Data Driven Path to Economic and Ecological Sustainability: A Roadmap for Community Choice Innovation

January 2017

North Bay Clean Energy Forum

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Introduction

This document was prepared by the North Bay Clean Energy Forum (Forum), a non-partisan civic group composed of persons with technical, business, and public policy backgrounds in the energy industry.

On May 5th, 2015, the Forum met with Geof Syphers, CEO of Sonoma Clean Power (SCP), to discuss policy and technical questions concerning Sonoma County's transition to a low greenhouse gas (GHG) economy. In that meeting, Mr. Syphers challenged the Forum to propose "audacious ideas" to help bring about this transformation. This paper is the Forum's response to Mr. Syphers' challenge. The Forum devised desired outcomes for the policy proposals made in this paper using a *planning from the future* technique[1] that starts with an ultimate goal (in this case informed by California greenhouse gas [GHG] reduction targets), then works backward to identify outcomes and flexible policy actions that can assist in achieving those goals in a rapidly changing informational and technological environment (See Appendix E).

The Audacious Idea

Communities around the world are witnessing the exponential growth of harmful environmental and societal consequences of excessive GHG emissions. As of this writing (September 2016), an unprecedented heat wave has taken place across the planet, with worldwide average temperatures setting a new record during each of the last 15 months, reaching more than one degree Centigrade above the 20th Century average. Anecdotal evidence is also alarming. To cite one example, in New Orleans, this year has seen 43 nights in which the temperature did not fall below 82 degrees Fahrenheit, far surpassing the previous yearly record of 13 nights. Similar examples that are filling scientific literature point to the need for urgent action. To meet this climate crisis, the Forum proposes this "audacious idea:"

[1] Known as the *Theory of Change,* this is "a rigorous yet participatory process whereby groups and stakeholders in a planning process articulate their long-term goals and identify the conditions they believe have to unfold for those goals to be met." http://www.theoryofchange.org/what-is-theory-of-change/

> *Transform Sonoma County into an electricity based economy powered by low or GHG-free renewable and distributed energy resources developed to create local jobs and optimize local investment. Going further, and recognizing our county's abundant renewable energy potential, we call for Sonoma County to exceed local requirements for renewable energy generation by 20 percent and export the remainder to other regions by 2050 — while seeking to eliminate or sequester GHG emissions across the board.*

A New Strategy for Climate Leadership

The North Bay Clean Energy Forum agrees with the widely-held view that Community Choice Energy agencies, such as Sonoma Clean Power (SCP), are uniquely positioned to play a comprehensive leading role in the local effort to reduce GHGs, breaking new ground even as they complement and support existing agencies and programs.

To fulfill this role, Community Choice Energy agencies (Community Choice) must capture low-to-no GHG opportunities from electric vehicles, local renewable generation, energy efficiency, and fuel switching, which will require in-house expertise in data analytics, energy efficiency program development, and emerging technologies. Expanding staff capacity to proactively seek low-to-no GHG opportunities will enable Community Choice to initiate scaled transformation in the local energy sector that is aligned with practical solutions and cutting edge climate policy. In addition, the technical nature of GHG reduction measures calls for a local workforce trained to implement solutions. These two steps, knowledgeable technical management and leadership at Community Choice and a locally trained technical workforce to implement solutions, are at the heart of fulfilling SCP's Community Choice mandate to slash greenhouse gas emissions in Sonoma County.

Given their unique environmental mission, legal status, local focus, and access to public resources (see Appendix D for a description of the legal scope of SCP's mandate), the Forum believes Community Choice Energy agencies are more than load serving entities; they are public champions empowered to take manageable risks that address the threat of climate change using innovative local, community-based solutions.

Core Concepts

Zero Energy Buildings + Transportation: "A zero energy building (ZEB) produces enough renewable energy to meet its own annual energy consumption requirements, thereby reducing the use of non-renewable energy in the building sector. ZEBs use all cost-effective measures to reduce energy usage through energy efficiency and include renewable energy systems that produce enough energy to meet remaining energy needs," according to the National Institutes of Building Science.[2,3]
While "Zero Energy Buildings" is the ideal goal, we propose that attaining "zero emissions buildings" (ZEB) is the practical standard that should be central to Community Choice policy and program development. This recognizes that not all buildings can meet their energy needs with on-site generation, and therefore grid supplied renewable energy is needed in many or even most cases to supplement or take the place of on-site energy production.

Zero emission buildings also provide a distributed platform for managing electric grid demand (e.g., smart grid, storage, load shift), optimizing distributed energy resource deployment, and electrifying the transportation system. Targeting zero emission buildings +transportation (ZEBT), where vehicles are included in the transformation to carbon free energy will create the most cost savings, stimulate local clean energy investment, create jobs, and boost the balance sheets of the public and private sectors. In the residential sector, the zero emission buildings + transportation approach could reduce total household GHG emissions from fossil fuel consumption by 80 percent or more (see Appendix A: Aiming for Zero Emissions Buildings + Transportation). For additional information, see Appendix B: How to Calculate Deep Retrofit Value.

Investment in local building upgrades is especially desirable as a job creator. According to PACENation,[4] which monitors PACE financing programs nationwide, PACE residential projects to-date number 104,000, creating 22,000 jobs; while commercial projects to-date number 790, creating 3,300 jobs. This suggests at least 40,000 jobs would be created just to address Sonoma County's 210,000 residences.

The leadership role of Community Choice requires determining and incentivizing already existing and soon to be available low cost technologies that contractors and homeowners can adopt and pay for with on-bill payment programs, whereby monthly savings exceed the monthly repayment cost of installed equipment. Community Choice must proactively make GHG reducing technologies available to replace

[2] Kent Petersen, et al; *A Common Definition for Zero Energy Buildings,* September 2015, National Institute of Building Sciences: http://energy.gov/sites/prod/files/2015/09/f26/bto_common_definition_zero_energy_buildings_093015.pdf
[3] The U.S. Department of Energy defines a Zero Energy building (i.e., Zero Net Energy building) as "an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy." DOE Releases Common Definition for Zero Energy Buildings, Campuses, and Communities, 2015: http://energy.gov/eere/buildings/articles/doe-releases-common-definition-zero-energy-buildings-campuses-and
[4] PACENation Market Data, September 25, 2016: http://pacenation.us/pace-market-data/

consumers' outdated products in their replacement life cycle, aiming for a complete transition to no carbon appliances over a 15-to 20-year period. To this end, Community Choice must also work closely with other like-minded agencies to bring about fast acceptance of these promising technologies and payment measures.

Emphasize Reducing Natural Gas Use: In the last five years, scientists have verified that methane's true global warming potential (GWP) should be considered higher than previously estimated, in the range of 85 or more times that of carbon dioxide ($CO_{2)}$ and thus as much as three times more than former estimates of methane's effect over the time of its presence in the atmosphere (approximately 10 years).[5] About 86 percent of natural gas is composed of methane, and significant amounts of methane are released during the process of natural gas production and distribution. In light of this new research, the Forum strongly recommends that details about the threat of methane emissions discussed in Appendix C of this report be addressed by Community Choice Boards of Directors and senior management. We believe it important that Community Choice help bring about the ongoing reduction and eventual elimination, in their service territories, of the use of natural gas (and propane) for space conditioning and water heating by substituting high efficiency electric heat pump technology powered by renewable energy.

On September 19, 2016, California Governor Jerry Brown signed Senate Bill 1383, the Short-Lived Climate Pollutants act, which establishes restrictions on destructive super pollutants including black carbon, fluorinated gases, and methane emitted from a range of sources including agriculture.[6]

Agricultural industry strategies, such as methane bio digesters that enable capture of animal waste generated methane gas for useful combustion and carbon sequestration, offer vital opportunities for innovative local clean energy acquisition and GHG reductions. We foresee Community Choice Energy agencies like SCP offering power purchasing agreements and other support to viable agriculture-based renewable energy projects.

Use Expertise and Data to Navigate Dynamic Clean Energy Transition: Achieving aggressive outcomes must be done in a complex, information rich environment of ongoing scientific, technological, and political knowledge. We believe a Chief Technical Officer (CTO) with an extensive and relevant technical, program, and business background, is required. Effective programs demand professional research, data collection, and data analysis, both local and nonlocal, and experience is required to expertly assess information to find potential breakthrough solutions. Scientific and technical expertise

[5] Even many environmental activist organizations continue to use the outdated GWP multiple of 35 for methane (meaning it has 35 times the warming potential as CO2). The Federal Government (EPA), against fierce oil and gas industry resistance, has recently moved to better regulate methane emissions, especially fugitive emissions from shale gas recovery. The State of California is attempting to move faster to address this threat. For more detailed information on this question and the threat posed by natural gas, see Appendix B of this report.
[6] "Governor Brown Signs Nation's Toughest Super Pollutant Restrictions into Law," https://www.gov.ca.gov/news.php?id=19549

and skilled data management are also vital for making continuous technical evaluations of program performance going forward. Near real time data systems also allow Community Choice management and oversight bodies to rapidly evaluate policies and management practices and make timely course corrections. Complexities that Community Choice faces in program development include ever more efficient vehicles and electric appliances, new advanced battery and thermal storage mediums, evolving standards for demand response technologies, and the future adoption of an effective pricing mechanism for carbon.

Invest in Electric Vehicle Adoption Programs. The Forum acknowledges and supports Community Choice efforts to achieve wider electric vehicle (EV) adoption and use of local renewable energy to charge EVs at home and at the workplace. We share the vision of future autonomous electric vehicles and the move toward "mobility as a service" that could significantly expand EV use. In the context of the rapidly evolving and dynamic EV marketplace, Community Choice policy assumptions need to avoid producing expensive programs that apply public resources to areas where scaled private investments are forthcoming. Therefore, the Forum recommends that Community Choice agencies carefully coordinate with private sector efforts.[7] To ensure a balance between the growing number of EVs and their need for public charging stations requires ongoing data-based monitoring of the type and volume of local EVs (i.e., short range vs. long range) and public charging station capacity. To support market forces driving technological innovation requires instituting a strategy to incentivize EV investment based on a simple formula: Dollar value per GHG reduction per capita vehicle miles traveled (VMT).

Practical Program Steps and Initial Pilot Studies

The strategic programs proposed below will enable Sonoma County to meet or exceed GHG emissions reductions mandated by Governor Brown and the State of California.[8] Pilot recommendations are included below applicable priority descriptions.

[7] As an example, we point to the extensive and ongoing development of Tesla charging stations by that company. As other companies follow Tesla's lead, more private investment in public charging stations may soon come about.
[8] Senate Bill 350 — Clean Energy and Pollution Reduction Act 2015 mandates 50 percent renewable energy generation and a doubling of energy efficiency for electricity and natural gas by 2030. http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350

1. **Prioritize Zero Emissions Buildings + Transportation (ZEBT).** Promote ZEBT project outcomes (i.e., whole building efficiency, renewables, and transportation) and implement financing and program solutions that enable whole-building on-site clean energy transformation and use cost barrier tunneling,[9] also known as *deep retrofit* strategies to achieve the fastest/best economic payback. (See Appendix A for practical example of ZEBT.)

    a. **Tariff policies.** Quickly implement innovative Time of Use (TOU) residential and commercial electric tariffs that enhance grid stability and that incentivize and optimize deployment of new renewable energy and energy efficiency sources and ZEB+T projects.

2. **Conduct building assessments and pilots.** Undertake detailed assessments of residential and commercial property building stock in the Community Choice service area, and use that data to design programs for reducing GHG by means of efficiency programs and fuel switching.

[9] Lovins, Amory; Lovins, L. Hunter; Hawken, Paul; *Natural Capitalism,* Chapter 6 -- Tunneling through the Cost Barrier, 1999: http://www.rmi.org/Knowledge-Center/Library/NC99-06_TunnelingThroughCostBarrier

a. **Building stock assessments**. Because program success depends on knowing where we are and where we want to go, immediately undertake building stock assessments of existing residential and commercial buildings to inventory existing energy consuming technologies, infrastructural support, building shell assessments, and consumer practices. We recommend a "300-home survey" and a "100-business enterprises survey" to be conducted by technical professionals, with the results compiled into a data bank that will guide the design of all programs to achieve GHG, financial, and social goals related to building sector improvements. We regard these assessments as essential to avoid future duplication and waste. Similar assessments by other organizations have cost between $400,000 to $1 million depending on the assessment goals and scope of work.

3. **Electrify all building functions.** Based on recent scientific consensus regarding the significantly larger short term climate-forcing effect of methane than that previously assumed (detailed in Appendix C), recognize the need to replace natural gas and propane with clean electricity and efficiency.[10]

    a. **Targeted efficiency, fuel-switching pilots.** Quickly start pilot programs to research and test highly-efficient electric technologies, especially heat pump technologies, for local residential and commercial space conditioning and water heating. Several promising technologies need preliminary evaluation and testing for this endeavor, particularly heat recovery ventilation (HRV) and CO_2 heat pump technologies for commercial enterprises.

4. **Mitigate heat events with heat pump AC.** Recognizing the probability of more prolonged and intensive heat events in coming decades due to climate change, promote the adoption of fuel-switching technologies (e.g., electric heat pumps with both heating and cooling capacity powered by renewable energy) to ameliorate related public health problems.

    a. See 3a above.

5. **Grow a local clean energy workforce.** To help create the needed local workforce and jobs, fund degree and certificate programs at two-year colleges that provide the technical skills required for solar array, HVAC (heating, ventilation, and air conditioning with heat pump technologies), heat pump water heater, and EV charger installation.

[10] Ramón A. Alvarez et al., "Greater focus needed on methane leakage from natural gas infrastructure." PNAS. 2012. http://www.pnas.org/content/109/17/6435.full.pdf

6. **Provide affordable easy-to-use financing.** Develop financial capacity (e.g., municipal H bonds) and financing instruments that make it possible for consumers to improve their cash flow while upgrading their buildings with Community Choice assistance and guidance.

    a. **Inclusive upgrade opportunity.** Develop a pilot program, using local expertise, to devise, test, and implement an attractive tariff (not debt) based on bill repayment program for all Community Choice customers that spurs consumer adoption of low GHG technologies (see Appendix E, page 44, for details).

7. **Expedite electric vehicle adoption and charging system.** Complementing the leading role played by the private sector, devise programs to encourage wider adoption of electric vehicles (EVs) and electrified mass transit (including time of use [TOU] tariffs), direct EV purchase incentives, incentivizing "mobility as a service," and wider EV charging opportunities, especially in homes and at workplaces. Work to exploit the advantages of using local renewable energy for EV charging and EV battery potential for use demand response systems for grid balance.[11]

8. **Partner with CCEs, industry experts, and established research organizations.** Expand collaborative partnerships and political, technical, and administrative alliances with other Community Choice Energy (CCE)[12] agencies and leading program development organizations in the clean energy industry (e.g., Northwest Energy Efficiency Alliance[13]) plus scientific and technical solutions groups (e.g., Lawrence Berkeley National Laboratory[14]) to more rapidly develop technical and political solutions that lead to expedited GHG reductions for all customers.[15]

    a. **Demand response and energy storage pilot programs.** In concert with other agencies inside and outside the County, participate in pilot studies that evaluate promising energy storage technologies for inclusion in a demand-response regime that includes electric batteries, thermal energy storage, and other scaled storage technologies currently available or under development.

[11] We recognize that SCP is in the process of developing a program/s pursuant to these aims.
[12] We recognize that the existing and several emerging CCAs are in the process of forming a 501(c)(6) association
[13] The Northwest Energy Efficiency Alliance (NEEA) is an alliance of more than 140 Northwest utilities and energy efficiency organizations working on behalf of more than 13 million energy consumers. NEEA is dedicated to accelerating both electric and gas energy efficiency, leveraging its regional partnerships to advance the adoption of energy-efficient products, services and practices. http://neea.org/
[14] Lawrence Berkeley National Lab is a member of the national laboratory system supported by the U.S. Department of Energy through its Office of Science. It is managed by the University of California (UC) and is charged with conducting unclassified research across a wide range of scientific disciplines. http://www.lbl.gov/
[15] This collaboration would be in addition to the new 501(c)6 trade association for Community Choice Energy agencies currently in development.

Conclusion

We recommend that in this time in human history, slashing GHG emissions by electrifying the local energy sector and minimizing citizen's costs is the Community Choice, and thus the Sonoma Clean Power mission. Implementing zero emissions buildings + transportation programs for homes and businesses, managed with "smart" data tracking, will lead to the fastest GHG reductions, best management control, and most economically viable path forward. Today, as the era of distributed energy resources dawns, these goals align with a range of new policy and technological opportunities. Like all load serving entities, Community Choice Energy agencies face disruptive forces that will reshape the energy industry. Because Community Choice Energy agencies don't own the transmission/ distribution system, they have a powerful advantage: The ability to be nimble, adapt, and drive the adoption of clean power through locally based strategies that will minimize total energy costs while strengthening the local economy.

The advent of the Internet of Things platform, big data, and increasingly competitive prices for private-sector energy solutions (e.g., solar energy, microgrids, storage, metered efficiency) bring opportunity to Community Choice Energy agencies that have the technical expertise to go beyond being a green energy supplier to become a green grid manager.

Electrifying the energy system, through Community Choice, is the fundamental goal. Cutting-edge data tracking and analysis in collaboration with other Community Choice agencies, research groups, and private-sector partners offers great promise. Finally, allowing EV programs to play a critical supportive role for private-sector transportation advances and public transport development will make transportation cleaner and more affordable for Sonoma County citizens.

Each of these strategies builds on Sonoma County's commitment to climate change goals; each of these strategies provides Sonoma Clean Power and its Community Choice partners with opportunities to lead the paradigm shift to clean energy. The North Bay Clean Energy Forum respectfully submits this report to the community for discussion and input.

Sincerely,

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(primary authors)

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Appendix A: Economic Analysis of 100% Conversion To Zero Emission Buildings and Transport (ZEBT)

Community Choice Energy agencies like Sonoma Clean Power (SCP) can help achieve very large GHG reductions in their communities' households by promoting "Zero Emission Buildings + Transportation" (ZEBT) policies and programs.

This simply means helping households and businesses achieve low-to-no GHG emissions by promoting and incentivizing already existing technologies. Achieving something close to ZEBT is relatively easy as a technical matter. As a practical matter, such programs present political and economic challenges that Community Choice Energy agencies like SCP can meet with aggressive program development and opt-in tariffed on-bill repayment services.

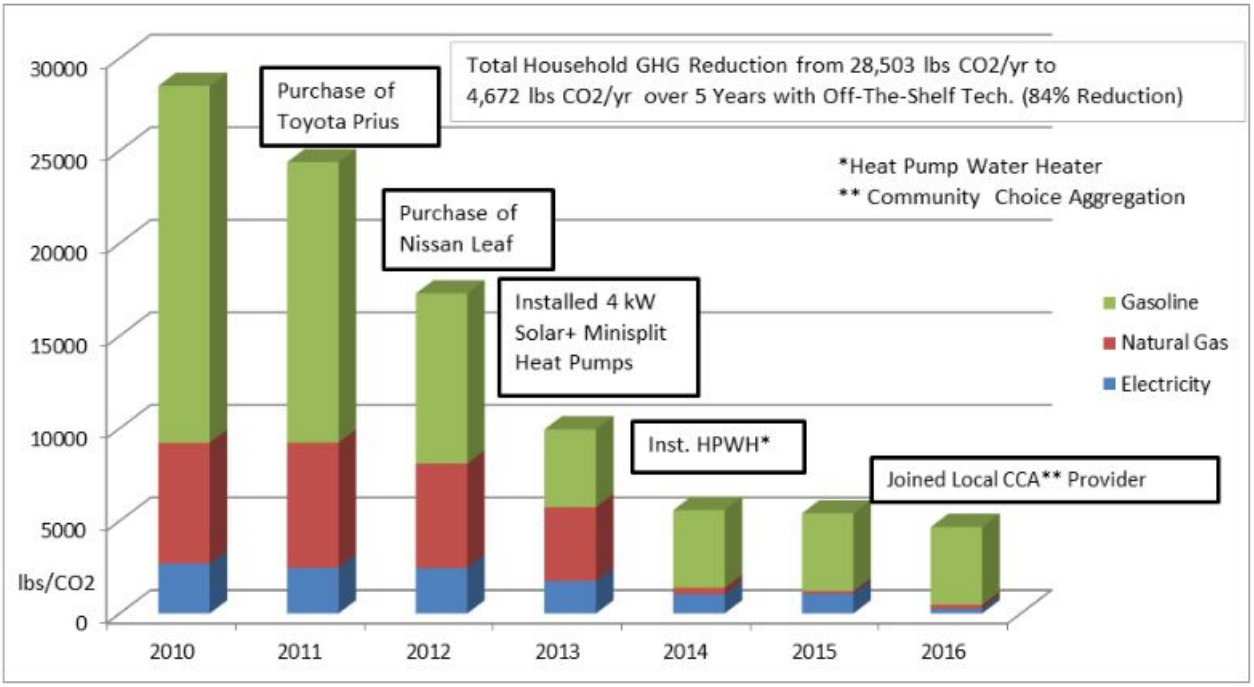
A tariffed on-bill repayment system can be designed to deliver GHG reduction measures that enable customers to participate *without up-front investment,* while enjoying savings that exceed monthly program charges, and with ability to move without any ongoing payment obligation. We estimate full payback for the ZEBT GHG reduction measures within 10 to 20 years, based upon financial parameters, project size, and ability to capture the economies of scale possible through wider deployment of promising technologies.

Real World Example

To demonstrate the effectiveness of a ZEBT strategy we offer the experience of a Sonoma County household that demonstrates what is possible and practical with a typical house that employs onsite solar, energy efficiency, and electric grid resources. Below is the graph of total GHG emissions reductions for the household of one North Bay Clean Energy Forum member who is carrying out ZEBT measures. Total GHG reductions in the household, through 2016, will be approximately 84 percent over a five-year period.

The house in this example is a typical 2,100 square foot, two-story home built in 1989 in a normal subdivision, with a 100-amp electrical panel adequate for all measures taken. It is representative, starting with average energy consumption for the home and vehicles. It has typical insulation and building quality for tract homes built from the 1960s to the early 2000s.

Table A-1: Total household GHG reductions (2010 through 2016)



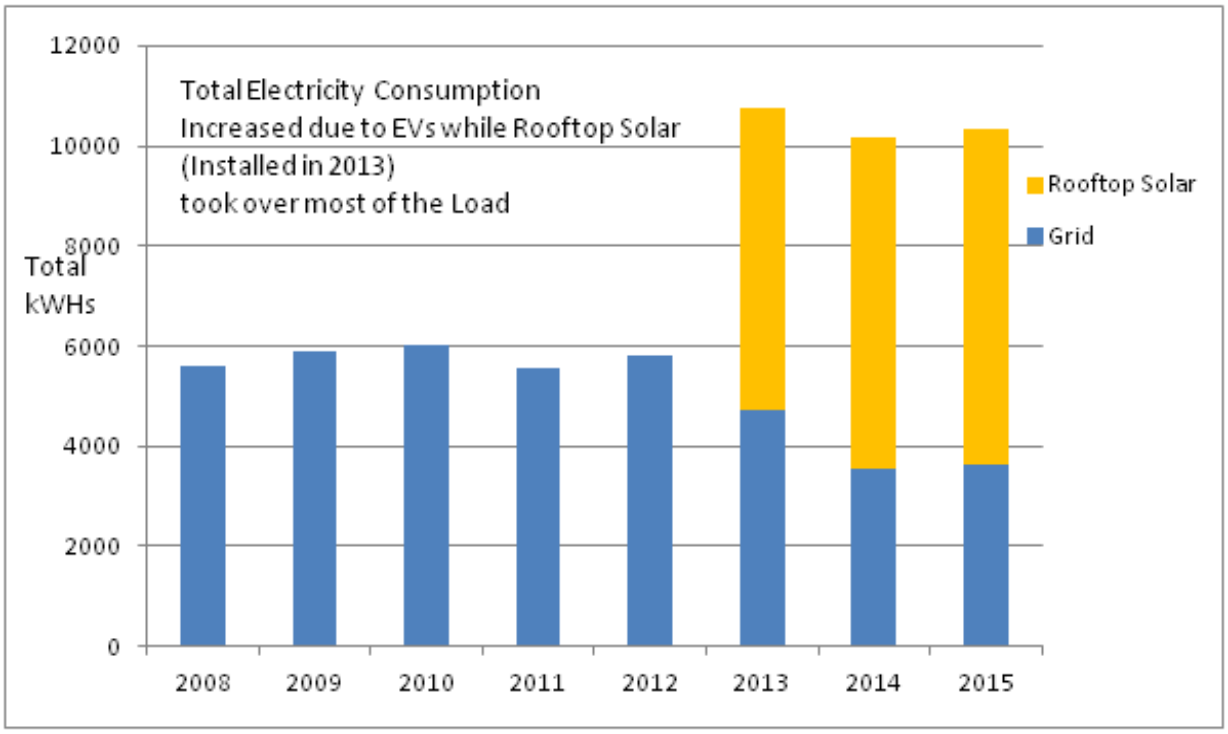
How were these large reductions in GHGs achieved?

Specifically, here were the steps taken to achieve the reductions by year:

- 2010 Baseline year with no improvements to house or vehicles, all of which matched the area “average” in household energy consumption for comparably sized homes per PG&E.
- 2011: Normal cycle car purchase replacement of Toyota Matrix with a Toyota Prius.
- 2012: Purchase of Nissan Leaf in September, so now the primary cars became the Leaf and a Toyota Prius, with a 1999 Nissan minivan retained for occasional hauling of loads, or transporting 5+ passengers.
- 2013: Installation of 24,000 btu mini-split heat pump system and 4kW rooftop solar array during April/May. Began using rooftop solar to help charge the Leaf. Purchase of heat pump water heater in the late fall.
- 2014: Replacement of 2011 Prius with 2014 model plug in version of Prius on lease.
- 2015: Became full SCP customer. Also learned to use mini-split system more effectively to gradually reduce furnace natural gas consumption.

- 2016: Became SCP “Evergreen” customer. Some additional reduction of gasoline consumption due to spouse’s retirement, effectively dropping total household miles driven from 20,000 to about 18,000 miles per year.

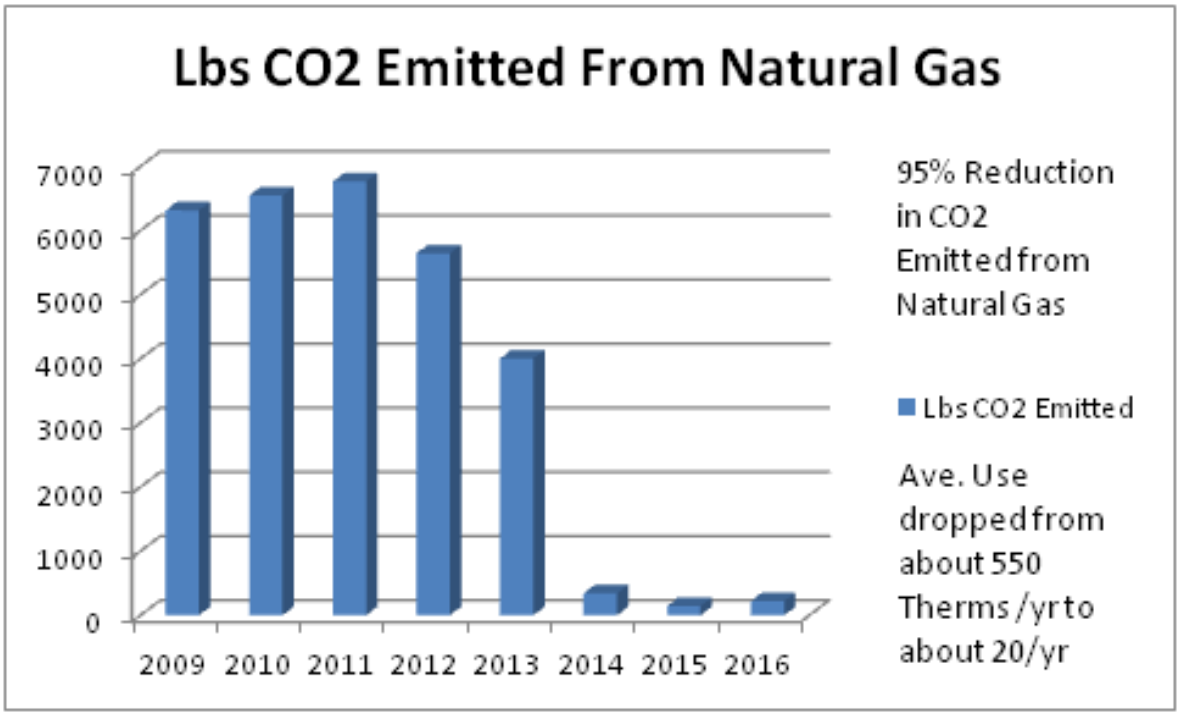
Table A-2: Increase in electricity use over time by adopting ZEBT measures



Switching from Natural Gas Heating/Cooling Appliances to Electric (Mainly Heat Pump) Appliances

Next, conversion of natural gas water heating and most household heating and cooling to heat pump technologies resulted in drastic reduction in natural gas use (some of which is still used for cooking and clothes drying). A “mini-split” heat pump now provides most zone heating and cooling in place of a natural gas furnace (which was retained for back up). A heat pump water heater (HPWH) replaced a natural gas water heater.

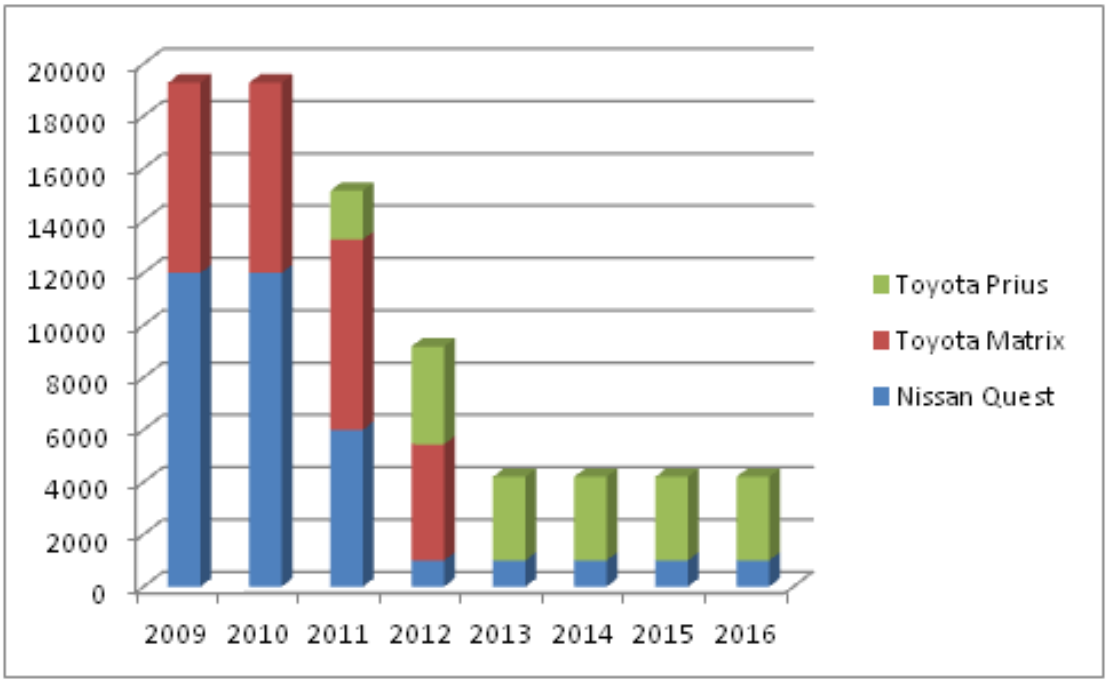
Table A-3: Lbs CO2 emitted from natural gas use



Reduction of GHGs through Purchase/Lease of EVs or High Mileage Vehicles

The household came to use one EV (Nissan Leaf) for local trips and commute as its primary car, replacing a 2005 Toyota Matrix. A Toyota Prius replaced a 1999 Nissan Quest van as the second car. The household kept the 1999 Nissan Quest van to be used for occasional back up for hauling loads. Net reductions in GHG emissions from gasoline based on 20,000 miles/year driving and approximately equal use of primary and secondary vehicles are shown below.

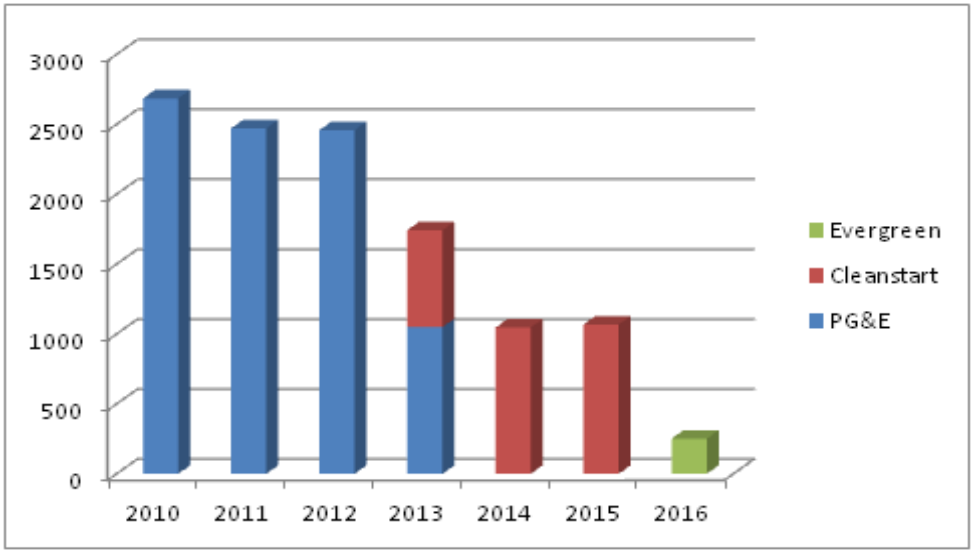
Table A-4: Net GHG reductions from electric vehicles



Grid Consumed Electricity Emissions

The GHGs emitted upstream from the remaining consumption of grid supplied electricity can be seen in the following chart. By 2016, virtually all of the grid supplied consumption was used at night to charge vehicles. Note that in 2016 this SCP customer joined SCP's Evergreen program, which supplied 100 percent renewable energy resulting in further reduction in total grid supplied electricity GHG reductions.

Table A-5: CO2 emissions reductions from grid supplied electricity



Moving Toward the Goal of Net Zero Energy + Transport (ZEBT)?

In September 2016, the household purchased a Chevrolet Volt, replacing the Leaf. The household plans to add around 2 kW of solar capacity as a deck cover in 2017 and purchase a Chevrolet Bolt (238-mile electric range). These measures should move the household substantially closer to full ZEBT by the end of 2017.

What Are the Main Steps to Reducing GHGs in This Example?

In this example, the primary reductions in household GHG emissions were achieved by:

1. Making inexpensive house shell upgrades (mainly some additional insulation around existing old aluminum frame windows) at a net cost of about $400
2. Installing a 4-kW rooftop solar array at net cost of $14,000
3. Installing a heat pump water heater plus mini-split heat pumps to carry most of the residence heating and cooling requirements, while keeping natural gas furnace for backup, at a net cost of about $9,500
4. Buying one EV (Nissan Leaf) and leasing a Toyota Prius hybrid vehicle. An existing old Nissan van (1999 Quest) kept for backup and occasional hauling, or carrying up to 7 passengers as needed. Net cost of vehicles was about $25,000 for the Leaf and $350/month for leased Prius (equivalent or better used and new plug in vehicles are now substantially less expensive).
5. Enrolling in SCP's "Cleanstart" and "Evergreen" programs, respectively.

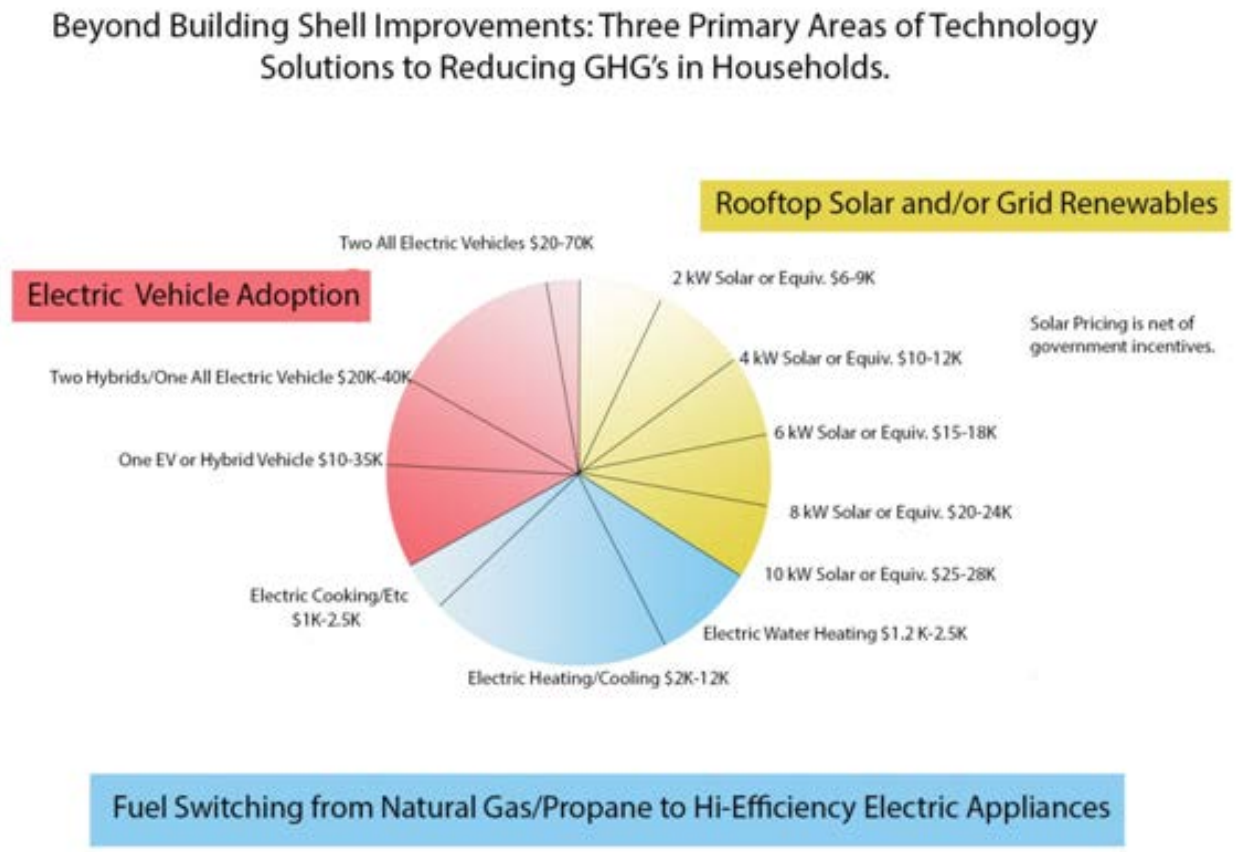
Can Other Households Achieve Similar Results?

This example shows that substantial GHG reductions in most households are achievable with available, affordable technologies. Clearly, every home will have different variables, such as whether or not to use heat pumps as a only mechanism for home heating (foregoing furnace back up), the number and size of vehicles needed, the viability of rooftop solar, etc. Despite this, we think the ZEBT approach shows the best path forward for most households.

When considering the costs of the measures taken, it is important to realize that the occupants were "first adopters," willing to pay higher prices for high mileage or EV vehicles, as well as heat pump appliances not yet widely used and more expensive than volume pricing and better market presence would allow. Nonetheless, the savings payback for the solar and heat pump systems in this example is less than ten years. The occupants were also willing to further reduce natural gas use through air

drying about 50 percent of household laundry, plus the use of more electric kitchen appliances (good quality toaster oven and electric pressure cooker) and reduce use of the remaining gas range and dryer. Such measures and behaviors added some incremental gains to overall energy performance. The pie chart shown below illustrates the investment in electric vehicles, fuel switching, and solar generation and current estimates of the range of costs to implement them. The cost range for improvements currently comparable to the household example above would be about $22,000, not including vehicles.

Table A-6: Three primary areas of technology solutions



Conclusion

The household in this example attained total GHG emissions of about 84 percent over five years with a payback for solar and heat pump systems of less than ten years. We therefore believe that an 80 percent reduction in GHGs is a realistic target for a majority of Sonoma County households over a 10- to 15-year period of appliance and vehicle replacement, given aggressive program development from SCP and other allied agencies.

As all components (solar array, heat pumps, and EVs) continue to drop in price, the ZEBT approach used here becomes more and more achievable. A broad range of technical improvements and lower costs promise better results in the future. EVs are dropping in price and increasing their range rapidly, and will soon move beyond being primarily for local trips. Rooftop solar arrays and community supplied renewable energy also continues to drop in price, with a reduction of about 20 percent in solar pricing during the three years since the installation on the house in this example. Other important innovations are on the horizon. Advanced natural refrigerant heat pump systems (e.g., CO_2; negligible GHG impact upon leakage) promise combined space heating and water heating in one unit with extremely high efficiency within the next ten years.

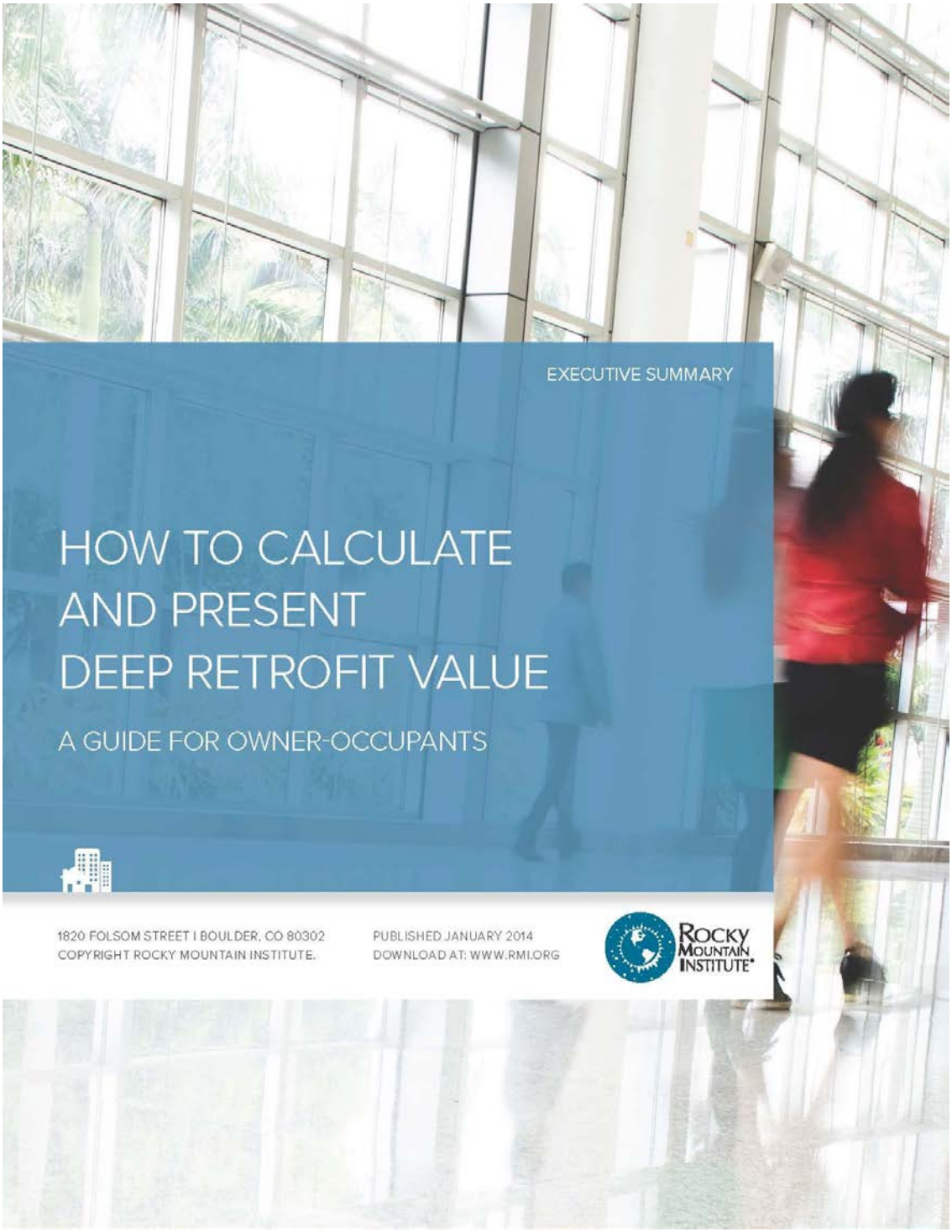
In conclusion, we hold that beyond the procurement and sale of renewable energy to their customers, the primary leadership role of SCP requires that agency to devise programs to advance the goals of ZEBT through:

Incentivizing basic building shell upgrades, plus the three critical areas of

1. Rooftop solar and/or grid-supplied renewable energy
2. Conversion of natural gas appliances to electric appliances, and
3. Incentivizing EV purchases.

A tariffed on-bill repayment system, allowing customers to adopt these measures without initial cost and pay for them in monthly installments that are less than the resulting savings, is the most promising strategy for widespread and fast adoption.

Appendix B: Calculate Deep Retrofit Value[16]



[16] Rocky Mountain Institute, *How to Calculation Deep Retrofit Value,* January 2014, Executive Summary.

TAPPING DEEP RETROFIT VALUE

Deep energy retrofits offer businesses myriad tangible, meaningful benefits beyond energy cost savings alone. But learning how to account for, articulate, and capture those benefits is the key.

This might come as a surprise to some, but energy efficiency is about more than energy, and deep energy retrofits, which achieve superior energy savings over conventional retrofits and can reduce a building's energy consumption by 50 percent or more, offer bottom-line benefits for business beyond energy cost savings alone. They generate substantial additional value that is typically ignored: improved employee health, productivity, and satisfaction; bolstered leadership credentials and reputation; access to tax, finance, and entitlement subsidies; improved risk management; reductions in non-energy operating costs; and higher occupancies, tenant retention, rents, and sales prices.

Accounting for, articulating, and capturing that present-but-overlooked additional value can drive far greater investments in building energy efficiency while generating returns that directly benefit a business's balance sheet. Such non-energy benefits of deep retrofits are not "soft" and intangible but in fact real opportunities for significant, quantifiable business value. Rocky Mountain Institute's ***How to Calculate and Present Deep Retrofit Value for Owner-Occupants*** (Deep Retrofit Value practice guide) shows how to tap into that value.

The guide helps professionals move forward with and achieve their goals to build business value through highly efficient buildings. It also helps professionals better demonstrate the impact of deep energy retrofits to peers inside and outside their organization.

IS DEEP RETROFIT VALUE FOR YOU?

The guide's basic value framework focuses on owner-occupants but can be applied, with adjustment, to residential spaces and other property types as well as new construction, tenant improvements, equipment replacements, and other types of sustainability investments. The guide is useful to anyone interested in better understanding how deep retrofits create value, but is primarily designed for:

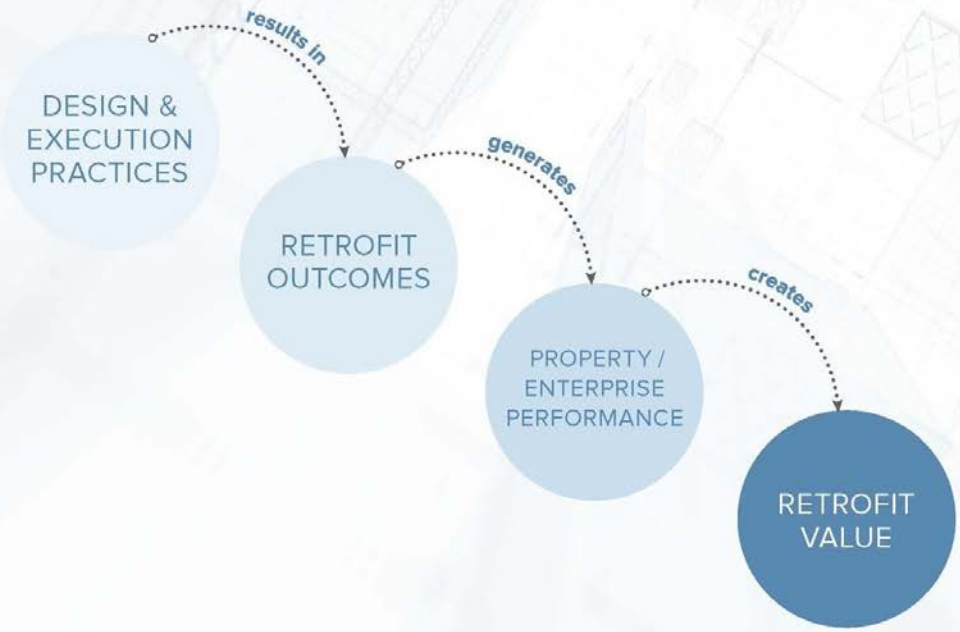
- **corporate real estate executives and their facility management staff** preparing retrofit capital requests;
- **internal corporate finance departments** and others with capital budgeting due diligence responsibilities;
- **architects, engineers, consultants, and other service providers** analyzing and documenting support for energy-efficiency recommendations;
- **company sustainability and energy managers** developing retrofit sustainability strategies and capital budgeting plans;
- **investors and lenders** interested in understanding occupant demand, the most important retrofit value driver for investors; and
- **valuation professionals, appraisers, and accountants** trying to understand the business value implications of an enterprise's retrofit-related energy efficiency and sustainability investment.

RMI'S RETROFIT VALUE MODEL

Deep Retrofit Value is based on the four pieces of RMI's Retrofit Value Model (see figure). That model shows, at a high level, the evaluation process business leaders should make of deep retrofit investments.

For example, consider the installation of an updated air ventilation system (a design & execution practice). This system uses less energy, improves air circulation, and creates better indoor air quality (direct retrofit outcomes). Because air circulation is improved, employees are more comfortable; because air quality is better, employees get sick less often (indirect retrofit outcomes). The ventilation system provides benefits with direct implications for an organization's bottom line: greater comfort and fewer sick days creates a context whereby employees are more engaged and productive—meaning more work is accomplished and more innovations are fostered—as well as reduces the costs associated with absenteeism and the recruitment of new employees to replace those that leave the organization (property/enterprise performance). And that improvement in property/enterprise performance has quantifiable value that can be directly tied back to the deep energy retrofit (retrofit value).

RMI RETROFIT VALUE MODEL



THE NINE ELEMENTS OF DEEP RETROFIT VALUE

The non-energy cost aspects of Deep Retrofit Value fall into nine discrete value elements. They serve as a menu of the potential types of value a retrofit can create:

1. **Retrofit Development Costs:** These costs are critical because they represent the initial capital investment against which future cost savings and other benefits are measured. Many retrofit projects have little cost premium if timed correctly with other capital improvement projects and if the project follows Deep Retrofit Value best practices.
2. **Non-Energy Property Operating Costs:** Deep retrofits can reduce these costs (e.g., maintenance, water, insurance, and occupant churn rate) and can add more occupied space in a building through equipment downsizing and better occupant use of space.
3. **Retrofit Risk Mitigation:** Deep retrofits are often subject to the standard and relatively high real estate risks of a "to-be-built" project where development costs and future operating cost savings are forecast to determine return on investment. These risks can be compounded by additional risks like new products and systems, new specialized service providers, new contracts and design processes, complex financing requirements, and potential savings underperformance from building energy simulation models. Following Deep Retrofit Value best practices and fully presenting the risks enables risk mitigation.

4. **Health Costs:** There is substantial evidence that intelligently retrofitted and operated buildings improve the health of building occupants and users, directly reducing health costs, for example through moisture and pollutant control, improved ventilation and access to outside air, access to the natural environment and daylighting, and temperature control.
5. **Employee Costs:** There is strong evidence that deep retrofits can reduce employee costs by lowering recruiting, retention, and employee compensation costs.
6. **Promotions and Marketing Costs:** The substantial expenses associated with promotions and marketing—typically in the range of 10 percent of revenues—often do not include all the time spent by non-marketing staff in promotions and marketing activities. Deep retrofits can provide the content many companies are looking for in order to shape their branding story, offsetting money that would otherwise be spent developing other approaches to sustainability branding.

7. **Customer Access and Sales:** Deep retrofits contribute to improved customer access and sales because customers of all types—consumers, businesses, and governments—are beginning to require demonstrated sustainability performance and leadership as part of their decision to purchase. Deep retrofits also increase sales potential since more healthy, productive, and satisfied workers are more engaged and innovative.
8. **Property-Derived Revenues:** Deep energy retrofits can provide additional company revenues from the enhanced demand for deep retrofit properties from potential tenants in the event a company must lease some of its space or from potential buyers of the property in the event a company must sell. Other revenues can come from purchase agreements, energy services agreements, renewable energy certificates, and government or utility tax credits, rebates, or other subsidies.
9. **Enterprise Risk Management/ Mitigation:** Deep retrofits can significantly contribute to mitigating some of the more pressing business risks facing companies today, primarily by contributing to an enterprise's performance as measured by sustainability reputation and leadership; individual occupant health, productivity, and satisfaction; and space flexibility.

To assess a deep retrofit project, a professional must evaluate the outcomes of a deep energy retrofit on a given value element and then address how the outcomes create business value. But professionals need not evaluate and present each of the nine value elements. It may make most sense to select the most promising value elements for initial analysis and then proceed to the others, if possible, for a more complete analysis.

For more information on Deep Retrofit Value, download RMI's How to Calculate and Present Deep Retrofit Value at http://www.rmi.org/retrofit_depot_deepretrofitvalue.

If you have any questions about Deep Retrofit Value, please contact Mike Bendewald (mbendewald@rmi.org) or Douglas Miller (dmiller@rmi.org).

Appendix C: Natural Gas and Methane Emissions

Why Community Choice Should Lead the Community Away from the Use of Natural Gas

Natural gas (CH4), whose principal component is methane, is widely touted as a “bridge fuel” that offers a greener alternative compared with coal and other greenhouse gas (GHG) producing fossil fuels. However, scientific research during the last five years has confirmed that the GHG footprint from using natural gas is significantly higher than previous estimates, and fugitive methane emissions from the full range of oil and natural gas production, including from hydraulic fracturing of shale, are greater than previously published industry and U.S. Environmental Protection Agency (USEPA) data indicates.

The previous underestimation of methane's GHG impact was due to misleading assumptions. They include:

1. The dominant methane component of natural gas remains in the atmosphere for an average of about 10 years. However, previously its impact has been calculated and considered mainly over a 100-year time frame. This widely followed approach effectively “dilutes” the true impact of methane emissions in the short term and has led to underestimating its short-term GHG effects. The 100-year time frame for considering the impact of natural gas was originally adopted when the net leakage and production of this gas were considered relatively small, and scientists were focused primarily on long-term impacts of all greenhouse gases. With the recognition that methane has a significant short-term impact, and the acknowledgement that the atmospheric presence of this gas has increased dramatically, the perception of its global warming potential (GWP) has changed. The short-term effect of natural gas, when considered on a 20-year time scale, increases its calculated global warming potential to 86 times that of CO_2, substantially more than the widely accepted numbers of 21 to 35 times that of CO_2 used by the USEPA and other agencies, which often still accept the 100-year time frame of its impact. One important factor in this new awareness is the widely recognized need to avoid a “tipping point” that scientists believe could occur in the near future, whereby warming temperatures release natural methane hydrates and spur methane producing soil organisms in arctic and subarctic regions. Such activity, it is feared, could help tip the planet toward rapid, unstoppable global warming.

2. Previous natural gas leakage rate estimates, based primarily on “bottom up” calculations of total leakage, were also based on faulty assumptions. Leakage rates have been and continue to be

supplied to the USEPA by the oil and gas industry, which selectively chooses measurement sites and limits such sites to large, established production wells. Instead of simply using the industry's "bottom up" approach, which takes leakage rates from large production facilities and multiplies that number by the number of such sites, research groups used "top down" measurements whereby airplanes, downwind ground and tower sites, plus satellite measurements measure emissions around and above newly developing or fully developed production fields. These direct measurements of methane, in a significant number of cases, were well above USEPA and industry bottom up estimates, often due to widely scattered "super emitter" locations. To cite one example from this large body of new research, one group[17] performed satellite measurements of the new Bakken and Eagle Ford production fields where they estimated the mean level of emissions to be 10.1 percent and 9.1 percent of total production, respectively. Other research groups doing similar direct measurements at other fields have also found high rates of leakage.[18, 19, 20, 21]

Without considering the publicized problems of polluting discharges, underground contamination of agricultural aquifers and drinking water, health effects of atmospheric leakage on nearby residents, and possible related earthquakes, the threat that fugitive methane releases are contributing to rapid warming prompted a large number of leading scientists to issue a warning to the Obama Administration. In a letter dated July 29, 2014, climate and other scientists from leading research universities and institutions warned that outdated data renders current estimates of the methane GHG threat far too low and immediate action should be taken to recognize this serious problem. As a result, the Obama administration undertook tentative steps to update its methane measurement methodology. But it remains unclear if the USEPA, which remains largely dependent on industry supplied data, will acknowledge the full scope of the problem and take the steps needed to adequately address and regulate methane fugitive emissions. A copy of the letter sent to the Obama administration, with a list of signatories, is appended to the end of this report.

In terms of public policy, concerned organizations should recognize that the true impact of natural gas on global warming is greater than previously recognized, and steps to develop and implement alternatives to this fuel are required. Even before the new and more realistic levels of methane's GWP were acknowledged, GHG contributions from buildings were shown to be in a range of about 35 to 45

[17] Oliver Schneising et al, *Remote sensing of fugitive methane emissions from oil and gas production in North American tight geologic formations*. AGU Publications. 2014. http://onlinelibrary.wiley.com/doi/10.1002/2014EF000265/abstract
[18] Gabrielle Pétron et al., "Hydrocarbon emissions characterization in the Colorado Front Range: A pilot study." *Journal of Geophysical Research.* 2012. http://onlinelibrary.wiley.com/doi/10.1029/2011JD016360/full
[19] Anna Karion et al., "Methane emissions estimate from airborne measurements over a western United States natural gas field." *Geophysical Research Letters.* 2013.http://onlinelibrary.wiley.com/doi/10.1002/grl.50811/pdf
[20] Scot M. Miller et al., "Anthropogenic emissions of methane in the United States." *PNAS.* 2013. http://www.pnas.org/content/110/50/20018.full.pdf
[21] Dana R. Caulton et al., "Toward a better understanding and quantification of methane emissions from shale gas development." *PNAS*. 2014. http://www.pnas.org/content/111/17/6237.full.pdf

percent in Sonoma County. Considering the new research and scientific recommendations made in the attached letter, the total threat from natural gas combustion and all other methane sources may approach in total all other sources of greenhouse gas emissions in or caused by our locality, including from transportation. Indeed, combining all sources of methane releases, including from agriculture, we believe that the threat from methane may be the largest short-term GHG threat faced by the planet.

Exhibit A: Letter from Leading Scientists to the Obama Administration.

July 29, 2014

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Eisenhower Executive Office Building
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Washington, DC 20504

Michael Boots, Acting Chair
Council on Environmental Quality
722 Jackson Place, NW
Washington, DC 20503

Ernest Moniz, Secretary
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Gina McCarthy, Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Dan Utech, Director for Energy and
Climate Change
White House Domestic Policy Council
1600 Pennsylvania Avenue NW
Washington, DC 20500

Re: Recommendation to accurately account for warming effects of methane

We write to recommend that you take several actions to ensure that the strong, near-term warming influence of methane emissions be accurately measured, reported, and addressed in the Administration's program to slow global warming. To assist with the development and implementation of urgently needed methane reductions – particularly in the oil and gas industry, the agricultural sector, landfills and coal mining – the most current and relevant information possible regarding the very important contributions of methane emissions to near- and long-term global climate change must be available to and used by policy-makers.

Accurate representation of methane's warming influence on the climate is important not only because methane's warming influence over the 21st century makes it the second most important anthropogenic greenhouse gas (with a current radiative forcing of 1 watt per square meter compared to 1.7 for CO_2),[22]

[22] IPCC, CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS. CONTRIBUTION OF WORKING GROUP I TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SUMMARY FOR POLICYMAKERS at Figure

but also – at least as importantly – because the climate system responds more quickly to methane with its short residence time in the atmosphere than to CO_2, where climate lags are quite long. This difference means that aggressive mitigation of methane emissions is essential if the near-term pace of climate change is to be slowed. Such a slowing is essential to increase the likelihood of avoiding climatic tipping points and to moderate the intensification of current climate impacts, including Arctic sea-ice loss (which has also been implicated in intensifying extreme weather anomalies), ice sheet melt, permafrost thawing, and declining seasonal snowpack.[23] Methane reductions are also feasible technologically today and can, in many cases, be achieved in a cost-neutral or even cost-positive way, and this opportunity for action must not be under-estimated.[24]

Specifically, we ask that that the Administration's methane mitigation effort include steps that will slow near-term climate change while also contributing to capping long-term warming. Because use of the 100-year Global Warming Potential (GWP) spreads out the strong near-term warming influence of methane over a period roughly ten times its atmospheric lifetime, the present reliance on GWP-100 in identifying optimal actions obscures the potential for cutting emissions of methane (and other short-lived warming agents) to slow the pace of climate change. To facilitate better development of emissions-reduction policies that will contribute to limiting both near- and long-term climate change, we recommend that the Administration and agencies adopt and require the use of both the 20-year and the 100-year GWPs for methane.

Due to the use of only the 100-year GWP and the use of outdated GWPs from early IPCC assessment reports, the warming influence of methane emissions over the next several decades has been underestimated by as much as a factor of four in many recent assessments, leading to neglect of important and practical opportunities for slowing near-term warming. As made clear in AR5, "there is no scientific argument for selecting 100 years [as the time horizon for GWP] compared with other choices."[25] Analyzing the relative warming influences of greenhouse gas emissions using the 100-year GWP instead of the 20-year GWP for methane obscures methane's strong warming influence over the next few decades and so the potential for reducing the rate of warming leading up to the hoped-for 2ºC peak warming.[26]

SPM.5, page 12 (2013). The cited radiative forcing of 1 W/m2 for methane includes feedbacks; the concentration-based estimate of methane's forcing is 0.48 W/m2.

[23] Drew Shindell et al., Simultaneously Mitigating Near-term Climate Change and Improving Human Health and Food Security, *Science* 335, 183 (2012); J. J. West et al., Scenarios of methane emission reductions to 2030: abatement costs and co-benefits to ozone air quality and human mortality, *Climatic Change* 114, 441 (2012).

[24] *Id*.; USEPA, GLOBAL MITIGATION OF NON-CO_2 GREENHOUSE GASES (2006). Because methane is emitted by a limited number of major sources, mitigation measures will be straightforward to target and implement.

[25] IPCC, CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS. CONTRIBUTION OF WORKING GROUP I TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE at 711 (2013).

[26] *See* R. W. Howarth, A bridge to nowhere: methane emissions and the greenhouse gas footprint of natural gas, *Energy Science and Engineering*, pre-publication (May 19, 2014).

While the 100-year GWP remains useful in developing policies that will achieve long- term climate stabilization (assuming tipping points are avoided), use of the 20-year GWP for methane is particularly important if the world intends to reduce the likelihood of reaching critical tipping points over the next several decades.[27] Choosing the appropriate GWP is also important to ensure that emission reductions actually accomplish commitments to slowing global warming. For instance, a recent study demonstrated that analyzing methane emissions using a 100-year GWP resulted in an inability to achieve shorter-term targets over coming decades.[28] In your future efforts, we recommend the Administration and agencies require both 20-year and 100-year GWP values be presented and used to estimate the warming influence (and consequent impacts) of methane emissions.

The Administration recently released its "Strategy to Cut Methane Emissions" under President Obama's Climate Action Plan.[29] The selection and implementation of the mitigation measures outlined in the Strategy are dependent on the estimates of the climate consequences of methane. EPA's greenhouse gas inventory converts methane emissions to CO2 equivalents using a seriously outdated value.[30] Because of this shortcoming, the analysis of emissions and their effects in the Methane Strategy requires re-calculation using the best-available updated GWP values. Additionally, the Administration needs to update the methane GWP values used in the National Climate Assessment ("NCA"). While the most recent NCA is a comprehensive synthesis of the latest scientific knowledge regarding climate change, it uses the 100-year methane GWP of 21 taken from the IPCC's Second Assessment Report (AR2) that is no longer supported by the science.[31] Indeed, as reported in the 2013 Intergovernmental Panel on Climate Change's Fifth Assessment Report (AR5),[32] the 20-year GWP of methane is now estimated to be 86 and the 100-year GWP to be 34;[33] these values represent, respectively, 19% and 36% higher values than in AR4, and are even higher than the values from AR2. There is now simply no question that emissions of methane are much more important to control than has been earlier recognized.

[27] See, e.g., James Hansen et al., Target atmospheric CO_2: Where should humanity aim? *Open Atmospheric Science Journal* 2, 217 (2008); K. Anderson & A. Bows, Beyond 'dangerous climate change': emission scenarios for a new world*, Philosophical Transactions of the Royal Society A* 369, 20 (2010).
[28] M. R. Edwards & J. E. Trancik, Climate impacts of energy technologies depend on emissions timing, Nature Climate Change 4, 347 (2014).
[29] CLIMATE ACTION PLAN: STRATEGY TO REDUCE METHANE EMISSIONS (2014), available at http://www.whitehouse.gov/sites/default/files/strategy_to_reduce_methane_emissions_2014-03-28_final.pdf.
[30] USEPA, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990 – 2012 at 1-8 (2014). The methane GWP values reported in the main text of the inventory are derived from the Second Assessment Report, although general emissions estimates based on AR4 and AR5 GWPs are available in Annex 6.1 to the inventory.
[31] USGCRP, US NATIONAL CLIMATE ASSESSMENT: CLIMATE CHANGE IMPACTS IN THE UNITED STATES 269 (2014). R. W. Howarth and other scientists also submitted a background paper on GWP values during the peer review process for the NCA (Methane Emissions from Natural Gas Systems: Background Paper Prepared for the National Climate Assessment (Feb. 2012) available at: http://www.eeb.cornell.edu/howarth/publications/Howarth_et_al_2012_National_Climate_Assessment.pdf). At the time of passage of the Global Change Research Act, the legislative record indicates that Congress anticipated that research plans under the GCRA: "will enhance our understanding of the Earth system on a global scale, improve our capability to predict natural or human induced changes and, most importantly, provide the best scientific information on which we can develop necessary and responsible policy decisions." (136 Cong. Rec. H12996-01, H13001 (October 26, 1990)).
[32] Myhre et al., Anthropogenic and Natural Radiative Forcing, in CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS. CONTRIBUTION OF WORKING GROUP I TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE IPCC Table 8.7 at 714 (Cambridge Univ. Press 2013).
[33] It should be noted that these values (34 and 86) are the estimates for biogenic methane and fossil methane with CO2 reported elsewhere. Fossil methane is associated with higher global warming potentials of 36 over 100 years and 87 over 20 years.

The Administration and federal agencies have multiple opportunities and obligations to adopt and communicate the most appropriate and accurate GWP values for methane through President Obama's methane strategy, CEQ's upcoming greenhouse gas guidance under the National Environmental Policy Act (NEPA), and EPA's greenhouse gas emissions inventory (see the appendix for specific suggestions).

As evidence continues to mount that serious climate change impacts are already upon us,[34] research indicates that mitigation of short-lived pollutants such as methane can play a significant role in slowing the rate of climate change, while producing many co-benefits for human health and food security.[35] To support the accurate evaluation of the benefits of methane mitigation, the Administration and agencies should develop a two-track strategy directed at limiting both long-term warming and the near-term rate of warming. Doing this requires using the GWP for methane (and other short-lived warming agents) that accurately reflects the latest science and provides decision-makers the best possible understanding of and options for addressing both near- and long-term climate change and disruption: specifically, a 20-year GWP of 86 and a 100-year GWP of 34.[36]

The challenge of limiting global warming to 1.5 to 2ºC is much more difficult than is apparent using only GWP-100 in the analyses, and only development of both near- and long- term strategies has the potential for success that the Administration is striving for.

Signed,

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[34] See IPCC Working Group II, CLIMATE CHANGE 2014: IMPACTS, ADAPTATION, AND VULNERABILITY (2014); USGCRP, US NATIONAL CLIMATE ASSESSMENT: CLIMATE CHANGE IMPACTS IN THE UNITED STATES (2014).
[35] See D. Shindell et al. (2012), supra note 2.
[36] Please refer to supra note 1 regarding appropriate GWP values for fossil as opposed to biogenic methane.

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Specific Opportunities for the Administration to Greatly Improve Treatment of Methane

The Administration and federal agencies have multiple opportunities and obligations to adopt and communicate the most appropriate and accurate GWP values for methane through President Obama's methane strategy, CEQ's upcoming greenhouse gas guidance under the National Environmental Policy Act (NEPA), and EPA's greenhouse gas emissions inventory.

CEQ is currently responsible for drafting guidance for analyzing greenhouse gases under NEPA. This guidance will provide a blueprint for analysis of greenhouse gases from major projects. The use of the updated methane GWP estimates from the IPCC AR5 for both 20- and 100-year timescales will provide decision makers and the public a more accurate representation of the environmental consequences of a project. The NEPA regulations require that "information must be of high quality. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA."[37] These requirements can be best met by using the updated GWP estimates and considering the effects of emissions on both the near-term pace of warming and the long-term cap.

EPA recently finalized several changes to the Greenhouse Gas Reporting Rule,[38] which included updating the GWP for methane. EPA declined to adopt the best-available estimate from the AR5, and instead adopted the lower value from AR4 due to concerns about international reporting. For domestic use, we recommend that EPA make available full emissions information for methane using both the 20-year and 100-year GWP from the AR5. Regardless of international reporting requirements, domestic laws require the use of the best-available science, which by definition includes use of the most current estimate of methane's GWP. There is no reason why EPA cannot use the current figures for domestic purposes while also complying with all international reporting requirements.

[37] 40 C.F.R. § 1500.1(b).
[38] USEPA, 2013 Revisions to the Greenhouse Gas Reporting Rule and Final Confidentiality Determinations for New or Substantially Revised Data Elements; Final Rule, 78 Fed. Reg. 71904 (Nov. 29, 2013).

Another important focus for methane mitigation is the fugitive emissions from the oil and gas sector. Oil and gas drilling and hydraulic fracturing have significantly expanded in recent years. At the same time, there is growing evidence that EPA's emission factors for methane leakage from these activities may, at least in some cases, substantially underestimate actual methane releases.[39] Use of updated methane GWP estimates would aid the prioritization of methane mitigation efforts in this sector as well as inform decision-makers and the public about the climate consequences of oil and gas projects.

We would add that the failure of analyses using only the Kyoto basket of greenhouse gases to include the strong warming influences of black carbon, precursors of tropospheric ozone, and the reduction in sulfate loading associated with reduced CO2 emissions also creates a misleading representation of the potential for slowing global warming by cutting emissions of short-lived gases and aerosols, and we also recommend that the warming influence of these species also be properly and fully treated.

[39] See, e.g., D. R. Caulton et al., Toward a better understanding and quantification of methane emissions from shale gas development, Proc. Natl. Acad. Sci. DOI 10.1073/pnas.1316546111 (2014); S. M. Miller et al., Anthropogenic emissions of methane in the United States, Proc. Natl. Acad. Sci. 100, 20018 (2013); G. Pétron et al., Hydrocarbon emissions characterization in the Colorado Front Range: A pilot study, J. Geophys. Res. 117, D04304 (2012); R. W. Howarth et al., Methane and the greenhouse-gas footprint of natural gas from shale formations, Climatic Change DOI 10.1007/s10584-011-0061-5 (2011).

Appendix D: Community Choice Energy — Maximizing Statutory Authority

An important question for any emerging Community Choice Energy agency to ask itself is: What is the full statutory authority of Community Choice Aggregation (CCA) under the law, and how can our community exercise it to our fullest advantage?

Community Choice law is found largely in Public Utilities code section 366.2. There are other places where CCA law is addressed, but the original AB 117 law that created CCA in California is ensconced in 366.2.

There are two key elements of CCA law. One is that CCAs enjoy decision-making authority over the sources of energy for electricity generation within the requirements of the State's Renewable Portfolio Standard and general law. The other is that CCAs have the authority to set their own rates. These are two very powerful roles, within each many further opportunities may come into play.

In the case of decision-making about energy sources, a CCA can rapidly increase the percentage of renewables in the power mix, thereby reducing greenhouse gases. Utilizing this role, CCAs can also spur development of renewable resources, generate economic stimulus and jobs.

Rate-setting authority in a not-for-profit public agency setting allows for a significant competitive advantage relative to the incumbent, profit-driven utility enabling the lowering of rates to CCA customers. It also allows for the accumulation of net revenue, that can be borrowed against as well as expended to enhance the CCA program.

CCAs are also uniquely positioned to:

- Issue revenue bonds to help meet the broad spectrum of CCA goals and mandates, including the finance of renewable energy program development
- Develop innovative programs that make use of having access to load data
- Aggregating customers and/or projects and/or purchasing to achieve scale that enables projects, programs, or purchases that might otherwise not be feasible

- Be responsive to customer input through a public process where decision-making is done by local government accountable to its constituents
- “Elect” to receive public benefit funds collected by the CPUC for use in administering energy efficiency programs
- Apply for grant funding available to governmental agencies

But that is not the end of the story. CCAs can also:

- Develop innovative programs to advance energy efficiency in the home and workplace, discontinue the use of non-renewable fuel sources, and spur the use of electric vehicles. Help ensure that all segments of society meet GHG reduction goals by providing special assistance to low income communities above and beyond the basic programs available via the incumbent utility
- Offer incentives to encourage energy conservation or to buy down the cost of a clean energy technology
- Build and own local energy assets of any kind, including generation, storage, etc.
- Undertake or participate with other agencies in testing of promising energy related technologies that serve the goal of GHG reduction such as biogas electricity generation from agricultural and foodstuff waste products
- Support relevant water, transportation, waste management, or other sector activity that involves energy/community benefit
- Lead and coordinate a widespread public education campaign around the issues of climate change and its threat to the biosphere

These are just a few of the many ways that CCAs can optimize the opportunities presented to them under statute. The above is not meant as an exhaustive review of all the potential activities allowed under the statutory authority of Community Choice agencies.

Appendix E: Planning from the Future Assumptions and Outcomes

Assumptions

The Forum devised desired outcomes for the policy proposals we make in this paper using a *planning from the future* technique[40] that starts with an ultimate goal (in this case informed California GHG targets), then works backward to identify outcomes and flexible policy actions that can assist in achieving those goals in a rapidly changing informational and technological environment.
The Forum holds that meeting ambitious GHG reduction goals must be undertaken in light of these key environmental assumptions and public policy strategies:

Key Environmental Assumptions:

- **Accelerated threat.** The climate crisis is accelerating rapidly, and its damaging effects are already affecting global environmental sustainability, international security, food sufficiency, and public health.

- **Tipping point.** Public policies must be implemented that not only prevent long term ecological damage, but also prevent the occurrence of a fast approaching "tipping point," whereby natural feedback mechanisms, such as melting methane hydrates in polar regions, will amplify human caused warming and lead to irreversible ecological destruction on a wide scale. We emphasize that recognition of the "tipping point" threat has immediate public policy and program development implications, particularly as regards to public policies concerning methane emissions.

- **Public health impact.** Increasing global average temperatures may impact Sonoma County not only through a gradual warming, but also through increasingly frequent extreme weather events in coming decades. The public policies enacted to prevent climate change should complement measures to forestall potential public health problems arising from extreme weather in the long term. To cite an example of this problem, European climate scientists argue that the loss of around 60,000 lives due to unprecedented hot weather in Europe in 2003 was part of a clearly observable trend due to global warming. This leads us to point out that, in coming decades, the

[40] Known as the *Theory of Change,* this is "a rigorous yet participatory process whereby groups and stakeholders in a planning process articulate their long-term goals and identify the conditions they believe have to unfold for those goals to be met." http://www.theoryofchange.org/what-is-theory-of-change/

threat of extreme and/or prolonged weather heat events should be taken into account in SCP program development. Heat pump technologies, powered by renewable energy, provide highly efficient cooling as well as heating from the same device, and thus will be useful to counter warming weather in a fashion far more efficiently than through using current technologies.

Public Policy Strategies:

Establishing a Community Choice Aggregation program in Sonoma County was the biggest single act yet to address the climate crisis. Sonoma Clean Power is positioned well to continue its leadership using its substantial resources to achieve ecological sustainability through public policies and programs that move to a very low GHG 100% renewable energy system that supports local rooftop solar energy to ensure building owners have every technological option to pursue the Zero Energy Building + Transportation (ZEB+T) approach.

- The Forum strongly support goal number one in the recitals of the SCP Joint Powers Agreement — significantly reducing GHGs — and encourage SCP to screen all prospective programs for the degree to which they achieve this goal.
- Programs should be based on data derived from building and transport stock assessments completed by technical professionals; there are many reasons for this, and chief among them is to establish a baseline so that metrics can later be applied to determine the degree of success in achieving goals.
- Deep GHG reductions can be achieved via electrification of virtually all areas of energy consumption using renewable energy as the electricity power source. Electrification will concentrate on domestic and commercial transport, space conditioning, and water heating;
- Deployment of integrated technologies, such as electric heat pumps powered by renewable energy, is a fundamental policy strategy that enables fuel switching from fossil gas to clean electricity. Simultaneously, we see an opportunities for CCAs to collaborate to accelerate the development of heat pumps using CO2 or other “natural” refrigerants to avoid the risk of backsliding on GHG goals.
- While a fuel switching (fossil fuels to electricity) strategy requires emphasis on renewable energy, this approach must be complemented by efficiency improvements selected to improve overall project cost-effectiveness by reducing building thermal, water, and electrical plug loads..

- The societal transformation we envision demands experienced, high level policy and technical management working in close concert with an experienced engineering staff. The need for relevant and experienced technical expertise cannot be overemphasized.

- An important aspect of energy program implementation is the need to leverage efficiency and fuel switching savings to pay for program costs to the extent possible. A model for this approach already exists locally in the Pay-As-You-Save® (PAYS) program developed for the Town of Windsor. Taking such programs as an example, SCP programs must offer customers no or low cost entry points and reduced overall monthly utility costs, enabling near seamless implementation and reducing customer resistance as much as possible. SCP also must include all levels of society, with special focus on disadvantaged communities, in the energy transformation process.

- Load management and grid resilience should be seen as a desirable outcome in policy considerations to reduce GHGs.

Prioritized Outcomes

The Forum, through extended discussion, has devised a list of outcomes we expect to result from the policies and programs set forth above. What follows are a description of these outcomes and the public policy paths from which they are derived.

Outcome: SCP Plays Leading Role for Energy Procurement, Public Policy, and Technical Development Using Data

A key outcome for SCP depends on recognition that, in addition to its central role procuring and selling clean energy, the agency must devote significant staff time and resources to create data-driven technical programs.

Data-Driven Strategies Include:

1. **Building Stock Assessment**

Underlying these programs SCP must use professional data development and analysis that will help avoid waste, focus resources on effective solutions, and create a feedback mechanism to evaluate economic and technical results going forward. The “300 home stock assessment” should be the initial program that creates a model for other data-driven assessments in the commercial and industrial sectors.

Outcome: Sonoma County Has a GHG-free transportation system.

To eliminate fossil fuel use, we must address transportation. A clean-energy transportation system needs charging station infrastructure, incentives, and technical guidance to popularize the purchase of electric vehicles. “Mobility as a service” and improved mass transit systems promoted by other organizations are part of the outcome.

Transportation fuel-switching strategies include:

1. **SCP offers comprehensive incentive packages for gasoline-to-electric vehicle fuel switching**:

SCP’s rate structure is a powerful tool for promoting adoption of electric vehicles, and their expanded use as grid stabilization and demand response tools. Energy tariffs must reward commercial and private EV owners for charging behaviors that provide deeper grid protection, encourage deployment of renewable electricity sources (especially local solar), and maximize GHG reduction benefits. Options include an electricity rate incentive for properties that support charging for peak solar hour benefits at homes and workplaces, night charging, and eventual vehicle-to-grid (V2G) capabilities. Tariff incentives may be used to drive EV adoption and reward beneficial behaviors during early phases of deployment.

2. **Residential smart charging technology is incentivized:**

Residential charging technology offers EV owners maximum flexibility and reliability. Moreover, as the number of long-range electric vehicles increases, this will also increase the amount of charging done at home during overnight or off-hours; at the same time long-range EV owners will be looking for public charging stations with higher amperage (level three) to support longer trips. Focusing resources on residential charging also allows private industry and governments to strategically build public and workplace stations over time in order to take advantage of emerging fast-charging technologies, plus obtain a better understanding of where to locate stations to effectively serve this fast-growing market.

It may be possible to integrate the great savings in fuel costs that come from EV adoption with a tariffed on-bill repayment program to support “whole-house conversions.” Consumer acceptance of EVs and solar panels together will spur integrated whole-house adoption of clean energy technologies and lifestyles to produce ZNET conversions that support efficiency and the shift to a 100% clean electricity system.

3. **Charging stations at multifamily complexes and workplaces are ubiquitous**:

Workplace and public charging stations located at high-population areas provide convenience, range extension options, and, most importantly, new demand for excess renewable power generated during

peak daytime hours. EVs and their batteries introduce load balance to the grid across the "duck curve."[41]

4. **Fast charging technology serves both residents and visitors to the County**:

Battery and charging technology is evolving quickly to support range and refueling comparable to fossil fuel vehicle system. The challenge is in the pace of technological innovation and balancing infrastructure investment with new opportunities that will change the needs of electric vehicle owners, so adaptability is key. We note, however, that installation of public charging systems is hampered by site availability, development costs, ADA requirements, and other significant obstacles. Therefore, with respect to practical steps that SCP can take to achieve fast EV deployment, the support of home charging may offer the fastest path forward, with incentivizing workplace charging stations powered by local solar energy from rooftops and carports also playing a vital role in EV charging station deployment.

5. **The local mass transit system is electrified (e.g., buses, train)**:

Electrifying local mass transit services will afford low-income and no-car households a clean energy option for travel. The strategic installation of charging stations to support mass transit vehicles needs to be considered in any EV infrastructure plan. Developments in the "mobility as a service" movement, meaning providing autonomous vehicles for public use, merit close scrutiny moving forward. "Mobility as a service" schemes should play a role in expanding commuter access lines to main mass transportation services such as Golden Gate Transit and the Smart Train. Emerging autonomous vehicles could be used to make it easy for residents to get to the Smart Train stations. Finally, investment in local renewable generation can be used to electrify the Smart Train system.

Outcome: Buildings employ clean electricity to provide space/water heating, not fossil fuels.

While highly efficient electric technology is already available for space/water heating, State policy barring rate-payer support for fuel-switching strategies for incentive programs has been a barrier to widespread adoption of these technologies. Local actions by SCP could go far to remedy this unfortunate situation.

[41] California Independent System Operator (CAISO), *What the duck curve tells us about managing a green grid,* 2016, https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

Building fuel-switching strategies include:

1. **SCP offers incentive packages for replacing water and space-heating equipment fueled by natural gas, propane, and even resistance electric elements with electric heat pump technology**

Electrifying building space conditioning, water heating, and other fossil-fuel appliances eliminates direct GHG emissions and creates new demand for clean electricity generation. CPUC regulations and their status as natural gas providers limit the ability of most Investor Owned Utilities to pursue fuel-switching strategies; however, Community Choice utility interests are aligned with fuel-switching benefits.

Fuel-switching incentives or electricity rates can drive adoption of high efficiency heat pump technology combined with SCP or onsite solar generation — to capture significant long-term GHG reductions.

2. **Use of new high efficiency standard electric water heaters is widespread:**

As the energy system evolves to a distributed model, thermal storage technology will provide options for stabilizing the local grid and increasing overall efficiency.

SCP can conduct a pilot program to determine the effectiveness of water heaters as a capacity resource in a comprehensive local demand response system. We note the emergence of the new "Advanced Water Heater Standard" as well as other high efficiency thermal storage devices for the home as promising candidates for local pilot projects.

3. **Appropriate heat pump technologies are applied throughout the county, including the local coastal microclimates:**

According to the U.S. Environmental Protection Agency, "If the nation's climate warms by 1.8°F, the demand for energy used for cooling would increase by about 5-20%,"[42] noting that this warming is expected to increase peak summer electricity demand over much of the nation. As cooling-degree-days increase, many property owners will need to consider installing air conditioning systems. A pilot program to determine the most efficacious applications of heat pump technology in the wide variety of Sonoma County microclimates would support wise and timely investment by building owners.

4. **Modern heat pump heat-recovery-ventilation (HRV) technology is in use in commercial and public buildings:**

Advances in heat pump heat-recovery-ventilation (HRV) technology can deliver multiple benefits for commercial and public buildings. Working with local property owners and industry experts, SCP should conduct pilot programs to identify new HRV technologies showing promise for larger buildings. Here, as

42 Climate Impacts on Energy, accessed May 2016: https://www3.epa.gov/climatechange/impacts/energy.html

with other technical strategies outlined in this report, the need for in house technical expertise to guide program development is mandatory.

Outcome: All residents to have access to clean energy value.

Equal access to clean energy value requires an equitable and sustainable economy that serves all residents.

From an economic perspective, investment in renewable energy and efficiency stabilizes and reduces energy costs. This is of special importance to low-income households, who would benefit from the expedited deployment of local programs that complement and expand existing State and Federal programs for disadvantaged communities.

From a public health and safety perspective, climate change means an increase in the average summer temperature in a coastal area whose building stock is typically not equipped with air conditioning.[43] While heat-pump technology is replaces water and space-heating equipment, it also provides, by design, cooling/air conditioning. The concomitant benefit is that this technology will literally save lives, especially among vulnerable populations like the elderly, ill, and children.

As a public agency dedicated to GHG reductions, SCP is key to implementation of local, data-driven solutions that address the State's commitment to distributed energy resources,[44] as defined in Public Utilities Code, Section 769, which prioritizes the deployment of distributed energy resources defined as "distributed renewable generation resources, energy efficiency, energy storage, electric vehicles, and demand response technologies."

Equal access strategies include:

1. **Implementing ongoing microeconomic analysis to quantify the impact of local community energy development:**

Microeconomic and technical analysis can be used to identify emerging strategies that can be applied locally to expand on State market transformation programs. Emerging strategies suited to local deployment include virtual net metering and neighborhood micro-grid strategies, as defined by CPUC guidelines; the use metered negawatts; community energy notification systems; and direct subsidies for disadvantaged community fuel switching programs.

43 "We would expect that households in zones which currently do not require cooling equipment may potentially invest in such equipment if the climate becomes warmer." California Energy Commission, The Impacts of Climate Change on the San Francisco Bay Area Residential Electricity Consumption, CEC-500-2012-035: http://www.energy.ca.gov/2012publications/CEC-500-2012-035/CEC-500-2012-035.pdf
44 Public Utilities Code Section 769 was instituted by AB 327, Sec. 8 (Perea, 2013). This new code section requires the electrical corporations to file distribution resources plan proposals by July 1, 2015. According to the Code, these plan proposals will "identify optimal locations for the deployment of distributed resources." It defines "distributed energy resources" as "distributed renewable generation resources, energy efficiency, energy storage, electric vehicles, and demand response technologies." http://www.cpuc.ca.gov/General.aspx?id=5071

2. **Identify ways to increase public involvement in efficiency improvements and fuel switching through methods such as opt-in tariffed on-bill repayment programs and free technical support:**

A central premise of public adoption must include well-designed programs that are attractive for customers (e.g., How$mart®, Midwest Energy Co. in Kansas, Roanoke Electric's Upgrade to $ave, and Ouachita Electric's HELP PAYS)[45] that make it easy for all residents to participate. Policy should be guided by local economic models that include the full impact of local renewable development and energy efficiency measure installation, as opposed to methods of rate-payer-based accounting previously used by the CPUC and other statewide agencies.

3. **Incentivize and foster local renewable generation and enact policies to enable neighborhood microgrid strategies;**

Using the PG&E Distributed Resource Plan, local government partners (e.g., Sonoma County Water Agency), and local economic analysis, SCP can identify target communities and business districts that could benefit from microgrid strategies. Using rate structures, government funding tools, and public-private partnerships, SCP can facilitate microgrid development to provide energy stability, local investment, and job creation.

4. **Establish a local "pay-for-performance" or metered negawatt market to reward deep energy retrofits:**

Using the California Public Utilities Commission's open-source, open-data, open standard CalTrack engine, known as the Open Energy Efficiency Meter,[46] SCP develops a local trial "pay-for-performance" program for metered energy efficiency in residential and commercial properties. In such a program, SCP may purchase affordable grid capacity and greenhouse gas reductions from local third party providers using existing Smart Meters. Offering Incentivized performance contracts with third parties to achieve energy efficiency holds some promise that should be thoroughly examined. Moving to pay-for-performance would provide a competitive advantage over the IOU through lower prices and a 2-to-1 benefit in avoided transmission and distribution costs. The metered efficiency pay-for-performance process would allow to SCP to focus investments that deliver both environmental and economic benefits for its customers.

[45] How$mart Program, MidWest Energy: https://www.mwenergy.com/environmental/energy-efficiency/howsmart. Roanoke and Ouachita's programs. Supported by Clean Energy Works, are described here: https://cleanenergysolutions.org/training/inclusive-financing-distributed-energy-solutions

[46] The Open Energy Efficiency Meter creates a standard weights and measures for energy efficiency that is reliable for both markets and grid operators. In simple terms, this means that using the meter, private companies, utilities, and regulators will all calculate the same level of savings for a given set of building efficiency projects. www/openeemeter.org

Outcome: Success requires community partnerships, policies, and control.

Political alliances and regional partnerships will be essential to achieving ecological sustainability. These local and inter-county partnerships should create the political will for progressive and enabling policies that target emerging opportunities such as microgrids and distributed energy resources. In addition, local government partners can prioritize policies that foster the adoption of deep energy efficiency, microgrids, and local renewable energy generation.

Recognizing our unique local conditions and need for locally practical solutions, we strongly argue that SCP should avail itself of the experience and resources available from both local organizations and groups in other regions. Naturally, the process requires close work with local government organizations such as the Regional Climate Protection Authority, concerned County organizations, and other local groups. Likewise, we urge close cooperation with groups in other regions such as the Northwest Energy Efficiency Alliance (NEEA), whose $35 million annual budget is devoted largely to conducting scaled stock assessments and energy transformation programs similar in scope to what we are proposing for Sonoma County.

Undoubtedly, outside organizations such as the U.S. Department of Energy, Lawrence Berkeley National Laboratory, Northwest Labs, CAISO, and other agencies will be valuable partners for SCP program development. We emphasize, however, that advanced technical expertise is only one piece of the solutions we seek. The hard work of creating useful assessment data, and applying that data to create practical financial, technical, and implementation methods, and later their evaluation and adjustment, is primarily a local activity. SCP must work closely with local organizations, especially local businesses, to enhance the growth of local renewables, efficiency, and fuel switching.
As the main point of contact for County energy users, SCP can inform its customers on an ongoing basis about renewable and energy efficiency audit services provided by other agencies to help homeowners plan energy efficiency and solar projects.

Collaboration strategies include:

1. **Including and implementing distributed energy resources and microgrid projects in the Sonoma Clean Power Resource Plan:**

Distributed energy resources and microgrid technologies are locally deployed strategies that require participation and coordination among community, business, and government partners. In preparing its resource plan, SCP has an opportunity to commit to and invest early in the disruptive transition to local generation, electrification, and cost control through proactive efficiency. The resource plan offers an opportunity to engage the community and stakeholders in defining the long-term environmental and economic goal and identifying critical steps to reaching that goal. As a living document, the resource

plan is an important tool to ongoing dialogue and integration of new opportunities that can expedite Sonoma County's move to a clean energy economy.

2. Analyzing local peak demand characteristics to inform policy and program development: Using building assessment and utility bill data, SCP is positioned to respond to local opportunities such as eliminating propane use in rural areas, replacing natural gas furnaces with electric heat pumps that can provide both heating and cooling as average climate temperatures increase, and strategic investment in EV charging infrastructure in an environment of fast-changing technological and industry advances.

3. Assuming control over local distribution:
The distributed energy resource (DER) approach, a key element of State policy and the subject of CPUC rulemaking R.14-08-013,[47] will require a combination of smart technology to monitor and interact with local generation and efficiency resources and significant investment in generation, storage, and efficiency capacity.

As a load serving entity, SCP is poised to lead locally driven grid coordination in order to capture economies of scale and cost for its customers and maximize greenhouse gas reductions. DER lends itself to local management, and local management offers opportunities that support the local economy through affordable energy rates, infrastructure investment, and project jobs. SCP can lead the shift from outside to onsite power and increase the resilience of the local grid to serve community needs like emergency response during natural disasters and public health and safety issues associated with changing temperatures, climate mitigation, and equitable access to clean power.

Outcome: Sonoma County is a renewable energy exporter.

To achieve ecological sustainability means helping other communities. With progressive efficiency and renewable energy policies, markets, and community adoption, Sonoma County could become a net exporter of clean renewable power from solar, wind, and other sources. Building on Sonoma County's reputation for climate leadership, we could again set an aggressive community goal to deploy maximum efficiency and renewable energy resources that directly contribute to a reversal of climate change impacts.

[47] The California Public Utilities Commission (CPUC) rulemaking R.13-08-013 was opened to respond to Public Utilities Code Section 769, which was instituted by AB 327, Sec. 8 (Perea, 2013). As stated on the CPUC Website: "This new code section requires the electrical corporations to file distribution resources plan proposals by July 1, 2015. According to the Code, these plan proposals will 'identify optimal locations for the deployment of distributed resources.' It defines *distributed energy resources* as 'distributed renewable generation resources, energy efficiency, energy storage, electric vehicles, and demand response technologies.' " http://www.cpuc.ca.gov/General.aspx?id=5071

We acknowledge that the action steps offered in the accompanying tables of this document are provisional because opportunities arising from data analysis, experience, new technologies, innovative policies from elsewhere, and infrastructure investment may allow us to move faster than currently anticipated. California State GHG guidelines should be considered our baseline goals, with an assumption that pushing the envelope toward greater achievements must be anticipated. Sonoma County, with a wealth of geothermal, wind, and solar resources, should move to be a net energy exporter when our resources are fully utilized locally.

Net exporter strategies include:

1. **A directive from the Sonoma County Board of Supervisors adopting the ecological sustainable vision:**

In support of ongoing climate efforts, including the Climate Action 2020 plan, Sonoma County leaders can make ecological sustainability and recovery a formal goal to establish proactive expectations and inspire action and investment in a transformative future. Since 2000, local leaders have stepped up to repeatedly set national precedents for locally driven climate protection policy and action. As the consequences of climate change escalate beyond predictions, it is imperative to respond with vision and courage.

2. **Committing to a timeline and resources for deployment of progressive energy management policies and responsive customer service to engage and build community support:**

In light of State policy prioritizing the expedited deployment of distributed energy resource, local partners led by SCP and RCPA can chart a course using Climate Action 2020 recommendations and emerging opportunities as identified by the data-driven techniques included in this paper. Building momentum that will propel the community into a restorative status depends on a flexible partnership that can evaluate and respond to the forthcoming paradigm shift. Committing to an ambitious goal and a date-certain deadline will, as President Kennedy’s moon shot project did, make the impossible possible.