. As summarized in the chart below, Architecture 2030 envisions efficiency alone offsetting nearly 50% of GHG emissions by 2035 across the entire inventory of US buildings.



Based on these studies, it is reasonable to assume with use of a highly effective implementation strategy, it is possible to reduce electricity and gas usage by at least 20% below current levels within ten years of commencing services.

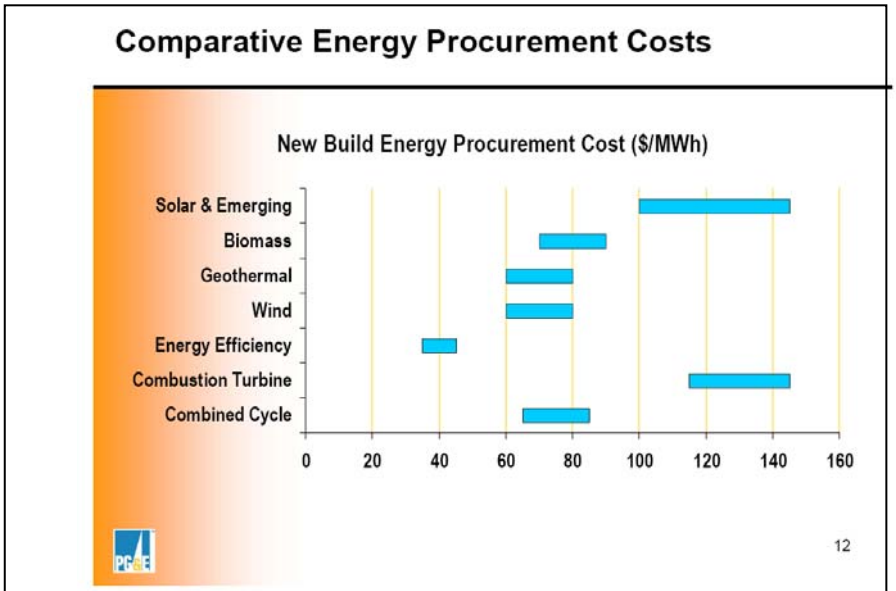
Delivering High Performance Efficiency

Under current procurement methods, energy efficiency remains the lowest cost of soft path alternatives, as indicated by a chart from PG&E (Fig. 6, below). This indicates that investment in energy efficiency typically saves electricity for less than half of the cost of currently preferred sources of supply.

[14] http://www.nyserda.org/sep/EE&ERpotentialVolume1.pdf
http://www.nyserda.org/publications/Final%20Statewide%20Natural%20Gas%20Efficiency%20Potential%20Study.pdf

[15] http://www.architecture2030.org

Figure 6



Source: PG&E, Appendix, Investor Conference, April 4, 2007, New York, NY

So, if efficiency is such a good deal, why aren't people buying more of it?

The answer is that the marketplace for resource efficiency products, even when stimulated by rebate programs, is rife with market barriers that inhibit many consumers and businesses from buying them:

- Lack of capital (or competing demands for capital) to pay co-payments
- Limited debt capacity (or a need to save it)
- Uncertainty about length of occupancy (risk occupant may not see savings)
- Risk that measures may fail before savings pay for measure cost
- Building owner is not the bill payer (e.g., new development or rental property).

Public funds for efficiency and climate change programs are limited. Limited program budgets can actually dampen the market for efficiency products when they are oversubscribed as customers wait for the new round of program funding instead of implementing cost-effective projects.

Traditionally designed utility efficiency programs depend principally upon rebates to overcome resistance to purchasing efficiency measures. Rebates improve the financial performance of measures, and thereby increase the implementation rate. However, because rebates address only some of the market barriers, participation remains well below the level that would be expected in a freely functioning market. As a consequence, rebate-based programs are typically burdened with heavy overhead costs (marketing, administration, etc.). In support of PG&E's efficiency program for 2006-08, for example, *only 43% of the program's $975 million budget is allocated for customer incentives* (presumably leaving the remaining 57% to indirect costs).[16] Additionally, rebates tend to drive up market prices because vendors know customers will not pay the full measure costs. Rebates in this way distort the normal supply and demand relationship.

[16] From slide 15 in a PG&E PowerPoint presentation for the Edison Electric Institute's International Utility Conference (London, UK, March 4-7, 2007) entitled "Strategic Value Creation."

Sonoma faces two choices for implementing resource efficiency. One is to follow the traditional route, and accept the costs and performance limitations that come with it. The other is to choose a different implementation system that has been proven to perform more effectively and cost less. The latter route, as defined by the Pay As You Save® system designed by the Energy Efficiency Institute, is proposed for Sonoma. [17]

This system was designed specifically to remove the principal barriers to the purchase of resource efficiency. In doing so, it enables the power of the marketplace to accelerate the purchase of cost-effective efficiency measures. Proven in service with two electric utilities in New Hampshire, and being implemented by three of Hawaii's four utilities under legislation passed by the Hawaii Legislature for delivery of solar water heaters as part of that state's ambitious push for energy independence, this is recommended as the best resource efficiency implementation system for Sonoma. As well, this approach provides the lowest cost per avoided ton of GHG of any measure in this plan.[18]

An introduction to PAYS® follows. A broader discussion of market barriers to resource efficiency, and the PAY® response, is provided in Appendix B.

The PAYS® Advantage

Pay As You Save® (PAYS®) is a market based system that eliminates the principal barriers to customers purchasing and installing proven, cost effective energy efficiency measures.

1. PAYS® eliminates the barriers that have kept customers from purchasing efficiency products and saving money. PAYS® customers have:
   - No up-front payment, no debt obligation, no credit checks, no liens;
   - A guarantee that their monthly utility charges will be less than their estimated savings;
   - The assurance they will pay only while they remain at the location; and
   - A promise that failed measures will be repaired with no increase in their monthly payments or the payment obligation will end.

2. PAYS® assigns bill-paying responsibility to a meter location rather than to an individual customer. Since customers assume no new debt when they buy PAYS® products, the approval process for customers, especially public or private facilities managers, is simplified. Successive customers at that location pay the PAYS® surcharge and benefit from the savings.

3. The annual PAYS® surcharge added to a utility bill is always lower than the estimated annual savings from the PAYS® product (savings are described on an annual basis to allow for the fluctuating performance of weather-dependent measures). The surcharge remains on the bill for that location until all costs are recovered. This means tenants or anyone uncertain about the duration of their occupancy can purchase PAYS® products, assured they will receive savings that exceed their payments during their occupancy.

[17] Energy Efficiency Institute, Inc., Colchester, VT. PAYS® was created and is being developed by EEI co-founders Harlan Lachman and Paul Cillo.

[18] Virtually the entire cost of efficiency measures delivered under this approach may be assigned to the direct beneficiaries (instead of the entire ratebase). In this way, utility costs will be insignificant.

4. Third party capital pays the upfront costs for PAYS® products. PAYS® attracts sufficient capital to meet demand because it offers solid investment opportunities. PAYS® can also be used to enhance current efficiency programs, making them available to more types of customers while producing more efficiency with available funding.

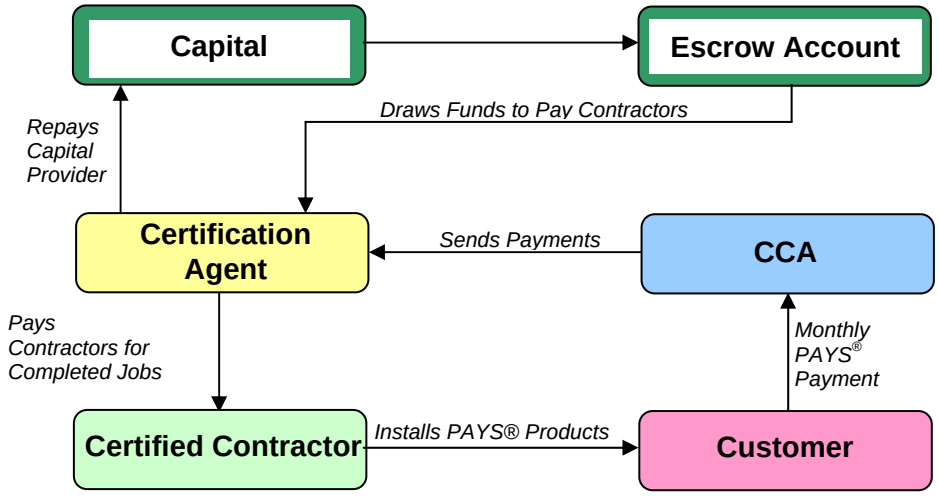
Consider the offer PAYS® allows vendors of efficiency products and services to make to customers. Vendors can offer to install measures and the customer pays them nothing. There is no lien, credit check or having to deal with a bank. There is no new debt. Someone the customer trusts verifies that the measure (or package of measures) is appropriate and that the customer will save significantly more each year than (s)he will spend. Customers are guaranteed that if the measure fails and is not repaired, they stop paying. If they move from the premises, for any reason, the payment obligation ends. Simply put, for the first time, customers can buy efficiency without risk. This is a marketplace that works.

PAYS® System Requirements

- A capital provider to fund the up-front costs of the measures;[19]
- A certification agent to certify that PAYS® products are appropriate and will result in sufficient savings to cover the costs of installation, financing and management fees, and still deliver net savings;
- An entity to administer a voluntary PAYS® surcharge or utility to bill PAYS® charges, collect payments from customers with PAYS® products, and forward the funds to the certification agent who repays the capital provider; and
- A surcharge or (for utility-based approaches) PAYS® tariff to enable a utility to bill customers for PAYS® products at the location where they were installed.

Roles and Responsibilities

The following flow chart illustrates the roles and responsibilities in the PAYS® system as applied to a Community Choice Aggregation.



[19] When operated within the framework of a Sonoma Community Choice Aggregation, it is anticipated that the structure of both CCA and PAYS® will enable efficiency measures to be attractively financed with low-cost bonds.

Certification Agent	CCA
• Contracts with certified contractors and customers • Certifies projects as PAYS® products • Contracts with CCA so it may authorize a surcharge at installation location • Collects payments from CCA & repays bondholder	• Implements CCA Opt-Up surcharge at locations when notified by Certification Agent • Assigns surcharge and and collects payments from customers via the utility • Sends Certification Agent payments equal to monthly billed PAYS® charges • Notifies successor customers of PAYS® obligations upon application for service
Certified Contractor	**Customer**
• Markets PAYS® products • Identifies qualifying products • Applies to Certification Agent to qualify PAYS® products • Installs products and is paid by Certification Agent upon successful installation • Can finance installations	• Contracts with Certification Agent to buy certified PAYS® products • Pays monthly charges as long as they remain at the premises and product functions • Realizes net savings • If owner, obligated to notify successor customers about PAYS®

The PAYS® system is uniquely suited for delivering the high performance services and equipment required to approach the "Green" end of the efficiency spectrum. Advantages for the CCA-PAYS® system relative to traditional programs include:

- **High Performance:** Contractors may be required to offer products selected for maximum life cycle value, thereby advancing the average efficiency of the installed fleet of targeted products toward the high performance end of the scale.
- **Low Prices:** Customers, instead of purchasing items at retail rates, can benefit from bulk pricing obtained by contractors who will bid for the opportunity to enjoy rapid sales and payment cycles across many customers. Because rebates are not required for the most cost-effective measures, their effect in distorting market prices upward will be diminished.
- **Broad Perspective:**
  - Financial benefits are calculated for *all* metered resources affected, not just those of the host utility (e.g., an upgrade to a premium clothes washer will reduce electricity, natural gas, water, *and* wastewater bills). This will expand the range of measures that qualify for delivery. As a collateral benefit, CCA customers will thereby be able to realize cost-saving water efficiency services with the potential to reduce indoor residential water use by up to 50%;
  - The lifecycle value of products will be determined across an entire system, not just a single product. For example, comprehensive efforts to improve thermal efficiency of a building shell will at some point reduce not only cooling and heating loads, but will also diminish, if not eliminate, the need for HVAC systems in new buildings; and
  - Contractors with ability to deliver synergistic packages of efficiency services will be rewarded for maximizing resource savings and minimizing transaction costs.

- **Early Retirement:** Traditionally, appliances are not replaced until "burnout" at the end of their lifetime. Under PAYS®, it will often be cost-effective to replace appliances early if something sufficiently better is available.[20]
- **Reduce/Reposition Rebates:** Utility rebates now offered to encourage the purchase of the most cost-effective measures will not be necessary with PAYS®. Those funds, or a portion of them, may be repositioned upmarket to enable purchase of measures currently not sufficiently cost effective for customers, but still cost-effective for the utility (e.g., solar water heaters).
- **Serve Everyone:** PAYS® enables service to existing and new development, and owners and tenants. As cost-effectiveness is the only criterion for limiting service, relatively more savings may be achieved per dollar invested in new than in existing development. This is because it is cheaper to do it right the first time than to pay to remove existing equipment and install new. More importantly, it is far more cost-effective to supply green design services in support of new development than for renovating old (e.g., for natural lighting, and passive solar performance). In concert with the principal promoted by Architecture 2030 mentioned above, design is the key to achieving a climate neutral (or better) standard in buildings.
- **Accelerate RD&D:** The PAYS® system will open, possibly for the first time, large scale markets for high performance efficiency services. This could trigger several responses: (1) new, higher performance products; (2) support from highly credible research organizations (e.g., Lawrence Berkeley National Laboratory) to assess performance of efficiency equipment and design practices in field conditions; and (3) revision of demand side models to embody the advantages provided by PAYS®, if not CCA as well.[21] RD&D is the key to continuous improvement, and for avoiding a boom-bust cycle in efficiency services. Once one round of improvements is complete, RD&D will enable the next cycle to begin.
- **Reduce Rate Impacts of GHG:** The proposed CCA will be in a unique position to consider efficiency plans in coordination with commitments to energy supply and other infrastructure costs. This, combined with the facts that PAYS® is the first program to shift the cost for measures from all ratepayers to those who benefit directly, and because efficiency is less expensive than any form of supply, will ensure that the CCA / PAYS® effort will produce the lowest possible rates of any utility.
- **Reduce Customers Bills:** While most utilities are concerned about offering competitive rates, customers pay monthly bills that are the product of rates and usage. Over time, the recommended PAYS® effort will reduce usage and hence bills for all customers.

Potential Performance

The PAYS® system, although proven to increase participation in efficiency programs, has not yet been deployed as the principal engine of a large efficiency program. Consequently, there is no model with which to predict performance in Sonoma County.

[20] Note that the emissions embedded in appliances due to their operation typically far outweigh those associated with their constituent materials, manufacture, and eventually disposal.

[21] The sophisticated model used in support of Itron's *Potential Study* would probably have to be modified to reflect higher participation rates and lower measure costs for most measures, shift focus to higher-performing measures (e.g., premium appliances, tuned windows, structured plumbing, and architectural services for new construction), and integrate additional financial benefits as when right-sizing capital equipment (e.g., heating, air conditioning, solar DHW and PV systems) and reducing water and wastewater volumes and costs.

Regardless, success of the PAYS® system within Sonoma County hinges primarily upon:

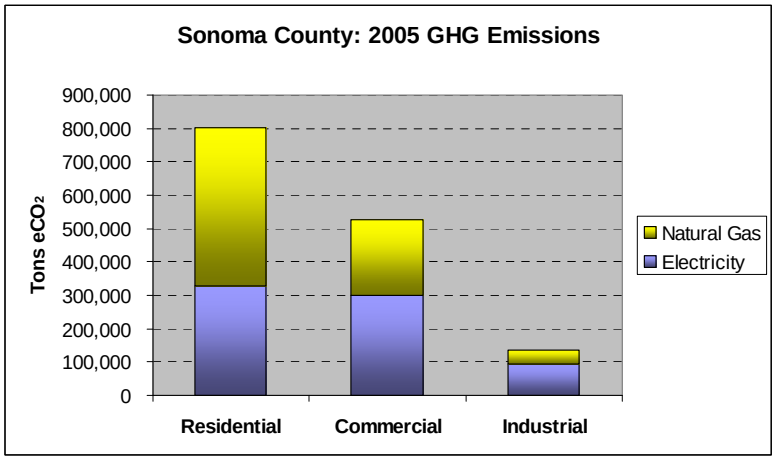
- ***Physical Opportunity:*** Customers' current technologies and usage patterns will dictate opportunities for reducing GHG emissions via on-site measures;
- ***Financial Opportunity:*** Eligibility for measures provided by PAYS® is dictated by potential cost savings. Those savings will be determined by CCA rates, which will be determined by:
  - The supply-side procurement strategies of electric, gas, and water utilities, particularly as they relate to the effect of high performance efficiency; and
  - Volumetric pricing (specifically, the design of rates); and
- ***Elegant Design:*** The quality of the design and management of the PAYS® infrastructure.

Each of these factors is discussed below.

Physical Opportunity

Utility-related GHG emissions in Sonoma County arise mainly from the residential sector (Fig. 7 below). The breakdown of type and amount of energy used by each discrete end use within homes was estimated in 2004 by the Residential Appliance Saturation Survey.[22] Figure 8 summarizes the type of energy used by different residential end uses, and their saturation, within Climate Forecast Zone 4 (which includes Santa Rosa). This indicates that space and water heating is conducted predominantly (>90%) with natural gas; cooking and clothes drying is accomplished equally with either gas or electricity; and most other uses are powered exclusively with electricity. Interestingly, 42% of homes in this zone have central air conditioning: something that is unnecessary with good design.

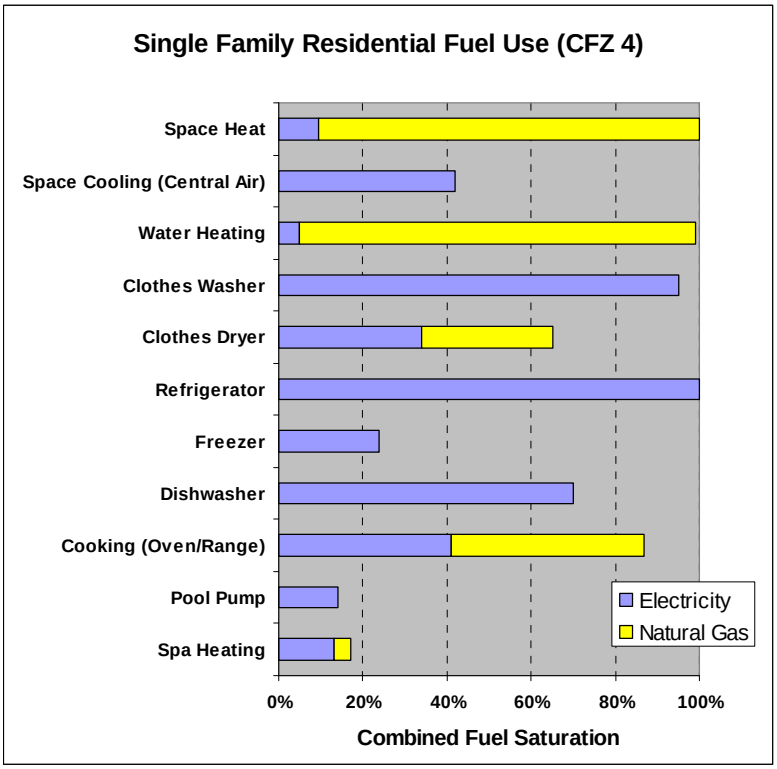
Figure 7



Source: Climate Protection Campaign

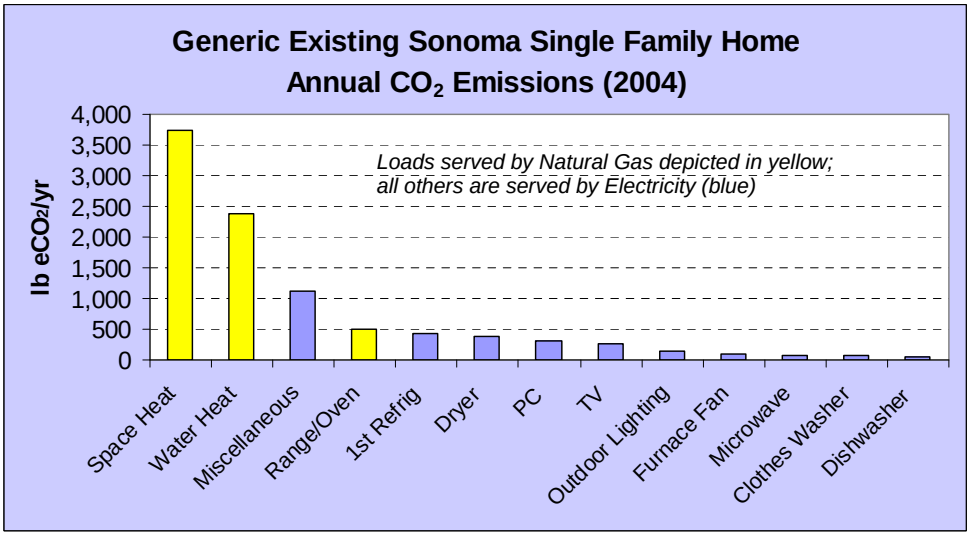
[22] *California Statewide Residential Appliance Saturation Survey*, Final Report, prepared by KEMA-XENERGY, Itron, and RoperASW for the California Energy Commission: June 2004

Figure 8



Data from the Residential Appliance Saturation Study may be taken forward one more step to reveal GHG emissions by end use category. Figure 9 presents the situation for a generic Sonoma County residence that is outfitted with the most common appliances (emissions for uses fueled with natural gas are depicted in yellow; those with electricity in blue).

Figure 9

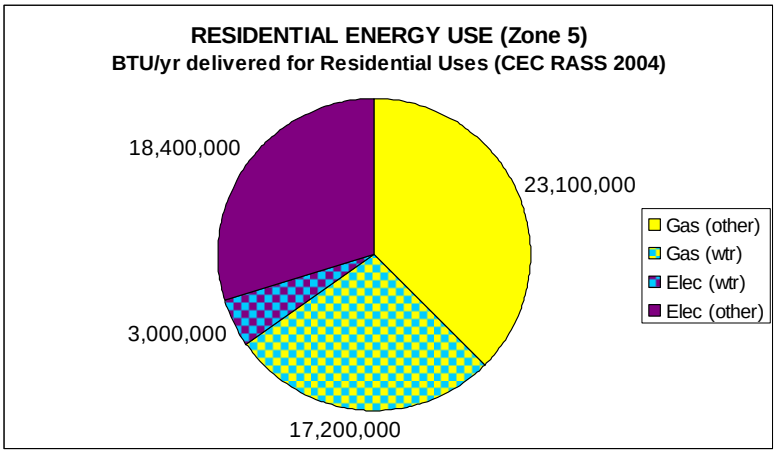


For this house, efficiency measures targeted to achieve GHG reduction should focus first on the quality of its thermal envelope and hot water demand. The loads served by electricity, although not, in this instance, contributing as much to GHG emissions, are also fruitful to address because the electricity costs more than the gas, making it financially more attractive to save and because of the ubiquity of these loads.

The detailed information necessary for estimating the amount of energy, and consequently GHG, savings available via the PAYS® system across the whole of Sonoma County's uses of electricity and natural gas is not available for this report nor, as noted earlier, is it within the scope of this report. However, as an example of what is possible, Resource Performance Partners (RPP) evaluated the potential for saving water (and related energy) in Sonoma County homes with the PAYS® system, based on previous research it performed in other projects.

Approximately one-third of Sonoma County's residential energy use is related to water use. Figure 10 shows total annual energy used in the average Petaluma residence, with a checkered overlay to denote the portions of electricity and gas that serve water-related uses (e.g., water heating, clothes washer motor, heating for the dryer to remove residual moisture).[23] This is not trivial, for approximately 80% of all GHG emissions related to municipal water use in Sonoma County occur on the *customer's* side of the meter.

Figure 10



Resource Performance Partners learned that indoor residential water use – the portion of water use that causes almost all water-related GHG emissions – can be cost-effectively reduced to less than 40 gallons per person-day in the average household. This is a reduction of up to 50% - potentially, a huge improvement relative to that achieved with normal efficiency practices. This determination was made using 2006 utility rates, a $75 rebate from PG&E for a clothes washer, and no water utility rebates (none were offered at the time for the measures evaluated).

Measures evaluated included:

- Aerators and showerheads;
- Leak repair;
- High efficiency toilets;
- Premium clothes washer (13 gallons per full-sized load); and
- On-demand hot water recirculation system.

[23] Data for Figure 10 reflect the numerically average residence, and so reflect the average deployment of gas and electric water heaters (most are gas); and gas and electric dryers (those with electric heat are more common).

Cost-effectiveness was determined both as individual measures and as a package. The package will generate net annual savings of at least $100 for the average household, even in Santa Rosa, where more has already been done to improve residential water efficiency than anywhere else in the County. When evaluated as individual measures, only the on-demand hot water circulation system is questionable as to whether it will save sufficient funds to qualify as a PAYS® product.[24] Meanwhile, utility rates are rising, and extensive water rebates are in the works. These will expand the number of deals that are cost effective.[25]

The effect of the complete water-saving package for an average house on energy would be to reduce hot water use by approximately 26%, and thereby household gas and electricity consumption by approximately 9% and 5%, respectively. Despite the fact that these measures are normally promoted to address water alone, their full implementation would reduce GHG emissions household energy use in the average Sonoma County home by approximately 8%. This helps to indicate the ability for a CCA/PAYS® effort to meet or exceed the aforementioned savings estimates suggested by ACEEE, the National Laboratories, and NYSERDA.

PAYS® for Green Supply

PAYS® is not only useful for effective customer investment in resource efficiency products. It can also be used by itself, or in concert with investment from the CCA to cover that portion of the cost ineligible for financing within the PAYS® approach, to effect customer investment in renewable energy technologies.[26]

The first step would be to allow PAYS® to be used by CCA customers to buy a targeted number of solar water heaters.[27] Preliminary analysis reveals that these can probably be delivered as PAYS® products (that is, at no initial cost while generating net positive cash flow) wherever it will offset electric water heat for both retrofit and new construction. In the case of a standard gas water heater, a rebate of approximately $1,500 will be needed to support installations in retrofit and new construction. Such support could possibly become available via State Assemblyman Jared Huffman's Solar Water Heating and Efficiency Act (AB 1470). It may also make sense for the CCA to fund the rebate. Otherwise, some customers may pay the difference, perhaps on the bet that their home will be worth more, or that it will pay off when gas prices continue to rise.

The provision of a solar water heater would reduce energy consumption for water heating by up to an additional 75%. Total household savings, in combination with other water-related measures, would approach approximately 28% and 7% for gas and electricity, respectively.

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[24] A study is underway by Lawrence Berkeley National Laboratory to improve estimates of potential resource savings available with this technology.

[25] Most of the pending rebates would not be needed to promote purchases were the water utility to offer PAYS®, for it is more effective to remove market barriers with the latter than it is to overcome them with the former. However, if PAYS® is implemented by the CCA instead of the local water utility, CCA customers will probably receive these rebates.

[26] RPP recommends Local Power include a PAYS® analysis as part of its supply portfolio. The benefits include having those who benefit from reduced use paying for most of the cost, the economic benefits of buying Green in Sonoma County, and lower rates for all customers while we meet our supply needs and 25 by 15 target.

[27] A more through analysis might also evaluate such measures as a gravity film drainwater heat recovery system, demand water heater, or even a clothes washer with an on-board ozone system (to preclude its need for hot water).

These two measures for the residential sector alone – indoor water savings combined with a solar water heater – indicate the promise of using PAYS® to promote the sale of efficiency and renewable technologies. Assuming the water saving package is accepted by 75% of the County's residents, and a solar water heater by 50% (the implementation plan is addressed below), the following *countywide* results are possible due only to residential water measures (a full program would of course offer a full array of measures to all customer classes):

- Countywide Resource Savings up to:
  - Electricity: 2%
  - Natural Gas: 10%
  - Municipal Water: 14%
  - GHG: 8%
- Local Investment (for installed equipment): $0.8 B
- Net Increase in Annual Disposable Household Income: $30 million

With PAYS®, high performance efficiency and local renewable investment are possible. Achieving this possibility, however, depends upon whether these investments are integrated with supply side planning, and on the elegance of the design of the Sonoma's implementation of the PAYS® system.

Integrating Supply and Demand

Almost all utilities address resource efficiency after having addressed their supply needs. This approach seems reasonable, since having a sufficient affordable and reliable supply is the single most important task for any utility.

Utilities can buy all of their power on the open market. In fact, the entire restructuring movement was predicated on eliminating the high cost of power by unencumbering supply markets from the long-term contracts that often resulted in customers paying more for their contracted power than that which was available in the marketplace. However, California and other states that restructured found that an unregulated marketplace for an essential service may be gamed so that suppliers make more money while customers pay more. The promise of cheaper power through restructuring has proved to be a myth.[28] Consequently, utilities currently, once again, seek long-term supply agreements to achieve price stability and security. This is all the more true in the instance of Sonoma County's proposed CCA, for it is founded on the view that price stability and security in energy also depends upon substituting renewable for non-renewable sources. There are currently so few renewable sources available that their capacity must be expanded to enable service to Sonoma County at reasonable cost (via the financial capability offered by a CCA).

Contracts for power offer price and supply stability to the extent the purchaser is obligated to purchase that power. There is little incentive to a supplier to commit to delivering power at below market prices unless it offsets potential short term losses with a must-buy arrangement that guarantees profit over the long-term. However, a firm commitment to purchase power creates a problem for resource efficiency

[28] cf. Johnston, David Cay. "A New Push to Regulate Power Costs." New York Times. 4 Sept. 2007. Section C, Page 1.

efforts that have the potential to reduce supply needs below contracted levels. When efficiency efforts succeed to the point of reducing demand below the level of contracted supply, the normal result is that all customers end up paying for supply they will not use and do not need. At that point, further efficiency improvements cause increased financial liabilities for utilities. This is usually resolved by raising rates, discouraging efficiency, or both. If we are going to meet our climate change goals, we must ensure that supply arrangements do not conflict with resource efficiency goals.[29]

Sonoma County's proposed CCA, because it is being designed from the ground up, has a unique opportunity to integrate its planning for supply and demand side resources, and thereby minimize both GHG emissions and overall costs. The principal strategies for this are typically ones that enable economic parity in efficiency investment while preserving a guaranteed revenue stream to support supply side investments. These include:

- High volumetric rates;
- Well-planned efficiency resource acquisition strategy; and
- Flexibility in power purchase contracts.

High volumetric rates will maximize the volume of efficiency services that may be financed and delivered to end users.

An energy bill is constructed from a multiplicity of fixed and variable components. The sum of these is controlled by the obligations of debt service, operations and maintenance (O&M), and so forth. From a GHG perspective, to the extent delivered energy continues to incur GHG emissions, good policy requires a price signal that encourages customers to select efficiency over energy to the extent it will reduce both emissions and cost. The more sensitive price is to volume, the stronger the feedback will be to a customer as they vary consumption. The more they use, the greater the cost; and vice versa.

An example of emphasizing volumetric pricing through a change in policy direction is the recommendation to replace the 100% fixed charge for auto insurance with a variable fee based upon miles driven. The principle is the same: to provide an equitable way to automatically reward people for behavior that benefits the whole.

The better the acquisition of efficiency resources is planned, and forecasted accurately, the easier will be the integration of supply and demand strategies. The procurement portfolio is ideally assembled according to the volume, unit cost, and other relevant parameters of each potential element. However, this information is not as easy to develop on the demand side.

Successful integration of resource efficiency and supply within Sonoma's proposed CCA therefore requires significant supply flexibility, especially in the beginning, even if in the short term this results in higher unit prices until resource efficiency goals have been realized. Even when resource efficiency goals have been met, there still needs to be enough flexibility on the supply side to ensure that customer desire for new or lower priced resource efficiency technologies does not conflict with supply agreements.

[29] Another conflict between supply and resource efficiency is rate design. Most rate designs allow usage to determine revenues. When utilities know the revenues needed to pay expenses are dependent on usage (as are reserve funds set up to address uncertainties), they find it in their interest to thwart resource efficiency efforts. We must establish a rate design that allows the highest volumetric charges to promote the resource efficiency efforts required to meet our climate change goals, while at the same time providing for a guaranteed revenue stream.

Given the current lack of information and precedent with which to estimate savings achievable with the PAYS® implementation system, flexibility in power contracting remains the essential key for integrating high performance efficiency with an unusually climate-friendly power portfolio. Local Power's proposed supply resources are scaleable, and will not be fixed in capacity until later in the planning process. At the earliest, the five-year construction period would begin in 2011 (following CCA setup, and transfer of customers in 2010). As these resources would be built for the Sonoma County CCA, the CCA will be contractually required to cover debt service and operating and maintenance costs. The financial obligation for debt service may extend for 20 to 30 years; and for O&M, 40 years or more.

These financial obligations extend far beyond CCAP's 2015 target for GHG emissions. Subsequent GHG targets will surely be lower. A full power portfolio that looks (and is) superlative by today's standards for emissions could later become a liability. Consequently, it is important to plan a way to continuously reduce GHG emissions.

The principal way is to commit to building only the green power supply infrastructure that is expected to remain, for its lifetime, below the most optimistic level to which efficiency services might lower demand. The balance would be filled in with short to medium term power purchases. The latter sources would be discontinued as soon as efficiency efforts trim the load.

One strategy to counter a lack of knowledge about the amount of efficiency that will be purchased over time is to build a larger amount of green power initially, and hope that a ready market will be available for it later if it becomes excess to the CCA's needs.[30] This needs to be approached carefully, however, as there are many examples of the failure of this strategy. Seabrook and Shoreham nuclear power plants were going to produce "power too cheap to measure." Customers are still paying for power never generated and these plants caused the demise of more than one utility. Although the green technology under consideration in this instance is significantly different from nuclear technology, the business lesson remains important regardless.

The design solution preferred by Sonoma's proposed CCA is that "surplus" green electricity may be sold into the general market or that it would have beneficial use within the CCA to reduce GHG emissions in other sectors. Such uses might include electrification of transportation to offset gasoline and diesel fuel, and operation of geothermal heating systems to offset natural gas for space heating. These are excellent, and possibly necessary strategies for meeting CCAP's 25 by 2015 targets – providing efficiency goals are met, there is sufficient supply, and that firm plans and commitments are in hand for use of excess power as it develops.

In other words, flexible supply, a rate structure that promotes resource efficiency while promising stable revenue, and a well planned efficiency acquisition strategy are keys to integrating supply and demand strategies. With a phased and flexible acquisition plan, and a progressive pricing plan, there is a potential to achieve a new green standard while also offering low utility bills.

[30] Considering the scale of financial activity in the offing, substantial investment in follow-up analysis (e.g., to estimate the amount of efficiency that can be delivered via this approach) is warranted to reduce the uncertainty faced by ongoing resource planning.

Implementing the PAYS® Efficiency System

The short window of opportunity available for achieving the climate goal means the efficiency system must be fully designed, staffed, and ready to deliver service as soon as Sonoma's proposed CCA is established and customers have been transferred into it.

Market Sectors Addressed

The market will be subdivided in two ways. First is a split between new construction and existing development. The second relates to the different types of end uses: residential, commercial, industrial, and so forth.

New Construction

The ability to address new construction is critical to reducing GHG emissions. Sonoma County's population is expected to increase by 12% between 2005 and 2015, leading to ~23,000 new residential units. There will naturally be an increase in non-residential building to meet the needs of these new residents.

It is imperative to achieve the highest standard for efficiency in new construction as soon as possible. At a minimum, it is important to install every cost-effective measure possible at the time of new construction, for once that opportunity is missed, it might not be cost-effective or practical to do so later, to the detriment of long-term GHG goals. A more important but rarely understood point is that unless new construction is built to a carbon neutral (or better) standard, the overall GHG situation will be made worse by such buildings. Our objective is to make an ecological U-turn and reduce total GHG emissions.

This need is being increasingly recognized, and addressed, around the world. The UK government seeks to gradually reduce GHG from new homes through 2016, after which they are to produce no net emissions. In the United States, *Architecture 2030*, an advocacy organization founded in 2003 by Edward Mazria, is finding an enthusiastic response to its "2030 Challenge" of achieving climate neutrality throughout the built environment by 2030. Their proposed route to meeting the challenge involves increasingly better design for new buildings, coupling new growth with renovations elsewhere in the built environment, and bringing ecological literacy into the design curriculum.

Local government in Sonoma County is now taking steps to address emissions, as with adoption of voluntary green building ordinances, their transition to mandatory status in some cities, and a tightening of building codes. Rohnert Park, arguably the local leader in this movement, was the first to require all new construction to exceed Title 24 energy standards (by 15%). The City of Petaluma is poised

Not so easy ...

Being green can be tough to implement locally

December 26, 2007
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Last week, the Santa Rosa City Council unanimously voted to adopt environmentally friendly standards for new residential and commercial construction.

The council should be congratulated: These rules are a critical step in combatting climate change.

At the same time, the new policies raise issues of cost and fairness.

The ordinance -- which will require builders to earn a certain number of points by choosing among a range of water- and energy-saving options -- will add about $1,100 to the cost of a new home. Given the median home price of $500,000, that may not seem like a lot of money.

But, as John Lowry, executive director of Burbank Housing, pointed out in an opinion piece in Sunday's Forum section, the cumulative fees add to the underlying cost of housing locally and make it more difficult for buyers to enter the market.

The second issue is one of equity. New buildings are already more efficient than older structures, yet the regulations affect only new construction. In the near future, the council must also consider regulations requiring older homes to **be** retrofitted (most likely when sold or remodeled) -- changes that are sure to generate opposition.

The debate in Santa Rosa and the four other local cities who've adopted similar ordinances highlight the difficulty of ``walking the talk'' when trying to reduce the local carbon footprint.

to impose aggressive new conditions upon new development to approach a zero net water standard – something that may also retard GHG emissions growth. In both cases, developers will be required to meet these standards at their own expense. In Sonoma County, as elsewhere, this limits the progress that can be made via regulatory standards alone.

With the PAYS® system, far more effective standards may be applied, *along with money to pay for them*. With PAYS®, developers and builders will pay nothing more to meet - and exceed - these standards. Moreover, including efficiency measures will not increase the price of the building. The PAYS® charge will not show up as debt or require a larger mortgage, thereby eliminating any concerns that mandating efficiency might preclude anyone from buying. For the first time, the natural resistance from those upon whom tougher standards are imposed can be mitigated without compromise, and while achieving a better result.

The principal steps for achieving this are:

1. A team of experts investigates all resource efficiency measures, including design support at the beginning of the process, passive solar features, and appliances, and develops rigorous new construction standards (adjusted for microclimates across Sonoma County) that will further Sonoma's goals;
2. Experts develop PAYS® charges for measures to offset development costs to meet the standard based on the best available baseline data; and
3. Experts develop PAYS® New Construction Program Design (e.g., contracts, protocols, custom options, etc.).

<u>Existing Development: Retrofit Projects</u>

Sonoma County's existing building stock is an enormous potential source of avoided GHG emissions, particularly among units built prior to the advent of more rigorous building standards. This also represents a large business opportunity, and through the approach described in this plan, a way is provided for Sonoma County's citizens to enjoy lower operating costs and more comfortable buildings.

RPP recommends delivering efficiency services to this sector by two mechanisms. First, services will be offered via a market driven effort. However, for a variety of reasons (e.g., distrust of contractors in one's home, fear of disrupting established routines, a desire to avoid any program or offering), some customers will not take advantage of these offerings. Because all CCA customers will pay the economic, environmental, and health costs related to the ongoing waste of resources from non-serviced sites, and because a high participation rate is required to achieve Sonoma's GHG 25 by 15 target, a mechanism is required to provide resource efficiency improvements to these locations too. Accordingly, a mandated Time of Sale approach, complete with financing (described below), is recommended.

Retrofit activity will be led by the market driven approach. With PAYS®, almost all the barriers that cause customers to put off installing cost-effective resource efficiency products are eliminated. While some may avoid engaging retrofit services until selling their property and being required to do it, many will want to realize savings now.

The following steps are recommended for developing a market driven PAYS® system:

1. Experts recommend packages of measures that may be eligible for delivery to customers via the PAYS® system. Packages of services, instead of individual measures, will be offered wherever appropriate to (a) minimize the burden of non-productive transaction costs, and (b) avoid "lost opportunities" by installing items with both high and low rates of return;[31]
2. Experts develop the standards for determining which package of measures will be appropriate for each customer. This involves characterizing and verifying expected resource savings for each measure and package of measures (net of interactive effects).
3. Experts develop PAYS® retrofit program, including contracts, operational protocols, custom options to enable increased efficiency for the benefit of program customers, etc.

Upgrade services not elected while buildings are under current ownership will be provided at the Time of Sale, as indicated above. As with other such upgrades, this will require appropriate legislation by cities throughout the county and by county government. Mandated measures, like all PAYS® products, will be constrained to those that deliver net cash flow, and the CCA or its designated capital provider would finance the work. A Realtor® advisor to the Climate Protection Campaign who recommended Time-of-Sale upgrades said properties in Sonoma County turn over once every seven years, on average. This would enable almost every building within the Sonoma CCA service territory to meet, within a decade, the most rigorous building standard in California.

Lost Opportunity Market

There is only one other sector to be addressed to ensure a comprehensive resource efficiency effort capable of meeting Sonoma's GHG objective. This has traditionally been called the Lost Opportunity Market. This sector involves purchase decisions that are unplanned and unavoidable.

For example, if pipes burst in a building and cause massive damage to floors, walls, and appliances, customers must immediately arrange for the repair of their premises and replacement of any damaged equipment. If they have insurance, they must deal with any strictures imposed by their insurer on these repairs and replacements.

As with new construction, the benefit of these opportunities is that the financial cost for more efficient equipment or building practices is only the incremental cost between the less efficient and more efficient practice and equipment. However, inasmuch as resource efficiency is the last thing on a customer's mind when trying to regain occupancy and the last thing on the mind of an insurance adjuster when trying to minimize expenditures, this has traditionally been a challenging market to serve.

It is recommended that no action be contemplated initially for serving this sector. Once PAYS® is established, and the New Construction and Retrofit solutions are operating smoothly, it will be possible to work with many of the suppliers and contractors involved and familiar with the approach of those programs to develop a Lost Opportunity Market program that meets their needs and takes advantage of the latent resource efficiency opportunities.

[31] It is all too common to deliver only items that are the most cost-effective while foregoing more expensive measures that also save energy and money. This practice, called "cream skimming," is popular and easy, but carries a heavy penalty. Later, when the need to further improve efficiency becomes clear, the financial feasibility of next steps may be an issue. Hence, it is better at the outset to deliver the largest package of services possible.

Financial Procedure

One option for a CCA is to finance the upfront costs for efficiency services with revenue bonds issued by the CCA. This source would minimize participant (and non-participant) costs and, in some cases, allow more measures to qualify for PAYS® treatment, thereby helping the CCA to meet its 25 by 15 target. These bonds can be reissued each year to adjust for variations in service delivery needs.

Debt service for bonds will be collected via service charges that are added to participants' electric bills (the charge is of course specific to the package of measures provided to each individual participating customer). This will be accomplished under the CCA's authority to order the placement of surcharges upon the electric bill.[32]

The CCA will guarantee repayment to the bondholders. The experience with PAYS® in New Hampshire with nonpayment of PAYS® fees was extraordinary: the default rate was less than 0.0024% (people, generally good about paying utility bills, are even better when the bills are smaller – plus the CCA will have a number of tools to minimize bad debt including the right to make repairs to ensure continued payments and the right to extend payment terms to cover missed payments and repair costs). Funds needed to provide a reserve for bad debt, along with other support services needed to administer the CCA's efficiency programs, would be financed with measure costs and recovered from participants over time.

Rebates are easy to incorporate with the PAYS® system. To the extent rebates are available from whatever sources, they will be used to lower the purchase price and the amount of the monthly PAYS® charge. Tax credits, although usable in most cases, can add complexity to the transaction because they cannot be used to lower the initial cost (some customers cannot use them, others must wait until they file their taxes, and for most customers, they will show up as a credit allowing a smaller tax payment rather than a refund they can spend).

Finally, some customers may wish to purchase services and equipment over and above those that produce immediate savings when measured against current billing rates. Just as homeowners now purchase solar PV systems, for example, that will pay for themselves over the long run only if electricity rates continue to rise, many customers are likely to want to make significant improvements for reasons that transcend mere financial bean-counting (e.g., environmental commitment, security, comfort, and so forth). The CCA/PAYS® structure can support these customers as well by financing (for repayment on the electric bill over time) the portion of the upgrade that is cost-effective for the original and successor occupants at that address. The customer would then have to pay as an up-front charge only the portion of the cost that is not cost effective by current rates. In this way, should for any reason the current occupant move, the successor occupant would not be obligated to pay anything "extra" for utility services. This would be an "Opt-Up" service to be designed with the CCA and its Energy Service Provider.

[32] CCA's ability to do this was confirmed by CPUC's Carlos Velasquez with EEI's Harlan Lachman in a telephone conversation on February 13, 2008. Carlos indicated, after checking with a contact at PG&E, that a CCA may utilize its "Bill Ready Billing" option to include such charges. For background, Harlan had asked if it would be possible for a community aggregator to offer a two tiered generation tariff such that all customers opting into the aggregation plan would have a volumetric charge but they could also opt for green generation surcharge with a fixed variable charge. Harlan made it clear that by fixed variable charge he meant a charge that would include a fixed amount for their location but amounts between different locations would vary. Harlan defined the PAYS® obligation as generation in the Amory Lovins' sense of a negawatt, with the belief that if those responsible for a community aggregation effort continually describe their resource efficiency effort as an acquisition plan, there is enough precedent in the country and especially in California to justify that assumption.

Following is a proposed implementation schedule.

Time Estimate for PAYS® Implementation	
Stage	**Time**
Develop Initial PAYS® Implementation Plan	6 months
Create CCA Implementation Plan (including efficiency services), JPA, Ordinances, Approval Process, Continue Education and Local Support Process. Modify PAYS® Implementation Plan as appropriate	1.5 years
CCA Setup, Transfer Customers, etc.	1 year
Energy Efficiency Service Delivery Commences; operates continuously thereafter (or until such time that additional efficiency services are no longer cost-effective)	Continuous (given new construction, new products, and replacement services.)
Build Rollout of Renewables	5 years

Implementation Issues

This paper offers a vision for reaching – and continuing beyond – CCAP's climate objective. We have outlined a strategy that transcends the limitations of previous efforts. This recommended strategy comes with good news and challenges.

The good news is that the recommended course of action:

- Once in place, requires little financial resources (i.e., few, if any rebates are required. Rebates will only be used to the extent necessary to qualify efficiency measures and customer owned renewable technologies as PAYS® products that while desirable, are not sufficiently cost-effective with current rates to warrant customers purchasing them);
- Uses market forces to ensure the lowest possible utility cost while realizing Sonoma's goals;
- Addresses all key market barriers inhibiting investment in resource efficiency;
- Should be available to all customers regardless of income, age, education, or ownership;
- Takes advantage of existing rebates and tax credits but does not rely on them to effect investment in resource efficiency;
- Leverages the extraordinary interest in green building locally, particularly the efforts of the Redwood Chapter of the US Green Building Council, and related institutional support from cities and the Sonoma County Water Agency; and
- Offers a comprehensive effort that addresses all resource efficiency opportunities in every sector.

The challenges of this approach include:

- The need to start immediately – the system must be in place and ready to go and integrated into plans from the beginning. As recommended by California energy policy, efficiency must drive and not be driven by the amount of resource acquisition;
- The need to rapidly develop expertise among local developers, designers, and builders in high performance resource efficiency;
- While other PAYS® efforts have proven customer acceptance, its ability to effect customer purchase of resource efficiency that would not otherwise be purchased, and the ease of combining PAYS® with existing rebates, no utility has allowed it to be offered with more than a limited pool of capital, meaning there is no model for the Sonoma CCA to emulate;
- Resistance from other energy and water distribution utilities due to lost revenue concerns, and possible concern over a new entity delivering efficiency services by a different (and better) method in a market without previous competition;
- EEI, the developer of PAYS®, has repeatedly informed RPP that efficiency advocates and experts have tried to undermine key PAYS® elements in those jurisdictions in which it is being implemented either due to a lack of understanding, a desire to simplify design and implementation (and gut the benefits of the PAYS® offer), or fears that PAYS® might not work but be used to justify ending existing programs created by these advocates and experts;
- The need to resolve all inherent legal issues in the new relationship created by both the CCA and the new PAYS® system;
- Unlike existing programs with firm budgets that limit participation, lost revenues, and allow for careful planning for limited savings, the PAYS® system, once in place, will be limited only by effects of a working marketplace; and
- The care needed to translate the ideas outlined in this document into an effective, system designed for simple administration, continuous improvement (to reflect new technologies), and synergistic integration with green power supply.

APPENDIX A: Baseline Energy Usage and Greenhouse Gas Emissions

Considerable attention has been given to energy efficiency in California. As a result, per capita consumption of electricity has remained flat for the last thirty years in California while it continued to rise across the US in general. California's performance is the result of federal appliance standards, state and local building standards, and demand side management programs presented by energy utilities. However, because California's population has continued to rise, so has overall energy use and related impacts.

The Community Climate Action Plan (CCAP) is focused upon greenhouse gas emissions as a primary impact of energy consumption. This section summarizes recent projections of electricity and natural gas usage, planned demand side measures to reduce usage, and the likely amount of related greenhouse gas emissions. When compared to Sonoma's GHG emission goal, the magnitude of further reductions needed is revealed.

Projected Energy Use

The most useful projections for the purpose of this report are those made by Itron, the California Energy Commission, and PG&E.

Current regulatory direction regarding energy efficiency in California appears to refer particularly to the "Itron Potential Study" of May 24, 2006. This is the most recent and thorough of a sequence of studies to examine the potential for energy efficiency within the service areas of California's four electric Investor Owned Utilities. Key findings, together with CEC's 2005 estimates of baseline energy use (net of energy efficiency efforts committed through 2008), are summarized in Table A-1 below. Table A-1 refers to energy use and savings in residential, commercial, and industrial buildings – it does not address energy use in other sectors (these include mining, agricultural, street lighting, and TCU (transportation, communication, and utilities).

The data in Table A-1 provides an initial indication of the possible reach of energy efficiency as evaluated by Itron's team. As with all studies in this complex arena, however, a clear interpretation of such data requires adjustment for many confounding details. In this instance, the only adjustment made is to place energy usage and potential savings on a more equal footing. This is done by adding savings that PG&E has already committed to provide back to CEC's baseline estimates of energy use and demand. This step was taken to avoid double-counting, as those savings were included within Itron's estimates of potential savings.

Table A-1

ANNUAL ENERGY USAGE AND EFFICIENCY SAVINGS ESTIMATED FOR PG&E SERVICE AREA

Electric Energy Baseline Usage and Savings by 2016 (GWh)

Sector Modeled	Baseline	Potential Savings		Market Savings Performance by Incentive Level		
	CEC Estimate	Technical	Economic	Full	Average	Current
Residential Existing Bldgs (2004-2016)	40,428	11,969	8,996	4,555	3,861	3,102
Commercial Existing Bldgs (2004-2016)	41,139	5,553	4,583	1,818	1,557	1,109
Industrial Existing Bldgs (2005-2016)	14,171	2,411	2,200	1,517	1,300	1,024
Residential New Bldgs (2003-2016)		448	273	125	n/a	71
Commercial New Bldgs (2003-2016)		2,061	1,900	757	n/a	326
Industrial New Bldgs (2003-2016)		214	211	128	n/a	119
Emerging Technologies (2006-2016)	n/a	5,812	5,812	774	637	501
Subtotal	**95,738**	**28,468**	**23,975**	**9,674**		**6,252**
Add back Committed Savings	4,314					
Comparable Baseline	**100,052**					
Savings as % of Baseline		***28%***	***24%***	***10%***		***6%***

Electric Baseline Peak Demand and Savings by 2016 (MW)

Sector	Baseline	Potential Savings		Market Savings Performance by Incentive Level		
	CEC Estimate	Technical	Economic	Full	Average	Current
Residential Existing Bldgs (2004-2016)	9,994	2,579	1,311	879	689	447
Commercial Existing Bldgs (2004-2016)	8,082	1,275	798	421	323	170
Industrial Existing Bldgs (2005-2016)	2,002	328	287	198	163	123
Residential New Bldgs (2003-2016)		483	288	146	n/a	80
Commercial New Bldgs (2003-2016)		423	394	167	n/a	71
Industrial New Bldgs (2003-2016)		34	34	21	n/a	19
Emerging Technologies (2006-2016)	n/a	1,817	1,817	209	166	123
Total	**20,078**	**6,939**	**4,929**	**2,041**		**1,033**
Add back Committed Savings	936					
Comparable Baseline	**21,014**					
Savings as % of Baseline		***33%***	***23%***	***10%***		***5%***

Natural Gas Baseline Usage and Savings by 2016 (Millions of Therms)

Sector	Baseline	Potential Savings		Market Savings Performance by Incentive Level		
	CEC Estimate	Technical	Economic	Full	Average	Current
Residential Existing Bldgs (2004-2016)	2,404	376	153	101	83	48
Commercial Existing Bldgs (2004-2016)	778	32	8	12	8	3
Industrial Existing Bldgs (2005-2016)	1,664	211	211	95	71	36
Residential New Bldgs (2003-2016)		103	46	30	n/a	12
Commercial New Bldgs (2003-2016)		28	22	3	n/a	2
Industrial New Bldgs (2003-2016)		n/a	n/a	n/a	n/a	n/a
Emerging Technologies (2006-2016)	n/a	231	231	26	20	16
Total	**4,846**	**981**	**671**	**267**		**117**
Add back Committed Savings	90					
Comparable Baseline	**4,936**					
Savings as % of Baseline		***20%***	***14%***	***5%***		***2%***

Notes

1. Source: *California Energy Efficiency Potential Study* , Itron, 24 May 2006 (CEC's estimates of Baseline Usage also copied from this study).
2. "Technical:" The result of installing all measures considered, regardless of cost, but subject to availability, saturation, and feasibility
3. "Economic:" All measures evaluated that individually pass the Total Resource Cost test (e.g., are cost-effective from PG&E's perspective)
4. "Full:" Market performance with expanded list of measures, and financial incentives set at full incremental cost (relative to default equipment)
5. "Average:" Market performance with 2004 measures, and financial incentives set halfway between "Current" and "Full" levels
6. "Current:" Market performance predicted with measures offered in 2004 and financial incentives held constant at 2004 level
7. Baseline usage values presented in the Itron report are from California Energy Commission, *California Energy Demand 2006-2016: Staff Energy Demand Forecast* (Staff Final Report), September 2005. This usage as presented in the Itron report is net of savings already committed by PG&E and funded by the CPUC. The potential savings developed and presented by Itron, however, include these savings. To avoid double-counting, the committed savings are added to the baseline values to create a "Comparable Baseline." These savings are in Table 1-5 of the CEC reported cited in this footnote.

The figures below present the performance indicated by this study: baseline usage expected in 2016 within the PG&E service area for all buildings, and how the baseline can be reduced given various levels of attention through efficiency programs. Generally speaking, the best level of performance anticipated as both achievable and cost-effective within the constraints of the *Itron Potential Study* is the scenario labeled "Full Incremental Cost." In this case, financial incentives provided to end users cover 100% of the incremental cost of all measures offered. All measures included within this category individually pass the Total Resource Cost test (as do those that provide the "Economic Potential" savings scenario). The "Full Incremental Cost" basket of

measures, if implemented, is expected to reduce baseline electricity and gas usage by 10% and 6%, respectively, below baseline usage over the ten-year period examined by this study.

Fig. A-1

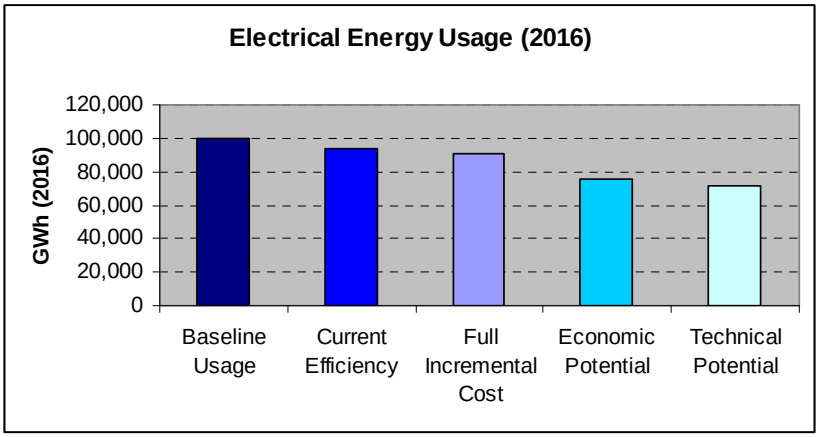


Fig. A-2

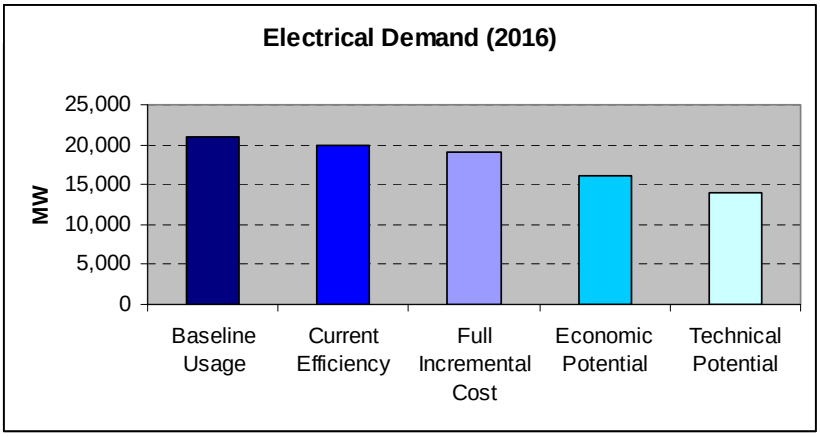
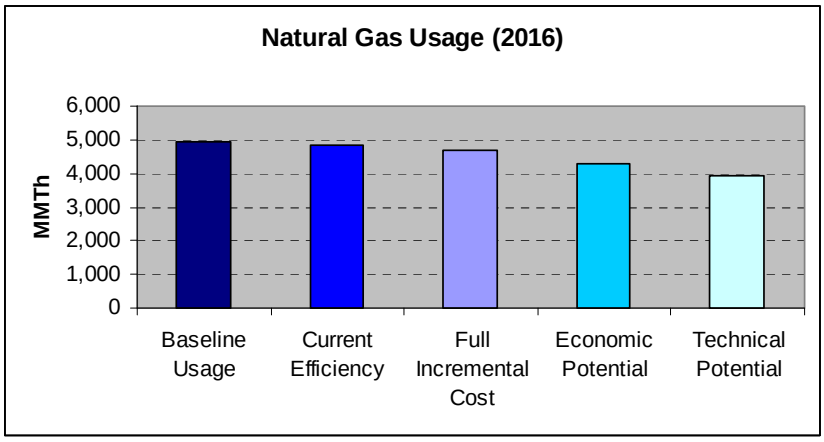
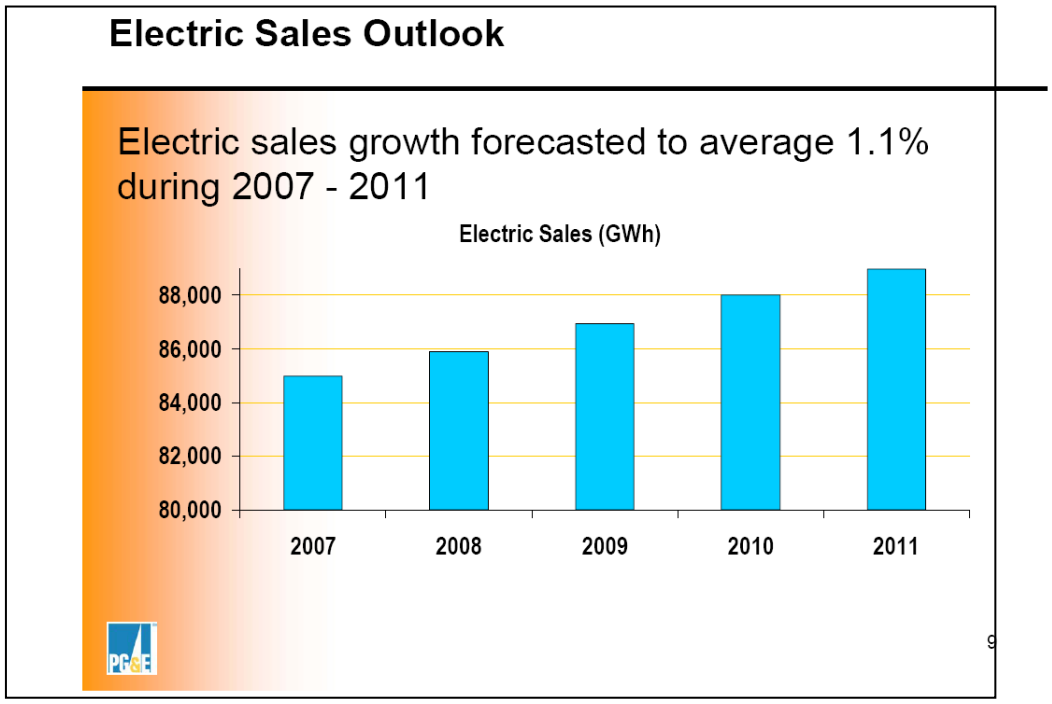


Fig. A-3



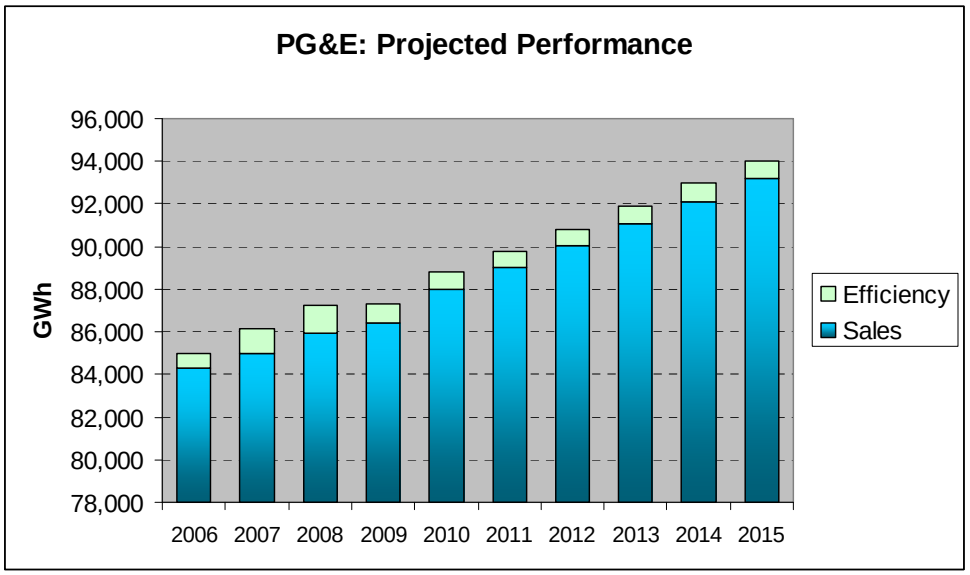
PG&E's projected performance for the same period, for their service area, may be estimated from recent public documents. Figure A-4 displays projected electrical energy sales; Figure A-5 extends these across the study period and combines them with savings projected by PG&E.

Fig. A-4



Source: PG&E, Appendix, Investor Conference, April 4, 2007, New York, NY

Fig. A-5



Source: Sales data from Fig. 5 above; Efficiency data from PG&E 2006 Long-Term Procurement Plan, Table Vol. 1, IVC-2 (Scenario 3)

The integrated view provided in the chart above suggests that PG&E proposes to supply perhaps as much as half of new growth in electricity demand with efficiency, and the balance with new sources of electricity. This is generally in keeping with the CPUC's current policy directive. However, if the energy growth rate PG&E assumes – generally higher than that assumed by the

CEC – does not occur, some of PG&E's projected savings, or new generation capacity, would be excess to its needs.

Baseline Projections for Sonoma County

Baseline energy use projections are developed below as follows:

1. Determine energy usage data in Sonoma County via the most recent publicly available data;
2. Project baseline energy usage for Sonoma County by:
    a. Consulting CEC forecasts to determine expected future energy use in relation to population for the entire PG&E Service Area (none are available for Sonoma County);
    b. Assembling population projections for Sonoma County; and
    c. Developing energy use projections for Sonoma County based upon (a) and (b) above.

This method considers population as the primary driver of electricity and natural gas consumption. Secondary drivers, such as square feet of commercial space, and industrial productivity, are also helpful, but the additional complexity of such a model exceeds the needs of this review.

Table A-2

Sonoma County Historic Energy Use			
Parameter	**Total**	**Population**	**Per Capita**
Electrical Energy	GWh/yr		kWh/capita-yr
1990	2,186	388,222	5,631
2005	2,870	466,891	6,147
Annual Growth	1.83%	1.24%	0.59%
Electrical Power	MW		kW/capita
1990	n/a	388,222	n/a
2005	n/a	466,891	n/a
Annual Growth		1.24%	
Natural Gas	MM Th/yr		Th/capita-yr
1990	109	388,222	281
2005	122	466,891	260
Annual Growth	0.73%	1.24%	-0.50%
Notes			
1. Energy data from Climate Protection Campaign			
2. Population data from US Census (estimate for 2005)			

These data show an absolute increase in the consumption of both electricity and natural gas in Sonoma County over time. This is not surprising, given the concomitant increase in population, although the rates differ. Electricity use has risen faster than population, while natural gas, perhaps due to better construction standards and rising prices, has risen less quickly.

The California Energy Commission (CEC) has, since its inception, developed end-use based energy forecasts as one of its principal products. Information summarized from the most recent forecast is provided below.

Table A-3

ENERGY USE PROJECTIONS PG&E Planning Area			
Parameter	**Amount**	**Population**	**per capita**
Electrical Energy	**GWh**		
2005	97,550	12,970,814	7,521
2015	112,231	14,925,894	7,519
Annual Growth	1.41%	1.41%	0.00%
Electrical Power	**MW**		
2005	21,354	12,970,814	1.65
2015	25,647	14,925,894	1.72
Annual Growth	1.85%	1.41%	0.43%
Natural Gas	**MMTh**		
2005	4,724	14,321,555	330
2015	5,266	16,854,497	312
Annual Growth	1.09%	1.64%	-0.54%

Notes

1. PG&E's planning area for natural gas includes the planning area for the Sacramento Municipal Utility District (PG&E provides gas service to SMUD electricity customers).

2. Source: California Energy Commission, *California Energy Demand 2008-2018: Staff Draft Forecast* (values for 2015 calculated from growth rates provided in CEC report). These, CEC's latest projections, are net of the effects of current appliance standards, building codes, and PG&E end use efficiency programs through 2008.

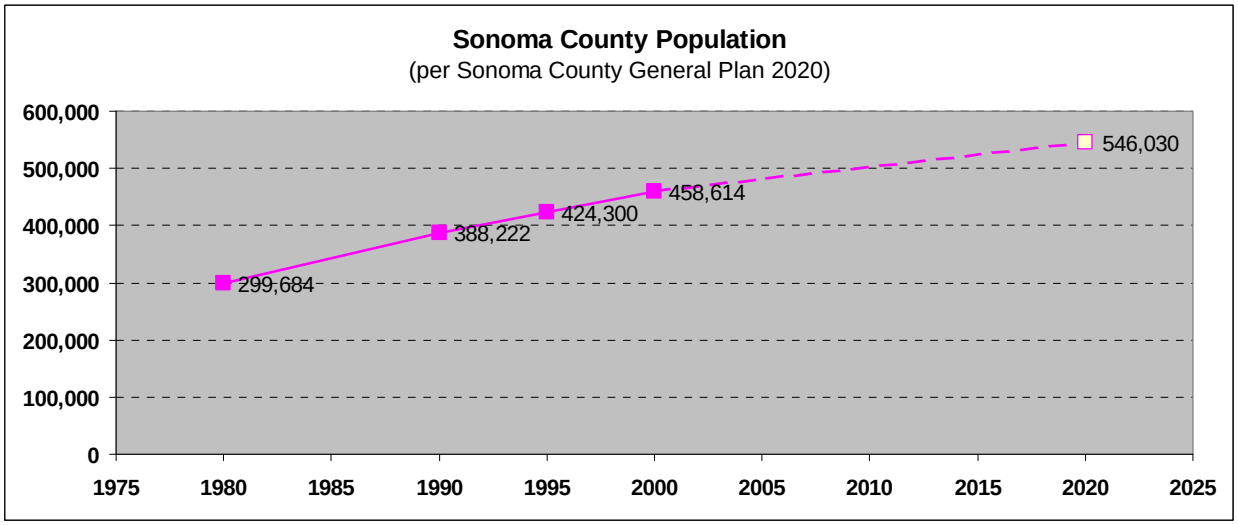
This forecast anticipates continuing improvements in building standards and baseline appliance efficiency, and the effect of PG&E energy efficiency programs currently mandated by the CPUC (through 2008). Net of these effects, total electrical energy and demand is expected to increase through 2016 at rates virtually identical to population growth. The demand for natural gas is also expected to increase, but at a slower rate due to relatively higher price hikes expected for natural gas than for electricity. Accordingly, per capita consumption of natural gas is expected to decline slightly. However, *overall* gas use is estimated to rise because population is increasing faster than individual consumption is falling.

As with any forecast, uncertainty exists. The largest factors of uncertainty accompanying the forecasts above are (1) population predictions, and (2) accuracy of electrical consumption reporting.

Baseline energy use for Sonoma County may be estimated by extending recent per capita energy use (Table A-2) forward by the per capita rates developed above (Table A-3) in accordance with expected population growth. Figure A-6 below presents census data for Sonoma County and the population projection for 2020 provided in the County Planning Commission's Recommended

Draft General Plan.[33] The latter projection reflects estimates embedded in General Plans for each City in Sonoma County and, for unincorporated areas, the County's projections. The projected population for 2020 is close to that predicted for Sonoma County by the Association of Bay Area Governments.

Fig. A-6



Key data from above are assembled in Table A-4 below to develop baseline energy use estimates for Sonoma County in 2015. Sonoma County population for 2015 is estimated at 524,176 (a straight-line interpolation between the values given for 2000 and 2020).

[33] http://www.sonoma-county.org/prmd/gp2020/recdraft/lue.pdf

Table A-4

ENERGY USE PROJECTIONS Sonoma County			
Parameter	**Per Capita Use**	**County Population**	**Total County Use**
Electrical Energy	**kWh**		**GWh**
2005	6,147	466,891	2,870
2015	6,146	524,176	3,221
Annual Growth	0.00%	1.16%	1.16%
Electrical Power	**kW**		**MW**
2005		466,891	n. a.
2015		524,176	n. a.
Annual Growth	0.43%	1.16%	n. a.
Natural Gas	**Th**		**MMTh**
2005	260	466,891	122
2015	246	524,176	129
Annual Growth	-0.54%	1.16%	0.62%

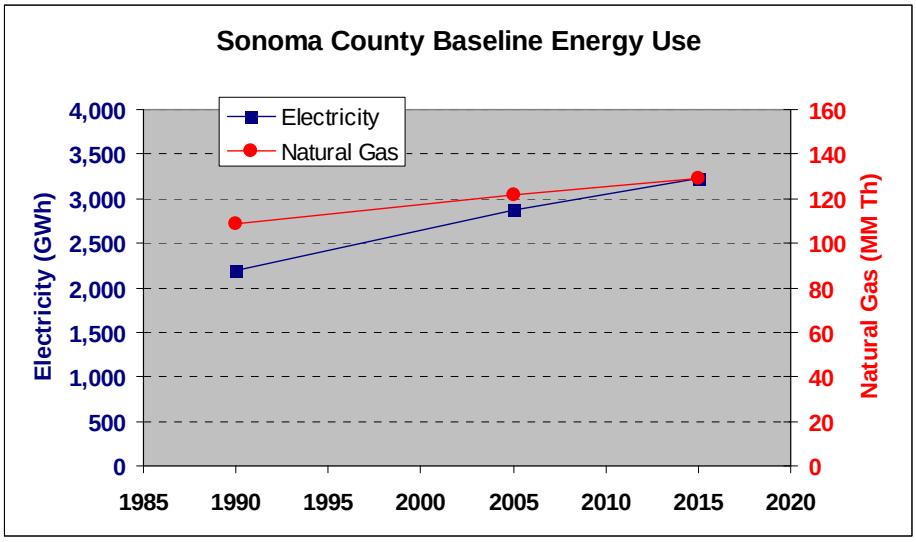
Notes

1. Electrical Energy: Per capita usage for 2015 is estimated by adjusting 2005 per capita usage by the annual per capita growth rate predicted by the CEC for the entire PG&E Planning Area (2008 Draft CED). Total Sonoma County usage for 2015 is per capita usage multiplied by the population anticipated for the County in local General Plans.

2. Natural Gas: Total consumption for 2015 is estimated by the same method described above for electrical energy.

Figure A-7 summarizes historic and expected baseline electricity and natural gas use in Sonoma County between 1990 and 2015. Electrical energy and natural gas usage is anticipated to increase at about the same and half the rate of population, respectively.

Fig. A-7



Projected Baseline GHG Emissions

Baseline emissions for Sonoma County are estimated by multiplying estimated baseline energy usage by appropriate unit GHG emission factors. The latter, both for PG&E, and for CCA (electricity in 2015), are summarized in Table A-5 below.

Table A-5

GHG Emission Coefficients				
Energy	**Organizing Entity**		**Units**	**Source**
	PG&E	CCA		
Electricity				
1990	0.566		lb eCO_2/kWh	Climate Protection Campaign (PG&E Mix)
2005	0.523		"	"
2015	0.41	0.22	"	See Notes
Natural Gas				
All	12.3		lb eCO_2/Th	ICLEI

Notes

1. Emission coefficients for 2015 estimated on the basis of the following:

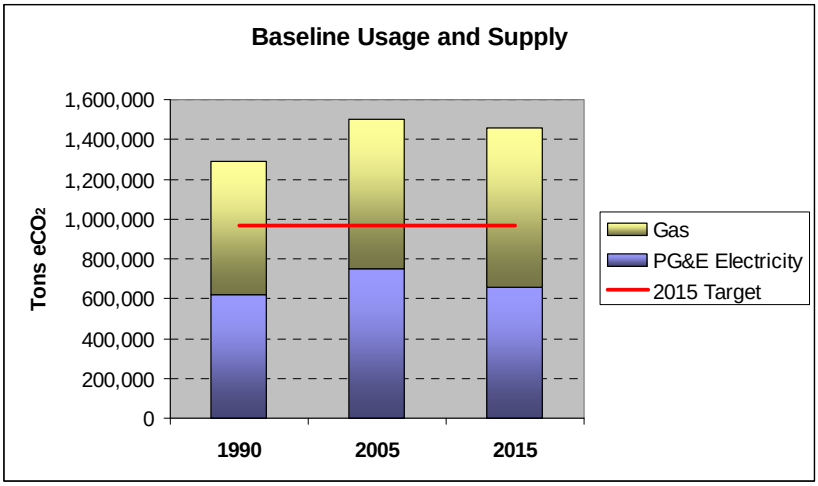
PG&E: Based upon assumed best case w/o existence of CCA: Increased Reliability and Prefered Resources plan under Scenario 3 (17.7 million metric tons of CO2 emissions to supply an estimated 94,266 GWh). Mass of emissions given by PG&E's *2006 LTPP* (Table Vol. 1, VIB-ll); electricity sales estimated from projections for 2007-2011 by PG&E in *Appendix* , Investors Conference, April 4, 2007, NY, NY.

CCA: Based Local Power's estimate of approximately 310,000 tons of GHG emissions associated with the supply of 2,827 GWh (Energy Element of the Sonoma County Community Climate Action Plan, prepared for the Climate Protection Campaign, dated August 17, 2007).

2. The emission coefficient for natural gas is at the burner tip - it does not include leaks between wellhead and burner tip, energy consumed for compressors in pipelines, or additional parasitic losses associated with future LNG operations - effects that may easily double the emissions associated with natural gas. ICLEI: International Coalition for Local Environmental Initiatives. Their protocol is used in Sonoma County to calculate emissions.

Baseline energy usage in 2015, net of efficiency efforts committed through 2008, is estimated at 3,221 GWh and 129 MMTh (Table A-4). Baseline emissions expected in 2015 are found by multiplying these values by the appropriate coefficients provided in Table A-5 above. The resulting baseline value for 2015 is approximately 1,460,000 tons eCO_2. This exceeds the nominal target of 966,000 tons (25% less than the 1990 total) by approximately 500,000 tons, or 50 percent. This relationship is shown in Figure A-8.

Fig. A-8


Baseline Usage and Supply
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Tons eCO2
1990
2005
2015
Gas
PG&E Electricity
2015 Target

APPENDIX B: Resource Efficiency and Market Barriers[34]

Subject

This paper generally discusses the principal barriers to the purchase of cost-effective end-use efficiency measures, reviews standard mechanisms employed to overcome them, and presents a new approach designed to address lessons learned.

Marketplace Reality

Standard economic theory suggests that buyers, guided by the "invisible hand" of the marketplace, will purchase goods that return the greatest risk-adjusted value over their lifetime. Were this true, residents of Sonoma County would have long ago updated their homes, apartments, and businesses with thick insulation, efficient lighting, solar water heating, premium windows, the best appliances and so forth, for these proven technologies all deliver excellent lifecycle economic value.

However, this has not occurred. The fact that most buildings, including new buildings, lack optimal levels of insulation, efficient lighting, solar water heating, super windows, premium appliances and so forth indicates that with regard to resource efficiency, the market system has not delivered optimal results. One of several unfavorable consequences of the resulting legacy of suboptimal purchase decisions is excessive greenhouse gas emissions. However, given that these suboptimal purchase decisions by definition also deliver poor economic value, untapped attractive investment opportunities can become more available if market barriers are removed.

Market Barriers

The prevalence of uneconomic choices made by buyers with regard to energy efficiency reflects areas of potential improvement in the market place. Instead of steering buyers toward choices that provide the greatest value, imperfections and barriers within the market as it currently exists instead shunt most buyers in other directions.

These barriers must be understood in order to overcome them. Principal market barriers to the purchase of resource efficiency products include:[35]

> Trusted and Accurate Information: There are numerous product claims and beliefs about the value (or lack of value) of resource efficiency products: the marketplace is rife with misinformation. Without trusted, accurate, and timely information, customers cannot act in their best interests.

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[34] Prepared for the Climate Protection Campaign by Ned Orrett, President, Resource Performance Partners, Inc., in consultation with Harlan Lachman, President, Energy Efficiency Institute, Inc., Colchester, Vermont (one of the originators of the Pay As You Save® system).

[35] This report focuses on issues that directly affect end users' purchase decisions. Ignored here are deeper issues addressed by ecological economics (e.g., matters external to the market system) and issues related to policy practices in the regulated utility environment.

Uncertainty that Savings will Pay for Investments: Efficiency requires superior design, materials, equipment, and proper installation; things normally presumed to increase up-front costs.[36] If potential buyers lack sufficient assurance they will realize enough savings to profit from their investment in resource efficiency, they are less likely to purchase such products. Uncertainty can arise from concerns that savings will be less than expected, a product may fail, or the purchaser may relocate before sufficient savings are realized to repay the investment. Unless these real and legitimate concerns are overcome, they will inhibit otherwise reasonable purchases of resource efficiency products.

Lack of Capital (or Competing Demands for Capital): For buyers to pay for resource efficiency products, they must have funds available and they must be willing to use these funds to buy efficiency products as opposed to all other potential purchases. Resource efficiency purchases compete for residential customers' capital that could be used for consumer goods, housing, education, and entertainment. For many potential buyers, the perceived value of reducing an ongoing expense is less compelling than that of a new car, a home, a child's education, or the latest home entertainment system. Businesses also have investment alternatives competing with resource efficiency, such as increased marketing, training, product development, and production. Manufacturers in particular are typically far more inclined to invest in incremental production capacity than in resource efficiency, despite the fact that performance of the latter, unlike the former, improves the bottom line directly. Most businesses are focused on their business, not resource efficiency.

Limited Debt Capacity: Unlike most consumer purchases, resource efficiency equipment and services pay for themselves. In other words, over their useful lives, many of these products and or services will produce bill savings that exceed their cost. That makes them perfect candidates for financing. However, debt capacity is limited for consumers, businesses and industry. Most potential buyers will and have decided to forgo purchases that reduce ongoing expenses to make sure they retain sufficient debt capacity to be able to afford other high cost purchases that are perceived as more valuable.

Uncertainty about Length of Occupancy: As noted above, one cause for uncertainty that sufficient savings will be realized is that renters, homeowners, businesses, and industries cannot be sure how long they will remain at their current premises. Most resource efficiency products require several years to generate sufficient savings to repay their cost. Homes and businesses always turn over. Today's economic realities are even more uncertain (e.g., the residential housing market in Sonoma County) and the longer the payback for a resource efficiency purchase, the less likely it will be made.

Building owner is not the Bill Payer (e.g., New Development or Rental Property): One of the principle reasons for purchasing resource efficiency products is the anticipation of future savings. These purchases are unlikely to be made by persons or businesses who will not realize any savings, such as developers of new buildings, and landlords of buildings with meters for each tenant. Developers, aside from those beginning to engage Green Building practices, typically build just to the Title 24 energy standard. Accordingly, leased

[36] This is not always true. Elegant design will "tunnel through" cost barriers and actually decrease a project's initial cost, as when incremental building shell improvements cost less than the space conditioning equipment it avoids.

housing and commercial spaces are commonly among the least efficient from a resource efficiency perspective.

Addressing Market Barriers: Standard Methods Employed

Numerous efforts have been made for at least twenty-five years to mitigate the market barriers presented above. This section reviews what has been tried, and learned, with the objective of informing more successful designs in the future.

Audits: Since the late 1970s, policy makers were aware that a lack of information about the effectiveness of energy efficiency measures or a lack of confidence in available information was inhibiting the purchase of resource efficiency products. National audit programs, mandated on a state-by-state basis, were therefore developed to supply credible information for all classes of customers. However, since these efforts addressed only this barrier (i.e., one of the six summarized above), they educed little investment in resource efficiency. Even when combined with loan programs or services from energy service companies (ESCOs), lack of attention to three other market barriers limited the results produced by these programs.[37]

Tax Credits: As early as the 1980's, on national and state levels, tax credits have been offered for some resource efficiency investments. The problem with tax credits is that because they are realized long after the investment must be made, they address few of the barriers noted above. Additionally, tax credits are limited to those high tax-paying individuals and businesses that can use them. They do not benefit renters, homeowners, or businesses with low tax obligations, or consumers and businesses that pay no tax (including municipalities and non-profits). Accordingly, tax credits have generally had a limited impact.[38]

Rebates: Most current resource efficiency efforts rely on rebates or subsidies paid to lower the cost of targeted resource efficiency products. The theory is that if the up-front cost is sufficiently reduced, the resistance to purchases from the market barriers noted above will be lessened.[39] As rebates rise, the need for purchaser's capital declines. Debt may be avoided. Concerns of a purchaser not remaining at a location long enough to get a return on one's investment are reduced because the rebate significantly reduces the time required to recover one's investment. Additionally, warranties may last as long as the payback period or longer, reducing concerns of unrealized savings due to measure failure. Inasmuch as many such programs offer large rebates, often equal to more than half the cost of the product (not counting any additional program costs), it is not surprising that they are usually fully subscribed. In fact, when these programs attempt to address the other market barriers described above by also offering audits and financing, the program costs may easily exceed the cost of just going out and paying for customers to install resource efficiency products.

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[37] The three unaddressed barriers include (1) uncertainty that savings would be realized (all loans and ESCO contracts are tied to the original customer and are due upon relocation), (2) limited (or reserved) debt capacity, and (3) split incentives

[38] One exception, high solar tax credits, kept the solar industry alive for a number of years. However the number of units installed is inconsequential when compared to the number of cost effective projects that have still not been implemented.

[39] There is an important fine point here, however: customers must still front the full initial cost of a measure when the rebate is not provided until *after* a purchase, as is often the case.

One reason that subsidy programs are usually fully subscribed is that they have always been limited to relatively modest goals in terms of measures and numbers of participants. The cost of rebate programs includes the subsidies, administration, promotion, and evaluation. The high cost associated with these efforts has made them self-limiting. There is a limited amount of ratepayer or public dollars that policy makers are willing to commit at any one time.

The self-limiting nature of rebate programs is such that they rarely serve renters, result in installation of measures with more than two to three year paybacks to the customer, or serve customers with limited capital or debt capacity. Their overall impacts are typically small enough that few customers complain about having to pay higher rates that result from their paying for other customers' savings. And, when annual funds for a rebate program are exhausted, efficiency activity typically stops because consumers or businesses who have not yet acted are naturally unwilling to pay significantly higher costs for the same service just provided to their neighbors. Such customers wait until the next annual cycle or do nothing at all.

Standards: California has been the nation's leader in effecting standards that mandate purchase of more resource-efficient products, and our standards for housing, buildings, appliances and cars exceed the national averages. The guaranteed effect of standards, relative to the slow and uncertain effect of the other approaches normally used to overcome market barriers, makes them attractive to resource managers.

However, regulatory standards, while effective, are not informed by a free market: they are created by a political process which involves compromises. In other words, code requirements are usually suboptimal from resource efficiency and financial perspectives. Additionally, standards do not address the market barriers noted above. Hence, while standards force purchase of more efficient products, they often also create hardships and resentments via higher initial costs and procedural hassles. Moreover, standards and their enforcement entail prescriptive responses that inhibit innovation. If the power of the marketplace could be brought to bear on resource efficiency, the resentment and problems caused by standards would be greatly reduced, and emphasis would shift from mere compliance to maximizing resource efficiency.

Effectiveness

For more than twenty-five years, renewable energy and energy efficiency programs offered principally by government and utilities have included tax credits, audits, low interest loans, and substantial rebates as techniques to overcome the market barriers described above. While these have improved the situation relative to business as usual, most experts believe that resource efficiency could still save enough energy to meet 25-30% of our nation's energy consumption. Therefore, despite our best efforts to stimulate the marketplace for resource efficiency products so customers will purchase goods with the greatest life cycle value, this objective remains elusive. As a consequence we continue to accelerate global climate change, maintain our excessive dependence on foreign energy, and diminish our national economic strength. This situation indicates the prevalence and durability of market barriers, and the difficulty of overcoming them.

Perhaps the best way to determine the effectiveness of energy efficiency programs is to measure how closely the participation rate, as a function of financial value, approaches what would occur in the "No Barrier" condition. Two figures provided in a 2002 California study illustrate this point.[40]

Fig. 1

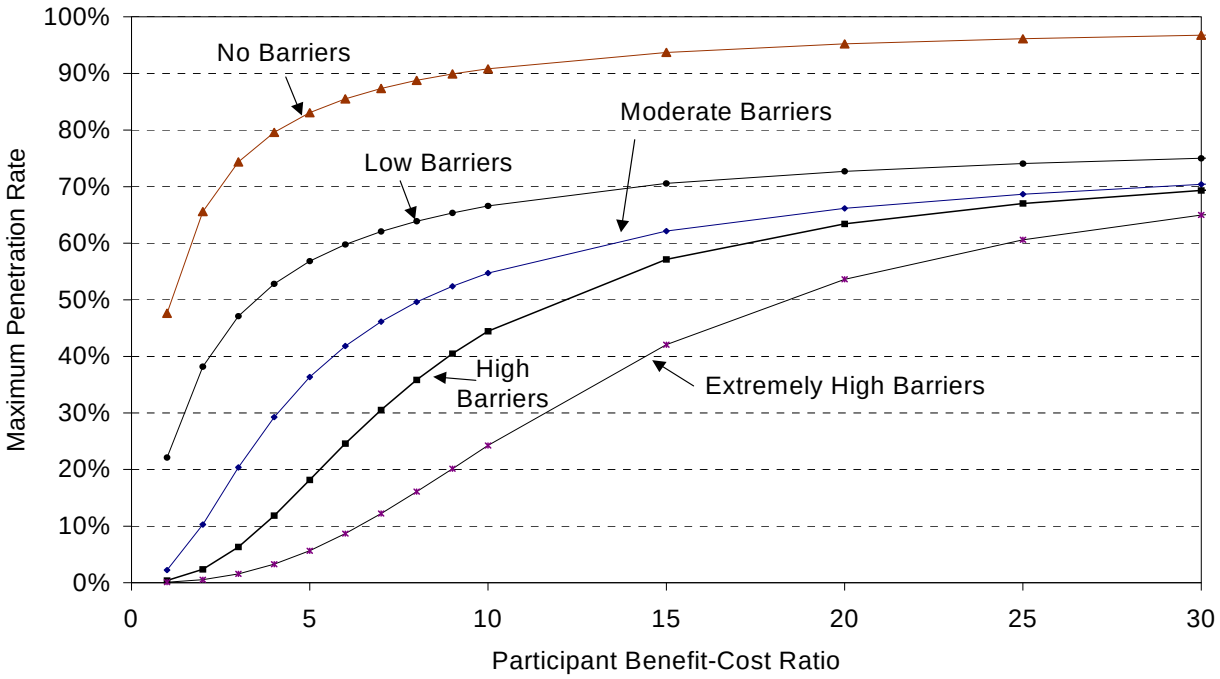

Figure 1 provides a family of adoption curves that range between "Extremely High" and "No" barriers. For example, when considering measures facing "High Barriers," an offer having a benefit-cost ratio for participants of four (e.g., an item with an installed cost of $100 that will provide total present value benefits of $400) will be adopted by approximately 13% of the population potentially served by that measure. However, were there no market barriers, approximately 80% of the population will adopt it. The ability to fully overcome market barriers, in this instance, represents the potential to leverage a 6-fold participation increase.

To carry this further, Figure 2 presents an adoption curve embedded in software used to estimate future savings potentially developed from an electrical efficiency measure that could be deployed in California. This example reflects the "High Barrier" curve that appears within the family of curves presented in Figure 1. As noted above, in the situation where the participant would anticipate a benefit/cost ratio of four under normal market conditions, adoption of this measure would be limited to approximately 13% of the population for which this measure potentially applies. This small adoption rate for a measure that is highly cost effective – that is, a measure that saves four times more than it costs – reflects the effect of market barriers at work. There is so much

[40] These appear as Figures B-2 and B-3 in a study jointly funded by The Energy Foundation and the Hewlett Foundation: Michael Rufo and Fred Coito (XENERGY, Inc.), *California's Secret Energy Surplus: The Potential for Energy Efficiency (Final Report)*, 23 Sep 2002.

"friction" in the marketplace surrounding this resource efficiency opportunity that only 13% of the potential transactions will be made.

Fig. 2

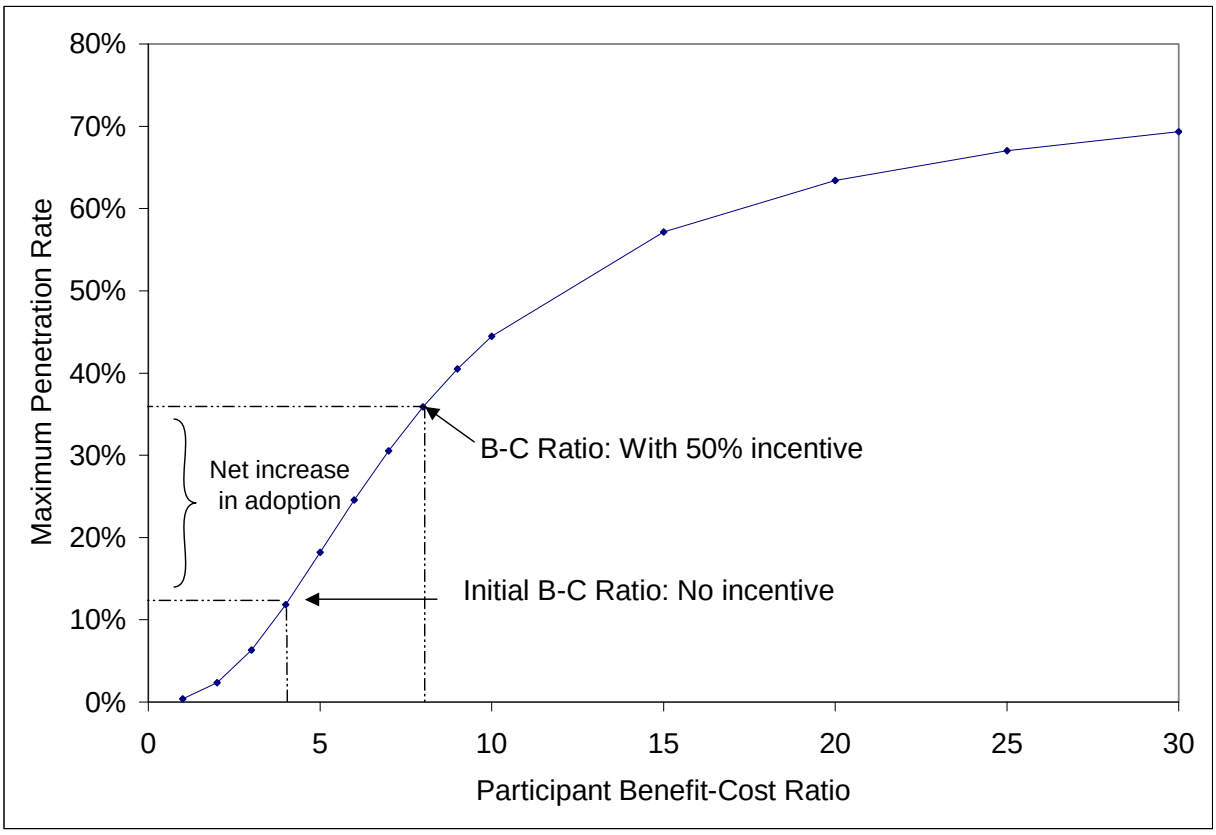

Figure 2 is annotated to indicate the effect of a rebate to overcome this friction. In the instance shown, an incentive sufficient to offset half of the measure's cost is provided. This has the effect of doubling the participant's benefit/cost ratio from four to eight. With this expectation of earning *eight times one's original investment*, evidence indicates participation will increase from 13% to a maximum of 37% of all potential participants. However, the fact that 63% of the potential participants will reject such an attractive investment opportunity is evidence that market barriers continue to block this offer. A large rebate, while helpful for addressing some market barriers, clearly does not address them all.

When we refer back to Figure 1, we see that 80% of the potential deals will get done if the market barriers are fully removed. This is more than twice the participation rate predicted when an incentive equal to 50% of the cost is provided under the scenario of "High" market barriers. In other words, this large incentive mitigates less than half the effect of the market barriers. Surely a system that more comprehensively addresses all market barriers is worth considering. In fact, the study that provided these figures included among its research recommendations: "Refine

achievable potential estimates as function of alternative programmatic approaches." The best programmatic approach known is described next.

A Marketplace that Works

The Pay As You Save® (PAYS®) system was designed to eliminate all of the barriers to all utility customers wanting to purchase and pay for cost effective resource efficiency products.[41] Under PAYS®, the cost of energy efficiency measures is recovered through tariffed charges collected by the customer's local utility. Customers see immediate net savings from lower usage, even though they may be paying back the entire cost of installing the efficiency measures in their bills. Making PAYS® available to customers stimulates consumer and business investment in energy efficiency by providing customers with the opportunity to have cost-effective energy efficiency measures installed in their homes or businesses with:

a) No up front payment;

b) No debt obligation;

c) Assurance that a reliable independent party has verified the appropriateness of the measures and savings estimates; and

d) A guarantee that measures will either be replaced or the payment obligation terminated if the measure fails and can't be made to function.

The charges are assigned to meter locations, not individual customers, so customers need not worry that they are committing more money for efficiency than they will save on their utility bills. If they move before the efficiency measures are paid off, their obligation to pay ends. Successor occupants (who will also benefit from the bill savings) pick up the remainder of the payments.

The PAYS® system overcomes each of the aforementioned market barriers as follows:

Trusted and Accurate Information: Although products and their installation are marketed by vendors who stand to profit from their sale, each product must be independently certified as being appropriate and its savings estimates must be verified as significantly exceeding the product's installed cost. While potential purchasers of resource efficiency products are not assured they will get the best product at the lowest cost, everyone is assured that any PAYS® product they buy is appropriate to their situation and is estimated to save them significantly more than it costs.

[41] PAYS® was developed by the Energy Efficiency Institute, Inc.'s Paul A. Cillo and Harlan Lachman. Some limited examples and variations of the PAYS® system are beginning to be offered by various utilities (principally electric utilities). These are generally narrowly focused on sectors difficult to serve by traditional programs. They typically include financial incentives, unnecessary under PAYS®, which require large budgets that effectively preclude availability by all customers. Other versions may include features that sustain rather than eliminate market barriers, such as requiring landlords to take responsibility for repairs to measures that benefit their tenants. The PAYS® system is believed to be the best and least costly way to enable a robust, widespread, and durable market for high performance resource efficiency measures.

Uncertainty Savings will Pay for Investment: All PAYS® payment obligations must be structured so that the customer sees immediate net savings.[42] Savings estimates include no adjustments for inflation or societal escalators and must be based on current rates. Typically no more than three quarters of the savings may be used to pay for all of the costs for each year of payments, including equipment, installation, administration, and any necessary repair costs. The balance of the savings are retained by customers, which means they will save money during every year they remain at the location served and the products function. The assurance that the customer's payment obligation ends if they leave the premises or the measure fails during the payment term and is not repaired means that for them there is no uncertainty that the savings will pay for their investment. PAYS® products are as risk free as possible.

Lack of Capital (or Competing Demands for Capital): Because PAYS® products require no up-front payment, there is no need for customer capital. More importantly, the capital provided by third parties is restricted to qualifying PAYS® products so there is no competition for it. This capital will either be used for resource efficiency or it will not be used at all.

Limited Debt Capacity: Because the PAYS® obligation runs with the meter, it is not individual debt. Unlike normal product purchases, a customer's obligation to pay for products delivered under the PAYS® system ends if the product fails and is not repaired, or if the customer relocates. PAYS® obligations do not limit a consumer's or a business' ability to borrow because the PAYS® obligation is, in effect, just a commitment to pay lower utility bills. It is not debt reflected in utility customer's books or finances.

Uncertainty about Occupancy: A customer's PAYS® payment obligation ends at the time that customer relocates. The payment obligation remaining at the time of relocation, if any, transfers to the next occupant at that location. The original purchaser does not have to recover the unrealized portion of their investment as part of a sale price. All they must do is inform the successor customer that (s)he will realize the benefits of the installation and pay a lower utility bill than they would have had to pay absent the installation.

Building owner is not the Bill Payer (e.g., Rental Property or New Development): Tenants will be attracted to buy PAYS® products because they pay for them only while they are a tenant at the location in which those products were installed. As tenants pay for building improvements that benefit themselves, their landlords will also benefit because their properties will become more valuable. The landlord's only obligation in this process is to agree to disclose to each new prospective occupant the PAYS® payment obligation that is part of a lower monthly utility bill.

PAYS® is attractive to developers when used as recommended by EEI's Cillo and Lachman. They recommend paying developers more than the incremental cost for installing the most resource efficient equipment and appliances – as long as the payment qualifies as a PAYS® product. The occupants benefit because they have a lower utility bill than they would have absent the installation and they obtain a more efficient building without

[42] Due to the seasonal effect of some resource efficiency measures, net benefits are assured on an annual, not billing period, basis.

increasing its cost (or their mortgage). The developer benefits because, for the first time, it is less expensive to build resource efficient buildings than inefficient buildings. In fact, since each dollar spent on efficiency returns more than a dollar to the developer, market forces, for the first time, will reward developers for finding and installing any cost-effective resource efficiency product. Instead of forcing developers to increase the cost of their buildings, they will be the ones looking to build more efficient and less expensive buildings. This approach can also leverage efforts made by Sonoma County's cities to mandate Green Building standards by converting many, if not all, resource efficiency-related requirements from cost to profit centers for builders.

Other Comparisons to Traditional Programs

The PAYS® system has been under development for the past ten years. Over that time, the concept has been refined to offer these and other additional benefits:

No Budget Ceiling: Unlike expensive rebate programs, once the PAYS® infrastructure is in place, PAYS® requires no subsidies for the most cost effective measures. These measures will provide customers with sufficient annual savings to more than cover their annual cost (including equipment, installation, interest, marketing, and program administration). The PAYS® design transfers the cost of many program functions (e.g., marketing, analysis, quality control, etc.) to the vendors who stand to profit from the sales. This means that the only limits on the number of resource efficiency products purchased is the ability of the marketplace to meet the demand and vendors willing to provide products at a cost that is sufficiently cost effective to qualify them as PAYS® products.

Multiple Measures: In contrast to some traditional resource efficiency programs that address single measures, the PAYS® approach may be configured to supply integrated packages of products and services. In this manner, more value may be delivered with each transaction.

Multiple Resources: Most traditional efficiency programs target only the resource supplied by the utility operating (or paying for) the program. Products that might qualify as PAYS® products if bundled with products saving other resources (e.g., natural gas and water) will often not qualify individually because the transaction costs cannot be spread over sufficient savings. Furthermore, given that building occupants pay 100% of the cost for PAYS® products, and that multiple resource flows impinge on some products (e.g., a clothes washer that affects the consumption of natural gas for heating water, electricity for drivepower, and water for washing that later becomes wastewater), it makes sense to design a program that addresses multiple resources simultaneously.

The significant GHG reductions sought in Sonoma County may in fact *require* designing demand side services to deliver multiple GHG reduction measures across all metered resources (electricity, natural gas, and water). This will help to maximize overall value by minimizing the transaction and other overhead costs relative to the value of services delivered. This is especially important for service to end use sectors where transaction costs could otherwise become prohibitive.

Enhancing PAYS® with Traditional Program Strategies

Although PAYS® will create a robust marketplace for resource efficiency products, it will not capture all opportunities desirable from a societal perspective. EEI's Cillo and Lachman recommend supplementing PAYS® with the following strategies proven by traditional programs:

Subsidies: PAYS® works because it aligns the interests of the principal participants in each transaction (e.g., building owner, occupant, contractor, and capital provider) toward maximizing the amount of cost effective resource efficiency delivered. However, there are many products that are not cost-effective (or only marginally cost effective) to customers under current rates that are cost effective from a societal perspective (e.g., when considering impacts on climate change, inflation, energy inflation, distribution and transmission costs that could be delayed or eliminated if sufficient investments in resource efficiency are made, etc.). Subsides can and should be used to ensure these products are purchased and installed. This is especially true in new construction when only the incremental cost needs to be expended as opposed to retrofits where the entire replacement cost is required. If these investments are not made when buildings are planned and built, instead of involving only the incremental cost to buy the most resource efficient products, the cost will increase to the full cost for buying replacement products, installing them and removing the existing substandard products.

EEI's Lachman and Cillo recommend that subsidies be used only in the amount required to qualify resource efficiency products and services as PAYS® products. Although some customers will get subsidies and others will not, all receive the same benefit. They all get at least one quarter of the savings.

With the PAYS® system in place, market barriers will be lowered significantly and utility funds will not be required to encourage customers to purchase resource efficiency measures that are sufficiently cost effective. When relieved of that need, available utility funds may be reallocated to serve projects heretofore unaddressed. For example, a solar water heater retrofit not currently cost effective to a homeowner could be made so if its cost is offset sufficiently to qualify it as a PAYS® product. With PAYS®, occupants will pay the portion of the cost that positively benefits themselves, and society will pay the portion of costs that may not benefit occupants directly but will benefit all ratepayers or taxpayers.

Under this approach, the market for "naturally" cost effective resource efficiency products will not suffer the "boom and bust" cycle that is inherent under the normal ebb and flow of rebate funds. These products will no longer require rebates. Rebate-assisted products will instead be those on the frontier for which little, if any, funding is currently available.

Standards: As noted above, although they work well, standards raise costs for builders and developers, and often cause hardships, especially to those most subject to the aforementioned market barriers. PAYS® can be combined with upgraded standards. The standard ensures a minimal level of efficiency. PAYS® can eliminate the barriers to implementing the standards to both developers and current occupants. More importantly, it will at the same time open the marketplace to deliver solutions aimed more and more to exceed, not just meet, those standards.