Bridge TO THE Clean Economy

EV Communities Alliance • AltaTerra Research • Pacific Municipal Consultants
With support from the Marin Community Foundation

Low Carbon, High Impact Market Initiatives For The Bay Area
ACKNOWLEDGEMENTS

The Bridge to the Clean Economy is a collaborative project of the following organizations under the leadership of the Bay Area Climate Collaborative. It was made possible by the generous support of the Marin Community Foundation. – May 2012.

The Bay Area Climate Collaborative (BACC) is a 501c3 public-private partnership accelerating the clean energy economy. Partners include Bank of America, Pacific Gas & Electric, clean energy companies and local governments representing over 70% of the Bay Area population. The BACC drives practical market-oriented and cross-sector initiatives that reduce carbon, advance economic development, and accelerate penetration of climate solutions. Initiatives include co-facilitation of the Bay Area EV Strategic Council, the $5 million Local Government EV Fleet national demonstration project to catalyze adoption of EVs in fleets and the Bay Area Next Generation Streetlight initiative aimed at upgrading 200,000 streetlights to LED and generate $10 million in annual savings. The BACC is a project of the Silicon Valley Leadership Group. www.baclimate.org

EV Communities Alliance is a public-private collaborative that assists metropolitan regions to accelerate the mass deployment of Electric Vehicles. Current projects of the Alliance include development of the Bay Area EV Strategic Council and the Bay Area EV Corridor Project, a $4 million dollar EV infrastructure deployment effort; leadership of EV strategic planning efforts in the Monterey Bay and Central Coast regions; development of the Ready, Set, Charge California! EV-ready community guidelines project; and EV-readiness initiatives in the Los Angeles/South Coast region. The Alliance is also developing the Vehicle-to-Grid Consortium to accelerate V2G market structures in California and nationwide. Richard Schorske, Executive Director of the EV Communities Alliance, was instrumental in the conception and execution of the Bridge to the Clean Economy.

AltaTerra Research is a market research and education services firm focused on high-value solutions for resource efficiency, clean energy and sustainable business in the corporate and institutional marketplace. AltaTerra Research will review and refine research results, consult on initiative concepts and co-host selected webinars. Don Bray, Co-Founder and President of AltaTerra, played an instrumental role in the initial development of the BACC. For additional information about AltaTerra Research, visit www.altaterra.net.

Established in 1995, Pacific Municipal Consultants (PMC) is a full-service municipal services consulting firm with expertise in a broad range of planning, environmental, finance, urban design & revitalization, public outreach and sustainability services. PMC has offices throughout the Western United States including Rancho Cordova, Los Angeles, San Diego, Oakland, Monterey, Chico, Davis, and Mt. Shasta. For additional information about PMC, visit www.pmcworld.com.

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The Bridge to the Clean Economy drew heavily from over 150 leaders participating through the BACC’s Steering Committee, the Bay Area EV Strategic Council and the extensive interviews and dialogue sessions specifically for this project. The BACC gratefully appreciates these many distinguished leaders who generously participated with their time and insights. Many of the insights, ideas and resources from these leaders are reflected in the Bridge to the Clean Economy without formal endorsement of the results. All material presented here, including any errors or omissions, are solely the responsibility of the Bay Area Climate Collaborative.
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1 Executive Summary

*Bridge to the Clean Economy: Low Carbon, High Impact Market Initiatives for the Bay Area* is an action plan for high-impact, market-oriented initiatives that rapidly reduce greenhouse gas emissions in the 2- to 5-year time frame. The need for scaled clean energy and its benefits are well established. But time is of the essence. The initiatives presented here define specific projects and strategies for accelerating solutions in the current economic, technical, and political context. These initiatives combine proven technologies with private sector leverage to accelerate clean energy scale in the Bay Area.

The San Francisco Bay Area is poised to seize the benefits of the clean energy economy. But in a time of austerity, choosing investment strategies wisely -- and creating leadership focus to achieve them -- is a core challenge that must be met. California’s landmark Global Warming Solutions Act (AB32) is driving essential clean energy incentives and requirements with a target of reaching 1990 emissions levels by 2020. However, additional regional action is required to meet targeted reductions. To address the need for rapid local action that will benefit both the economy and the environment, the *Bridge to the Clean Economy* defines specific market-based initiatives we can move now.

Developed with extensive input from over 150 leading experts across every sector of the economy, this plan lays out regionally-actionable strategies in four key domains: distributed renewables, electric vehicles, commercial building efficiency, and residential energy upgrades. In each of these domains, the market context, specific projects and strategies, key market participants, and proposed plans of action are detailed. The *Bridge to the Clean Economy* is not intended to be comprehensive of all useful strategies and projects, but rather emphasizes select areas of action that are broadly applicable, regionally addressable, and not yet deployed at scale. It is important to emphasize that many other worthy ideas are not addressed in this action plan either because they are already achieving scale, because they are not proven for near-term implementation, or because they do not have large-scale, near-term impact potential.
CRITERIA

To be considered for inclusion in the action plan, projects and initiatives must:

- Be market-oriented (complementing public policy-focused strategies)
- Provide payback rates relevant to key actors
- Deliver significant GHG reductions in the 2013–2017 time frame (or be a key enabler for scaled solutions)
- Support regional economic development
- Be regionally actionable

INITIATIVES

Featured initiatives are divided into three categories: Fast-tracks, Gateways, and Key Enablers.

1. Fast-tracks are deployment strategies that deliver direct and larger-scale economic and emissions benefits. These strategies focus on discrete market segments where the solutions are proven and opportunity exists for accelerated scale-up. Fast-track strategies include:

   - **Solar on Schools**: Deploy 500 MW at the Bay Area’s 159 school districts (counting 15 projects already in the pipeline) to generate 600,000 metric tons of cumulative CO$_2$ avoidance over three years, reduce budget pressure, and create an estimated 19,000 job-years.

   - **Solar Group-Buy Benefit**: Add 33 MW solar PV per year by engaging half of the Bay Area’s largest employers in solar group-buy employee benefits for 38,000 metric tons of cumulative CO$_2$ avoidance over three years. These solar installations provide immediate payback for purchasers and will scale rapidly as panel prices continue to drop.

   - **Generation at Waste Water Plants**: Direct food waste to anaerobic digesters at waste water treatment plants for 390,000 metric tons of cumulative CO$_2$ avoidance over three years. Leverage performance-based contracts to deploy strategy with minimal or no up-front cost to local facility operators. This is a particularly under-appreciated opportunity.

   - **LED Streetlights**: Upgrade 400,000 municipally owned streetlights to save $20 million per year, generate over 1,000 job-years, and achieve 90,000 metric tons of cumulative CO$_2$ avoidance over three years.

   - **Residential Affordable Multi-Unit Turnkey Programs**: Upgrade 130,000 affordable multi-unit dwellings using non-profit turnkey programs with under-five-year paybacks and deliver 114,000 metric tons of cumulative CO$_2$ avoidance over three years.
2. **Gateways** deliver modest clean energy benefits initially, but facilitate more rapid scaling over the longer-term by “bootstrapping” the market and highlighting new clean energy investment opportunities. Gateway strategies include:

- **High ROI Commercial Building Efficiency Upgrades**: Target underserved, mid-sized leased commercial properties with rapid payback with energy efficiency (EE) measures aimed initially at common areas. These projects leverage LED lighting, advanced building energy management systems and demand response strategies that can be further scaled throughout a building and campus as payback opportunities are validated. Immediately deployable strategies provide 46,000 metric tons cumulative CO$_2$ avoidance over three years and grow substantially over time.

- **Foreclosed Property EE Upgrades**: Scale energy efficiency upgrades in conjunction with other investor refurbishments as an economically viable approach now being demonstrated by select market participants. 10,000 units per year of energy upgrades will deliver 120,000 metric tons of cumulative CO$_2$ savings over three years. This strategy can grow over time as the foreclosure backlog continues to ripple through the regional economy.

- **Aggregate EV Purchase**: Leverage the aggregate purchase of electric vehicles with battery finance and energy service strategies to drive rapid cost-parity with conventional vehicles. Over three years, this strategy delivers nearly 7 million gallons of gas savings -- resulting in $20 million in net fuel savings to consumers (or more with likely gas prices increases). 40,000 metric tons of CO$_2$ would be avoided over three years. This strategy will grow substantially as EVs accelerate in the market.

3. **Key Enablers** open the door to scaling clean energy solutions. Key Enablers include:

- **Mid-Tier Finance Pool for EE Upgrades**: Increase the implementation of commercial energy upgrades in underserved segments by leveraging private, philanthropic and public investment to fund a $50 million pool for innovative financing solutions and generate over 23,000 metric tons of CO$_2$ reduction over 3 years.

- **Valuing Home Performance**: To catalyze residential energy upgrades, recognize and make visible home energy performance in the Multiple Listing Service (MLS) so purchasers and appraisers can gain visibility into the economic benefit of energy-efficient buildings.

- **EV Battery Finance and Vehicle-to-Grid Energy Services**: To enhance the economics of electric vehicles, finance batteries separately to reduce the up-front purchase price of EVs and connect vehicle batteries for two-way energy flow to the grid. Accelerating vehicle-to-grid (V2G) connectivity will enable new revenue generating energy service opportunities with benefits for EV owners, building owners, utilities, and energy service companies.

For each of the strategies identified above, the *Bridge to the Clean Economy* action plan details the benefits, background, key players, and specific steps to make these solutions a reality.
KEY THEMES

The research underlying Bridge to the Clean Economy highlighted a common set of catalysts for action-at-scale across most of the initiatives. The first and most important catalyst is leadership engagement. While the solutions identified provide significant economic benefits and are currently feasible with off-the-shelf technologies and approaches, in some cases the accessibility and benefits of rapidly emerging solutions have not yet been recognized by many of the relevant decision-makers (e.g. solar on schools, LED street lighting). For other solutions, business leaders may need to refine strategies and partnerships needed to realize these opportunities (e.g. valuing home performance, EV battery finance).

Additional prerequisites for scaled action include better information on emerging opportunities and more strategic targeting to optimize both economic and environmental benefit. Some areas of opportunity -- such as energy efficiency in the commercial sector -- are broadly recognized as having high potential, yet information to more effectively target specific market segments is difficult to access, weakening outreach efforts to educate and aggregate would-be customers which are fragmented and costly.

A third factor is the importance of turnkey services. For nearly every strategy, successful early projects provide integrated services that offer “end-to-end” solutions to customers and consumers. Such solution “packages” provide business case analysis, custom-development of finance strategies, management of competitive procurement processes, turn-key project execution, and independent validation of results.

Financing is a much discussed key enabler. Where financial models have dramatically reduced or eliminated up-front customer investment requirements, solutions have scaled quickly. Power purchase agreements and leases for solar power are the obvious examples. For energy efficiency, commercial PACE programs and on-bill finance play -- or will soon likely play -- a prominent role. However, other market segments need similar innovation such as expanded efficiency service agreements (ESAs) for commercial properties and electric vehicle battery finance.

Finally, innovative catalyst organizations and partnerships will play increasingly critical roles in driving solutions to scale. In some cases, these will be non-profit or joint venture structures that can bring together business and governments to drive solutions. In other cases, “intrapreneurial” collaboration may create new opportunities. For example, solar group-buy programs have involved collaboration between human resources and environmental sustainability teams. Similarly, philanthropic foundations, public employee pension trustees, and traditional financial institutions may be able to adapt new investment vehicles for the energy efficiency and renewable energy markets.

In summary, the Bridge to the Clean Economy intends to further leverage market forces to accelerate the clean energy economy. By bringing together key market participants and catalysts around this high-potential set of clean energy strategies, the Bay Area will meet the biggest challenge of the 21st century: enhancing our shared prosperity while mitigating the impacts of runaway climate change.
2 INTRODUCTION

Bridge to the Clean Economy: Low Carbon, High Impact Market Initiatives for the Bay Area, is an action plan for high-impact, market-oriented initiatives for rapid greenhouse gas emissions reductions in the 2- to 5-year time frame. The benefits and need for scaled clean energy implementation are well established. But time is of the essence. The opportunities presented here are specific pathways for accelerating solutions in the current economic, technical and political context. These initiatives combine proven technologies with private sector leverage to accelerate clean energy scale in the Bay Area.

The benefits of the clean economy are many and the Bay Area is poised to seize them. The region’s assets are significant – intellectual capital, venture and other investment, innovative culture – but in a time of austerity and with over 100 cities and counties and a multiplicity of initiatives, choosing investments and creating leadership focus can be a challenge. Government investment which has driven much of the clean energy scaling in recent years is dropping precipitously. Federal clean energy investment is on a trajectory to decline 75 percent by 2014 from its peak of $44.3 billion in 2009 (Brookings 2012). Local governments are facing continued dramatic cuts in staffing and services.

It has always been true that market forces will be the essential determinants of the adoption and speed of penetration of clean energy solutions. This requires moving the fastest most addressable pathways even as improved policies, technologies and practices are developed and implemented.

And time is of the essence for both climate and the economy. To address the need to move quickly, the Bridge to the Clean Economy action plan is focused on the specific market-oriented initiatives we can move now.

Developed with extensive input from over 150 leading experts across every sector, this action plan lays out regionally-actionable strategies in distributed renewables, electric vehicles, existing building commercial efficiency and residential upgrades. In each of these domains the market context, specific strategies, actors and plans of action are detailed.

This introduction provides an overview of the opportunity with clean energy, the projected impacts from climate change on California and the Bay Area specifically, and the Bay Area-specific GHG emissions context. This section closes with a description of the rationale for the domains, the criteria for the initiatives selected and how they are categorized.
2.1 CLEAN ENERGY OPPORTUNITY

The move to clean energy represents an unprecedented opportunity to advance the national and regional economy while delivering many important benefits including job growth, greater national security, improved public health, and safeguarding of our natural resources. Research by the Brookings Institute shows that clean economy jobs deliver nearly twice the export value of other jobs in the economy (Brookings 2011). From 1995 to 2010 growth in the Bay Area clean energy and related green economy jobs was 76 percent compared to a total of only 6 percent growth in the economy overall (Next10 2012). These jobs also demonstrated more resilience than the economy overall. Factoring in the costs of military needs to secure oil supplies, public health consequences such as asthma and impacts of climate disruption, the avoided costs are enormous.

It has been noted that Thomas Edison would recognize every major component of the electrical grid today from gas turbines to generate power to the common light bulb and everything in between. In contrast, Graham Bell would likely recognize virtually nothing in today’s communications and information technologies. The pace of innovation in communications and information technology is staggering. The average American replaces their cell phone every 21 months with significant new features in each upgrade (H. Victor 2011). Clean energy is the merging of the most advanced communications and information technologies for which the Bay Area is famous to improve the productivity of one of the most entrenched and aging parts of our economy, the energy sector. Change is coming to this aging part of the economy – but it needs to be accelerated.

For the Bay Area the opportunity is very significant. If just 10 percent of the Bay Area’s vehicles were plug-in vehicles, residents would save up to $1 billion a year in fueling costs that would instead become discretionary funds for the local economy. Opportunities such as deploying solar power on schools could support 19,000 job-years while reducing costs, upgrading streetlights on a third of the region’s inventory can reduce our energy needs by over 60,000 MWh with up to $10 million in savings, and creative finance strategies can open up sectors where efficiency adoption remains slow. These steps are essential to not only unlock the benefits but also to respond to the very real competitive challenge we face as other parts of the world continue to ramp-up their clean energy investments and opportunities. The Bay Area is poised to seize these benefits.

2.2 URGENCY FOR ACTION: LOCAL IMPACTS OF CLIMATE CHANGE

Research strongly indicates that California, like many areas around the globe, will experience sea level rise in low-lying communities, hotter and drier climate conditions, reductions in winter snow and increases in winter rains, and an increase in the occurrence of extreme weather events. The potential impacts in California due to climate change are extensively documented in the state’s 2006 report Our Changing Climate, summarized in the figure below from the California Energy Commission (CEC 2006c).

Figure 1 - California Climate Change Impacts, 2070–2099

Source: CEC 2006c.
It is worth noting that the projections of the effects of climate change have become more severe over time. Many projections have in fact been understating the speed and scope of the impacts and the scientific community, as represented by the authoritative Intergovernmental Panel on Climate Change (IPCC), recently upgraded their warnings to the global community (Harvey 2011).

Estimates of potential temperature increases range between 2 and 5 degrees Celsius by 2100 (SPUR 2011). Absent mitigation through aggressive clean energy implementation the specific impacts to the Bay Area will likely include:

1. Drinking water loss and drought
2. Heat waves and extreme weather
3. Sea level rise and flooding

One third of the state’s water is dependent on the Sierra snowpack, with some parts of the Bay Area in San Mateo, Santa Clara and Alameda counties are almost wholly dependent on snowpack water from Hetch Hetchy (Bay Area Council 2002). By 2050, scientists project a loss of at least 25 percent of the Sierra snowpack (DWP 2012) and drinking water could also be significantly further impacted by saltwater intrusion (CEC 2006c).

The Bay Area will likely also see increased heat waves especially in the eastern and southern portions of the region. Extreme heat days may rise from 12 days a year to 20 in 2035, continuing up to over 90 by the end of the century, resulting in increased heat-related illnesses and death particularly impacting the poor, the elderly and young children (SPUR 2011).

The San Francisco Bay Conservation and Development Commission (BCDC) reports that sea level in San Francisco Bay is likely to rise 16 inches by mid-century and 55 inches by the end of the century. The BCDC report estimates that approximately 180,000 acres of the Bay Area could be inundated by mid-century, and 213,000 acres could be flooded by the end of the century, including 93 percent of both the Oakland and the San Francisco airports (BCDC 2009).

2.3 Bay Area GHG Emissions Context

To assist tracking the region’s progress in mitigating climate impacts, the Bay Area Air Quality Management District (BAAQMD) conducted a GHG inventory for the nine-county San Francisco Bay Area using data from the baseline year of 2007.

The BAAQMD inventory concluded that the Bay Area contributed 95.8 million metric tons of CO$_2$e to the atmosphere as a result of electricity and natural gas consumption, the combustion of gasoline and diesel on local roads and state highways, and solid waste sent to regional landfills (BAAQMD 2010). Without any action taken to reduce energy consumption or other behavioral changes, the business-as-usual forecast estimates emissions in the San Francisco Bay Area will increase 20.6 percent by 2020 to 115.4 million metric tons CO$_2$e (BAAQMD 2010). Figure 3

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1 The nine-county Bay Area includes the counties of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.
below details the GHG emissions by source statewide (regional view is extremely similar.)

Figure 3 - California Emissions by End Use

Most of the nine counties included in the BAAQMD's GHG emissions inventory, as well as many of their incorporated jurisdictions, have developed or are in the process of developing climate action plans, sustainability goals, or local outreach programs. These programs seek to encourage, and in some cases require, actions in each of the clean energy domains discussed in this paper. These local government efforts are intended to reduce future Bay Area GHG emissions 23.9 percent below the 2020 projections. Though the Bay Area generally seems committed to reaching statewide reduction goals, additional emissions reduction efforts will be required to address the 2.3 percent that local governments have not yet planned to reduce; this gap will be discussed further below.

For the BAAQMD's calculations to be correct, local governments' plans and goals will have to be successfully implemented, but businesses and individuals will have to develop strategies that take advantage of them and result in actual reductions.

2.4 STATE POLICY AND REGIONAL SUPPORT

The State of California is the 15th largest emitter of greenhouse gases in the world, ultimately accounting for 2 percent of global greenhouse gas emissions. However, the State has been proactive in working to reduce emissions and has a long history of proven leadership in addressing energy and climate issues spanning the last 40 years.

There have been numerous initiatives in California to address climate change and energy efficiency. The flagship California policy related to climate change is the Global Warming Solutions Act (AB 32) signed by Governor Schwarzenegger in 2006. The landmark legislation requires the California Air Resources Board (CARB) to develop regulatory and market mechanisms that will reduce greenhouse gas emissions to 1990 levels by 2020. Mandatory actions under the legislation to be completed by CARB include:

- Identification of early action items that can be quickly implemented to achieve greenhouse gas reductions. These early action items were adopted by CARB in 2007 and include regulations affecting landfill operations, motor vehicle fuels, car refrigerants, and port operations, among other regulations.

- Development of a scoping plan to identify the most technologically feasible and cost-effective measures to achieve the necessary emissions reductions to reach 1990 levels by 2020. The scoping plan employs a variety of GHG reduction measures that include direct regulations, alternative compliance mechanisms, incentives, voluntary actions, and market-based approaches like a cap-and-trade program. The plan identifies local governments as strategic partners to achieving the state goal and translates the reduction goal to a 15 percent reduction of current emissions by 2020.

- Creation and adoption of regulations to require the state's largest industrial emitters of greenhouse gases to
report and verify their greenhouse gas emissions on an annual basis.

In addition, the State has enacted numerous additional legislation and policy initiatives related to climate change, transportation and vehicle efficiencies, energy, water, and solid waste.

Within the Bay Area, most of the counties in the region have engaged in some form climate action planning, including setting emissions reduction targets. Additionally, most local governments offer some form of support for green building that goes beyond Title 24 minimum code, ranging from permit streamlining for LEED certified buildings to requiring 15 percent more efficiency than Title 24. A number of regional agencies in the Bay Area are also active in supporting local governments and communities in climate planning by providing tools such as technical and research assistance as well as financing options.

Table 1 - Examples of Regional Government Agency Support

<table>
<thead>
<tr>
<th>Regional Agency</th>
<th>Domain</th>
<th>Activities</th>
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<tbody>
<tr>
<td>Bay Conservation and Development Commission</td>
<td>Open-space conservation and climate change adaptation</td>
<td>Analysis, modeling, and reporting impacts of likely sea level rise.</td>
</tr>
<tr>
<td>Bay Area Air Quality Management District</td>
<td>Air quality</td>
<td>Supports local governments in their climate planning and airshed-related environmental quality, created the regional emissions inventory, and supports local programs.</td>
</tr>
<tr>
<td>Association of Bay Area Governments (ABAG)</td>
<td>Regional metropolitan planning organization</td>
<td>Provides regional data regarding housing and development for local climate planning efforts and supports regional land-use planning. In partnership with PG&amp;E, ABAG implemented the Energy Watch program throughout the region.</td>
</tr>
<tr>
<td>Metropolitan Transportation Commission</td>
<td>Regional transportation systems and planning</td>
<td>Models GHG emissions from transportation and provides support for transportation-related projects.</td>
</tr>
<tr>
<td>Public Utilities Commission</td>
<td>Energy efficiency and alternative energy</td>
<td>Financing options for energy efficiency and renewable energy; utility-base renewable portfolio standards; smart grid upgrades, etc.</td>
</tr>
<tr>
<td>Lawrence Berkeley National Labs</td>
<td>Energy efficiency and alternative energy</td>
<td>Provides research on technologies and strategies for implementation.</td>
</tr>
</tbody>
</table>

Many nonprofit and public-private organizations in the Bay Area operate in this field as well. Services and products provided by these organizations include policy research, technical research assistance, sales of solar power modules and services, assistance to governments to connect with customers to provide home and business energy audits, and workforce training.
2.5 Policy Target Gap

While developing guidelines for the California Environmental Quality Act, the BAAQMD analyzed the effect state-led GHG reduction programs may have on local emissions. The State’s 1990 baseline was forecasted to 2020 using a business-as-usual scenario. A business-as-usual (BAU) forecast analyzes how emissions will grow if per capita consumption trends and efficiency improvements remain at their 1990 levels while the number of jobs, households, and people continues to grow. In other words, the BAU is the status quo scenario before state, regional, and local reduction efforts are taken into consideration.

In order to meet AB 32’s reduction target, the State must reduce 2020 BAU emissions by 26.2 percent; however, the strategies laid out in the AB 32 scoping plan will only reduce emissions an estimated 23.9 percent (BAAQMD 2009). In order to meet the AB 32 goals this 2.3 percent gap in GHG reductions, about 2.5 MMtCO2e, must be filled with additional reduction efforts and results, beyond planned policy action. Furthermore, even with moderate economic growth and business-as-usual (BAU) efficiency gains, it will be challenging to reach the AB 32 goal of reducing statewide GHG emissions to 1990 levels by 2020 (CCST 2011).

2.6 Methodology of the Bridge to the Clean Economy

2.6.1 Overall Emphasis

The Bridge to the Clean Economy was conceived in part to address the gap between state and local policies and AB 32 targets and also identify initiatives that can make the local and regional policy objectives real. It also is aimed at enabling regional and local leaders to move quickly and concretely even at a time of austerity, without requiring public investment and taking the current policy context as the starting point. By moving solutions quickly, economies of scale will make clean energy even more affordable, helping speed deployment going forward.

The Bridge to the Clean Economy is not intended to be comprehensive but rather emphasizes select areas of action that are broadly applicable and regionally addressable. The region’s emissions indicate that the vast majority of GHG emissions come from transportation and energizing existing buildings. For this reason, the clean energy domains selected are distributed renewable energy generation, existing commercial building energy efficiency, existing residential building energy efficiency, and electric vehicles.

Numerous relevant areas are not covered including: New construction (e.g., net-zero residential & commercial); Industrial energy efficiency (e.g., data centers, manufacturing); Water/waste-water related energy reduction; Goods movement emissions reduction (trucks, rail, ports); Existing light-duty vehicle (LDV) emissions reduction (clunker programs, CNG & EV retrofit); and Waste management (including solid waste, composting, recycling, landfill gas-to-energy, etc.) Some of these sectors have policy in place to ensure uptake of solutions such as green building strategies in new construction, others are better served through state and federal initiatives such as low-carbon fuels for the existing vehicle fleet, and others require highly targeted strategies and are less applicable for broad leadership engagement such as industrial efficiency and goods movement.

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2 In 2007, the Bay Area accounted for 19.75 percent of California’s 484.89 MMtCO2e net emissions. California BAU projections for 2020 are 506.8 MMtCO2e. Assuming the Bay Area accounts for the same proportion of emissions, Bay Area under BAU in 2020 would be 100.13 MMtCO2e. The 2.3 percent unaddressed portion of the region’s AB32 responsibilities would then be 2.303 MMtCO2e.
2.6.2 Method for Choosing Initiatives

To be considered for inclusion in the action plan, projects and initiatives had to:

- Be market-oriented (complementing public policy-focused strategies)
- Provide payback rates relevant to key actors
- Deliver significant GHG reductions in the 2013–2017 time frame (or be a key enabler for scaled solutions)
- Support regional economic development
- Be regionally actionable

The collective experience of project partners was leveraged for initial prospective initiatives and early interviews were utilized to explore concepts. Draft concepts were then developed and quantified and became the basis of the draft published online and used in the Bridge to the Clean Economy dialogues which included eight domain specific webinars, three in-person dialogue sessions, and numerous additional interviews. All the underlying calculations and sources summarized here are available on www.baclimate.org.

This is an extremely dynamic arena with new technologies, price improvements, policy developments and other innovations continually surfacing. It is likely that further refinement for these concepts is appropriate, that other initiatives could be surfaced of equal or greater significance. Leaders are encouraged to bring forward further insights to build on the groundwork the Bridge to the Clean Economy provides.

2.6.3 Types of Initiatives

Featured initiatives are divided into three categories:

1. Fast-tracks: Direct and scaled deployment with large tangible benefits.
2. Gateways: Deliver modest clean energy benefits but facilitate more rapid scaling by “bootstrapping” the market or making more apparent valuable opportunities.
3. Key Enablers: These open the door to scaling solutions.

The initiatives covered in the subsequent chapters are categorized as follows:

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<th>Key Enabler</th>
<th>Gateway</th>
<th>Fast Track</th>
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3 DISTRIBUTED RENEWABLE ENERGY GENERATION

There is justifiable optimism about the growth of distributed renewable generation, especially with solar photovoltaic power, but while the scale of deployment is growing, it remains modest. Specific opportunities such as solar on schools and solar group-buy benefits can rapidly scale solar power. But solar is not the only opportunity. By using food waste generation at waste water treatment plants is also an enormous and under-appreciated opportunity.

3.1 DEFINING THE DOMAIN

Rapidly increasing the amount of distributed renewable energy generation in the Bay Area will – in combination with energy efficiency measures – enable the region to accelerate achievement of GHG emissions reduction goals. Renewable energy technologies are also a market opportunity for local businesses and investors, and a low-carbon pathway to regional employment growth. Distributed renewable energy generation refers to small-scale power generators that can be either grid-tied or stand-along systems, delivering electricity and other energy services to consumers. (The broader category of “distributed energy resources” also includes advanced energy storage, demand response, and electric vehicles.)

Distributed renewable energy generation systems range in size from 1 kilowatt (kW) up to 20 megawatts (MW) of electrical capacity. These systems tap a variety of fuels, with solar and then wind the most popular sources, followed by hydro systems, different forms of biomass, and perhaps tidal and wave power systems in the not-too-distant future. (Geothermal power generation plants are almost always developed on a utility-scale due to remote sites and high up-front fuel development costs.) Systems in this domain include smaller projects integrated into buildings or carports, “brownfields” projects, as well as larger installations located at commercial and industrial sites.

Despite significant theoretical capacity for growth of distributed renewables throughout the Bay Area region, actual commercial activity has been limited. Given today’s technology and market conditions, distributed renewable energy systems are currently dominated by solar photovoltaic (PV) energy generation with estimated potential of over 16,000 MW throughout the Bay Area (Pacific Environment.

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3 It is important to note that power production operates on a continuum, with a key distinction being which side of a meter the generation operates under, which, in turn, influences regulatory protocols and the corresponding market. “Distributed generation” can be taken to include mid-range wholesale systems. For the purposes of this paper, any facility over 20 MW in size are considered utility scale projects.
2012). However, actual deployment of distributed solar PV in the Bay Area is estimated at approximately 360 MW peak capacity across nearly 33,000 sites\(^4\) (PG&E 2012d).

Though distributed wind energy generation is the most cost-effective renewable option at utility scales applications, it is not expected to be a large component of power supply portfolios within the largely urban Bay Area. As of 2005, there were an estimated 27 distributed wind generation deployments in the region (CEC 2005a). Industry observers have noted that actual power production has been disappointing, suggesting a lack of good sites and appropriate technology matches. Tidal and wave power have received some attention in recent years, though tidal resources by the Golden Gate bridge appear to have been overrated\(^5\). Potential new development of all forms of ocean energy are substantial (PG&E 2012c) but typically at utility scale. Even for these more cost-effective projects, significant technology and regulatory issues remain.

Geothermal heat pumps, which produce thermal energy instead of electricity, are gathering some interest, but they currently have high up-front cost and are primarily found only in new construction and specialized applications (Pike Research 2011a) in geographies where there are more extreme temperature swings, such as the Sierra Nevada. (These resources are also not considered distributed generation.) Fuel cells are an attractive peak-power cost-shaving technology for large commercial and industrial facilities, often replacing highly polluting diesel generators. Yet today, fuel cells are predominantly powered by natural gas. While natural gas can provide cost benefits under today’s record low fuel prices, the greenhouse gas reduction benefit is less robust than with distributed renewables and include other significant pollution issues\(^6\). Fuel cells can run on biofuels or hydrogen generated by renewables, but these applications are less common. Combined heat and power (CHP) generation is the best choice for natural gas generation, especially for large commercial and industrial facilities, as well as large multi-family residential facilities.

Aside from solar PV, biogas and other biomass and waste-to-energy projects are increasingly becoming part of the distributed renewable energy portfolio for California and the United States as a whole, and are among the most viable near-term opportunities in the Bay Area.

### 3.2 Market Context

In 2011, Governor Brown announced a goal for 12,000 MW of new local distributed renewable power generation by 2020, building on the state’s objectives to reduce state levels of carbon emissions under AB 32 and the state’s long history of support for the rich diversity of renewables available in California. Existing support for this ambitious goal includes a number of policies and programs, especially for different types of solar power, which holds the most potential by virtue of widespread resource availability. CPUC programs overseeing the investor-owned utilities include the California Solar Initiative (CSI), which provides incentives to residential, commercial and virtually every other solar installation sector including schools, non-profits and low-income housing, and the Self-Generation Incentive Program (SGIP), which offers incentives to wind as well as non-renewable distributed generation technologies such as fuel cells.

Because PV holds the largest potential, the market discussion here focuses on this technology. With the goal of securing 3,000 MW of solar-generated electricity by 2017, CSI has been a key driver behind the dramatic growth of solar PV in.

\[^4\] Statewide under the CSI program reached 1,000 MW as of 2011 with a long term goal of 3,000 MW by 2017 (Baker 2011).

\[^5\] http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2010/12/26/BABJ1GOUGA.DTL

\[^6\] Groundwater contamination caused by hydraulic fracture, or “fracking”, is a point of increasing concern and the lifecycle GHG impact of natural gas when factoring in fugitive methane emissions when drilling has led some researchers to suggest that the emissions impact is worse than coal (Post Carbon 2011).
California. The California Energy Commission (CEC) has two parallel programs: New Solar Homes Programs (solar incentives for new residential construction); and Emerging Renewables Program (incentives for small wind and fuel cell systems under 30 MW). Numerous other policies and programs play an important role in the promotion of distributed renewables including net metering, a well-established policy allowing solar and small wind system owners to reduce their annual electricity bills by bartering on-site generation with host distribution utilities. Others include “virtual net metering,” also referred to as “community solar,” whereby renters, multi-family units and others without suitable solar sites can purchase solar energy from larger utility solar installations via voluntary premiums; renewable energy credits, whereby air quality benefits are quantified, monetized and then traded as a commodity; and the Renewable Auction Mechanism, allowing utilities to aggregate distributed renewables as part of their qualifying portfolio of generation sources to meet the state Renewable Portfolio Standard (RPS). California’s RPS requires that 33 percent of the state’s total electricity be generated by renewable energy by 2020.

Consistent and significant support for local renewables at the state level has helped offset erratic federal policy characterized by recurring political battles over renewal of short-lived incentives, such as the recent fight to re-authorize the Production Tax Credit (PTC) for wind and geothermal facilities. This dynamic has complicated industry efforts to grow the renewables market, due to lack of policy certainty. In contrast, the CSI has benefited the state since it is a relatively durable program that slowly phases out solar subsidies as the market matures. In the residential market, CSI incentive amounts have dropped by 75 percent since 2007, averaging 60 cents per watt for projects installed in 2011. In the non-residential market, average incentives have dropped by more than two-thirds, averaging $0.98 per watt in 2011. (Environment California 2011)

Solar PV costs have dropped notably. Since 2001, manufacturers have cut the retail cost of a solar module by more than half (SolarBuzz 2012). The Lawrence Berkeley National Laboratory (LBNL) concluded that the installed cost of solar is dropping “precipitously” since 2008, with a pronounced drop of 18 percent from 2009 to 2010 and another additional 11 percent drop in price in the first six months of 2011 (LBNL 2011c). The price drops are reflected in both module “hard costs” as well as process “soft costs.” Current solar PV costs make it financially attractive as a means to reduce upper tier billing rate burdens.

The accessibility of distributed solar PV has also been heavily influenced by new business models. In 2006, SolarCity introduced the new business model of leasing of solar systems to customers. Under a lease linked to a “power purchase agreement” (PPA) customers are able to install systems with little or no upfront cost. For customers that consume large amounts of electricity, these systems can immediately be cash-flow positive. The overall cost of leases and PPAs are higher than outright purchases and can complicate property resale. However, for most property owners considering solar PV in today’s economic environment, these models have proven increasingly attractive across all customer segments.

Smaller-scale residential solar PV deployment is especially fragmented with many small installers. Market consolidation is under way among PV manufacturers, but 75 percent of employment in this sector remains firmly rooted in local communities in the form of installation and maintenance jobs. The industry has also seen increasing maturity with a broad range of technology innovations, standardization, and increasingly sophisticated business models. New software systems, for example, are enabling installers to better manage resource assessments and installations and are helping connect potential customers with the most appropriate financing options.
These recent trends have clearly influenced growth in deployments across the board. However, while commercial installations have continued to increase, the rate of adoption has been tempered by this sector’s more complex ownership structures and more stringent expectations on payback rates for capital projects—typically three years or less. Other uncertainties such as tenant turnover and facility load fluctuations can also result in uncertain payback calculations. As a consequence, some vendors such as Recurrent Energy (Garlinghouse 2011)—which originally targeted commercial deployments—have shifted their attention to utility scale projects. Other energy service companies, such as Chevron Energy Solutions and Honeywell, have focused on government and education markets, which often have clearer ownership structures and greater tolerance for longer payback periods. Additional growth is predicted in the government sector over the next 3 to 5 years, although some Bay Area localities have tapped many of the most attractive locations for PV deployment. The commercial building sector has more room for growth in the coming five years and beyond, but future tax policy uncertainties make predictions after 2016 difficult, particularly given the planned phase-out of the Business Energy Investment Tax Credit (ITC). Commercial growth is likely to be focused on municipal, education and owner-occupied private major commercial facilities.

### 3.3 DISTRIBUTED RENEWABLE INITIATIVES

Distributed renewables, particularly solar photovoltaics are growing quickly but from a small base. To penetrate the market more quickly, the following three fast track strategies can create leverage to accelerate distributed renewables:

- **Solar on schools**: Capitalizing on schools as a highly addressable market with significant roof space, deployment would provide both significant increase in renewable power generation but also significant cash flow value for districts.

- **Competitive Solar Employee Purchase Programs**: Aggregation employees through major employers can significantly reduce costs for residential solar and by incorporating programs as a regular benefit, such programs can provide ongoing value.

- **Clean Power Generation at waste water treatment plants**: An under-recognized opportunity, food and bio-wastes have very significant power generation potential and are especially cost-effective when combined at existing treatment sites.

#### 3.3.1 SOLAR POWER FOR SCHOOLS

**Initiative Type**: Fast track

**Opportunity**

Schools comprise an attractive market for the deployment of solar PV systems. School facilities are characterized by significant flat roof space and parking lots and typically have consistent energy demand profiles over long timeframes, making an attractive value proposition. In addition, schools can be good candidates for larger scale systems, reducing the cost of power production. A single point of ownership and decision-making can enable installations on multiple buildings at a given school campus, or even on multiple school campuses within a school district. Finally, as public...
agencies under considerable budget pressure but with extremely low probability of bankruptcy, they are frequently willing to trade payback rates in favor of cash flow advantage.

In the Bay Area and elsewhere, solar PV deployments on schools are already gaining increasing attention. PG&E has a solar schools program (PG&E 2012b) that has deployed 1 kW systems on over 120 schools within its service territories. More significantly, at least 15 school districts have engaged in large scale solar deployments across multiple campuses to reduce energy costs. This list of schools includes the East Side Union High School District (7.1 MW), San Mateo High School District (3.7 MW), and Milpitas Unified School District (3.4 MW). In addition, Mt. Diablo Unified School District is now in the process of installing 11.2 MW of PV at 51 school sites in what is likely the largest K-12 project in the US.

Districts are taking varying approaches to these projects. San José Unified School District entered into a partnership with Chevron Energy Solutions and Bank of America to build what was one of the largest solar power and energy-efficient facilities programs in K–12 education in the United States. This program includes a total of 5.5 MW of solar PV installations across 14 district sites, energy efficiency measures, and an energy education component. The program is expected to reduce energy costs by more than 30 percent and save the district’s general fund more than $25 million over the life of the system. The CSI and other tax incentives offset the total project cost by more than $11 million. A key feature of this project is the use of a PPA. Bank of America owns and maintains the solar PV equipment and sells power to the district at prices set below utility market rates through its Bank of America Public Capital Corp Energy Services team.

**Figure 4 - Mills High School Solar Installation**

Source: San Mateo High School District

The San Mateo Union High School District leveraged public funding, in keeping with most other districts in the Bay Area who have done projects. It undertook a $28 million deployment on all six of its high school campuses in 2009 utilizing voter-approved general obligation bonds. The district utilized consulting support from Sage Renewables and owns the 3.7 MW solar PV system, which was installed by SunPower Corp. using the same company’s solar panels. Other vendors provided integration management, roofing, and other services. The project included roofing upgrades and was paired with a separate energy efficiency plan. The primary objective of the project was to reduce district expenses. With the combination of solar and energy efficiency, the school district is expected to reduce energy usage by 48 percent and energy bills by 72 percent, producing $58 million in savings over the 25 year life of the system. CSI played a key role, covering 22 percent of cost.
The financial modeling factored in an expected electrical utility bill increase of 5.34 percent a year in the absence of the solar PV installation (McManus 2011).

With private financing, savings are more modest, especially early and the value is highly sensitive to the negotiated specifics. With public debt, the impact grows more quickly (Whelan 2012). Reportedly, about 40 percent of recent school projects in the state have used PPAs, while approximately 30 percent have used school deals have been general obligation bonds, with the balance utilizing subsidized bonds. Bonds are seen as the most attractive option except in cases where there is insufficient debt capacity or a low income or unsupportive community (Swezey 2012).

Distributed solar PV projects benefit the Bay Area in multiple ways. In addition to GHG emissions reductions, PV projects typically deliver general fund savings for school districts at a crucial time of state funding cutbacks. These systems provide budget predictability by stabilizing energy costs, recycling scarce public funds back into the classroom. In addition, school-based renewable energy systems can be integrated into and the science and technology curriculum, providing learning opportunities for students, staff, and the broader community.

### 3.3.1.2 Impact

The 15 known school districts that have deployed significant solar systems average 3.2 MW in peak capacity. Extrapolated across the 159 school districts in the Bay Area yields the following potential in this fast track strategy:

- **500 MW** peak capacity
- **850,000 MWh** per year

- **200,000 metric tons CO2e** averted per year (600,000 metric tons CO2e over 3 years)

Detailed analysis by San Mateo Unified School District suggests savings can be on the order of $1.3 million per year for a typical system (about $400,000 per MW per year) and a payback of 9 years. It is important to note that the cost of solar systems is dropping quickly and making payback periods continually more attractive.

### 3.3.1.3 Challenges

Deployment of solar PV on schools requires significant capital from either public or private sources, or a combination. Concerns about warranties, performance, and liabilities require concerted legal attention. PPAs in particular are complex legal agreements for which there are no broadly adopted customer standards. Financial factors include uncertainty of future utility rate increases; rapidly dropping solar PV technology costs and obsolescence risk; complex financial scenarios comparing future expected utility bills against PPA payments that may ratchet up over time; creditworthiness considerations; varied financing options with important implications arising from use of bonds, grants, rebates and leases; and investment and management of bond funds. Construction risks include decisions about which specific solar PV technologies to deploy; assessment of appropriate installation sites; possible re-roofing needs; and selecting from the myriad of competing vendors. Finally, the long operating time frame of such infrastructure projects – 20 to 25 years – coupled with the cost and relative novelty of such projects, elevates scrutiny of the development process beyond most other construction projects.

Unlike municipalities, which have more experience with energy generation and complex projects such as water treatment plants, school districts have traditionally had limited exposure to projects of this scope. The complexity is a challenge for public agencies, especially at a time of significant budget cuts and subsequent staffing reductions. District administrators also expressed concerns about the
“lack of sophistication and integrity […] despite strong contractual language” of certain vendors (not those referenced above). This latter concern may reflect the emerging state of solar PV deployment services. Industry growth is leading to many new entrants with mixed levels of expertise. Finally, performance of systems can vary from original projections based on variable design and deployment factors.

Financing structures require careful attention. Evaluation can be complicated by the limited transparency in ESCO-administered projects. To enable more robust analysis, the Lawrence Berkeley National Labs has assessed financing options for non-residential projects and developed a decision tree to assist in decision-making (LBNL 2009a).

It is also noteworthy that the CSI program has played a major role in the school deployments to date. Shrinking incentive levels, however, may lead to greater reliance on the more complex PPA model – whereby tax benefits can be captured by the private sector.

### 3.3.1.4 Key Players

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<th>Key Players</th>
<th>Examples</th>
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<tbody>
<tr>
<td>School boards &amp; administrators</td>
<td>Association of California School Administrators, California School Boards Association</td>
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<tr>
<td>Community leaders</td>
<td>Engaged leaders who can create support</td>
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<tr>
<td>Non-profit catalysts</td>
<td>KyotoUSA HELIOS project, Joint Venture Sustainable Schools initiative, US Green Building Council, School Energy Coalition</td>
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<tr>
<td>Industry</td>
<td>SolarCity, SunPower, RGS Energy, Chevron Energy Solutions</td>
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### 3.3.1.5 What is Needed

Momentum is building for schools and community colleges to install solar PV systems. Accelerating this promising trend requires enhanced customer outreach, education, and streamlined transaction protocols. An initiative in this sector can build on the work of the highly successful Santa Clara County and Joint Venture Silicon Valley Renewable Energy Procurement (REP) project which brought together 9 local governments to deploy 14.4 MW of solar with PPAs on 70 sites (the REP project is now being expanded to the Regional REP program encompassing peninsula and east bay agencies.)

To assist with stakeholder education, the California Division of the State Architect developed a solid guide for school administrators in 2009 entitled “Grid Neutral: Electrical Independence for California Schools and Community Colleges.” This publication offers step-by-step guidance to school administrators on how best to advance solar and other clean energy projects to become “grid neutral.” This can serve as a useful starting point, yet additional engagement from groups such as school administrator associations would be beneficial. Much of the early stage education has been self-organized by motivated community members, teachers, and staff. Strengthened grassroots education tools, with relevant impartial local case studies, can provide synergies with the state guide to further local community efforts. Greater transparency on cost and ROI calculations from vendors, especially ESCOs, would be of particular value.

Ultimately, school-based leadership is required to move initiatives forward. School and community college board members are especially important in the process because the scale and visibility of such efforts requires their active engagement. Elected leaders are encouraged to educate...
themselves, build support, and provide direction to senior staff on exploration and initiation of such projects. School solar project provide flagship opportunities to drive not only the benefits of solar but a broader range of efficiency and other infrastructure upgrade opportunities.

Independent, third party guidance and support is also extremely important. This is where organizations such as Joint Venture Silicon Valley (JVSV) and KyotoUSA’s HELiOS provide particular value. These non-profit organizations provide critical “free” services to agencies through community support – and can offer a more independent analysis of costs, challenges, and alternatives. As one prominent example, in November 2011 HELiOS and the National Renewable Energy Laboratory completed solar master plan site assessments for all schools in the Berkeley, Oakland, and West Contra Costa school districts. The solar master plans for these districts include financial resources and detailed models, including tax equity benefits for investors, defining opportunities to leverage private investment and reduce district and community outlays. These services – foundational education, knowledge sharing, best-practices, links to unbiased resources – can enable school leaders to gain the required information to move with confidence from a general concept to project commitment. Community and philanthropic support to scale such efforts can help build regional momentum and further reduce transaction costs.

The solar industry also has an important role to play by increasing standardization and innovation. PPA agreements can create a barrier to adoption due to their complexity and lack of commonality. SolarTech, an industry association, has played an important role by developing a prospective standard PPA (SolarTech 2012a,b) -- but not commercial providers have integrated these principles into their PPA offerings. Other opportunities for innovation include increased use of tools such as aerial assessment. Already gaining traction in residential markets, this approach could speed up assessment of solar potential for prospective customers, quickly making apparent the site-specific benefits of solar deployment.

Regional leaders can build on the HELiOS and Sustainable Schools projects to develop accelerate solar PV projects on schools and community colleges in the Bay Area. Energy services companies and major lenders can also play an important role enabling projects in district which may prefer a PPA strategy.

### 3.3.2 Solar Group-Buy Benefit Programs

**Initiative Type:** Fast track

#### 3.3.2.1 Opportunity

Nationally, an estimated 19 percent of total solar PV generating capacity is residential, following both non-residential (commercial, schools, public agencies, etc.) and larger utility-scale projects. While residential rooftop solar PV is recognized as being more costly than larger scale alternatives, it is very competitive for many customers, especially for larger residences that can use solar PV to reduce or eliminate expensive peak power consumption from the grid. The primary challenge for this residential market is reaching a highly fragmented group of customers that lack good information about their energy use and access to solar fuel. With so many vendors, technology options, and differing financing strategies, the purchase of a solar PV system is daunting for the average consumer. The due diligence required is commensurate with a major home remodel. This can dissuade prospective buyers who may lack the time or motivation to address the complexity of a project.

From the vendor perspective, barriers to market access can include uncertainties about potential customers’ ownership and credit worthiness (e.g., “underwater” mortgages), intention to sell, roof condition, variable consumer interest, and varying energy use patterns. In recent years vendors have sought to address marketing hurdles through community-based aggregation approaches - “group-buys” -
which often include single-vendor negotiated price breaks. These efforts have produced uneven results largely due to the difficulties in reaching a sufficiently large pool of prospects via community-based, often volunteer- or municipally-driven, outreach efforts. As a result, providers have since de-emphasized community-based strategies and favored channel-based solar employee purchase programs that aggregate purchases through employers. Employers can offer this as an employee benefit. For example, companies such as Hewlett-Packard, Google, and eBay have partnered with SunPower, REC Solar, and SolarCity respectively for these kinds of aggregation programs. Focusing on employers that have large groups of easily reachable prospective participants who can be quickly educated significantly reduces transaction costs.

This aggregation model was recently updated with the introduction of channel-based competitive strategies in which consumers are aggregated into a competitive pool, allowing large employers to periodically access multiple vendors. In these programs, bulk purchases are conducted through an RFP process, enabling companies to select the best vendor offering at a given point in time. This most recent form of group purchasing leads to a more competitive process and better consumer value. This kind of employee purchase program was innovated at the City of San Jose in 2011. Named SunShares, the program enabled employees to purchase solar PV or solar water heaters at significant discounts.

Competitive aggregate employee purchase programs are now underway at a number of Bay Area companies including Adobe, Bayer, Genentech, and the Silicon Valley Leadership Group. These programs are managed through an independent administrator, Group Energy, which supports employee communications and education, vendor engagement, RFP management, and all associated tracking. This strategy can ultimately be integrated as an ongoing part of a business employee benefit strategy.

**Community Solar and Solar Gardens**

Community solar programs were originally launched by municipal utilities in the Pacific Northwest. Under these programs, consumers can elect to purchase renewable energy from solar PV programs via “virtual net metering.” The Sacramento Municipal Utility District was the first utility to offer this model in California. Since 60% of urban residents are renters, and centralized installations can capture economies of scale, this is an attractive option for both customer and utility. Also known as “solar gardens”, investor-owned utilities are now also exploring this model. SB 843 was introduced in the California Legislature in 2011 to allow state-wide participation in these projects.

### 3.3.2.2 Impact

Of all the businesses with a significant presence in the Bay Area, the top 97 have over 1.8 million employees nationally. If half of the companies with a representative distribution implemented aggregate solar purchase benefits for their employees, such action in this fast track initiative yields:

- **33 MW** peak capacity added per year
- **55,000 MWh** added per year
- **13,000 metric tons CO2e** averted in first year (78,000 metric tons CO2e cumulative over 3 years)

It is important to note that such a program is repeatable annually (at least) and the declining cost of solar will make solar PV accessible to an increasing number of home owners over time. The above calculation assumes each year adds 33 MW. These systems can be deployed with zero down leases producing immediate cash benefit.
Furthermore, such deployments add to property value. A Lawrence Berkeley National Labs study showed improved home equity of $17,000 on systems of 3.1 kW capacity (LBNL 2011e).

### 3.3.2.3 Challenges

Solar employee purchase programs hold promise for making residential solar PV (and potentially solar water heating) more visible, accessible and at a lower cost. These programs face four main challenges: familiarity to decision-makers; incorporation into benefits programs; effective program design and execution; and unforeseen complexities not in the control of the program management.

Although some companies have put in place employee purchase programs, most management and benefits program administrators are not familiar with them. They may be viewed as unconventional or burdensome with limited value, especially in today’s economic climate. To gain greater adoption rates, it is important to have an executive champion who can convey the value of solar PV purchases as part of a company’s overarching sustainability strategy. Utilizing competitive, multi-vendor approaches – such as the competitive SunShares model -- can defray concerns about single-vendor influence.

Effective program design and execution is essential to yield a sufficiently large purchase pool to generate a customer-relevant discount (and vendor willingness to participate). In an early assessment of these programs, AltaTerra Research identified a set of factors that heavily influence the success of a program (AltaTerra Research 2008). Of particular importance is starting with large employers with broad reach and an appropriate employee demographic base. Other factors include ensuring a communication strategy that is not just transactional but actively engaging and fun.

Another challenge may lie in the complexities inherent to still-maturing industries that have not yet achieved the scale and sophisticated marketing mechanisms of other products and services commonly offered through employee benefits programs. Human resource directors may be reluctant to implement programs that have modest uptake or are not consistent geographically. Further, even when vendor performance is strong, local government and utility practices associated with solar deployments can make the experience frustrating and add unforeseen cost (Sunrun 2012). The cost of varied permitting and inspection processes among municipalities is a point of particular concern with the solar industry. SolarTech is playing an important role by working with local agencies and non-profit partners to encourage more standardization.

### BUSINESS PROCESS TOOLS FOR SOLAR INSTALLERS

Industry observers have noted that significant soft costs associated with residential solar deployment is due to a fragmented installation industry. This is especially true with medium-sized firms which have not achieved sufficient size to garner scale economies.

Companies such as Clean Power Finance provide integrated services to installers, including consumer financing models, solar home equity lines of credit, as well as software packages that can bring down costs and decrease the lead time of project development by connecting design and installation directly to sales and financing.

These tools can enhance quality, reduce costs, and scale financing mechanisms to improve terms.
### 3.3.2.4 Key Players

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<th>Examples</th>
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<tr>
<td>Solar Vendors</td>
<td>SolarCity, SunPower, CentroSolar, Westinghouse Solar</td>
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### 3.3.2.5 What is Needed

Solar employee purchase programs can provide enhanced corporate reputation, lower energy costs and improve home equity for employees – at very little cost to the company. They can also play a valuable role supporting corporate sustainability goals. Large technology and finance companies are ideally suited for these programs. Institutions such as hospitals, universities, and smaller firms aggregated through business associations are also good candidates.

Executive leadership is important to advancing this strategy. The organizational decision to incorporate a solar employee program may require top-level support. Clearly, the program will be more successful with visible executive participation, e.g., through featuring the program prominently at company events. It is very helpful if the program is integrated into an overall corporate strategy that promotes on-site solar PV deployment as well as a sustainability vision that provides education, generates enthusiasm, and drives employee engagement.

HR administrators and upper management focused on attracting and retaining workforce will find solar employee purchase programs particularly appealing. While these types of purchase programs are not traditionally offered, they are increasingly popular among employers as their contributions to defined benefit programs are dwindling in scope. While solar PV purchases are highly customized at this time, as the PV market expands, these purchases may become more like buying a car or a larger household appliance. Observers have also noted that these programs are likely to be most effective when bundled as a package of associated “green” benefits that may include home energy efficiency, green product discounts, outings and related features.

Finally, business associations have an important role to play. Associations can incorporate programs as member company benefits and educate businesses on the opportunities with these programs. This would enable smaller companies to participate as larger collectives. Programs can also expand the base of solar PV buyers by incorporating “friends and family” participation incentives.

### 3.3.3 Generation at Wastewater Plants

**Initiative Type:** Fast track

**3.3.3.1 Opportunity**

Power generation from organic wastes is a largely untapped resource in the Bay Area. This is primarily evident when one examines the municipal solid waste stream. Nearly 50 percent of residential solid waste stream -- and over 30 percent of the overall waste stream -- is made up of organic...
matters, half of which is high energy food scraps (CalRecycle 2008). The bulk of this waste goes into municipal landfills where it is buried and natural anaerobic processes generate methane, a potent greenhouse gas.

Figure 5 - Material Classes in California’s Overall Disposed Waste Stream

Landfill practices regarding methane vary, with some operators capturing and flaring the gas, others generating on-site power, and still others not capturing the gas at all. California regulators are tightening requirements for methane capture and incentivizing power generation (CalRecycle 2011a). As an example, the City of Santa Clara had captured methane and produced electricity at its landfill since 1986 (Staub 2011). In 2009, the municipal government worked with energy services company Amaresco to upgrade systems at the now closed landfill -- with no cost to its general fund -- in order to continue generating power even as methane flows decline.

However, capturing and utilizing methane from landfills, while valuable, is comparatively inefficient from an operating point-of-view since the gas is generated over a large area in a highly diffused manner and highly dependent on landfill conditions -- the specific composition of wastes, depths, moisture levels and landfill management practices. A high percentage of fugitive gasses are also a problem. Furthermore, many landfills in the region have reached capacity and have closed, in turn reducing power generation potential while also causing waste to be diverted over increasingly larger distances, resulting in greater GHG emissions from transport (Zito 2009). Anaerobic digestion, as discussed below, reduces greenhouse gas emissions more than 20 times as much as landfills (Kennedy/Jenks 2008).

Waste water treatment plants (WWTP) similarly receive very large volumes of organic waste. This waste undergoes a treatment process, generating residues in the form of biosolids that may be incinerated, used as fertilizer, or sent to landfills. Typically, WWTPs incorporate limited anaerobic digestion as part of the treatment process, producing methane that many facilities use to self-generate power for the energy intensive treatment plant processes (BACWA Biosolids Committee 2008). Other facilities simply flare the methane, adding to the regional greenhouse gas emission inventory.

The prime opportunity for the Bay Area lies in capturing more municipal organic waste for more efficient generation of methane at WWTPs. This strategy is already in practice at the East Bay Municipal Utility District (EBMUD) in Oakland, which has been using food waste to improve biogas production in the 12 digesters at its wastewater treatment plant since 2004. It currently generates 90 percent of the 5 MW of electrical capacity it needs to operate. In the next 2 years, EBMUD aims to bringing in 120 tons per day of post-consumer food waste which, when combined with a new 4.5 MW combined heat and power (CHP) unit, is projected to generate more than the total energy required to operate the treatment plant. This approach will allow the public agency to sell excess biogas-generated electricity back to the local electricity grid under a net metering arrangement (Hagey 2011). San Francisco generates 3.2 MW from its waste water treatment plant digesters (City of San Francisco 2012). The feasibility study for a similar food waste energy project at
Central Marin Sanitation Agency (CMSA) showed a $3.7 million capital outlay for the project with a payback of 5 to 7 years, factoring in operating costs, transport and disposal savings. The food waste would generate 230 kW of additional baseload power (Kennedy/Jenks 2008).

Figure 6 - Bay Area Wastewater Treatment Plants

Source: San Francisco Baykeeper, 2011. 11

While these strategies help accelerate renewable energy generation in the Bay Area, they do not address the growing problem of biosolid disposal. Current biosolid disposal strategies are becoming more costly and generate carbon emissions through incineration or from the transportation of biosolids to landfills. Transportation distances are climbing because of landfill closures and increasing resistance to agricultural applications of biosolids, and consequently increasing emissions.

One effort to increase energy capture and further reduce biosolid wastes is under development. A sixteen-member consortium of Bay Area public agencies in charge of wastewater treatment for over two million residents is exploring a biosolids-to-energy project to diversify available biosolids management options. Known as the Bay Area Biosolids to Energy (BAB2E) Coalition12, the project goals are to maximize the renewable energy and resource potential in biosolids and minimize greenhouse gas emissions, while diversifying biosolids management options to include alternatives that will not be dependent on agricultural use of the biosolids or the need to send biosolids to landfills. The project is aligned with state and federal initiatives to develop renewable energy resources and reduce greenhouse gas emissions. In 2011 the BAB2E Coalition received a Public Interest Research (PIER) grant of nearly $1M from the California Energy Commission for a biosolids to energy demonstration plant.

Newer innovations can enhance both economic and environmental benefits. For example, the strategies pursued by the cities of San Jose and Palo Alto will combine food waste with sewage sludge to generate methane through a digester, but then will compost the digestate with yard waste using a traditional aerobic composting process. The resulting compost can then be sold to a variety of consumers. This integration of features produce an attractive financial package. Based on the most attractive feasibility analysis performed by Palo Alto Green Energy, the facility construction showed that such a project could cost $40 million but would result in 1.4 MW of power generation and savings of over $40 million over 20 years (Palo Alto Green Energy 2012). However, even if both of these projects come to fruition, it would only cover a small portion of the total organic waste stream in Santa Clara County (de La Beaujardiere 2012).

3.3.3.2 Impact

The 9-county Bay Area generates approximately 420,000 tons of dry food waste per year from residential and

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11 http://maps.google.com/maps/ms?ie=UTF8&hl=en&msa=0&msid=109262111492176228196.00046a5b66c994c6fdd03&source=embed&ll=37.766372,-122.305298&spn=1.042177,1.757812&z=9

12 www.bayareabiosolids.com
commercial sources and at least 174,000 tons of dry biosolid waste. This waste could be processed at a subset of the 101 WWTPs in the Bay Area\textsuperscript{13}. These prospective fuel sources could yield the following potential:

- **550,000 MWh** per year
- **130,000 metric tons CO\textsubscript{2}e** averted per year (390,000 metric tons CO\textsubscript{2}e over 3 years)

It is important to note that the carbon benefit could increase by utilizing the compost in land strategies with durable sequestration. Payback rates for anaerobic digesters at WWTPs vary significantly though EPA reports project payback periods of as little as 3 years (EPA 2012).

### 3.3.3 Challenges

Challenges facing power generation from municipal waste streams include those inherent to any capital intensive infrastructure project. Compared to solar PV, the challenges are larger due to inherent concerns related to waste treatment in general: screening alternatives for toxins and biohazards; residual byproduct handling; differing technologies; cost comparison to conventional fuel; and complex financing alternatives. Differing ownership and contracting structures require flexible approaches.

Control of the food waste co-digestion streams in sufficient quantities, ideally on a long-term basis, is very important and can be a challenge (Pletka 2012). In practice, securing, handling and transporting food waste from restaurants and markets is most accessible whereas residential food wastes require local policy and significant operational adaptation that may be impractical. In some cases, whether to use food waste for energy or compost has generated public debate (de Snoo 2012) however anaerobic digestion of food waste produces energy, whereas composting consumes energy in an aerobic process (Kennedy/Jenks 2008).

Nevertheless, the savings potential and payback rates can be very attractive - and the fundamental concepts and costs involved are relatively well known to most administrators of waste treatment facilities. In the case of anaerobic digesters, which utilize organic solid waste, new arrangements may be needed between waste haulers and wastewater treatment facilities, though they are generally mutually financially advantageous, given rising landfill fees.

Yet these projects suffer from limited visibility to the general public, being less well known and “glamorous” than solar systems in particular. As a consequence, they are less understood by the community at large, making the task of building stakeholder support more difficult. For example, there is often an assumption that burning methane from landfills or treatment plants adds net new carbon to the atmosphere. In fact, there is no net new carbon released into the atmosphere from these applications from a short term perspective - since that carbon was absorbed by the plants that make up the organic solid waste in the first place.

The limited visibility and appeal to stakeholders can factor into political challenges. In Palo Alto, the effort to allocate a 10-acre portion of land for the proposed anaerobic digester resulted in a major political fight. The land was an extremely degraded plot in a large 126-acre former dump – ideal in many respects – but had been allocated 5 decades ago to become a public park. Allocating the land for the digester required a public vote. This engendered a major political fight, with community leaders and environmentalists on both sides of the issue; however, the measure allocating the land for the digester passed decisively in 2011.

\textsuperscript{13} http://maps.google.com/maps/ms?ie=UTF8&hl=en&msa=0&msid=10926211149217628196.00046a5b66c994c60dd03&source=embed&ll=37.766372,-122.305298&spn=1.042177,1.757812\&z=9
### 3.3.3.4 Key Players

<table>
<thead>
<tr>
<th>Key Players</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitation districts, municipalities</td>
<td>Bay Area Clean Water Agencies (<a href="http://www.bacwa.org">www.bacwa.org</a>) and individual agencies</td>
</tr>
<tr>
<td>Bay Area Biosolids to Energy</td>
<td>A collaboration with 16 regional agencies on a regional biosolids disposal and energy generation facility (<a href="http://www.bayareabiosolids.com">www.bayareabiosolids.com</a>)</td>
</tr>
<tr>
<td>Elected and Civic Leaders</td>
<td>Leaders who can mobilize community and agency support</td>
</tr>
<tr>
<td>State and Federal Agencies</td>
<td>Including the US Department of Energy (www1.eere.energy.gov/wip/solutioncenter/financialproducts/espc.html)</td>
</tr>
<tr>
<td>Energy Services Companies &amp; Energy Service Coalition</td>
<td>Honeywell and Johnson Controls. Energy Service Coalition (<a href="http://www.energyservicescoalition.org">www.energyservicescoalition.org</a>), which provides model RFPs, educational tools, model contracts, funding strategies, project tracking guidelines, and other resources.</td>
</tr>
</tbody>
</table>

### 3.3.3.5 What is Needed

Waste water treatment plants are relatively small in number and geographically clustered. Sub-regional interagency taskforces organized on the peninsula, East Bay, Richmond-Marin and Vallejo areas or through the Biosolids to Energy collaborative could be an effective means to educate and empower plant directors and municipal leaders. Local projects, such as those at the East Bay Municipal Utility District and Central Marin Sanitation District, can be used as case studies.

These projects are a good fit for energy services companies (ESCOs) such as Chevron Energy Solutions, Honeywell, Johnson Controls, or Siemens. These companies have experience working on complex energy projects in the municipal sector. They can bring both finance and technology expertise to the table. Most importantly, government agencies can utilize performance-based contracts with ESCOs that help guarantee project performance, reducing operational and financial risk.

Aggregate purchasing of necessary hardware, such as digesters and other equipment, may be possible. This portfolio of projects may allow for aggregated service and financial contracts, including transportation of waste fuels and related equipment maintenance.
California is the national leader in energy efficiency but enormous opportunity for energy and cost savings remain. Significant commercial segments remain underserved by government, utility, and private sector programs. Advancing solutions with high rates of return such as LED street lighting and other outdoor lighting applications as well as building energy management and demand response can provide gateways for greater savings. Further finance innovation also remains essential.

4.1 Defining the Domain

The Bay Area has roughly 1 billion square feet of commercial real estate\(^\text{14}\). The U.S. Energy Information Administration (EIA)’s Commercial Building Energy Consumption Survey (CBECS) defines commercial buildings as all buildings in which at least half of the floor space is used for a purpose that is not residential, industrial, or agricultural, so they include building types that might not traditionally be considered ‘commercial,’ such as schools, correctional institutions, and buildings used for religious worship.

Like commercial buildings throughout the country, these buildings are characterized by significant variation in building types and uses. Schools, hospitals, offices, hotels, and retail each have extremely different energy use profiles.

By virtue of total volume, the two largest energy-consuming commercial sectors are offices and retail structures (DOE 2008b). For any given building (excluding industrial facilities), hospitals and supermarkets are generally the most energy-intensive\(^\text{15}\). Lighting and heating, ventilation, and air conditioning (HVAC) systems are the single largest end-uses of electricity in commercial buildings in California. Commercial buildings vary significantly in usage patterns, age, and ownership structures. According to the 2003 CBECS, ownership patterns break out according to these four primary categories: private sector owner-occupied (33%); private sector leased (43%); government-owned (21%); and unoccupied (3%). Table 2 shows the distribution of building uses and corresponding electricity and natural gas percentages. Nationally, \(^{\text{14}}\) Estimated based on statewide commercial square footage and percentage of state employment in the Bay Area according to the CA from Dept of Finance.

\(^{\text{15}}\) U.S. supermarkets use on average around 50 kilowatt-hours (kWh) of electricity and 50 cubic feet of natural gas per square foot per year, or more than $4 per square foot in average annual energy cost. For an average-sized (50,000 square foot) store, this equates to more than $200,000 in energy annual costs (Energy Star 2012e).
approximately 20 percent of today’s commercial buildings were built in the 1990s, while 46 percent were built between 1960 and 1989 (DOE EIA 2003). After a substantial slowing due to the current “Great Recession,” new construction of commercial buildings is beginning to accelerate again, particularly in Silicon Valley, with over 400,000 square feet under construction in new office space alone as of Q4 2011 (Kidder Mathews 2011).

Table 2 - Building Uses for PG&E Service Area

<table>
<thead>
<tr>
<th>Building Use</th>
<th>% of Total Size</th>
<th>% of Total Electricity</th>
<th>% of Total Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Office (&lt; 30k SF)</td>
<td>6%</td>
<td>7%</td>
<td>4%</td>
</tr>
<tr>
<td>Large Office (&gt;= 30k SF)</td>
<td>15%</td>
<td>20%</td>
<td>13%</td>
</tr>
<tr>
<td>Restaurant</td>
<td>3%</td>
<td>9%</td>
<td>21%</td>
</tr>
<tr>
<td>Retail</td>
<td>14%</td>
<td>13%</td>
<td>4%</td>
</tr>
<tr>
<td>Food Store</td>
<td>3%</td>
<td>9%</td>
<td>3%</td>
</tr>
<tr>
<td>Refrigerated Warehouse</td>
<td>3%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Unrefrigerated Warehouse</td>
<td>8%</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td>School</td>
<td>10%</td>
<td>5%</td>
<td>7%</td>
</tr>
<tr>
<td>College</td>
<td>4%</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>Health</td>
<td>3%</td>
<td>6%</td>
<td>13%</td>
</tr>
<tr>
<td>Lodging</td>
<td>6%</td>
<td>4%</td>
<td>8%</td>
</tr>
<tr>
<td>Miscellaneous*</td>
<td>24%</td>
<td>17%</td>
<td>20%</td>
</tr>
</tbody>
</table>

*churches, gas stations, prisons, movie theaters, and other.

Source: 2006 CEC’s Commercial End Use Survey

Lighting, heating, ventilation, and cooling systems comprise the majority of energy consumption in commercial buildings. A study by LBNL indicates that a reasonable estimate of economic savings from “green building” practices in existing commercial buildings nationally is approximately 34 percent of electrical use and 35 percent for natural gas (LBNL 2008). Typical commercial sector energy efficiency measures include: efficient cooling equipment (chillers, central AC); space and water heating equipment; refrigeration equipment & controls; improved interior and exterior lighting and controls (occupancy sensors, daylighting, etc.); IT and equipment power supplies; energy management systems, programmable thermostats and duct insulation. Of these measures, lighting, refrigeration, and HVAC systems have the biggest impact on electricity savings, while space heating has the biggest impact on natural gas consumption (LBNL 2008, PNNL 2009).

The Bay Area features a comparatively high concentration of energy efficient and green commercial buildings. An estimated 30 percent of California’s federal EPA’s Energy Star-certified commercial floor space is in the Bay Area – over 136 million square feet in 722 buildings (Energy Star 2012b). In addition, at least 470 buildings are certified by the U.S. Green Building Council (USGBC) as meeting criteria of being recognized as Leadership in Energy and Environmental Design (LEED). It is estimated that LEED-certified buildings in the Bay Area total over 86 million square feet. (It is likely there is a large overlap between LEED and Energy Star certified buildings). Another 831 buildings representing nearly 50 million square feet are in process of LEED certification (Energy Star 2012d). For the most part, these buildings are recently built Class A properties certified as green buildings at the time of construction. However, since only about three percent of all commercial space is newly-built or renovated in any given year (Next10 2010), the bulk of the need for efficiency upgrades to reduce greenhouse gas emissions in the commercial segment rests within the existing building stock. While LEED ratings may incorporate a wide range of varied efficiency measures, studies indicate an average energy efficiency gain of just 10 to 25 percent (Wikipedia 2012).

### 4.2 Market Context

Even as overall commercial building energy consumption has grown in California for the last two decades, total energy use within the sector has remained essentially flat on a square foot basis due to sustained gains in building energy efficiency (Next10 2010).
At the federal level, there are a range of different green building incentive programs. Among them are tax deductions on energy efficient components and accelerated depreciation on smart meters and smart grid systems.\textsuperscript{16} Federal programs place a heavy emphasis on new technology development and early commercialization investments as well as partnership programs and information resources.\textsuperscript{17} The U.S. Department of Energy Commercial Building Initiative (CBI) serves as an umbrella for these offerings and includes among its participants the Retailer Energy Alliance, Commercial Real Estate Energy Alliance, and Hospital Energy Alliance. Each of these organizations is focused on different building segments, with whole-building demonstration project collaborations. Among the targets of these efforts is the development of marketable Zero-Net Energy Commercial Buildings by 2025 (DOE 2009b).

California has a long-term goal to bring 50 percent of all existing commercial buildings to zero net energy (ZNE) by 2030 through the implementation of deep energy efficiency retrofits coupled with a greater reliance upon clean distributed energy generation. State energy efficiency policy and implementation measures are driven by both the CEC and CPUC.

The CEC administers the building energy efficiency standards known as “Title 24,”\textsuperscript{19} which governs the design and construction of buildings through standards that ratchet up over time and includes elements such as insulation and windows ratings, as well as appliance efficiency standards.\textsuperscript{20} California implemented these trend-setting standards in 1978, which reaped benefits across the entire U.S. For example, when California instituted efficiency standards for refrigerators, manufacturers began to produce a more efficient product nationally, which then reduced energy consumption in all 50 states. These standards apply at the time of construction of a building or the manufacturing of an appliance. The most recent update to Title 24 building standard was developed in 2008 and applies to all buildings whose building permit was submitted on or after January 1\textsuperscript{st}, 2010. Generally speaking, these building standards are updated on a triennial basis and incorporate the latest technology advances in green building technology. In addition, in 2010 the state adopted a green building standards code CalGreen which provides for a number of elective energy efficiency measures.

However, while energy efficiency standards apply at the time of upgrades, the state lacks energy efficiency standards that apply to existing building stock which are not undergoing construction projects, a major gap in state regulations. At the local government level, public agencies have also adopted codes requiring LEED ratings for new buildings and, in some cases, tenant improvements. As of 2010, 24 local governments have required LEED Certified or better for new construction, most of which are LEED Silver, and 20 have some requirement for tenant improvements (Bay Area Climate Collaborative 2010). Even so, the link between lower levels of LEED certification and energy efficiency can be tenuous, particularly compared to the most rigorous standard of “zero net energy.”

While the CEC’s primary role is standard-setting that impacts energy consumers statewide, the CPUC regulates the state’s investor-owned utilities by including requirements for a very wide range of incentive and outreach programs for energy upgrades such as PG&E’s Energy Watch program.\textsuperscript{21} The CPUC has authorized one of the most aggressive energy efficiency programs in the country for PG&E, Southern California Edison, and San Diego Gas & Electric. In total, $3.1 billion in ratepayer funds are being invested in programs designed to reduce consumption. This funding represents a 42 percent increase compared to the previous three-year program cycle. The end

\textsuperscript{16} http://www1.eere.energy.gov/buildings/tax_commercial.html
\textsuperscript{17} Resources include the new “design guides” for medium and big box retail, small and medium office buildings, and K-12 school buildings http://www.ashrae.org/standards-research--technology/advanced-energy-design-guides/50-percent-aedg-free-download
\textsuperscript{18} DOE defines “Zero-Net Energy” as buildings that use cutting-edge efficiency technologies and on-site renewable energy generation to offset their energy use from the electricity grid.
\textsuperscript{19} http://www.energy.ca.gov/title24/
\textsuperscript{20} http://www.energy.ca.gov/appliances/
\textsuperscript{21} http://www.pge.com/energywatch/
The goal of such CPUC incentives is to create a viable market for net zero energy homes by 2020 and net zero energy commercial buildings by 2030 (CPUC 2009).

The market for efficient, green buildings is rapidly growing. Webcor Builders reports that buildings meeting the LEED Silver ratings cost no more to build than buildings built without green measures. Because of this cost dynamic, these LEED ratings are now a requirement in class A commercial buildings, and are also being applied to even older buildings for whom competitive pressure frequently leads to upgrades (Williams, P. 2011). That competitive pressure is reflected in the price premiums being paid for certified properties, though these factors also correlate to these properties being predominantly class A properties with professional property management support. Reviews of national research indicate rental premiums of 6 percent and 5 percent for LEED Gold and ENERGY STAR certification and sales price premiums of 35 percent and 31 percent, respectively (LBNL 2011b). More efficient buildings also maintain higher occupancy rates (Next10 2010). Concurrently, capital investments in companies focused on energy efficiency measures, technologies, and projects continue to see strong investment, attracting $646.9 million out of $4.9 billion in 2011 cleantech venture capital (Ernest & Young 2012).

While retrofits in private buildings can be attractive from a cost-reduction and tenant improvement perspective, for green branding, and for workforce productivity gains, significant barriers to widespread implementation still exist. One of the largest is the tension between who pays for the retrofits and who reaps the financial benefits (known as the “owner-agent” dilemma). This long-standing challenge is a consequence of the structures and arrangements of leasing contracts that inherently create disincentives for energy efficiency investment (EPA 1994). Table 3 below is a summary of different leasing structures and how they can be renegotiated to incentivize investment in energy efficiency, boosting the acceptance and adoption of all the projects recommended in the following section.

Table 3 - Summary of Leasing Structures for Commercial Building

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Net lease</td>
<td>Tenant</td>
<td>Property owner</td>
<td>Increase in rent that is less than anticipated energy savings</td>
<td>Tenant: energy savings Property owner: higher rent</td>
</tr>
<tr>
<td>Gross lease</td>
<td>Property owner</td>
<td>Property owner</td>
<td>None</td>
<td>Property owner: energy savings payback Possible increase in NOI raises property value</td>
</tr>
<tr>
<td>Fixed-base lease</td>
<td>Property owner until pre-set limit, then tenant</td>
<td>Above limit: tenant Below limit: property owner</td>
<td>Unclear; reevaluation of energy limit may be needed</td>
<td>Tenant if consistently above limit. Property owner if, before upgrades, tenant is consistently below limit.</td>
</tr>
</tbody>
</table>
Efforts underway to address owner-agent challenges include “green leases” which establish greater alignment and standards between owners and tenants. However, other barriers include: market fragmentation, split incentives, upfront capital costs, difficulty securing credit, lack of confidence in efficiency outcomes, and information gaps. Simple and immediately beneficial actions such as benchmarking with ENERGY STAR Portfolio Manager are rarely used. Even among those willing and able to act on the value proposition of green buildings, competing priorities typically narrow the scope of desirable payback periods to three years or less for most building managers (Pike Research 2010a). This short payback requirement significantly constrains the range of potential measures and strategies that can be deployed under current circumstances.

Advancing projects requires extensive “hand-holding” for building or energy managers who typically are focused on addressing occupant comfort issues and have little time or expertise for building business cases. However, programs that have gained a measure of success typically provide end-to-end “turnkey” services. Turnkey services include identification, quantification, qualification of energy-saving measures, securing financing and finally subcontracting execution on those measures. Energy service companies (ESCOs), the largest historical provider of energy efficiency upgrades (Deutsche Bank 2012), provide such turnkey services including providing debt financing with guaranteed “performance-based” contracts. This has traditionally worked well with very large corporate and institutional customers that have the ability, credit worthiness, and desire to take on debt and has resulted in very large efficiency projects. In practice, ESCOs have focused overwhelmingly on the government and municipal-university-school-hospital (MUSH) market, with over 90 percent of their revenues from those sectors (Pike Research 2012).

The limited penetration into the much larger private commercial property space leaves major gaps in the market. Other financing options are emerging and playing a key role. Property Assessed Clean Energy (PACE), On-Bill Finance (OBF), and Efficiency Service Agreements (ESA) provide key options and are discussed more fully below. Locally, programs such as Oakland Shines are cited as models for turnkey services which bring together information, support and execution for commercial customers.

“The potential for cost-effective energy efficiency investments in the US is on the order of $150 billion a year” -- Capital E

4.3 Commercial Initiatives

Given potential savings and proven technologies for achieving energy saving reductions in commercial buildings, it may seem surprising that market penetration of these solutions remains very early stage.

- **Light Emitting Diode (LED) Street Lighting:** Streetlights form one of the largest “low-hanging fruit” in a highly addressable market. The Bay Area has an estimated 700,000 streetlights. Scaled deployment of LED streetlights is occurring in other parts of the country, and numerous Bay Area local governments have piloted select deployments. Greater durability and demonstrated significant efficiency create an immediate fast track opportunity. Bay Area deployments can leverage scale for improved purchase and financing terms

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22 See http://sustainca.org/green_leases_toolkit


24 www.oaklandshines.com
and consequently will further accelerate the price improvement on this key technology to make it penetrate the market more quickly.

- **High ROI Upgrades for Leased Offices:** High ROI improvements on common areas like lighting can provide gateway to further improvements, especially in the mid-tier commercial leased office space where efficiency upgrades have significant room for growth. Individual measures can also be bundled with building energy management systems (BEMS), which gather and present data and automate energy savings, helping to uncover additional savings opportunities for further action. BEMS can also be easily integrated with automated demand response to deliver significant energy savings and potentially enhanced integration of renewable energy. A combination of outdoor LED lighting and controls, BEMS, and Auto-DR provide a portfolio of high ROI opportunities for the mid-tier commercial lease market.

- **Mid-Tier Commercial Finance Pool:** This initiative is a key enabler to broaden the availability and marketing of financing tools and business models for mid-tier owner-occupied buildings. It is ideal for owners that cannot self-finance or take on new balance sheet liability for energy efficiency improvements. It expands the Efficiency Service Agreement (ESA) model, in which the customer pays for energy savings rather than buying and managing new efficient assets, and leverages and complements other existing or emerging financing products like property assessed clean energy (PACE), on-bill financing (OBF), and on-bill repayment (OBR) to create a robust market of financing options in the commercial building space.

### 4.3.1 LED Street Lighting

**Initiative Type:** Fast track

#### 4.3.1.1 Opportunity

Lighting is widely recognized as the largest, most accessible energy efficiency opportunity today. In a study by the Electric Power Research Institute (EPRI 2009) the achievable potential energy savings in commercial lighting is over 12 billion kWh in the western states by 2030, far in excess of any other single energy efficiency measure. While numerous competing lighting technologies exist, LED technologies provide the strongest overall opportunity due to exceptional efficiency gains and dramatic and accelerating cost reductions (Summit Electric Supply 2011), paralleling the experience with its parent technologies, semiconductors.

Figure 7 - LED streetlight upgrade

Recent DOE studies have shown that the costs of LED streetlights have been decreasing 20 percent annually (DOE 2008). Furthermore, new investment by lighting companies in technology advances is overwhelmingly going to LED (Pike Research 2011c), which now claims an estimated 85 percent to 95 percent of total lighting research and development.

While LED lighting is still not cost-effective for every application, LEDs have a very strong ROI today as replacements for high-pressure sodium (HPS) and metal halide (MH) lighting typically used in roadway, outdoor area,
and large indoor applications. All of these market segments have a very high usage of inefficient lights (Figure 8) - and the US Department of Energy’s (DOE) GATEWAY demonstration program has highlighted high-performance LED technologies that can cost-effectively replace HPS and MH fixtures. (DOE 2011b). The cost benefit of LEDs comes both from lower energy use and substantially greater durability. In addition, light quality is typically substantially improved for these applications. Following detailed analyses, including resident “before and after” evaluations, the cities of San Francisco, Oakland and San Jose all selected LEDs as their technology of choice going forward.

Figure 8 - LED Prevalence in the Outdoor Sector – U.S.

Source: DOE 2010 U.S. Lighting Market Characterization (DOE 2012b)

Savings in specific applications can be dramatic. Los Angeles, California is currently in the process of converting its entire streetlight inventory (140,000 fixtures) to LEDs. To date, the city has replaced over 75,000 units, resulting in annual energy savings of over 33 million kWh and avoided energy costs of almost $3.0 million per year. The project has led to a reduction of almost 20,000 metric tons of carbon dioxide equivalents (MTCO$_2$e) per year. Installed LEDs have realized savings of over 60% of baseline fixture’s energy use (City of Los Angeles 2012). The estimated total project cost is $57 million; the city secured a 7-year $40 million loan, along with rebates totaling $16.4 million. Estimated annual energy and maintenance savings once the project is complete is $10 million, resulting in an expected payback of roughly seven years (Clinton Climate Initiative 2011). This is currently the largest LED installation in the country.

Streetlights form one of the largest “low-hanging fruit” in the region with an estimated 700,000 streetlights. Roughly half are owned and maintained by utilities, primarily PG&E, and the rest are owned by municipalities. In December 2011, as part of the Next Generation LED Street Lighting Initiative the BACC and partner Energy Solutions surveyed cities and counties in the Bay Area to evaluate inventory and interest in LED streetlight upgrades. The 58 (out of 109) agencies that responded had more than 290,000 non-decorative streetlights in their inventories. Respondents indicated that more than 240,000 of the existing fixtures would be converted in the long term, with many agencies indicating they would like their conversions to be complete by 2015.

Rapid scaling of LED manufacturing has enormous implications for maximizing the cost/value curve. Accelerated large-scale deployments in higher-value markets like the Bay Area can most rapidly bring down global manufacturing costs so that other regions of the world can more quickly take advantage of LED economies.

### 4.3.1.2 Impact

There are two major segments in lighting with immediate opportunity: parking lots and streetlights. Because these segments require different strategies and have different benefit profiles, parking lot lighting is addressed in the next initiative.
In this fast track initiative, targeting municipally-owned streetlights, estimated at approximately 400,000, would yield:

- **122,000 MWh** in energy savings per year
- **30,000 metric tons CO2e** averted per year (90,000 metric tons CO2e over 3 years)
- **1,011 job-years**

Annual cost savings are approximately $15 million per year. Simple payback of streetlight upgrades is estimated at 4.6 years.

### 4.3.1.3 Challenges

The large number of agencies who are planning conversion projects in the near future is a clear indication that agencies are confident that LEDs present an attractive alternative to the existing technology, and that converting to LEDs is a priority. While agencies are prioritizing conversion projects, there are some barriers to adoption. The most prominent barrier is the high up-front cost associated with upgrades. Nearly half the respondents to the BACC survey cited access to funding or financing as a significant barrier to implementing conversion projects. A related cost factor is staffing. With recent budget cuts and subsequent lay-offs, the remaining local government staff is exceptionally oversubscribed. Securing staff time for what can be a technically complex project can be very challenging.

An additional area of concern relates to standardization and performance. LED technologies are relatively new to the high-volume markets. There are many products available, and it can be difficult even for sophisticated agencies to identify which products offer the right features at the highest value. In addition, the relative novelty of LED lighting, when compared to the century-old incandescent bulb, has prompted many new and often inexperienced companies to enter the LED market. This market dynamic has resulted in a very uneven quality in LED lighting fixtures.

Finally, long-term performance is an area of concern for some. While LED fixtures are rated to last 3 to 7 times longer than HPS fixtures, LED streetlights have not been demonstrated for their entire rated lifetime. Should fixtures not perform as expected, the financial benefits will not be as strong.

### 4.3.1.4 Key Players

<table>
<thead>
<tr>
<th>Key Players</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local governments &amp; Regional agencies</td>
<td>Association of Bay Area Governments, Metropolitan Transportation Commission, California Statewide Communities Development Authority (CSCDA)</td>
</tr>
<tr>
<td>Non-profits</td>
<td>Bay Area Climate Collaborative</td>
</tr>
<tr>
<td>Utilities</td>
<td>Pacific Gas &amp; Electric</td>
</tr>
<tr>
<td>Turnkey Providers</td>
<td>Pacific Gas &amp; Electric, Chevron Energy Solutions, General Electric</td>
</tr>
<tr>
<td>Client consultants</td>
<td>Energy Solutions</td>
</tr>
</tbody>
</table>

### 4.3.1.5 What is Needed

Clearly, there is significant interest to move forward among a large number of local governments. The key is addressing the specific barriers local governments are facing. Financing can be secured through several options. Small agencies may wish to utilize PG&E’s on-bill financing which provides for zero percent financing up to $250,000\(^{25}\), medium-sized agencies can utilize the California Energy Commission’s energy efficiency fund\(^{26}\) which offers financing of up to $3 million at 3 percent with variable terms that guarantee cash positive projects, and finally large agencies with over 10,000

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\(^{26}\) [http://www.energy.ca.gov/efficiency/financing](http://www.energy.ca.gov/efficiency/financing)
streetlights may be best served by large scale bond or private finance. Up-front costs may be further aided by executing collaborative procurements to leverage scale for improved purchase terms. ABAG and CSCDA are among the agencies that can assist local governments with securing financing and MTC is exploring an incentive program tied to streetlights.

Staffing challenges can be addressed through the use of turnkey programs. These programs offer end-to-end services including arranging financing, managing procurement, and directing deployment. PG&E offers a turnkey streetlight upgrade program with extensive experience in the region. PG&E’s program offers close integration with management of incentives, data cleanup and other key project areas. Numerous other private providers also offer these services.

Standards, and the confidence they bring in the technology solutions, are rapidly being address through a number of guidance efforts that provide important tools for selecting quality lighting. These include the DOE’s CALiPER program, guidance from the Illuminating Engineering Society, and, for streetlights, new specifications from the DOE-supported Municipal Solid-State Lighting Consortium (MSSL Consortium). Leveraging of these new guidance options is needed to address quality concerns.

Further education is required for all of these options and non-profit catalysts are playing an important role. Non-profit organizations such as the BACC, can bring together local governments for education, the latest information, and organize aggregate procurements which reduce both the transaction costs and improve the purchase terms for local governments as has been done with the Santa Clara/Joint Venture Renewable Energy Procurement Project (as discussed in the prior chapter) and other similar efforts.

4.3.2 LEASED OFFICE HIGH ROI UPGRADES

Initiative Type: Gateway

4.3.2.1 Opportunity

In the commercial building sector in the Bay Area, office space comprises the largest single building use after restaurants, the majority of which was built prior to stringent building efficiency standards (CEC 2006). Within office space, the highest concentration of ownership is the non-owner occupied segment, known as the commercial office lease market (Deutsche Bank 2012). As described earlier in Table 6, the net leasing structure of this market means that the tenant pays the utility bills while the property owner invests in retrofits. In much of this market, however, the decision-making authority for energy efficiency lies with large organizations like Real Estate Investment Trusts, fee-based property management companies, and private and publicly traded real estate firms instead of building owners (Deutsche Bank 2012). As a result, decision-making for a large proportion of commercial leased office space (as well as retail and other commercial space) is actually concentrated among a few major firms, which provides an opportunity to engage in targeted outreach and partnerships to accelerate near-term retrofits in this market.

Based on information from the building and efficiency industries, much of the class A (higher rent) office buildings in the Bay Area are already being well-served with efficiency upgrades, including upgrades to meet LEED or other green building certification (Williams 2011). As a result, Class B office buildings, which make up approximately half of the regional square footage, have more opportunity and need for targeted retrofit initiatives.

One potential strategy is to advance an initiative of high ROI upgrades that can lead to deeper retrofits. On-ramping new customers with outdoor LED lighting and controls, either alone, or paired with building energy management systems (BEMS), for example, may be a good approach for a broad

27 http://www.pge.com/mybusiness/energysavingsrebates/rebatesincentives/relighting/lightemittingdiodes/ledturnkey

28 http://www1.eere.energy.gov/buildings/ssl/consortium.html
effort targeting the class B commercial lease office space. These high ROI upgrades which emphasize energy use affecting all tenants help overcome the status quo alternative, which may be particularly strong in the sector due to the split incentives, third-party decision-making, and capital constraints. BEMS, which provide high ROI alone by gathering and presenting data and automating energy savings, also help to uncover additional savings opportunities for further action. They can also be easily integrated with automated demand response (Auto-DR), which shifts power consumption to times when energy demand and prices are low. With some building-specific operational adjustments, Auto-DR can deliver significant energy savings as well as potentially enhanced integration of renewable energy. A step-by-step approach beginning with lighting and controls or BEMS, or a bundled effort with Auto-DR, can present high ROI opportunities for these commercial buildings.

“LED parking lot lights consistently use 60–70% less energy than standard technologies” — US DOE

As discussed earlier, lighting is widely recognized as by far the largest, most accessible energy efficiency opportunity today (EPRI 2009). A move to LED lighting can be a fastest-to-deploy strategy within the commercial sector, as it is much simpler to execute and has much lower transaction cost than many efficiency measures. It is also far easier to finance than more complex full-scale approaches featuring less certain payback timetables. In addition, LED lighting upgrades do not close the door for future equipment replacement cycles in bigger (and more comprehensive) energy efficiency packages. As the price declines and post-LED standards are beginning to emerge, rapid-cycle equipment replacement may become more common, as is the case with contemporary personal computers.

In addition or in conjunction with LED lighting and control upgrades, the mid-tier commercial lease sector could benefit from an acceleration of Building Energy Management (BEMS). Studies indicate that simply providing information-rich feedback alters behavior in favor of beneficial action. Energy bills alone provide insufficient information for most consumers, as they do not answer basic questions such as whether the bill amount is normative or unusual relative to prevailing climatic conditions, for example, or what actions may be most appropriate (and cost effective) to reduce costs.

BEMS are helping to provide much greater visibility into energy economics and potential efficiencies at the individual facility level. BEMS provide monitoring and control of energy consumption (and potentially distributed generation) by providing real-time data on building equipment and controls, lighting, and HVAC systems including proactive and prioritized system fault notifications and cost analytics of inefficiencies and upgrades. The data reporting and transparency they provide enable rapid identification of equipment that is underperforming relative to expected specifications — identifying opportunities for adjustments or, if necessary, replacements. This intensive approach to continuous monitoring and improvement is sometimes defined as “continuous commissioning” (Figure 9).

Figure 9 - Continuous Commissioning Benefits (Conceptual)

29 A promising new technology is organic LEDs
In a detailed study by Microsoft Corporation, LBNL and Accenture, the benefits of an advanced “smart” BEMS were evaluated in its early stages of implementation. In the first half of 2011, Microsoft deployed BEMS technologies from three different vendors across 13 buildings representing 2.6 million square feet within the company’s campus. These buildings varied in age from almost new to over 20 years old. Annual energy cost savings from continuous commissioning enabled by automated fault detection alone may exceed $1 million for Microsoft. Among the conclusions, a BEMS can be established with an upfront investment of less than 10 percent of annual energy expenditures, with an expected payback period of less than two years\(^\text{30}\). This is consistent with other research showing rapid paybacks (Accenture 2011, Bloomberg 2011, Greentech Media 2011, Novar 2011, Pike Research 2010d).

BEMS are especially well-suited for large facilities that operate long hours and have fixed budgets but increasingly BEMS tools such as those by Serious Energy and SCIEnergy are being offered on a “software as a service” model, simplifying deployment and making them more applicable to a broader range of buildings. PG&E is currently working with C3, a SaaS BEMS company, to develop state-of-the-art reporting systems for commercial customers in California. This software, which monitors energy use via smart meters, is being tested on PG&E facilities and four other large customers in the Bay Area. (PG&E Next100 2011a). Penetration rates for BEMS vary significantly with some vendors estimating 50-80 percent utilization in buildings over 100,000 square feet (Bloomberg 2011) but less than 10 percent for buildings below this size, indicating a significant opportunity among the mid-size buildings sector.

\(^{30}\) The BEMS immediately identified costly long-standing faults that had previously been unnoticed. One example was a faulty control code for an air handler’s chilled water valve resulting in the valve always being 20 percent open, wasting several thousand dollars in energy. This issue was not easily visible before, but the analytics software was able to detect it immediately.

Another opportunity that has the attention of large companies with very large energy bills — but less focus in the mid-tier range — is demand response. Demand response (DR) programs encourage commercial businesses to reduce their electricity use during periods of peak demand, reducing the need for costly and more polluting\(^\text{31}\) fossil-fueled “peaker” plants. With appropriate automated controls, “DR curtailment events” can be scheduled with advanced notice just like generation resources on the power grid. While demand response does not currently have wide-scale deployment, it is increasingly likely that it will be integrated into Title 24 and will gain traction in large commercial settings without significant intervention due to clearer economic benefit and available expertise. As a result, the proposed Bridge strategy focuses on mid-sized commercial opportunities.

In California, DR programs have been in place for years through utilities and third-party aggregators, traditionally focused on large industrial consumers. Conventionally, the

\(^{31}\) PG&E peak and non-peak period emissions varies from 0.67 tons CO\(_2\) per MWh for summer peak power compared with 0.49 for summer off-peak (CESA 2010).
economic benefits have only accrued to consumers large enough to shed 300 to 500 kW during a peak load event (Anthony 2012). With demand charges, however, shedding even marginal demand at particular times can have a significant impact on monthly utility bills, even for smaller commercial customers.

Still, DR has historically been relatively “low tech,” often managed by person-to-person requests for curtailment of designated processes to mitigate generation vs. load imbalances. These non-automated processes resulted in an uneven level of participation, relegating this resource as a minor enhancement to the power grid due to its limited reliability, at least in the past (Global Energy Partners 2010). Lawrence Berkeley Labs, PG&E, and other partners have developed fully-automated systems (auto-DR) with open protocols known as OpenADR. With OpenADR, any party on the grid can participate by responding to utility or aggregator signals and curtailing demand with customer-approved, pre-programmed rules, ensuring guaranteed response times to DR events. Through OpenADR, any load connected to the power grid can participate, dramatically increasing the potential scale of available resources. Auto-DR is a gateway that connects properties to a broad set of integrated demand-side efficiency opportunities, and sets the stage for related technologies such as microgrids and “virtual power plants.”

PG&E provide incentives for auto-DR which include deploying BEMS and related technology with up to $250 per kilowatt of avoided electricity demand capacity (PG&E 2011b). California is developing programs to further develop incentives for auto-DR. Several Bay Area startups such as Gridium and AutoGrid are developing and deploying light-weight SaaS demand response and energy management to reduce demand charges using these new protocols.

**4.3.2.2 Impact**

The analysis assumes a strategy to deploy LED outdoor lighting and controls across commercial and retail parking lots, and BEMS and auto-DR in the mid-tier leased commercial office market. The combined impact of fast-payback “gateway” measures — targeting 50,000 surface parking lights on mid-sized commercial, older leased office space, BEMS deployment with 15 percent energy savings realized, and auto-DR deployment - is as follows:

- **59,500 MWh** electricity per year
- **51,000 therms** natural gas per year
- **15,000 metric tons CO2e** averted per year (46,000 metric tons CO2e over 3 years)

Annual cost savings for lighting are approximately $2 million per year and provide ancillary benefits such as better visibility and a decrease in the number of theft incidences (DOE 33). Electricity market structures are also critical to capturing the full value of DR across all building sectors. The CPUC, in cooperation with the California Independent System Operator (CAISO), is in the process of designing an enhanced incentives and ancillary service market structure for auto-DR, which is urgently needed to capture the full economic and environmental benefit of auto-DR. The CAISO hopes to tap as much as 4,000 MW of DR capacity by 2020 across California in order for it to be better able to manage intermittent renewable energy resources. At present, Southern California Edison has the largest portfolio of DR at 1,500 MW, but many of the resources included in this portfolio are manual systems tied to industrial operations that are not able to respond to real-time price signals. At present, auto-DR represents a tiny slice of the total DR market, but it is the fastest growing segment and the focus of vendors, utilities, aggregators and grid operators.

32 PG&E implemented a limited rollout of auto-DR between 2007 and 2009, with the estimated load reduction of 35 MW at 134 sites (Global Energy Partners 2010). While half of the load reduction was at five industrial sites, what is particularly noteworthy is the diversity of additional participating DR sites: office buildings, schools, retailers, health care facilities, food processing, and even fitness centers. For offices, the most significant load adjustment is increasing thermostats as little as 2 to 4 degrees during the hottest days to mitigate grid peaks.
2011b). For BEMS it is important to note that building energy management savings here are projections based on likely immediate efficiencies due to uncovering building operation failures. BEMS systems also lay the groundwork for not only ongoing monitoring and “continuous improvement” but also for more advanced strategies including peak power cost shaving, integration of EVs and renewables, demand response and other measures.

4.3.2.3 Challenges

One of the major challenges for commercial building efficiency is to ensure that a strategy focused on a group of high ROI measures leads to continued efficiency upgrades in the commercial building sector. Advocates of “pulling out” individual high ROI measures like LED outdoor lighting/controls and BEMS argue that they can be implemented quickly, are minimally disruptive to tenants, and provide an on-ramp for further involvement of decision-makers in deeper retrofits due to their high level of impact. On the other side, advocates of whole building approaches point out that decision-makers frequently feel they are “done” after implementing one measure. Or, doing high ROI measures eliminates options to implement other measures that could only be considered as a portfolio because they would not be cost-effective alone (the “cream skimming” argument). While these arguments against doing a few high ROI measures are valid, a number of factors exist that mitigate the impacts or encourage continued efficiency upgrades.

First, as discussed earlier, lighting, BEMS, and auto-DR can be fastest-to-deploy strategies within the building market. All other things being equal, it would be best to “do all building systems at once.” However, timing is crucial with respect to accelerating near-term GHG reductions, as emissions reductions today extend the “tipping point” for runaway climate change. A pound of carbon saved today is worth more than a pound of carbon saved tomorrow, due to the long life of CO₂ in the atmosphere. Second, rapid scaling of these technologies can bring down manufacturing costs for LEDs and lower implementation costs for BEMS and auto-DR as these industries grow. For LEDs, in particular, accelerated large-scale deployments in higher-value markets like the Bay Area can most rapidly bring down global manufacturing costs so that other regions of the world can more quickly take advantage of LED economies. Lower costs for these particular technologies and measures will mean more comprehensive whole building efficiency portfolios and, in turn, can successfully include lower ROI measures in the future.

Finally, BEMS and auto-DR are compatible with, and actually encourage, future building retrofits. The continued delivery of energy performance data, if well-executed, should help convince decision-makers that they are not “done” and have further opportunities for good energy efficiency investments.

Separate from the “whole building” versus individual measures concerns, advancing BEMS and DR deployment also faces several key barriers. First, in today’s economic environment, facilities’ upgrade budgets are being reduced to lower current-year costs. Even a two- or three-year payback period may be insufficient to allow an efficiency investment when current-year budget-cutting is paramount. Implementation of these services may need significant time, additional training and new operational processes to address complexities such as the need to understand utility rate structures and incentives, assessment of varied tools and features, integration with incompatible and heterogeneous building systems, aging and non-functional components, data availability and quality problems, and other issues.

Unlike a high-visibility LED or solar PV retrofit, for example, the BEMS and DR value-add is poorly understood and driven by exposing inefficiencies that are often invisible, and as a
consequence, underappreciated. As a result, the projected cost savings may not be deemed reliable. The widespread adoption of smart-meters, however, coupled with a significant array of SaaS energy products may reduce this barrier as these products can combine utility data and building data with simpler controls and internet-connected building systems.

### 4.3.2.4 Key Players

<table>
<thead>
<tr>
<th>Key Players</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building owners and managers</td>
<td>Building Owners and Managers Association (BOMA)</td>
</tr>
<tr>
<td>Facilities Managers</td>
<td>Cushman &amp; Wakefield, Jones Lang LaSalle</td>
</tr>
<tr>
<td>Utilities</td>
<td>Pacific Gas &amp; Electric, publicly owned utilities (e.g. City of Palo Alto), public energy agencies (e.g. Marin Energy Authority)</td>
</tr>
<tr>
<td>Industry Specific Associations</td>
<td>Example: Retail. California Retailers Association (CRA), California New Car Dealer’s Association (CNCDA) and sector specific support Better Bricks project <a href="http://www.BetterBricks.com">www.BetterBricks.com</a></td>
</tr>
</tbody>
</table>

### 4.3.2.5 What is Needed

Commercial buildings demonstrate wide variation in energy usage patterns both within and between different building segments and ownership structures. Given these variations, this action agenda focuses on those strategies with the most rapid paybacks, broadest deployment potential, and that enable ongoing incremental improvement in energy efficiency.

Accelerating these technologies within the Bay Area market context will require careful attention to the specific commercial segments where these opportunities can best be deployed. Particularly underserved are mid-sized class B office buildings and medium-sized retail – buildings all in the range of 50,000 to 100,000 square feet. These segments are less likely to have professional facilities management, are more likely to be in older building structures, and therefore have a large potential for major energy reductions. Targeting of opportunities can be further refined based on building age. The year 1990 often serves as a reference point as the year that California building energy codes were made more stringent. Since most class B office buildings are leased (89 percent in Santa Clara County, according to CoStar), exterior lighting provides an effective starting point for efficiency advances. Lighting is an expense either shared by all tenants – making cost benefits easily translatable into shared assessments or adjusted lease payments, or already covered by the owner – making the incentive to take action very direct.

In order to narrow the focus of the initiatives, there is a need and opportunity for a more comprehensive assessment of the energy efficiency opportunities in specific geographic and functional aggregations of Bay Area commercial lease buildings, especially mid-sized building stock. An assessment focused on age, size, usage, and existing energy efficiency levels will provide accurate targeting of upgrades. One method to mitigate costs is to take advantage of an emerging business area call no-touch or zero-touch building energy performance assessments, which leverages available real estate and energy performance data. A first pass at
evaluating energy efficiency opportunities may be possible with these low cost audit approaches. Esses\textsuperscript{35}, FirstFuel, and Retroficiency have all received attention recently for their technology advances and novel business models.

With a clear target set for energy reductions, building owners and managers can be brought together directly through the Building Owners Management Association (BOMA) and other relevant industry associations for sector wide education and action. Near-term tasks will include LED lights and controls in outdoor applications, BEMS and auto-DR, perhaps in that order of progressive implementation. Aligned participants within the commercial building industry can pool purchasing efforts and secure financing and available incentives collectively to reduce transaction costs. This can also lead to identification and implementation of a small set of optimal strategies appropriate for building managers, each designed for different sub-segments of the commercial market.

4.3.3 **Mid-Tier Commercial Finance Pool**

**Initiative Type:** Key Enabler

**4.3.3.1 Opportunity**

A number of studies in recent years have demonstrated that cost-effective energy efficiency opportunities are plentiful in the commercial and industrial sectors. A recent study for the California Public Utilities Commission quoted McKinsey & Company’s research indicating that 27% of the energy consumed in average US buildings could be saved with an astounding 25% return on investment (a payback of 4.25 years) (HB&C 2011).\textsuperscript{36} A 2012 report by Deutsche Bank and the Rockefeller Foundation confirmed the availability of high return efficiency investments in estimating that nationwide, there is approximately $100 billion in non-residential building efficiency opportunities available in the next ten years that would save $376 billion overall and reduce CO\textsubscript{2} emissions by 234 million metric tons annually (Deutsche Bank 2012). For companies, these energy savings go directly to profits. The fact that these massive opportunities exist begs the question of why upgrades to existing commercial and industrial buildings have not already been widespread.

Several factors prevent uptake of efficiency upgrades in these sectors including energy costs being a small portion of a company’s operating budget, perceived complexity, inconvenience, cash flow or capital constraints, and lack of trust in the results (performance risk). In a study of more than 2,880 executives with budget-level responsibility, 38% listed limited internal capital, 21% listed insufficient return on investment, and 16% listed performance risks as leading barriers (HB&C 2011). Optimal financing tools also must not just make capital available on the right time-scale but bring together marketing with an end-to-end solution that potentially leverages other financial incentives and makes it easy for a building owner to take action. Overcoming these issues is significant for getting building owners to take action.

A variety of public and private stakeholders have recently increased efforts to offer new debt and non-debt financing products for commercial markets (as well as residential) in order to address a number of the barriers discussed above. Public-private coordinated projects in the Bay Area are pursuing several energy service models. A number of resources provide excellent detail on these models so we provide only limited descriptions here.

- **Property Assessed Clean Energy** (PACE), a secured tax-lien financing product: public or private investors fund energy efficiency upgrades (or other

\textsuperscript{35} (http://www.greenbiz.com/blog/2012/04/18/essess-google-street-view-building-energy-efficiency

\textsuperscript{36} Simple payback, a method of calculating the time required for accumulated energy cost savings to offset the initial invested capital, is an easy calculation but does not take into account the time value of money, which is a key factor for an investor or financial decision maker. More accurate metrics are either return on investment (ROI) or internal rate of return (IRR), which both calculate the return on the investment over time, taking into account the time value of money. These can be compared with other potential investments by an investor or customer. The Deutsche Bank-Rockefeller Foundation analysis indicates that a 5 yr payback equates to a 15% IRR over ten years if cash flows are relatively constant
clean energy) through a lien on the property tax. The product is secured by the property with the capital repaid over a long term, enabling a low rate. The financing agreement transfers with sale of the property, along with the energy benefits37.

- **On-Bill Financing** (OBF), an unsecured utility-financed product and **On-Bill Repayment** (OBR), a utility-billed third-party product: With utility-based OBF in California, utilities provide 0% interest capital for energy efficiency improvements with repayment as a line item on the customer’s utility bills. Bill neutrality, in which the savings equal or exceed the monthly loan payments, is required. With OBR, utilities provide billing and collection for a third-party investor providing the capital. The third-party investment in OBR is attractive in part because the OBF rate-payer funds are limited but it does introduce new billing and collection issues for the utilities.

- **Efficiency Service Agreements** (ESAs), third-party financed off-balance sheet products. Third parties fund, design, implement, own, and manage energy efficiency improvements and bill customers for these services for the length of the agreement. Various models exist in which a customer pays a fee to the third-party who assumes their utility bills, or pays a lower utility bill and pays a fee to the third-party based on their savings. In both cases, the customer’s total cost of energy is less than it was prior to the efficiency improvement and the customer continues to reap the energy savings benefits at the end of the agreement. On-bill repayment (OBR) can be used as the billing and collection mechanism for some types of ESAs.

The current opportunities around PACE are significant and expanding rapidly with the involvement of many regional parties that have approved PACE financing. This includes the City of San Francisco’s commercial PACE program; Sonoma County runs one of the most successful commercial PACE programs in the nation with over $7 million in approved funding for 37 projects (Environmental Energy Technologies Division 2011); and nearly 50 Bay Area cities that are signed on to participate in the pilot phase of the CaliforniaFIRST Program, operated by the California Statewide Communities Development Authority, supported by Bay Area company Renewable Funding, and expected to launch Summer 2012. As an early developer of commercial PACE, the City of San Francisco is helping to establish standards and best practices for CaliforniaFIRST and other cities’ pilot programs. Santa Rosa-based Ygrene Energy Fund has also signed a contract with the City of Sacramento to invest up to $100 million in a commercial PACE program as part of the The Carbon War Room’s PACE Commercial Consortium. Research suggests that by 2015, $2.5 to $7.5 billion will be available annually (Pike Research 2010c).

OBF and OBR are also receiving significant attention by the utilities, CPUC, local governments, and non-profits who are working to expand pilot efforts using various sources of funding. PG&E, the investor-owned utility (IOU) operating in the Bay Area, has an OBF program offering up to $100,000 per commercial loan and $250,000 per government loan (with some specific types of loans up to $1 million). While the Southern California IOUs have operated OBF pilot programs since 2006, PG&E only recently launched an OBF program in the third quarter of 2011 but reports that it has a full pipeline of approximately $5 million in loans to 300 customers across different markets (Cadmus 2012). As a result the Bay Area can expect to see growth in PG&E OBF offerings, although limited to the rate-payer funds it has available.

OBR is a promising strategy as a major conduit for energy efficiency finance. Its key feature is the prospective payment simplicity for consumers and confidence it provides lenders.

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37 See DOE 2010a for detailed discussion of PACE.
The CPUC is in the process of finalizing guidance for the IOUs to design and participate in OBR pilots during the state’s 2013-2014 energy efficiency portfolio cycle. In fact, the CPUC has highly prioritized the rapid design and development of novel financing products, including credit enhancement for small business markets and non-residential OBR, during 2012 for the 2013-2014 period and has proposed a total of $200 million in energy efficiency funding across all products and markets for this period (CPUC 2012).

Efficiency Service Agreements (ESAs) for commercial retrofits are not a new product area but have been expanding recently, especially for large commercial projects. Two companies, San Francisco-based Metrus Energy and Transcend Equity (recently purchased by San Francisco-based SCienergy), are widely considered the experts in efficiency as a service, but have mainly focused on million-dollar plus projects (CalCEF 2010). Both of these companies offer ESAs that allow customers to upgrade facilities without incurring balance sheet debt. This financing parallels power purchase agreements (PPAs), which have played an instrumental role in the growth of distributed solar PV. Metrus finances, owns, and manages the efficiency upgrades itself, billing the customers for the energy savings. Transcend assumes the utility bills, integrating payment of the efficiency assets into a total energy payment that it bills the customer (DOE 2010c). Transcend reports an average 30–40 percent reduction in utility costs (Greentech Media 2011). ESCOs are typically engaged to execute the upgrades.

All of these financing models discussed above should be advanced because building owners and operators have varying needs. As a durable lien on a property with longer term (20 to 25 years) and inclusion of renewables, PACE is likely to appeal to property owners needing the option to transfer the debt to new owners in the event of sale, considering solar or other generation, and with stronger balance sheets that can assume debt. OBF’s very low cost may appeal to smaller property owners, while ESAs off-balance sheet financing creates more flexibility for owners who do not have a balance sheet which can tolerate debt but have very stable building use patterns. OBR is a conduit that can serve many options. As the Deutsche Bank study concluded, “a robust market will offer multiple options for owners seeking third-party investment in building retrofits” (Deutsche Bank 2012). Given the significant work underway by various public and private entities on PACE, OBF, OBR, and more traditional ESAs and ESCO products for large commercial and institutional energy efficiency upgrades in the Bay Area, one opportunity is to expand the reach of financing by leveraging the ESA model for the less well-served mid-tier owner-occupied commercial and industrial property segment. This segment has not had good access to traditional loans or ESCO products and may be unable to assume debt such as PACE or OBF.

The innovative non-profit finance firm CalCEF is in the early stages of developing such a program. It would establish a revolving capital fund organized under non-profit management. This fund would target efficiency projects in buildings under 100,000 square feet with turnkey projects of less than $1 million, and offer turn-key end-to-end solutions with guaranteed performance insurance. The work could be tied to local contractors with marketing to groups of similar business types using business associations, local government programs, and local utilities as one of a portfolio of options including PACE and OBF.

Such a fund would benefit from leveraging capital from philanthropic sources through program-related investments (PRI). PRI is a type of mission investment from foundation endowments that foundations make in order to achieve their philanthropic goals. However, they are also investments which yield a return back to the foundation endowments operating as part of a foundation’s investment portfolio. PRIs are garnering increasing interest in the foundation community, though generally scale has been modest or

A growing number of foundations are members of the PRIMakers Network, dedicated to fostering program-related investments
dedicated to other sectors such as housing. As discussed in the residential section, the Marin Community Foundation, the San Francisco Foundation, and Packard Foundations have engaged in PRI for select energy efficiency projects.

### 4.3.3.2 Impact

There are approximately one billion square feet of commercial building space in the Bay Area. National figures for building occupancy suggest that 36 percent of this is owner-occupied. Approximately 27 percent is mid-sized (25,000–100,000 sq. feet) and 46 percent of space is class B, representing average rents. Commercial owner-occupied class B space therefore represents approximately 45 million square feet. In the commercial space, upgrades are likely to be dominated by lighting, HVAC, and controls and should be able to reduce consumption by 25 percent at a cost of $2 per square foot (HB&C 2011).

A fund would likely be split between commercial and industrial efficiency upgrades. For calculation purposes, however, if $50 million were allocated to the commercial sub-sectors described above, the funding would support approximately 25 million square feet of space retrofitted and the Bay Area could see the following savings impacts:

- **90,000 MWh** electricity per year
- **145,000 therms** natural gas per year
- **23,000 metric tons CO2e** averted per year (based on total investment; additional funds would create additional savings)

The fund would further provide benefits in the form of local employment, local economic development, and replicability to other regions.

### 4.3.3.3 Challenges

Accelerating commercial retrofits through advancement of financing mechanisms is challenged by the fact that financing is only one barrier to energy efficiency. Assuming that a non-profit financier can pool sufficient capital with terms that are attractive to both customers and investors, rapid deal-flow is a significant challenge. Most retrofit projects, especially the deep retrofits that achieve the greatest energy and emissions savings, are custom efforts that require the involvement of multiple parties during the assessment and design phases and create a certain level of disruption during implementation. When the project investment as well as the resulting savings is large, the parties involved are willing to incur the transaction costs. One challenge for this initiative is to find ways to keep transaction costs low, such as intelligently marketing the offering to customers, leveraging business associations, utilities, and local government to create interest and follow through.

A challenge particular to a novel financing product is educating the customers and partners to the point that they are willing to participate in something new. One solution is to pilot new models with industry sectors or companies that are trusted in the community in order to quickly gain acceptance.

Credit risk, while less of a barrier than with traditional bank loans, may still eliminate some of the target market, especially for retrofits that involve assets that are difficult to extricate in cases where customers fail to pay. Savings performance risk is also always a risk that must be managed through good retrofit design and use of qualified contractors.

4.3.3.4 Key Players

<table>
<thead>
<tr>
<th>Key Players</th>
<th>Examples</th>
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<tr>
<td>Building owners and managers</td>
<td>Building Owners and Managers Association (BOMA)</td>
</tr>
<tr>
<td>Industry-specific partners and</td>
<td>Example: Grocers. Andronico’s, Draeger’s, Lunardi’s, California Grocer’s</td>
</tr>
<tr>
<td>Associations</td>
<td>Association (CGA) and Schools.</td>
</tr>
<tr>
<td>Utilities/Energy Providers</td>
<td>Pacific Gas &amp; Electric, publicly owned utilities (e.g. City of Palo Alto)</td>
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<td></td>
<td>public energy agencies (e.g. Marin Energy Authority)</td>
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<tr>
<td>Foundations</td>
<td>PRIMakers Network, The Energy Foundation, community foundations (San</td>
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<td>Francisco, Silicon Valley, Marin, East Bay), Hewlett Foundation, Packard</td>
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<td></td>
<td>Insurance Services</td>
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</table>

4.3.3.5 What is Needed

Commercial and industrial buildings demonstrate wide variation in energy usage patterns both within and between different industry sectors, building segments and ownership structures. Given these variations, this action agenda focuses on a select segment of the commercial and industrial space that can benefit from near-term, highly organized, end-to-end solutions. The owner-occupied mid-tier space remains an area of opportunity for efficiency and targeting additional financing solutions will be highly beneficial.

A key component is establishing the initial finance pool which could be seeded by large local Bay Area foundations and community banks. This will require high level leadership engagement to build on the existing foundation interest in PRIs to a cohesive regional collaboration. The financial instruments, including insurance guarantees would be structured to create confidence in the rates of return. Such a fund could be managed under a non-profit or joint-powers agreement between local and regional agencies. This fund could be leveraged for both owner-arranged PACE projects and ESA projects as both will likely serve different parts of the market.

A second major element is identifying and enlisting participants for projects. Leveraging utilities’ and other stakeholders familiarity with the opportunities in various commercial and industrial building sectors in the Bay Area, an assessment of building energy usage, retrofit options, and financing issues will help identify and outreach to specific targets such as schools and industry sectors such as grocers.

A third major component is to develop a framework for finding and pursuing cost-effective efficiency savings for the target sector. This would include industry-specific energy-use baselines and energy management plans along with a roadmap to drive implementation efforts.

Finally, to ensure robust buy-in and industry engagement the fund could include oversight and direction with a cross-sector steering committee with the active participation of foundation leaders, deployment sector participants, workforce representatives and financial specialists.
5 Residential Building Upgrades

Energy efficiency in existing residential buildings is especially challenging. Multi-family units, particularly affordable housing, provide a large target whose mission-driven owners are more disposed to take action. Ongoing foreclosures present a difficult but noteworthy opportunity for energy upgrades that select investors are beginning to address. Ultimately for residential upgrades to become widespread however, it will be necessary to value home performance, especially at the time of sale.

5.1 Defining the Domain

The Bay Area has nearly 2.8 million housing units, of which approximately 1.5 million are single-family detached housing and another 390,000 in medium and large multifamily buildings (20 or more units). Close to 60 percent of these units are owner occupied, predominantly single-family homes (U.S. Census Bureau. 2010). The region has a high concentration of older residences; over 430,000 units were built before 1940 and an estimated 1.7 million built before 1978, when California adopted the Energy Efficiency Standards for Residential and Nonresidential Buildings, known commonly as “Title 24.”

According to the California Air Resources Board (CARB), 14 percent of California GHG emissions are generated by residential buildings (CARB 2008). These emissions are roughly equally divided between natural gas consumed (used for furnaces, water heaters, and stoves) and electricity for other residential energy needs. Energy use within any given residential structure varies significantly, with bigger and older homes being highly correlated with higher energy use. However, even among homes of the same size and age, specific building design details, types of appliances, and human behavior lead to wide variances in total consumption and end-use patterns.

Energy efficient and “green” homes are becoming more common, but remain a very small fraction of the overall Bay Area housing mix. Several energy and green standards exist. Flex Your Power, a statewide energy efficiency campaign, reports that 17 percent of new homes exceed Title 24 minimum energy efficiency codes by at least 15 percent (Flex Your Power 2011). Across the state, an estimated 144,876 homes have been qualified as meeting the federal Environmental Protection Agency’s ENERGY STAR guidelines to date (Energy Star 2012b); the Oakland-based organization Build It Green reports that 10,000 homes have been certified according to its green building criteria.
In aggregate, potential savings in energy and GHG reductions through efficiency upgrades is quite significant. Such energy upgrades can include, but are not limited to: HVAC systems, lighting, programmable thermostats and household appliances, enhanced insulation and sealing of windows, doors, and vents, and possible integration of on-site renewables such as solar PV. In addition to cost savings, co-benefits of residential retrofits include improved indoor air quality and physical comfort, and reduced water usage. Energy upgrades using a “whole-house” strategy can shrink energy use by 20 percent on average, with ROI timeframes of five years or less (Build it Green 2010).

5.2 MARKET CONTEXT

As a state, California leads the nation in energy efficiency. While national per capita energy use has doubled in 45 years, per capita energy use in California has remained virtually flat in that time, thanks in large part to energy efficiency standards and utility incentives (CEC 2008). Whole-house energy use in new homes built in 2006 decreased by 25% compared to homes built in 1990, despite the fact that the average square footage increased from 2,160 to 2,488 during that time (ConSol 2008).

Still, there are an estimated 1.9 million housing units constructed prior to Title 24 in the Bay Area. Title 24 energy efficiency standards are revised upward on a triennial basis and regulate the overall building envelope, lighting systems design, the water heating system, and the HVAC system. All new construction and remodeling projects over a certain square footage or cost must comply. The state has also adopted green building standards (CalGreen) with elective energy efficiency measures and has set a target for new construction to be “net-zero” by 2020.

CALIFORNIA MARKET CONSIDERATIONS

Because of the mild climate within the Bay Area, energy efficiency related to heating and cooling (such as insulation) offers less cost and comfort benefits than other climate zones with much colder or warmer weather. Experts acknowledge that technologies and incentives exist to green homes, but that market barriers challenging individuals in their decision-making are likely to include transaction costs, tradeoffs between initial cost and future benefits, relatively modest monetary savings, and lack of familiarity about how building systems actually work (Borgenson 2011).

Many local governments in the Bay Area have their own local green building standards for new construction and remodels (Bay Area Climate Collaborative 2010). The federal EPA’s Energy Star and the Bay Area’s own “Build It Green” programs provide guidelines to help determine efficiency metrics for residential buildings, including all of the above-mentioned sectors. They address some large appliances and even some end-user habits. However, new residential construction accounts for only 0.12 percent of California’s building energy usage each year (ConSol 2008).

Since California pioneered the policy of significantly decoupling utility profit from energy use for investor-owned utilities (IOUs), California utilities have been very active in developing programs to help customers conserve electricity.
Although such incentive and rebate programs have had relatively low participation rates, and mixed results, they serve as a foundation upon which to build. For example, PG&E offers free energy audits for customers, compact fluorescent light bulb exchange programs, rebates for energy-efficient appliances and remodeling, and web-based information about tax rebates and related incentive programs (PG&E 2011b). With other investor-owned utilities, PG&E and its customers can also access incentives offered through the statewide umbrella program “Energy Upgrade California,” discussed below.

The California Council on Science and Technology and other building performance experts have demonstrated that it is commercially viable today to construct buildings that use 80 percent or less energy than current typical construction designs (CCST 2011). Californians have also demonstrated their interest in pursuing deeper energy savings, evident from the above-national-average deployment of Energy Star appliances, solar PV, and the emerging “zero net energy” (ZNE) building movement. California’s unique combination of strong policy incentives, strong technology potential, and higher than average consumer motivation has prompted numerous companies to enter the state’s residential energy efficiency market in recent years. These firms offer a spectrum of products and services that go well beyond the conventional approach of offering tighter windows and deeper insulation.

An especially notable new technology that holds long-term promise is the emergence of high-tech home energy management systems (HEMS), which are the residential equivalent of the commercial Building Energy Management Systems (BEMS) discussed above. HEMS can play an important role in identifying saving opportunities, motivating consumer action, and enhancing visibility into energy consuming devices and systems. Initial HEMS products from prominent new industry entrants, including Google and Microsoft, received tepid consumer reception. However, the nearly completed deployment of the first generation of smart meters in California is ushering in a new generation of more consumer-friendly devices and approaches that have real promise for engaging customer interest in efficiency improvement.

A complete “ecosystem” of communications and control technologies is emerging, with increasingly “plug-and-play” functionality as part of the “Home Area Network” (HAN). Companies such as San Mateo-based PeoplePower are integrating “microcontroller” components into power strips and appliances, enabling remote control of energy use via Internet protocols and “cloud-based” data management. Promising market entrant Nest has introduced a networked learning thermostat shown above (Figure 10). Visibility to power usage within a California residence is further enhanced by the state’s three investor-owned utilities, which recently began offering consumers instant access to their home energy consumption data through a single “Green Button” that can be accessed on the Internet.

Lighting will help drive scaled adoption of these integrative home energy management technologies. While LED lighting remains considerably more expensive than conventional lighting options, costs are dropping very quickly and consumer interest is being spurred by innovative LED dimming-ability options and color controls. LED lighting upgrades and control technologies can also create the impetus for consumers to deploy a fully-developed Home Area Network with smart energy controls.

As noted above, advanced smart metering technology has now been deployed broadly in the Bay Area with approximately 90 percent of the full rollout completed on 9.7 million meters deployed in PG&E territory (Hull 2012), primarily wireless meters manufactured by Redwood City-based Silver Spring Networks. These advanced meters provide time-of-use reporting of energy consumption, a more

39 Honeywell recently initiated a lawsuit against Nest for copyright infringement http://gigaom.com/cleantech/the-implications-of-the-honeywell-nest-lawsuit
granular view that is essential for time-of-use pricing. These smart meters can also integrate with third-party (non-utility) Home Energy Management systems and networks, although PG&E is still working on the necessary communications protocols.

Aside from smart meters, the deployment of integrated home energy management solutions is at an early stage. Because of this, the bulk of residential efficiency continues to be led by older construction strategies including upgraded ducts, insulation, windows, weather stripping, and energy efficient appliances, furnaces and water heaters. Adoption of these green upgrades is growing but primarily occurs in new construction. McGraw-Hill Construction reported in February 2012 that nationally, there is rapid growth in “green homes.” These builders report 26 percent expect to “go green” in more than 60 percent of their projects. Another 25 percent expect from 16 to 60 percent of their new homes to be “green.” While “green homes” encompass energy and non-energy attributes of uncertain stringency, it offers a rough measure of trends. These figures still reflect the generally slow rate of innovation within the construction industry, yet both new builders and remodelers expect significant and rapid growth in this segment of their business (McGraw Construction 2012). By lowering costs and increasing know-how, these trends do penetrate into existing building stock through remodels, but aggregate impact on existing stock is modest.

The principal vehicle addressing the inefficiency of existing buildings in California has been Energy Upgrade California, a statewide program launched in February of 2011 to incentivize home owners to undertake energy efficiency improvements. The program offers two approaches: a basic package (including air sealing, attic insulation, duct sealing, and insulation of hot water heaters) and a comprehensive upgrade (which includes a “before and after” assessment, home ratings\(^\text{40}\), a variety of measures to tighten the “building envelope,” and HVAC system upgrades).

The program received significant funding through the American Recovery and Reinvestment Act (ARRA), as well as other sources. Multiple challenges have limited its success, including a very short time frame for program design and delivery, complex program design, stringent training requirements (which constrained service availability), a higher-cost whole-house approach, lack of availability of home PACE financing, and multiple incentive layers that have been confusing to consumers. However, the greatest constraint may have been the weak housing market. Asking consumers to invest in their homes at a time of declining property values has been exceptionally challenging. At the end of 2011, only about 1,100 home projects were completed or were in progress in the nine-county Bay Area, despite significant incentives. Initial performance for this program has been below expectations (Energy Upgrade 2012).

Nevertheless, Energy Upgrade California has provided a number of extremely important benefits beyond the total number of homes upgraded and the CPUC has made a 10-year commitment to support the program. It has put in place valuable infrastructure, having established a network of trained professionals with deep knowledge in energy upgrades. It has also provided a much better understanding of the challenges and potential solutions to engaging homeowners. The challenges include poorly informed consumers, a small economic value relative to other priorities, logistical barriers, different transaction times for different components (i.e. water heater failure replacements), and uncertain contractor performance. In addition, the challenge of verifying notable energy savings makes financing difficult. Consumers’ behavioral factors (open windows and doors) and non-energy factors that may increase costs (mold, asbestos, etc.) can impair the true

\(^{40}\) Using the Building Performance Institute standards (BPI) or Home Energy Rating System, Whole House Energy Rater (HERS II).
potential savings from energy upgrades. Finally, high transaction costs, split incentives for rental properties, and the fact that efficiency upgrades are often undervalued in the market, all combine to slow progress. This action plan recommends a set of actions which provide both addressable markets to create near-term efficiency gains as well as open up the market to further gains.

5.3 RESIDENTIAL INITIATIVES

Residential efficiency in existing buildings is a challenging segment to advance. To penetrate the market more quickly, the following three strategies can create leverage to accelerate residential energy efficiency:

- **Multi-Unit Upgrades with Turnkey Services**: Multi-unit dwellings, particularly affordable housing complexes, have relatively few owners and their mission-driven organizations make them receptive to implementing energy improvements. Attractive payback rates with turnkey services are already being demonstrated in this fast track initiative.

- **Foreclosed Home Energy Upgrades**: Upgrades at the time a property is being renovated can significantly reduce costs. With a large volume of properties going through foreclosure, this may be one of the largest addressable segments, especially since most of these properties were built before California’s Title-24 energy standards. This is a gateway strategy due to its especially challenging nature.

- **Valuing Home Performance at Time of Sale**: Energy upgrades are not properly valued in the home market. Making the true value of energy upgrades properly recognized by appraisers and underwriters in the home sale process would create an important motivator for home owners to upgrade their properties in this key enabler.

5.3.1 Turnkey Multi-Unit Upgrades

**Initiative Type**: Fast track

**5.3.1.1 Opportunity**

In California, more than three-quarters of multifamily buildings were built before 1982, at the advent of California’s Title 24 energy efficiency building standards (Estrada 2011). The large population of people living in these multifamily complexes, when combined with the age of these buildings, means that there is a huge potential for energy savings and carbon reductions. Studies indicate that many cost-effective upgrades can achieve savings of 15-30 percent in buildings with five or more units, creating a large addressable market in which aggregation of service delivery can result in efficiencies of scale. Certain multi-unit dwelling segments can also be reached via turnkey programs that leverage large-scale private investment.

One promising approach involves performance-based contracts with energy service companies (ESCOs). This third-party business model can "pencil out" favorably in cases where the housing is owned and operated by mission-driven institutions with longer payback horizons, such as non-profit housing agencies or public agencies. With these ownership structures, owners are more likely to be predisposed to support upgrades and the strategies developed in with affordable housing can be used as the basis for subsequently addressing the for-profit segment.

In a performance contract, the ESCO conducts a detailed audit, identifies and evaluates energy-saving opportunities, and recommends a package of improvements. They are typically paid for through the savings created by their upgrades. Solutions may include lighting, heating, cooling and energy system control upgrade. In addition, high
efficiency motors, weather proofing, water heaters, new pumps, water conservation measures. Even renewable energy production from solar, wind, or biogas generators may become part of the solution package. The ESCO will often guarantee that energy savings meet or exceed annual customer payments necessary to cover all upgrade costs. A typical contract term is 7 to 10 years. Monitoring and verification of the performance of the installations is included in the arrangement; if the project does not result in the expected savings, the ESCO pays the difference. To ensure savings, the ESCO may offer staff training and long-term maintenance services.

Several Bay Area public agencies are pursuing performance-based contract strategies. The Energy Policy Act of 2005 enabled public housing agencies to contract with ESCOs for efficiency upgrades. Acting on that opportunity, San Francisco’s public housing agency has a program underway to upgrade its 5,000 units relying upon performance-based contracts. The first project, launched in late 2010 with the Ameresco company, will save the San Francisco Housing Authority over $60 million from major energy and water technology upgrades during the twenty-year contract term.

While this signifies a valuable step forward, public housing represents a very small segment of the overall housing stock in the Bay Area. The larger “assisted” or “affordable” housing segment - which typically receives some kind of public support in the form of operating subsidy, capital subsidies, or tax treatment - has been largely ignored when it comes to energy performance contracting. Current regulations embedded in the program make it difficult to take on debt and to capture the energy savings over a long enough timeframe to pay off a loan. Building on the public housing upgrade strategy, the Washington DC-based Stewards for Affordable Housing for the Future (SAHF) is implementing a pilot program targeted at privately owned assisted housing, including both tenant-paid and owner-paid utility clients. As part of a SAHF pilot program, 2,500 units in approximately 25 buildings will be upgraded with a performance based contracts that begins in 2012 by the energy services company Johnson Controls. In addition, SAHF has been working with HUD to develop a series of policy flexibilities that would make energy performance contracting more feasible for assisted and affordable housing developments, with expected energy savings of 20 percent or more (Schaaf 2011).

A similar model is being developed in the Bay Area for other forms of assisted housing with the leadership of Strategic Energy Innovations (SEI). SEI provides turnkey services, including identifying energy efficiency retrofit opportunities, packaging the delivery of services, arranging financing and incentives, and qualifying the contractors. This set of services mirrors much of what ESCOs do, but simplifies project execution from a building owner or management perspective.

SEI is working with Ecumenical Association for Housing (EAH), a non-profit affordable housing builder and manager that has 81 properties with over 8,000 units in its portfolio, the majority of which are located in the Bay Area. SEI’s project with EAH is supporting energy efficiency upgrades in a diverse mix of 15 different multifamily properties, targeting a total of 250 living units. For an average investment of less than $500 per unit, a carefully selected set of measures can yield nearly a 20 percent reduction in energy use with a payback period of 4.8 years when excluding two outlier properties for two and four units respectively (5.6 when including these two small properties.)

While unable to provide performance guarantees like an ESCO, SEI can provide services with enhanced cost savings due to its non-profit status. Non-profits are also able to leverage philanthropic support to augment utility rebates, government incentives, private sector loans and, in some cases, a requirement of owners to contribute a percentage of their property reserves to help cover the cost of the total efficiency upgrade package. These dynamics have enabled the SEI program to address a broader set of project types and
achieve deeper savings by addressing longer-payback items than are typically addressed in utility-administered programs.

The role of forward-looking foundations in making the SEI initiative successful is noteworthy. The Marin Community Foundation (MCF) not only participated with conventional philanthropic support, but it also provided loans from its endowment portfolio. The loan financing from MCF is a type of “program-related investing” whereby a foundation achieves the dual objective of creating a positive social impact while also reaping a market-rate (or near market-rate) financial return. At a time when some investments in the traditional private equity markets are performing poorly, program-related investments offer a promising approach. Community banks can also provide strong alternative financing vehicles.

### 5.3.1.2 Impact

In the Marin Energy Efficiency Partnership, SEI upgraded a diverse set of properties of differing size and ages delivering approximately 20 percent efficiency gain. Extrapolating across the Bay Area’s estimated 130,000 affordable housing units in this fast track initiative yields the following potential:

- **24,000 MWh** electricity per year
- **5 Mtherms** natural gas per year
- **38,000 metric tons CO2e** averted per year (114,000 metric tons CO2e over 3 years)

Average payback across the Marin project was 5.6 years (4.8 when excluding buildings with less than 5 units) including SEI’s management services.

### 5.3.1.3 Challenges

Affordable housing is often characterized by a highly complex array of regulatory requirements due to the complex financing associated with both construction and ongoing operation. Building and managing this type of housing generally includes multiple funding sources: government grants, government loans, bonds, private loans, trust fund contributions, tax credit equity, local government in lieu fee support, and other sources. Each financing source typically imposes specific requirements that affect subsequent project management and operations, financing, and administration. A major aspect of SAHF’s initiative has been working with government agencies to remove policy barriers to the use of performance-based contracting. At a project level, significant specialized expertise is required to effectively structure innovative EE projects.

This complexity requires expertise not only for the overall project management, but property managers must also be responsible for the end results. Unfortunately, they are generally unfamiliar with many critical elements to success, including energy saving strategies, implications for ongoing operations, effectively dealing with vendor contracts and negotiations, evaluating contractor performance, and other aspects as well. Similarly, tenants may not be familiar with how to use new energy saving technologies or fully recognize their benefits. Since these stakeholders “run” the building, special training is often necessary.

SAHF’s strategies offer significant promise by leveraging the scale that ESCOs offer (which can yield lower cost financing), with the benefit of guaranteed performance. If the savings do not meet targets, ESCOs typically fix the problem, or cover the shortfall. The ESCO performance guarantee, however, encourages companies to target the easiest high-return elements of an upgrade (such as lighting and HVAC systems) frequently including a significant performance margin bonus (typically 15 percent). This approach to compensation can result in lost opportunities for longer-payback savings, and

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41 ABAG’s 2009 housing survey identified 128,150 housing units. [www.abag.ca.gov/pdfs/2009_Housing_Data.pdf](http://www.abag.ca.gov/pdfs/2009_Housing_Data.pdf)
thus greater overall cost. On the other hand, prospective ESCO clients and partners should be aware that ESCO facilitated financing can enable projects with minimal or zero up-front cost and immediate cash-flow benefit. In a more complex hybrid financing context, the physical upgrade process itself typically relies upon private capital and provides an investment return, whereas funding for program managers such as SAHF, SEI and other management agencies is often separately supported by philanthropic or public funds. As with for-profit apartment owners, affordable housing owners may also find the split-incentive problem, in which owners bear the costs of improvements but only the renters see the utility bill savings, to be a major hurdle. Owners can realize financial benefits if they are able to pass along higher rents to renters who recognize that the overall costs are lower due to improved utility bills. However, most renters will likely discount such claims in the absence of credible third-party verification.

### 5.3.1.4 Key Players

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<th>Key Players</th>
<th>Examples</th>
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<tbody>
<tr>
<td>Non-profits</td>
<td>SEI, Build It Green, Local Initiatives Support Corporation (LISC)</td>
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<td>Energy service companies</td>
<td>AmareSCO, Siemens</td>
</tr>
<tr>
<td>Large affordable housing providers</td>
<td>Eden Housing, Ecumenical Association for Housing (EAH), MidPen Housing</td>
</tr>
<tr>
<td>Property Management Associations</td>
<td>Professional Property Management Association of San Francisco (<a href="http://www.ppmaofs.org">www.ppmaofs.org</a>)</td>
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<tr>
<td>Community development banks</td>
<td>Union Bank, Low Income Investment Fund, Bank of America</td>
</tr>
<tr>
<td>Community foundations</td>
<td>East Bay Community Foundation, Marin Community Foundation, San Francisco Foundation, Silicon Valley Community Foundation</td>
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### 5.3.1.5 What Is Needed

Affordable housing providers are mission-driven organizations with unique energy efficiency opportunities and constraints. To leverage these opportunities, like-minded stakeholders have created the Green Affordable Housing Coalition (GAHC), a joint project of “Build It Green” and the Bay Area Local Initiatives Support Corporation (LISC). The coalition brings together developers and building professionals with a focus on affordable housing best-practices sharing (including information-sharing on new programs, resources, best practices, and policies) and can play a critical role in defining multi-unit strategy.

There is a need for stakeholders to develop a more comprehensive assessment of the state of the affordable housing stock in the Bay Area and opportunities for energy efficiency. This is one of the objectives of the Building Energy Efficiency Solutions (BEES) project between Berkeley, Oakland and Emeryville. Funded by the PG&E Innovator Pilot program, the BEES program assessing multi-unit dwelling needs, is piloting implementation strategies, and identifying policy options (City of Berkeley 2011).

42 www.cityofberkeley.info/bees
Where it exists, owner-tenant agency alignment issues can be addressed through enhancing and utilizing the CA Utility Allowance Calculator (CUAC). This tool, developed by the CEC provides calculations on appropriate rent levels associated with improved energy efficiency. Owners of properly designed projects realize higher rents as returns for improvements but the higher rents are less than the decline in utility bills, benefitting tenants. Currently CUAC is primarily used for new affordable housing developments and use for existing properties could be better defined.

Also of particular value would be the development of certification of the improved energy and utility bill performance of upgraded units (Benningfield 2010). Build It Green is working on such a certification system. This could ultimately develop into a guaranteed certification, similar to that offered by Advanced Energy Corporation in North Carolina on new affordable developments.

Key nonprofit housing agencies, including the largest organizations such as EAH, Eden Housing, and MidPen Housing, should be brought together with community development banks and foundations to create a high profile “validation project” that scales-up the approaches taken by SEI, SAHF, EAH, and other market leaders. This should be done in alignment with the Energy Savings Assistance Program aimed at affordable multi-family units currently under revision by the CPUC. Increasing the scale of such endeavors could result in more attractive financing and lower technology procurement costs. Build It Green, LISC and NPH are among the entities well positioned to provide leadership and facilitation of such an effort.

5.3.2 Foreclosed Home Energy Upgrades

Initiative Type: Gateway

5.3.2.1 Opportunity

California has one of the highest rates of homes in foreclosure in the country with 1 in 265 units in some stage of foreclosure (RealtyTrac 2012). While foreclosures slowed in 2011 compared to 2010 (Said 2012), nationally, the trend of residences going into foreclosure is expected to rise as much as 60 percent in 2012, and continue at similar rates into 2013 (Federal Reserve of New York 2012). While other parts of the state have been hit harder by the housing crisis, there is a significant ongoing stock of homes going into foreclosure in the Bay Area. As of February 14, 2012 there were an estimated 13,470 homes being auctioned off, with over 5,000 bank-owned, and over 10,000 in “pre-foreclosure” (Foreclosure Radar 2012a). In 2011 there were 103,707 foreclosure filings in the nine-county region.

A sampling audit shows the “average” foreclosed home in the Bay Area is 1,730 square feet and constructed nearly 50 years ago (Foreclosure Radar 2012a). This typical profile creates an ideal target for efficiency upgrades, having been built prior to Title 24 standards, with a manageable size. Based on current trends, 100,000 properties or more may move through foreclosure in the region in 2012, providing significant opportunities for energy saving retrofit.

Of course, working with distressed properties presents a number of physical and legal challenges. Distressed homes often have deteriorated from neglect and deferred maintenance or even theft and vandalism damage. In order to make them saleable, most of these homes need some level of

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44 www.advancedenergy.org
45 www.realtytrac.com/trendcenter/ca
46 Note on pre-1966 compared to 1990s homes. When looking at energy use per square foot, pre-1966 homes do not necessarily have the highest energy use as they usually have had one round of furnace and window upgrades. 1990s homes are similar in energy use because of need to replace furnaces that typically wear out in 20-25 years (Amram 2011).
refurbishment. This may include basic paint, drapes, carpeting and appliance replacements, but in many cases may require deeper work, such as mold abatement, new plumbing or electrical infrastructure, and even structural repairs. The costs of such repairs vary widely, yet can easily be tens of thousands of dollars.

Investors and lenders, especially the federally sponsored mortgage companies “Fannie Mae” (Federal National Mortgage Association) and “Freddie Mac” (Federal Home Loan Mortgage Corporation), have a strong interest in making the homes saleable and adding value. In alignment with available capital, energy upgrades could be relatively narrow and targeted, such as the basic Energy Upgrade California package -- which can cost $2,000 or less. This package includes the most basic and critical energy efficiency measures, such as attic insulation, air sealing, duct sealing, hot water pipe insulation, and furnace combustion safety tests.

Some investors may also be encouraged to do deeper and more comprehensive energy upgrades if there are well-secured payback mechanisms. These upgrades may cost as much as $20,000 or more and typically include detailed energy assessments that may result in the replacement of furnaces and water heaters, as well as weather stripping and other measures. One way to address the financing requirements for large-scale comprehensive retrofits is to encourage broader adoption of energy efficient home mortgages. New mortgage financing packages have been created to spur purchase of existing efficient homes or to provide financing for substantial energy efficiency upgrades. The loans permit higher housing expense-to-income and debt-to-income ratios if the home itself is energy efficient or contains energy efficient items. Up to 10 percent of the value of the property can be used for upgrades in the case of the Federal Home Loan Mortgage Corporation (“Freddie Mac”) Energy Efficient Mortgage (Energy Star 2012a). Despite the availability of these loans, it is estimated that less than one percent of mortgages are actually energy efficient loans (Tedeschi 2006).

### 5.3.2.2 Impact

An estimated 100,000 properties, mostly single-family homes, will likely go into foreclosure each year 2012-14. If 10% of these homes were upgraded with the “basic package” of Energy Upgrade California measures per year, which is modeled to deliver 10-15 percent energy savings, this gateway initiative would yield:

- **33,000 MWh** electricity savings added per year
- **2 Mtherms** natural gas savings added per year
- **20,000 metric tons CO2e** averted in first year
  (120,000 metric tons CO2e cumulative over 3 years)

The typical cost of the basic EE upgrade package is $3,000 to $5,000 but if executed as part of a broader set of upgrades, that cost could be reduced significantly. While simple payback periods are often long (five years or more), additional benefits include improved homeowner comfort, higher resale value, and monthly utility bill savings.

**ECONOMIC DEVELOPMENT FROM ENERGY SAVINGS**

The City of San José and Silicon Valley Energy Watch developed Green Energy Match (GEM), a residential energy savings program, in collaboration with WattzOn. Participating residents receive coupons for energy upgrade actions -- up to 70% off from local merchants. Energy savings lead to increased household income, which are funneled into more retail spending. San José residents sign up for the program using WattzOn’s web portal and make use of the tips, tools, and group tracking on the site. GEM data and performance results are being validated by Lawrence Berkeley Labs.
5.3.2.3 Challenges

While the conventional housing market is showing signs of improvement, this is not true of foreclosed properties whose values remain depressed and may even continue to decline. Nationally, analysts report home prices of traditional home sales dropped only 2.4 percent from a year ago. With distressed properties, the index of housing value was down 4.9 percent (CoreLogic 2012). Though banks release foreclosure properties in a controlled manner to minimize property value deflation, there is now increased urgency for lenders to sell the homes quickly to minimize financial exposure given the continuing and potentially growing number of properties going into foreclosure. By law, a property can go into auction within four months of a notice of default. (Foreclosure Radar 2012b) During that time, there is limited opportunity to take action to reduce the carbon footprint of the property.

The first opportunity to boost efficiency and lower carbon comes when a new investor purchases the property, typically at a non-judicial “trustee auction.” While investors nearly always have a need to make investments in the properties, they are frequently reluctant to engage in more than minimal cosmetic changes to maximize their return on investment to “flip” a property. Much of the time, these investors may not see any clear market value in doing energy upgrades, an issue discussed more fully in the next section.

5.3.2.4 Key Players

<table>
<thead>
<tr>
<th>Key Players</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lenders</td>
<td>Bank of America, JP Morgan Chase, US Bank, Wells Fargo</td>
</tr>
<tr>
<td>Home performance contractors and general contractors</td>
<td>Contractors who focus on renovating foreclosed properties</td>
</tr>
<tr>
<td>Local governments</td>
<td>Fremont, Richmond, San Ramon, San Jose and other local governments with high concentration of foreclosed properties.</td>
</tr>
<tr>
<td>Real Estate Investment Associations</td>
<td>San Jose Real Estate Investors Association (<a href="http://www.sjrei.net">http://www.sjrei.net</a>) which has three chapters covering the peninsula, east bay and south bay.</td>
</tr>
<tr>
<td>Real Estate Agents</td>
<td>In the 9 county region there are 16 associations including East Bay Association of Realtors (<a href="http://www.bayeast.org">www.bayeast.org</a>), San Francisco Association of Realtors (<a href="http://www.sfrealtors.com">www.sfrealtors.com</a>), Silicon Valley Association of Realtors (<a href="http://www.silvar.org">www.silvar.org</a>), Marin Association of Realtors (<a href="http://www.marinor.com">www.marinor.com</a>), Contra Costa Association of Realtors (<a href="http://www.ccartoday.com">www.ccartoday.com</a>), San Mateo County Association of Realtors (<a href="http://www.samcar.org">www.samcar.org</a>), North Bay Association of Realtors (<a href="http://www.norbarrealtor.com">www.norbarrealtor.com</a>).</td>
</tr>
</tbody>
</table>

5.3.2.5 What Is Needed

An opportunity exists for banks, local governments, and home performance contractors to educate investors of distressed properties on available opportunities for cost-effective energy improvements. This can be done through education of real estate agents and investors directly, and through real estate investment associations. A fully developed programmatic approach would include: presentations of relevant energy efficient loan products; development of a contractor network qualified to refurbish distressed properties and do energy upgrades; and information and marketing approaches to
ensure that the advantages of energy efficient homes translate into enhanced market valuation.

A key additional need is to ensure contractors are properly trained to do upgrades quickly, preferably as a turnkey service that both professional investors and individual home buyers can engage without hassle or major coordination requirements. While such contractors already exist, providers of new services for distressed properties may require cross-training and customized packages that feature appropriately scaled EE elements and relevant financing options.

At least two companies in the region, Harmon Pathway and Green Earth Equities, are known to be focused on including energy upgrades as part of refurbishment of foreclosed properties. Both are modest scale but successful. Notable in these efforts is attention at the front-end of the investment process to consider home purchase conditions which may best ensure that a home with an energy upgrade is likely to be sold with the added investment recouped at the time of sale. The apparent emerging success of these firms suggests that the operating strategy could be systematized at least to the degree that regional scale investors, such as socially-responsible real-estate investment trusts, could be established to provide greater scale. It is important to add that developing a successful market in energy upgraded foreclosed homes would be significantly aided by valuing home performance as discussed in the following section.

5.3.3 Valuing Home Performance

**Initiative Type:** Key Enabler

5.3.3.1 Opportunity

To capture the full value created by energy efficiency, it is essential that stakeholders proactively ensure that these improvements are effectively assessed and communicated to investors and home buyers. Many residential energy upgrades such as efficient insulation, lighting, and HVAC systems are not obvious with casual inspection, leading to significant under-valuation of these features and benefits in many sales transactions. Prospective buyers need mechanisms that clearly communicate the objectively measured lower cost of operation, as well as the non-monetary (but significant) benefits of enhanced HVAC system performance, and healthier indoor air quality. A proper market valuation can add a potentially significant additional motivator to home energy improvements.

The contribution of energy improvement to home resale value is deserving of more research, but there are notable case studies. In two studies spanning 2000 to 2011, the Earth Advantage Institute (EAI) in Portland, Oregon documented the increased value of homes with a “green” certification. From 2000 to 2008, the average price difference between certified and non-certified green homes was a 4.2 percent increase (Earth Advantage Institute 2009) in favor of certified homes. Quicker sales of these green homes were also verified in Portland. A review of domestic and international research literature by LBNL showed highly varied, but still significant value improvements (Lawrence Berkeley National Laboratory 2011c). It is notable that many homes in the Bay Area that are “under water” are so for less than the net gain in value attached to energy upgrades (SF Gate 2012) documented by these studies.

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47 Generally referred to as “REO services” for “real estate owned” services.
48 www.harmonpathway.com
49 www.greeneartnequities.com
50 Energy improvement have limited perceived value in the remodeling industry. Only window replacements were recognized in Remodel Magazine’s “Top 10” medium cost value improving remodeling projects in 2011: http://www.stonegatemtg.com/blog/?p=1097
51 2010 through 2011 EAI documented up to 30% greater home valuation for certified existing homes and 8% for new homes. This assessment was based solely on average sale prices, not comparables. http://www.earthadvantage.org/resources/library/research/certified-homes-outperform-non-certified-homes-for-fourth-year/ For similar research in the Seattle area see http://greenworksrealty.com/e-cert_report/Feb%202010%20GreenWorks%20Realty%20ECert%20Report.pdf
The EAI study included Energy Star, LEED for Homes, and other green home certifications. While green building certifications include many elements that capture environmental benefits beyond energy performance, efficiency upgrades represent a significant element in most cases. For such upgrades, there is some evidence for an increase in home values on the basis of direct energy performance improvement (Nevin, 1998). Nevin suggests that home values increase by $11 to $25 for every dollar reduction in annual fuel expenditures.  

From the seller perspective, these enhanced valuations can be very attractive. There is evidence that buyer demand is a factor in such valuation. According to the Yahoo! Home Horizons 2012 study, 50 percent of people consider green/energy efficient appliances/materials as a requirement of their dream home (Yahoo Real Estate 2011). These features are more popular than perennial favorites of home buyers, including criteria such as “building a custom home” (38%); “water views” (38%); and “mountain views” (32%).

A key part of ensuring that the market values green buildings (and the energy performance of residences) is making these building improvements more visible as part of the sales process. While a given home sale value may be influenced by owners, buyers, and agents who are cognizant of its energy performance attributes, individual sales valuations have limited impact on the overall market recognition of energy performance, especially in today’s depressed housing market. Ultimately the broader home market must institutionalize the value of efficiency features. Favorable energy efficiency-focused financing requires willing lenders and appraisals to underwrite their loans, and appraisers need market data to support the higher valuation estimates linked to energy performance.

Residential appraisers do have a new energy-oriented tool for the appraisal process. In September 2011, the Appraisal Institute, the global association of appraisers which provides training and standards, issued a new form for appraisers to use when doing valuations of residential green building features. The “Residential Green and Energy Efficient Addendum” documents many key green and efficient home features, such as energy efficient appliances, double paned windows, improved insulation, whole building certifications, and other elements. This evaluation form is added as an addendum to the standard Fannie Mae Form 1004, which is the appraisal industry’s mostly commonly used form for mortgage applications. However, appraisers primarily look to the local market and Multiple Listing Services (MLGs) for comparative data (“comps”) to validate the judgment of value on any home. If the data is not available on green attributes of any residence, then lenders may require appraisals to be redone.

MLGs are regionally-specific databases. They often serve as communications tools for real estate agents to share information on properties for sale. This data is frequently customized locally, but typically includes conventional data such as square footage and number of rooms, as well as special features like pools. Incorporating relevant home energy performance data into MLGs enables appraisers and agents to identify, compare and begin to value homes appropriately. In doing so, home owners are more likely to be motivated to make such improvements since they will then increase sales prices.

A comprehensive solution requires addressing all these elements. However, having good data in MLGs is an essential first step. The City of San Francisco MLS has incorporated some limited “green” features, but usage in San Francisco and the region is limited.

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52 Home solar valuation is well demonstrated in a recent study by Lawrence Berkeley Laboratories showing an average increase in value of $17,000 for a 3 kW system. http://eetd.lbl.gov/ea/ems/reports/lbnl-4476e.pdf

53 http://www.appraisalinstitute.org/education/green_offerings.aspx
5.3.3.2 Impact

Development and deployment of an energy-aware home valuation system is a key enabler as the benefits are indirect and system-wide, rather than direct and project-specific. This initiative broadly moves the entire market through:

- Increased visibility of efficient and green homes, creating a positive social norm and expectation among home sellers and buyers
- Increased relevance for energy efficiency in the remodeling industry, enhancing the priority of EE for homeowners considering remodels
- Increased motivation among homeowners to consider energy upgrades for environmental, economic, and health benefits

These influences are accentuated in the Bay Area because of the relatively high awareness of “green” features and their desirability on the part of residents in the region.

5.3.3.3 Challenges

A number of challenges will need to be surmounted to institutionalize valuing home performance in the Bay Area. Updating MLSs confronts a “chicken and egg” problem. In order for properties certified as green to be a useful real estate search criterion, it is necessary to have significant stock and turnover of green-rated homes. In San Francisco today, there are more than 300,000 housing units, but no more than 1,500 housing units in San Francisco are LEED-home or Green Point-Rated (a rating developed by Build It Green) (Hooper 2011). As a result, few real estate agents will search for homes with green certifications and, in turn, few agents will enter that data into the data base.

However, there is a significant shift occurring in the region in available stock. Numerous local governments adopted green building standards over the past six years. A survey by the Bay Area Climate Collaborative in 2010 showed that 46 cities in the region had mandatory new residential green construction standards or reporting requirements (Bay Area Climate Collaborative 2010). (Green-rated homes typically score greater than the minimally required 50 points on Build It Green’s residential construction “Green Point Rated” (GPR) calculations.) Numerous local governments include similar standards for remodels as well. While new construction continues to be slow because of the housing downturn, approximately 46,000 homes built in California in 2011, over 4,000 were built to GPR standards. In addition, California put into effect a statewide green building standard known as CalGreen54 last year. As a result, numbers of certified homes and industry awareness are both growing.

A second issue confronting green ratings is the cost of third-party verification. The accessibility and consistency of green-related information on various MLS tools require attention. New data fields will need to be easily searchable in listings. Those fields must be accessible through the variety of interfaces agents use to access the data, and agents may need training to understand their use and significance. Currently, where green MLS listings have been implemented, they have not always been consistent, reducing their value.

Finally, to be effective, widespread appraiser, lender, and insurer recognition is needed. Currently, appraisers lack a clear definition or methodology for appraising efficient or green homes. Finally, the lower cost of home operations will need to be proactively marketed to financial institutions to ensure that these are recognized in loan-to-value underwriting calculations, as they are now in the context of energy-efficient mortgages.

54 CalGreen establishes a state-wide floor of green building features which may increase home values compared to older homes. Most independent certifications (LEED, Green Point Rated) offer higher performance than CalGreen therefore valuations of certified buildings are likely to be greater than a baseline CalGreen building.
55 The (lack of) appraisal of energy efficient and green homes is becoming an increasing concern to home builders as they build more green homes. http://www.nahb.org/news_details.aspx?newsID=13934
### 5.3.3.4 Key Players

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</tr>
<tr>
<td>Appraisers</td>
<td>Appraisal Institute, North California Chapter (<a href="http://www.norcal-ai.org">www.norcal-ai.org</a>)</td>
</tr>
<tr>
<td>Mortgage Underwriters</td>
<td>Association of Mortgage Underwriters (<a href="http://www.mortgage-underwriters.org">www.mortgage-underwriters.org</a>)</td>
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#### HOME ENERGY FEEDBACK

PG&E has partnered with OPower, an online interface that allows account holders to monitor their energy use and compare it to other local households of similar size and features. With OPower, PG&E can provide a user-friendly format for users to automatically track energy use, and then rank performance with other typical homes in the area. Peer comparison is a powerful motivator for action on energy efficiency.

### 5.3.3.5 What Is Needed

Build It Green is leading an initiative to update local MLSs and educate REALTORS in inputting data into MLS fields. Drawing upon the National Association of REALTORS recently developed Green MSL Tool Kit, local real estate associations and appraisers, Build It Green is developing guidelines for use in greening MLSs. Additionally, they have developed and delivered a Certified Green Real Estate Professional training, which educates the real estate professional on green building and energy upgrade practices and benefits. To date, 300 professionals have been trained statewide (Asan 2011).

This initiative will offer an important starting point for the Bay Area’s efforts to reduce carbon emissions from the residential sector in the most cost-effective manner. However, greater engagement is needed from the real estate associations to align MLSs in the region and to adopt the green metrics system. These associations will then need to educate their members on the new MLS features, including typical uses and expected benefits. This educational effort should include outreach to ensure that appraisers use the Appraisal Institute’s Residential Green and Energy Efficient Addendum. Engagement from the broader business community to support these steps will be critically important, as recovery in regional home values play an important role in economic development. New homes, which are more commonly certified in some form, could also be included in the listings to further build the frequency of green and efficient homes.

It is also important to educate appraisers on proper use of the Residential Green and Energy Efficient Addendum. As appraisers utilize this tool, lenders may be increasingly willing to recognize some value in homes that are highly rated by a well established green certification system. This system will also be an important vehicle to educate all market participants about the relative and absolute value of potential green home upgrades: including home owners, buyers, real
estate agents, lenders, appraisers, and the architecture and builder community. Similarly, lenders need to be engaged in dialogue about how these new tools could help enhance the Bay Area’s real estate market, and how best to integrate green rating systems into underwriting criteria. Local banks and credit unions may be highly motivated to initiate or facilitate such dialogues as a means to gain visibility and competitive advantage. If the home performance can be linked to a guarantee, as noted earlier is being done by Advanced Energy Corporation in North Carolina for new affordable developments, this would likely further strengthen the case with lenders.

While there have been some appraiser validated studies on improved valuation with energy efficient and green homes, these studies involve small sample sizes. As the economy begins to improve and home sales recover, there is an opportunity for a more comprehensive assessment of the true value of green buildings. This is particularly relevant in the Bay Area given the high concentration of “green” homes. A regional study of green home valuation could be extremely effective in shaping local practices, especially if done with the participation of key parties such as the Appraisal Institute, as well as builders, lenders and real estate associations.
Electric vehicles (EVs) are an especially promising strategy for addressing transportation emissions which is actionable near-term and at a regional level. But while there is growing action across sectors to advance EVs, the purchase price gap with gas vehicles is a prominent hurdle. Bringing together an aggregate purchase of electric vehicles with battery leasing and energy services can change the economics and create up-front price parity to drive adoption of EVs with dramatic economic and emissions benefits.

6.1 DEFINING THE DOMAIN

In the Bay Area, over one third of all GHG emissions originate from the transportation sector, and over two-thirds of these emissions are from light-duty vehicles (Bay Area Air Quality Management District 2010). To achieve the rapid GHG emissions reductions, accelerated deployment of electric vehicles (EVs) is emerging as a key near-term strategy.

As of 2010, there were over 5.6 million vehicles registered in the Bay Area to serve the region’s 7.5 million people56. Multiple strategies can help reduce motor vehicle emissions: increased fuel efficiency standards for traditional gasoline powered vehicles; lower carbon fuels; increased use of public and alternative transportation (such as busses, trains, and bicycles); enhanced car pooling and car sharing; transportation demand management strategies (e.g., streetlight synchronization and ramp metering); roadway tolling and fuel pricing; smart driving techniques; more compact and bike/pedestrian friendly land-use patterns; increased telecommuting; diesel truck retrofits; port electrification; and vehicle electrification.

All of these strategies clearly have a role to play in shrinking the carbon footprint of the Bay Area’s transportation sector.

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56 This ratio of population to motor vehicles is much greater than Europe and the rest of the world according to DOE, and is an indicator how dependent Californians (and Americans) are on motor vehicles for transportation.
However, many of these strategies either have long timeframes (land-use planning reforms), small incremental impact on emissions (individual telecommuting), or are not readily implemented on a regional basis (low-carbon alternative fuels). Taking into account persistent trends in vehicle miles traveled, and the reality of the state’s established and auto-centric development pattern, the California Air Resources Board has put forward a statewide climate-friendly transportation and alternative fuel strategy that, by 2050, will be dominated by electric vehicles. Effectively, EVs are identified as the cornerstone of California’s climate change mitigation strategy for the transportation sector, which itself is the top target for carbon emission reductions. As noted in the chart below, well over half of the needed transportation emissions reductions are projected from the impact of EVs (considering the full “well-to-wheels” fuel cycle.) The balance of reductions is projected to come from a shift to lower-carbon combustion fuels, and a relatively small proportion from a vehicle miles traveled (VMT) reduction (which captures consumer shifts to public transportation, cycling and walking, carpooling, and reduction of trips.)

**Figure 12 - 2050 Vision for Light-Duty Vehicles**

![2050 Vision Light-Duty Vehicle Gasoline Reductions](Source: California Energy Commission, 2050 Alternative Fuels Vision)

EVs are expected to play a large role in diminishing GHG emissions from the transportation sector because they offer substantial net emissions reductions relative to the average vehicle on a full fuel cycle basis, taking into account both expected emissions reduction pathways for conventional vehicle emissions and California’s increasingly green (low-carbon) electricity grid. EVs include both Battery Electric Vehicles (BEVs) such as the Nissan LEAF and Mitsubishi “i” -- which are powered solely by electricity -- and Plug-in Hybrid Electric Vehicles (PHEVs) such as the Chevy Volt and forthcoming Toyota plug-in Prius, which include a supplemental gasoline engine. Evolving in emissions from today’s California grid power, a BEV emits approximately 70 percent fewer GHGs per mile in California than a comparable gasoline vehicle (TIAX 2007). PHEVs (based on a Chevy Volt) provide approximately a 48 percent emissions reduction. Of course, this number will shift as different PHEVs enter the Bay Area’s vehicle fleet mix, with different all-electric ranges. For example, the Volt has an all-electric operational range of nearly 40 miles, while the 2013 Plug-in Prius is rated at just 11 miles in all-electric mode before the gasoline engine is activated. For PHEVs in particular, the availability of recharging may also influence the percentage of miles that consumers will be able to drive in 100 percent electric mode. Another important EV emissions variable is the CO\textsubscript{2} intensity of the power grid. In some parts of the Bay Area, municipal and community-operated energy authorities, such as the Marin Energy Authority, will be offering 100 percent renewable power for a modest cost premium, which will enable BEVs to operate at a GHG emissions factor of nearly zero. PG&E is also considering deployment of a 100 percent green power option.

As California’s power grid becomes greener through the implementation of the state Renewable Portfolio Standard, which calls for 33 percent renewable electricity by 2020, the

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57 PHEVs feature a gasoline engine that supplements the electric drivetrain. Depending on battery size, PHEVs vary in all-electric range from an estimated 15 miles of all-electric operation for the initial PHEV Prius, to 40 miles of all-electric range for the Volt. (Initial Volt owners are recording more than 70% of their total mileage as “all-electric” miles, while data for shorter electric-range PHEVs is not yet conclusive.)
GHG intensity of each kilowatt hour (kWh) of electricity will decline significantly. Even with current electricity generation sources, an EV fueled by California’s grid-average electricity is cleaner than the cleanest of the current conventional hybrids, based on a full fuel-cycle analysis (which accounts for emissions throughout the energy production, refining, transportation, and transmission process)\(^58\) (TIAx 2007).

While our electricity supply is lower-carbon than the national average, California’s vehicle miles traveled (VMT) per capita are among the highest. California drivers average about 13,500 miles per year -- and gasoline sales in recent years have averaged more than 15 billion gallons annually. At an average price of $4 per gallon, California consumers and business are spending approximately $60 billion dollars per year at the pump (with the Bay Area accounting for approximately $12 billion of this total)\(^59\). In the event that gasoline prices increase again to the $4.60 average of the last oil price peak (in 2008), California will add another $9 billion dollars to the transportation fuel bill, with $1.8 billion in additional outlays flowing out of the Bay Area alone. Increasing gasoline costs directly erode household discretionary income, crowding out other spending and investment. Given that the per gallon equivalent cost of electricity is approximately $1 per gallon, shifting just 10 percent of the Bay Area’s vehicle fleet to EVs would result in a region-wide savings in fueling costs of $900 million per year. This consumption and investment shift would drive significantly enhanced local economic multiplier impacts. Unlike oil, which is largely sourced from outside the state and nation, California’s electricity feedstocks are almost 100 percent domestically sourced, and the majority of that is from in-state resources.

### 6.2 Market Context

The universe of EVs available for purchase is rapidly expanding. EVs in both BEV and PHEV configurations will soon be available across the full spectrum of vehicle types, from micro-cars to luxury sedans, and include SUVs, sports cars, small and medium-duty delivery vehicles, as well as a wide range of specialty vehicles. Among the models expected in 2012-13 are new offerings from Nissan, GM, Mitsubishi, Toyota, Ford, Daimler, BMW -- as well as startups Tesla, BYD, CODA Automotive, and Fisker. Tesla is manufacturing its vehicles in the former GM/NUMMI plant in Milpitas, while CODA is performing final vehicle assembly in Benicia. Ford, GM, Nissan and Volkswagen have all established research centers in the Bay Area -- with electrification as one of their R&D focal areas.

In addition, other major market players are developing related services for EVs, including “vehicle to grid” (V2G) technologies, a cutting edge approach which will link future generations of EVs to smart grids and distributed renewable energy networks. According to a report by GlobalData, the global V2G market will grow to $40.4 billion in 2020, with the U.S. V2G market growing to $12.4 billion in the same time period (GlobalData 2010). These revenues will derive from use of vehicle batteries in grid-related services, such as providing occasional power back to the grid to balance supply and demand, or to take advantage of time-of-use pricing that will enable EVs to “buy low” when energy is cheapest (typically at night) and “sell high” during the day, based on user preferences. (V2G opportunities are described in more detail below.)

California as a whole -- and the Bay Area in particular -- have historically outpaced the rest of the country in adoption of clean vehicles. At present, Bay Area PHEVs account for over 6 percent (Tam 2010) of vehicles in the region, compared to

\(^{58}\) In comparing fuels against standard gasoline, Biodiesel provides a 10 - 13% GHG reduction, Midwest corn ethanol (E 85) a 15 - 28% reduction, hydrogen produced by electrolysis a 26% reduction, and CNG a 20 - - 30% reduction (in light duty vehicles.) By contrast, a regular hybrid will provide a 25% reduction, a Plug-in Hybrid yields a 48% GHG reduction, and a Battery Electric Vehicle (BEV), a 72% reduction.

\(^{59}\) 2010 gasoline sales were reported by the California Board of Equalization at 14.8 million gallons http://www.boe.ca.gov/sptaxprog/reports/MVF_10_Year_Report.pdf.
2.4 percent penetration of the national fleet (DOE 2012). There are not yet any definitive statistics on the full range of EVs in the Bay Area (including legacy EVs, conversions, and PHEVs.) However, based on a combination of automaker, DMV, and local EV user group records, Plug-in America has estimated there were approximately 4,000 highway-capable EVs in the region at the end of 2011. The Bay Area has been the leading national market on a per capita, metro-wide basis for regular (non-plug-in) hybrid penetration — and will likely repeat this market leading performance for EVs.\(^\text{60}\) Bay Area hybrid penetration rates thus far appear to be strongly predictive of early stage EV sales, and are among the nation’s leading zip codes for EV adoption. However, precisely estimating future EV deployments is a challenge, as adoption rates will depend significantly on macroeconomic conditions (household income, credit availability, employment rates, consumer confidence, etc.), government incentives, future gas prices (and expectations of gas prices), battery costs, charging infrastructure, and overall consumer perceptions of EV product convenience, value, and quality. Given these variables, projections vary from a low of 5 percent penetration statewide by 2020 (by the California Air Resources Board) to an optimistic 13 percent penetration rate nationwide (projected by the Roland Berger consulting firm).

The California PEV Collaborative cites the following range of recent studies:

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\(^{60}\) EVs are penetrating regionally and nationally at a higher rate than hybrids. The Nissan Leaf and Chevrolet Volt had total sales of 17,345 in 2011, despite limited availability in most markets. By contrast, only 9,350 hybrids were sold in 2000, the first year the Honda Insight and Toyota Prius were offered in the U.S.— where total hybrid sales have topped 2 million. Statewide, California has led adoption of hybrids with 50 hybrids per 10,000 residents in 2011, approximately double the rate of other large states, such as Michigan and Texas (which have fewer than 26 hybrids per 10,000 residents), according to the Center for Automotive Research.

The primacy of vehicle electrification as a strategy for transportation emissions reductions is, of course, a new emphasis, as mass-market EVs have not been available since the 1990s. Until recently, therefore, efforts to reduce carbon emissions from vehicle sources in the Bay Area have been focused largely on other (complementary) strategies, as outlined in CARB’s AB 32 Scoping Plan, the CEC Alternative and Renewable Fuel and Vehicle Technology Plan, the Metropolitan Transportation Commission Regional Transportation Plan, BAAQMD Clean Air Plan, and Sustainable Communities Strategies, now under development by the Metropolitan Transportation Commission (MTC) and the Association of Bay Area Governments (ABAG).

As a group, these plans focus on the following core strategies: regional road and parking pricing strategies to encourage adoption of alternative modes of transportation; land use changes to reduce the need for car travel in new

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\(^{61}\) “New Bay Area Plan Puts Change in Motion”, MTC website Transportation 2035 summary and update, January 2012, http://www.mtc.ca.gov/planning/2035_plan/
developments; consumer incentives for cleaner vehicles; wider availability of low-carbon fuels; and support for public transit and pedestrian and bicycle infrastructure. The modeling of GHG reductions flowing from the ABAG and MTC initial Vision Scenario for transportation called for under SB 375 confirms that the existing pattern of Bay Area development -- with its legacy of decentralized employment and residential patterns -- will remain difficult to serve with enhanced public transportation and bike/pedestrian improvements alone. However, additional GHG reductions could be significantly advanced by an intensive and strategic approach to accelerating the mass adoption of EVs.

Based on the Bay Area Air Quality Management District Clean Air Plan, the Bay Area has already set a robust target for EV deployment: 100,000 EVs by 2020. In response, Bay Area public and private sector leaders are in the process of developing a strategic action plan to accelerate EV adoption across the region. The Bay Area EV Strategic Council has been created as a high-level executive forum for regional leaders committed to making the Bay Area the “EV Capital of the United States” -- as measured by the proportion of EVs in the total vehicle fleet. Key initiatives of this Council and its partners include development of a robust public charging network — as well as the streamlining of residential EV charger installation and the promotion of EV-friendly building codes and public works initiatives.

With investments by federal, state, regional, and local agencies, as well as the private sector, innovative regional initiatives on EV infrastructure are advancing rapidly. Approximately 2,000+ publicly accessible Level 2 (240 volt) charging stations -- as well as 70+ Fast Charge stations -- are likely to be in service in the Bay Area by 2013, along with several thousand additional residential Level 2 chargers. In addition, innovative demonstration programs will soon be under way in EV car sharing, EV battery switch stations, EV fleet deployments, and other EV-friendly policies and market-building activities.

The Bay Area’s existing EV initiatives are creating a robust charging infrastructure that by the end of 2012 will help signal to potential EV customers that this region is truly “EV-ready.” However, consumer research indicates that another essential prerequisite for EVs to achieve mass-market penetration is price parity with conventional vehicles. While the total cost of ownership for many EV models is already equivalent to -- or better -- than a comparable conventional vehicle, high up-front purchase prices are a serious consumer concern. A Deloitte Touche survey found that 73 percent of participating consumers expect to pay no more than $35,000 - after incentives - for an EV; and more than half view prices in excess of $30,000 as a major stumbling block. A Pike Research survey (Pike Research 2011d) determined that EV driving ranges are adequate for most daily users, but that the “optimal price point” for a typical consumer was $23,750. Unfortunately, even this relatively low EV price misses a substantial portion of consumers who can only afford lower cost vehicles.

The relatively slow initial adoption rate of conventional EV hybrid vehicles demonstrated that “early adopter” and “green consumer” behavior differs significantly from mass market behavior. To the mainstream consumer, an EV must include a compelling up-front economic value proposition. Unfortunately, current consumer perceptions of EV’s has been dominated by the high up-front cost disparity, as well as concerns regarding convenience and range.

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62 The Deloitte Touche survey found that 69% of car buyers consider the vehicle’s actual purchase price, rather than overall cost of ownership, the most important factor in their purchase decisions.

63 Nearly three-fourths of respondents (74%) drive 40 miles or less to work daily – with the average commute distance reported to be 22 miles.
6.3 Electric Vehicle Initiatives

To address the core issue of initial EV pricing, three strategies are identified here:

- **Aggregate EV Purchase Program**: Aggregate purchasing has potential to modestly reduce the up-front cost of EVs, making them more competitive with comparable internal combustion engine vehicles in this gateway strategy.

- **Battery Finance**: This key enabler could take much of the battery cost (e.g., $5,000 - $9,000) off of the vehicle “sticker” price and re-package the battery with EV “fueling” (electricity) payments. This would result in an integrated monthly “fuel system” cost that is still less than current gasoline-based fueling for average conventional vehicles. It also has potential to reduce the sticker price to “ballpark” comparability with conventional vehicles.

- **Energy Service Markets**: Another key enabler to increase the value of EVs for consumers is to link them to new revenue streams available via vehicle-to-grid (V2G) connectivity, tapping emerging markets for electric grid services, and thereby reducing net EV operating and ownership costs. While this approach may take several years to fully develop, early stage commercial projects will be emerging in the 2013 timeframe.

Because the three initiatives can be synergistic, their potential impact is assessed together.

### 6.3.1 Aggregate Purchase Program

**Initiative Type**: Gateway

**6.3.1.1 Opportunity**

As discussed in this report’s section on Distributed Renewable Energy, aggregate purchase programs have been very successful in the solar PV industry. This strategy can remove information barriers, drive down transaction costs, and enable vendors to pass significant savings on to consumers. Similar barriers and opportunities may exist in the EV market. As in the initial solar PV market development process, EV operating and cost characteristics and advantages are not yet well understood by many consumers, with significant consumer misperceptions currently impeding mass sales.
Experience suggests that EVs could be marketed in a manner similar to successful solar PV aggregate purchase programs—by enhancing consumer understanding and awareness, capturing economies of scale, and encouraging automakers to bring to market more affordable and diverse EV models.

Such a program could be based initially on an affinity group “channel strategy” that targets one or two affordable and broadly appealing models, appropriate to both fleet and consumer purchasers. A combined consumer and fleet focus has potential to leverage existing networks of affinity groups, e.g., business associations, environmentally conscious businesses, environmental and consumer groups, local governments, Clean Cities Coalitions, and so forth. Such a program would build upon some of the strategies developed by the “Plug-in Bay Area” campaign (developed by Plug In America) and other partners in the years immediately preceding the introduction of the Nissan LEAF and Chevy Volt, which helped encourage automakers to develop EVs.

Because of the dynamic nature of the EV industry, with a constantly expanding array of domestic and global players, such a program could incentivize automakers — in a “race to the top” dynamic — to make special efforts to strengthen their market position in the Bay Area, which is one of the top EV markets globally. Already, a number of major EV automakers have expressed interest in participating in an aggregate purchase program, which could be progressively expanded to include more vehicle models if initial efforts were successful.

As with other competitive aggregation strategies, formal manufacturer participation would likely be solicited via a request for proposals (RFP) to develop improved pricing, customer care approaches, and EV-specific services. The RFP could include innovative financing approaches, and the potential “bundling” of EV charging and energy services, discussed further below. A key touchstone for such a proposed program would be a strong focus on mainstream buyers for whom affordability and convenience are key criteria. The ultimate objective would be to leverage the program’s structure and volume to advance price parity with equivalent conventional vehicles.

The “program vehicle” (or vehicles) would need to meet a set of basic criteria for consumer acceptance: e.g., a five passenger vehicle with high quality accessories (e.g., navigation, AC, sound, etc.); provide a reasonable minimum in all-electric miles of range (e.g. 30 miles in the case of a plug-in hybrid) or reliably 75 miles of range (in the case of a Battery-Electric Vehicle); and the ability to ‘refuel’ rapidly with electricity, perhaps with a minimum of 50 percent of the original range (or not less than 20 miles) in approximately 10 minutes or less. The refueling speed could be achieved by Fast Charge technology, or potentially by means of a “battery switch” station utilizing vehicles that have been equipped with rapid battery switch capability. (See sidebar on the Better Place model below.) The net up-front cost to the driver would optimally be equivalent to an internal combustion vehicle in the compact vehicle class (i.e., less than a $20,000 purchase price, with typical lease-finance terms available.)

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64 [http://pluginbayarea.org/](http://pluginbayarea.org/)

65 Personal communications
An aggregate purchase program for EVs on par with today’s purchase programs for solar PV systems offers clear advantages. In the current model, many EVs are sold by dealers who may be just as pleased to sell one of the many internal combustion engine vehicles marketed by their company. An aggregate purchase program, by contrast, would bring EV-specific sales strategies and approaches to affinity groups, potentially with innovative “try before you buy” opportunities, “peer ambassador” programs with EV auto club members, and marketing partnerships with organizations like the Sierra Club, or even a big box retailer, such as Costco. To be most effective, however, such a program would need to aggregate sufficient EV demand to drive meaningful price reductions or the kind of innovative financing models described in subsequent sections of this report. The specific volumes needed are the subject of ongoing dialogue and negotiation with key manufacturing and finance partners. However, initial discussions suggest that a program could be launched with sales goals in the hundreds of vehicles over an initial launch period of some months, and then scale into the thousands in the 2013-2015 period, depending on model types, financing, discounts, marketing resources, and other factors.

Participant automakers as well as marketing channel partners must be closely involved in the initial design of such a group purchase to collaboratively develop a compelling suite of strategies that will drive demand beyond the existing volume discounts and incentives available to fleet buyers. Finally, any large aggregate purchase must be accompanied by a strong marketing campaign structure. This requires significant investment and strategic partnership development in collaboration with affinity group partners that can reach prospective buyers through multiple channels, bringing them timely and compelling information, and a reliable and efficient vehicle reservation and purchase process.

### MTC Go EV Campaign

A supporting strategy for accelerated EV demand involves the development of a region-wide “Go EV” campaign which has been endorsed in principal by the Bay Area EV Strategic Council. As part of its Climate Initiatives Public Outreach campaign, the Metropolitan Transportation Commission has initiated a strategy development process for the campaign in 2012, with a likely launch by early 2013. The campaign will be supported by a planned initial MTC investment of approximately $1 million dollars, with potential co-investment by industry partners.
6.3.1.3 What is Needed

Fortunately, the Bay Area is well positioned to execute a comprehensive EV marketing campaign. Regional assets include the EV Strategic Council structure as well as strong existing relationships among government agencies, NGOs, and the auto industry itself. The initial steps towards an aggregate procurement initiative are being planned in the early-mid 2012 timeframe and will include consumer research, development and market assessment of a draft RFP, and marketing campaign design.

Consumer research will help determine the optimum price and product parameters needed to shift the Bay Area EV consumer purchase pattern from the current baseline to a significantly higher level of market penetration. Issues explored will include price sensitivity, range and recharging issues, PHEV vs. BEV considerations, product form factors, and strategies to attract consumers to a “try before you buy” program. Based on different scenarios for product price/performance, a range of region-wide demand scenarios will be developed. In addition, the feasibility of “piggy-backing” similar regional aggregation programs onto the Bay Area program will also be considered, with special attention to the greater Sacramento, Los Angeles/South Coast, and San Diego markets.

Following completion of the consumer study, a draft RFP is planned to solicit automaker feedback and interest in the aggregate purchase approach. The draft RFP will test the scale at which automakers could introduce lower pricing, the specific product feature set, and timeframe. This initiative will require pro-active outreach and partnership development to engage automakers, finance and leasing companies, and energy service providers to collaborate on novel financing approaches that may include battery-plus-energy financing approaches.

Currently, EV profit margins are typically very low, with some EVs likely being sold as loss leaders. However, initial outreach suggests that a number of auto manufacturers are eager to establish the strongest possible beachhead in the greater Bay Area. The key to best-available pricing is establishing the strongest possible affinity group sales channel strategy. Key prospective partners that will be engaged in the feasibility study process include the Silicon Valley Leadership Group employer network (which reaches nearly one in three private employees in Silicon Valley), the American Automobile Association, the Association of Bay Area Governments, the Bay Area Council, Plug In America and EV owners’ clubs, private wholesale buying clubs (such as Costco), credit unions, the Sierra Club, and leading solar firms.

Based on this survey and outreach process, an optimized configuration of channel partners and strategic marketing strategies can be developed. Marketing approaches will be customized to channel partners, and will likely emphasize (among other approaches) “puppy dog” sales opportunities that involve “try before you buy” product placement, similar to programs pioneered by Volkswagen and others. In addition, co-marketing opportunities with car sharing organizations – such as San Francisco’s City CarShare -- will be explored that could potentially increase both the number of EV buyers and the number of consumers who opt into EV-focused car sharing as their preferred “sustainable mobility” solution.

6.3.2 Battery Leasing

Initiative Type: Key Enabler

6.3.2.1 Opportunity

The Aggregate Purchase program may deliver unit cost savings on its own, thanks to economies of scale and

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66 The Bay Area Climate Collaborative, in partnership with the EV Communities Alliance, has secured funding from the Rockefeller Brothers Fund for an aggregate EV purchase scoping project that includes both consumer research and industry outreach components.
manufacturer interest in accessing the benefits of a regional marketing partnership. On a parallel track, however, opportunities may exist for financially restructuring the battery cost and (potentially) the EV electric fuel payment to lower the up-front purchase price of EVs. These strategies may prove fruitful either as a program component within an aggregate purchase program, or as a stand-alone initiative.

The context for battery and fuel payment repackaging is closely related to strategies observed in other industries, notably cellular telecommunications. Cell phone companies initially passed nearly the full cost of handsets onto consumers at the outset of the industry’s scale-up, leading to initial cell phone hardware costs in the $1,500+ range. As a result, the industry initially achieved limited penetration levels for the technology. Over time, companies scaled up to mass adoption in part by enabling users to pay for the handset through monthly per-minute (or unlimited) use fees locked in with multi-year subscription contracts. Once this mechanism became ubiquitous, up-front handset pricing rapidly dropped to less than $100 -- and cell phone sales skyrocketed.

While price parity between EVs and conventional gasoline vehicles will ultimately be achieved in part by virtue of more cost-effective battery technologies and scale economies, it is likely that these advances will be incremental. Current cost curves for batteries are bending somewhat more slowly than in other technology areas such as computer storage and solar PV. However, the growing cost gap between gasoline and electricity pricing provides an opportunity to shift the cost of the battery into the “fueling cost” column in the mind of consumers and in the accounting framework of corporate customers. This approach would financially decouple EV batteries from the initial purchase price of the EV — financing the battery separately through a “pay as you charge” mechanism. This could involve “on-bill financing” via utility bills, or lease arrangements that bundle the battery payment with a “free” home charger. Another option would be to bundle the battery and fuel payment with a “free pass” for accessing a widely deployed public charging network, potentially including Level 2, Fast Charging, and battery switch station access (in the event that the Better Place model takes hold).

The impact on consumer behavior of restructuring EV financing with a battery + electric fueling “package” is potentially very significant. To use the cell phone market analogy, consider the consumer response to these two options. Option A requires consumers to pay $1,500 up-front for a cell phone and $50 month for airtime minutes. Option B invites consumers to pay just $99 up front for a cell phone, and $99/month for minutes over a two-year contract period. Consumers strongly favor the lower up-front cost, even though the total cost of ownership (TCO) for both options is identical. Likewise, the impact on consumers of taking $5,000 to $9,000 out of the up-front cost of a BEV or PHEV could be dramatic. With EV battery leasing re-framed as part of the fueling cost, an existing lower-cost BEV (such as the Mitsubishi i-miev) could be priced close to $15,000 after rebates; while a lower-cost PHEV could be priced closer to $25,000. For most drivers, the operating cost of the car -- paid largely through a bundled electricity/battery payment -- would still be less than the gasoline costs alone of a conventional vehicle, with savings being strongest for drivers with higher mileage (e.g.,15,000 miles per year or more).

A number of EV fleet manufacturers (such as Smith Electric) are already pursuing the battery-decoupled approach, because fleet buyers typically have more headroom in their operating expense budget (based on evolving fuel cost norms) than in their capital expense budget (Shroyer 2011). In Europe, Renault is using this strategy with the Zoe EV which sells for about $21,000 plus $110 per month (King 2012).

By transferring the battery from the capital expense to the operating budget, fleet buyers are discovering that their initial purchase price parameters and total cost of ownership (TCO)
requirements can be met by many EVs, even at today’s prices. GE Capital has reported interest in exploring battery leasing for consumer EVs (Stroll 2011), and the energy giant NRG is exploring this option in the context of its announced V2G business initiative in major EV markets, including Texas and California.

The possibility of a third party financing company owning the battery reflects the reality that EV batteries also have a strong re-use value -- even after their suitability for vehicle usage has faded. EV batteries typically carry warranties for 8-10 years or 100,000+ miles. At that point, batteries are expected to have lost 20 percent or more of their energy capacity, which makes them unsuitable for most vehicle applications. However, they would still have high value in stationary applications for utilities, energy service companies such as demand response aggregators, customers with PV and wind installations, or building owners requiring backup emergency power.

### 6.3.2.2 Challenges

There are a number of challenges to be addressed in financially repackaging EV batteries and energy payments. While leasing of vehicles is a mature market, the notion of a lease on a sub-component of a vehicle -- such as the battery -- is relatively novel. Lenders may require new legal arrangements and risk calculations to price the battery asset. The value of the battery at the end of its life is also an area of some uncertainty. The greater the value, the more attractive it is for financial institutions to own the asset. At this point, research on battery value in stationary applications is still in its early stages and difficult to evaluate -- as valuation models depend in part on regulatory structures and tariffs for energy storage applications, which are undergoing constant refinement. In response to these uncertainties, GM, Nissan, the Electric Power Research Institute (EPRI), the California Center for Sustainable Energy, UC Berkeley’s Transportation Sustainability Research Center and many others are exploring the technical and economic dimensions of stationary storage applications of EV batteries in order to more accurately assess battery residual values, as well as related V2G and energy storage applications.

Another challenge is the potential complexity of payment mechanisms for an EV owner. While battery financing linked to electricity fuel payments can mitigate the “sticker shock” problem, an EV owner could potentially be faced with multiple payments associated with their EV: monthly finance payments on the vehicle; battery finance payments; the home electric utility bill (including EV charging costs); and payments associated with public charging. It will be important to streamline and consolidate some or all of these payments to avoid confusion among EV owners. These options are discussed further below.

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69 [http://tsrc.berkeley.edu/PlugInElectricVehicleBatterySecondLife](http://tsrc.berkeley.edu/PlugInElectricVehicleBatterySecondLife)
6.3.2.3 What Is Needed

The central requirement to advance EV battery financing is formation of the necessary commercial partnerships, along with a regulatory structure that enables the appropriate rules and tariff structure to integrate EV services on the power grid, and provide reliable revenue back to the EV owner. These structures can be developed incrementally over time. Automakers can partner with finance firms to develop a battery lease model for light duty vehicles on a pilot program basis. Initial deployments can target a select fleet or consumer segment in relatively controlled circumstances. The core objective of such a deployment would be to fully develop the legal and commercial relationships needed to go to scale with this new financing option. Initial smaller-scale demonstrations would evaluate consumer receptivity to the battery lease concept as well as the provision of energy services being sold back to the utility grid while the vehicle is parked in a V2G-enabled charging station.

More comprehensive solutions can also be developed. Battery cost re-packaging is likely to be most attractive to the typical consumer if it is structured and marketed as a fully-integrated, user-friendly package of services. In its most ambitious and inclusive form, this package could include:

- Residential charger hardware procurement and installation
- Access to public charging networks (based on either unlimited use or per charge options)
- Favorable electric “fueling” charges (including potentially both electricity metered at home and electricity procured while “roaming” in the region or beyond).
- Participation in grid-related energy services, including “demand response” controls to ramp down vehicle charging at peak hours and ramp it up when electric power costs are low (based on pre-defined user preferences). V2G services can also include provision of “frequency regulation” or balancing and “firming” energy that can help integrate greater quantities of renewable energy into the grid, by utilizing vehicle and fixed battery storage to buffer spikes in supply (generation) and demand (load).

Some commercial EV market participants have already developed an integrated approach to residential charging infrastructure, energy use, and commercial charging network access that illustrates some of the elements of this solution set70. The NRG “eV2go” model of charging services (currently deployed in Texas) bundles home charger installation, electricity payment, and network access for a single payment of approximately $99/month in a two-year contract format, for example. For the consumer, a more comprehensive combined package -- home charger, favorable electricity “fuel” pricing, charger network access, and battery payment - - could help consumers do the following:

1) Reduce the hassle of home charger selection and installation;

2) Navigate the current maze of electricity rate structures to lock in the most favorable approach (this is particularly vexing at this time in the Bay Area due to the many complex options provided by local private and municipal utilities);

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70 NRG, the Texas-based utility and energy services company, is advancing this model. Beginning in Texas, NRG has offered a bundled package of services that includes a low-cost standardized price for purchasing and installing a residential charger, plus limited or unlimited access to the public charger networks for flat fees that vary from approximately $59/month to $99/month ongoing, based on a minimum commitment period of two or more years. NRG reports high rates of enrollment in the program by new EV buyers, who are presented with the program participation option at the time of purchase of a new EV. NRG will be implementing a variation of this model in Califomia, as part of its planned $100M investment in California Fast Charge and level 2 infrastructure. . http://www.pikeresearch.com/blog/texas-a-lone-star-in-ev-charging-infrastructure
3) In the case of “unlimited” users, levelize the cost of electric fuel over the entire duration of the contract period;

4) Reduce the number of bills to track and pay;

5) Reduce the overall cost of EV ownership through participation in grid services revenue generation.

In the most comprehensive implementation of this approach, auto dealers (and their allied business partners) would be able to offer such a package to the consumer with an attractive fixed monthly cost. If this payment were in the $180 - $280+ range (depending on battery size), which is comparable to or less than what the consumer might otherwise pay for gasoline alone. In this scenario, EV sales would likely receive a significant boost -- provided the up-front cost of the EV was the same or less than the conventional car equivalent (by virtue of shifting the battery cost into the fueling system package).

6.3.3 Energy Services Participation

Initiative Type: Key Enabler

6.3.3.1 Opportunity

One of the most promising features of EVs is their potential to store electricity at very low power prices, and then feed that power back to the grid or buildings in ways that generate revenue for the vehicle owner. The potential revenue from the establishment of a “vehicle-to-grid” technical and commercial architecture has been variously estimated at $1,000 to $3,500 or more per vehicle annually. This level of revenue flow could be among the longer-range “game-changing” strategies for accelerating EV adoption in the Bay Area and throughout the U.S.

The most inclusive name for the continuum of grid services that can be provided via bi-directional energy flow from the vehicle is called “V2X” -- with “V” representing vehicles, and “X” representing the full range of energy loads and services. This continuum is also expressed as V2B (for Vehicle-to-Building), or V2H (for Vehicle-to-Home), V2A (for Vehicle-to-Appliance), etc. The range of V2X applications is extremely broad. At this time, power flow to EV’s is essentially grid-to-vehicle or G2V. However, many automakers and charging companies are beginning to develop the capability to send power back from the battery to the grid or to other “off-board” uses, such as powering tools or other equipment via AC power.

An EV ecosystem equipped with bi-directional vehicles, batteries, electronics, and EV charging stations could enable EV owners to:

- **Provide Backup Power.** This service could be attractive for buildings during a power outage. This can be particularly important in an earthquake or disaster recovery situation. A typical EV battery the size of the Nissan LEAF (24 kWh) can power a typical home for as long as 1-3 days, depending on factors like air conditioning load, etc.

- **Provide Peak-Power Cost Shaving.** Similar to the role solar PV panels or fuel cells play for commercial facilities and large homes, EVs can power facilities at times when utility grid power is expensive, thereby reducing net costs. For example, EVs could charge off-peak at 9 cents per kWh, and deliver energy to facilities which would otherwise be paying 35 cents per kWh during peak periods.

- **Interact with “Demand Response” Signals.** EVs and chargers can be aggregated into a network that

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71 In the wake of the Japanese earthquake and tsunami, the Japanese gasoline delivery infrastructure was decimated, and EVs were called on to manage emergency functions, especially after the electrical grid was restored much sooner than the gasoline supply chain. http://wheels.blogs.nytimes.com/2011/09/01/in-a-blackout-nissan-mitsubishi-and-toyota-e-v-s-could-function-as-generators/
responds to signals from the utility or transmission grid operator to “ramp down” charging during demand peaks, or “ramp up” charging to soak up inexpensive electricity at night, such as surplus wind capacity. EVs plugged into appropriately equipped “smart” charging stations at home or work could be earning revenue for vehicle, battery, and charger owners -- and energy service companies.

- **Participate in the “Frequency Regulation” Market.** Grid electricity requires continuous and near-instantaneous balancing of supply and demand. This service will increase in importance as intermittent renewables such as solar and wind generate a growing portion of California’s electricity. EVs can become a cost-effective asset for grid operators to manage the grid’s need for “frequency regulation” services -- and potentially generate significant revenue for the EV owner. Many battery storage vendors are eyeing this market, and EV batteries will likely be tapped for these grid services.

As V2G revenue becomes available to customers at the lower end of current projections (e.g., in the range of ~ $1,000 per vehicle per year), initial price-parity with internal combustion engine vehicles can be achieved via financing approaches that value the battery as a source of grid ancillary service revenue.\(^{72}\) If revenue is in the $2,000+ per vehicle/per year range, as demonstrated in the Mid-Atlantic Grid Interactive Car Consortium\(^{73}\), then EVs could become more attractive than conventional vehicles on both an initial purchase price and operational cost basis, given new battery financing models.

In this example, an optimized V2G revenue flow could, over a five-year period, pay for a battery averaging $10,000 in cost. Once validated in real-world pilot program tests, revenues of this magnitude would significantly enhance the total cost of ownership advantage enjoyed by EVs.

Nissan, Mitsubishi, and Toyota are already beginning to include “V2-Home” (V2H) features in their vehicles in response to back-up power and energy security needs revealed in the wake of the Japanese tsunami and Fukushima nuclear disasters in 2011. Importantly, many of these new automaker developments do not require substantial changes in on-board power electronics, making some V2G approaches practical for near-term deployment. Among current models, the Mitsubishi i-MiEV, the 2012 Daimler Smart E, and the first generation BMW Mini E all have bi-directional power flow capability, as does the Build Your Dreams (BYD) vehicles imported from China.

V2G DEMONSTRATIONS IN THE MID-ATLANTIC REGION
In the 14-state PJM Independent System Operator territory, a university-industry initiative known as the Mid-Atlantic Grid Interactive Car Consortium (MAGICC) has demonstrated commercial frequency regulation services using V2G enabled vehicles linked to the grid. In the multi-year MAGICC demonstration, commercial payments have been provided to light-duty vehicle owners in the amount of nearly $2,000 per vehicle per year. This level of payment for use of the EV battery could – over the long-term – substantially boost the EV value.

In addition to automaker advances on V2X, recent market developments are advancing the commercial viability of V2G in the near-term, including: strong interest from utility grid Independent System Operators (ISO); commercial-scale utility

\(^{72}\)It should be emphasized that ancillary services typically require relatively infrequent and shallow battery discharge, and access to individual battery packs can be modulated negative impact on battery performance.

\(^{73}\)See [http://www.magicconsortium.org/](http://www.magicconsortium.org/) for links to articles and research.
V2G program development⁷⁴; communication and technology standards development; advances in EV metering and billing standards; and deployment of automated demand response software that optimally integrates distributed electric loads and generation.

In summary, development of the V2G market in the Bay Area will help drive these broader economic and environmental benefits. It will also position Bay Area companies to participate in rapidly growing V2G markets locally and globally, boosting green jobs. Linking EVs to grid services will help develop and capture new (V2G) revenue flows for EV owners in sufficient volume to positively impact mass adoption of EVs. Finally, as noted above, V2G opportunities can help provide the regulation services and storage capacity needed to integrate distributed electric loads and generation.

6.3.3.2 Challenges

While infrastructure exists for EVs to provide some grid services, such as demand-responsive charging, challenges remain to deploy the full range of potential V2G services and unlock the economic value they can provide. Automakers and finance companies may be uncomfortable with the implications for battery life and warranty costs. In addition, industry standards are not yet settled and integration into charging equipment remains an outstanding challenge.

Higher level “V2G” potential requires a broader range of deeper public/private partnerships and, in California, regulatory action. At present, California lacks as vibrant a demand response market as other regions of the country. However, recent rulings by the Federal Energy Regulatory Commission on demand response will likely accelerate market opportunities. Additionally, existing work on V2G communication and control protocols for bi-directional power flow will be needed, encompassing both the charger and the vehicle. These efforts are ongoing, but will need to be accelerated to scale from pilot-test to commercial implementation in the 2012 - 2013 timeframe and beyond.

6.3.3.3 What Is Needed

Though the potential for full scale V2G revenue flow to EV owners is largest in the longer-term (5-10 years+), immediate economic benefits may also be possible in the near future (2-5 years). Initiatives can initially target demand-response demonstrations, leading to the provision of frequency regulation and other ancillary grid services. For example, local governments have sizeable vehicle fleets and average mileage of these vehicles can be low, typically 6,000 miles per year. Many vehicles spend a high percentage of time parked in pooled locations. Many local governments are planning to deploy EVs as part of their strategy to reduce reliance on petroleum and to lower carbon emissions. Some of the municipalities and other fleet operators in the region may be prime candidates to roll-out select demonstrations of EVs that can, if aggregated, participate in grid services markets while parked during the day or night.

In addition, robust V2G connectivity can be demonstrated in Bay Area microgrid environments that integrate V2G enabled vehicles, chargers, building energy management systems, stationary battery storage, distributed renewables, and utility demand response programs. Target demonstration site options include locations where key components are already being developed or deployed, such as the Moffett Field campus in Mountain View/Silicon Valley, and solar PV-equipped office campuses in the City of Palo Alto, the County of Marin, and elsewhere.

To drive Bay Area innovation in the V2G market, a multi-stakeholder approach will be needed. The goal of such a collaboration will be to develop and deploy commercial partnerships and market structures needed to develop EV energy service revenue potential, and enable real-world

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⁷⁴ Introduction of V2G programs by major utilities (including NRG and PEPCO Holdings in the PJM territory) are encouraging automakers and other OEMs to develop and deploy V2X technologies.
commercial transactions in a V2G “ecosystem.” In this effort, the core deliverable would be to enable payment for V2G-related revenue from energy companies to actual EV owners and fleet operators. The establishment of this core transactions architecture -- including its technical, commercial, and regulatory elements -- would in turn encourage EV related companies to accelerate deployment of V2G equipped vehicles, infrastructure, and services.

This proposed stakeholder collaborative will be a “rapid deployment force” designed to bridge key gaps necessary for the rapid scaling of small to medium scale V2G market demonstration projects (involving regional market aggregations of 200 – 1000+ vehicles, initially) that can produce “game-changing” revenue for vehicle owners (e.g., $1000 - $2000+ per vehicle per year with minimal battery degradation). One initial focus of this effort could be in in-campus or microgrid contexts (e.g., Google, Stanford, and UC campuses) and local government contexts (e.g. San Francisco, San Jose, and the East Bay Green Corridor) where there is a strong track record of success in sophisticated clean-tech demonstration efforts.

### 6.3.4 Key Players

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<th>Key Players</th>
<th>Examples</th>
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<td>Utilities</td>
<td>PG&amp;E, Silicon Valley Power, Marin Energy Authority, CleanPower SF</td>
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<tr>
<td>DR &amp; Smart Grid Integrators</td>
<td>Auto-Grid Systems, EnerNOC, REV, Nuve, CarbonDay Automotive, GridPoint, SolarPlug Energy Fund</td>
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<td>Charging/Infrastructure Vendors</td>
<td>Aerovironment, Better Place, Coulomb Technologies, ECOtality, GE, Kanematsu, NRG, Schneider Electric and others</td>
</tr>
<tr>
<td>Automakers</td>
<td>Mitsubishi, Nissan, CODA and others</td>
</tr>
<tr>
<td>Research Labs</td>
<td>UC Berkeley– Lawrence Berkeley National Labs</td>
</tr>
<tr>
<td>Non-Profits</td>
<td>EV Communities Alliance (EVCA), Bay Area Climate Collaborative, Joint Venture Silicon Valley</td>
</tr>
<tr>
<td>Fleets</td>
<td>Local governments and business, including stakeholders in the Electrification Leadership Council, a large-scale fleet operators’ advocacy organization</td>
</tr>
<tr>
<td>Finance Companies</td>
<td>GE Capital, Wells Fargo, Bank of America, and others</td>
</tr>
</tbody>
</table>

### 6.3.5 Impact

It is important to note that each of the needed elements of the V2G “value chain” are being deployed somewhere in the country, though no region has put all these value chain components together into one integrated V2G ecosystem. Given the complexity of the challenge, a carefully coordinated and integrated approach to the multiple strategies presented will be needed. For example, the aggregation program provides access to potential scale economies, the innovative financing strategies can ease consumer objections to up-front costs, and the Go EV Campaign would attract consumer and manufacturer attention to drive direct sales. While it is difficult to assess the impact of EV pricing with the limited consumer data available, the following chart suggests a
range of consumer responses to various levels of discounts available through the integrated strategies described above.\textsuperscript{75}

The model assumes a base-case developed by the Center for Automotive Research (CAR) released in January 2011, which is a conservative projection of penetration of plug-in EVs based on sales forecasts (CAR 2011). The model was simplified by taking the Nissan LEAF as the base case vehicle -- although the CAR study did not differentiate between BEVs and PHEVs in the reported projections. The model below shows three different scenarios based on implementation of one, two, or three strategies, and utilizes a conservative price elasticity of demand for the resulting increases in sales volume for the first two scenarios. Scenario three is speculative. Implementation of the robust strategy would yield the following over and above the base case:

- 12,000 metric tons CO2e avoided in first year (40,000 metric tons over 3 years)

The Limited Strategy assumes that an aggregate purchase program alone -- without any other new strategies to reduce initial purchase price -- may yield the equivalent of a 5%+ percent price reduction\textsuperscript{76}. This estimate was derived from discussions with Tier 1 (established, higher-volume) automakers, and is equivalent to price reductions offered to fleet buyers. However, one of the challenges unique to EVs is that the initial purchase price of the vehicle is not the only “first-cost” issue. The other major issue is purchase and installation of a residential charger, which is typically a Level 2 (240 volt) device. The cost of this hardware can range from a few hundred dollars to nearly $1,000, with installations likewise ranging from the low hundreds to one thousand dollars or more in the event of a longer electrical conduit run or an electrical panel upgrade. Given the residential charge installation cost and variability, a number of automakers have suggested that an appropriate focus for initial price reduction in an aggregate purchase scenario might be to provide a free home charger managed as part of a “turn-key” program.

The Moderate Strategy proposes shifting a significant portion of the battery cost from the initial purchase price of the vehicle to a bundled payment of the battery with the electricity. Analysts’ estimates of proprietary battery costs range from $350 to $600 per kilowatt hour (kWh) of capacity, or approximately $7,000 to $14,000 for the current generation of mass-market EVs (the Volt is 19 kWh and the Leaf is 24 kWh). Given the uncertainty of battery values at end of use, the “Moderate Strategy” estimates the battery value to be shifted to a lease at 25 percent of the estimated “MSRP” of the battery (net after rebates). The residual value of the battery is difficult to ascertain as there is no historical data that is meaningful and is assumed to be zero in the model, though it is generally accepted that the batteries will have approximately 70 – 80 percent of their energy capacity left at the end of a typical 8 year warranty period.

The Robust Strategy is proposed to include the combined impact of repackaging the battery with the fuel payment -- along with the addition of grid services revenue in the amount of $1,000 per vehicle per year, half of the demonstrated revenue achieved by “grid-enabled vehicles” now being demonstrated in the Mid-Atlantic Grid Interactive Car Consortium (MAGICC) in the PJM Interconnect system. The figure of $1,000 per vehicle per year is also consistent with

\textsuperscript{75} The only recent, publicly available price sensitivity analysis available on the nascent EV market is provided via the Pike Research study referenced above, which identified that the typical consumer views EVs as reasonably priced at $23,750, with more than half not willing to consider an EV priced at $30,000 or more. Given that there are only two true mass-market vehicles fully deployed in the marketplace as of early 2012, and both the Nissan LEAF and the GM Volt have experienced an excess of demand over supply in the early months (leading to reports of sales above the MSRP), there is not yet any empirical data demonstrating real-world price sensitivity. Anecdotally, it may be instructive that the less convenient Nissan LEAF BEV – with a price point after rebates in the $25,000 range, has outsold the more convenient but more expensive Chevy Volt PHEV by more than 2-1 – with the Volt price-point after rebates being in the mid to high thirties.

\textsuperscript{76} Typical discounts on vehicle manufacturers suggested retail price (MSRP) ranges between 10 and 20 percent. http://en.wikipedia.org/wiki/Passenger_vehicles_in_the_United_States

http://en.wikipedia.org/wiki/Passenger_vehicles_in_the_United_States
public announcements by NRG, the large energy company that has developed a V2G enterprise known as “eV2g” in conjunction with their public charging networks now being deployed in Texas and other markets. The full implementation of any such initiative will require additional work to align utility rates, California Independent System Operator (CAISO) and CPUC rules, and bi-directional energy flow and metering capabilities in vehicles, chargers, and associated communications and billing infrastructure.

The up-front cost for the vehicle in the grid services scenario is assumed to be the same as with the battery finance program component -- however, the sales projection is more speculative on the basis of improved total cost of ownership. Over 3 years these combined strategies could result in nearly 7 million gallons of gasoline and 0.079 MMtCO2e avoided above the base case. Drivers would save $16 million in avoided gasoline and maintenance costs above the base case. This strategy grows over time as an increasing number of drivers switch to EVs. Potential adoption rates are shown as follows on Table 4.

Table 4 - Bay Area Regional EV Sales Scenarios: 2012 – 2015

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>California Base Case Per Year</td>
<td>18,442</td>
<td>27,783</td>
<td>32,573</td>
<td>33,531</td>
</tr>
<tr>
<td>California Base Case Cumulative</td>
<td>18,442</td>
<td>46,225</td>
<td>78,798</td>
<td>112,329</td>
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<tr>
<td>Regional Base case</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional Base Case Per Year (no campaign)</td>
<td>4,611</td>
<td>6,946</td>
<td>8,143</td>
<td>8,383</td>
</tr>
<tr>
<td>Regional Base Case Cumulative</td>
<td>4,611</td>
<td>11,556</td>
<td>19,700</td>
<td>28,082</td>
</tr>
<tr>
<td>CO2 Reduction per year (MtCO2e)</td>
<td>13,017</td>
<td>32,626</td>
<td>55,617</td>
<td>79,283</td>
</tr>
<tr>
<td>Limited Strategy – Aggregate Purchase only</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial price cut/ % increase in EV demand</td>
<td>5%/ 6.8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited Strategy Cumulative</td>
<td>4,611</td>
<td>12,025</td>
<td>20,718</td>
<td>29,667</td>
</tr>
<tr>
<td>CO2 Reduction per year (MtCO2e)</td>
<td>13,017</td>
<td>33,950</td>
<td>58,492</td>
<td>83,756</td>
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<tr>
<td>Moderate Strategy – Aggregate Purchase with Battery Finance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial price cut/ % increase in EV demand</td>
<td>25.7%/ 34.7%</td>
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<td></td>
<td></td>
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<tr>
<td>Moderate Strategy Cumulative</td>
<td>4,611</td>
<td>13,967</td>
<td>24,938</td>
<td>36,230</td>
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<tr>
<td>CO2 Reduction per year (MtCO2e)</td>
<td>13,017</td>
<td>39,434</td>
<td>70,405</td>
<td>102,287</td>
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<tr>
<td>Robust Strategy – All three strategies together</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial price cut/ % increase in EV demand</td>
<td>25.7%/ 60%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robust Strategy Per Year</td>
<td>4,611</td>
<td>11,113</td>
<td>13,029</td>
<td>13,412</td>
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<tr>
<td>Robust Strategy Cumulative</td>
<td>4,611</td>
<td>15,724</td>
<td>28,753</td>
<td>42,165</td>
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<tr>
<td>CO2 Reduction per year (MtCO2e)</td>
<td>13,017</td>
<td>44,392</td>
<td>81,177</td>
<td>119,043</td>
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</tbody>
</table>
7 Conclusion

Time is of the essence for both the economy and the global climate. The lack of progress on national and international policy makes regional action of special importance. The San Francisco Bay Area’s unique role advancing clean energy makes it a model for other regions, but while the region has noteworthy successes, we can do better. Bay Area leaders have the opportunity to not only incubate the leading technologies and innovate strategies but also ensure that those technologies and strategies are deployed at scale, bringing market forces to bear in favor of those solutions and making the benefits of the clean energy economy indisputable.

The initiatives outlined in the Bridge to the Clean Economy are not exhaustive of all the work required to usher in a prosperous clean economy. Rather, the Bridge action plan offers a market-driven strategic approach -- and a set of economically viable projects -- that can be implemented immediately and begin scaling in the 2013-2017 timeframe.

It is understood that policy makers and market actors must move solutions together for optimum impact. By bringing key market leaders and catalysts together around these clean energy opportunities, each with strong ROI and emissions reduction potential, regional leaders can help bridge the gap between where we are now and where we need to be.

Together, the Bay Area will meet the biggest challenge of the 21st century: enhancing our shared prosperity while mitigating the impacts of runaway climate change.


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