Energy Research and Development Division

FINAL PROJECT REPORT

Richmond Advanced Energy Community

California Energy Commission

Edmund G. Brown Jr., Governor

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ABSTRACT

The Richmond Advanced Energy Community project pioneered zero-net energy solutions that will be demonstrated in Richmond, California, adopted and scaled-up by communities throughout the state, including disadvantaged communities. To achieve this goal, the Richmond Advanced Energy Community project developed innovative financial, policy, and program models that can substantially reduce greenhouse gas emissions and other harmful pollutants. This report describes the zero-net energy-focused plans, policies, and programs developed to advance the city's environmental and public health goals, and to serve as a model throughout California and beyond.

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PREFACE

The California Energy Commission's Energy Research and Development Division supports energy research and development programs to spur innovation in energy efficiency, renewable energy and advanced clean generation, energy-related environmental protection, energy transmission and distribution and transportation.

In 2012, the Electric Program Investment Charge (EPIC) was established by the California Public Utilities Commission to fund public investments in research to create and advance new energy solutions, foster regional innovation and bring ideas from the lab to the marketplace. The California Energy Commission and the state's three largest investor-owned utilities – Pacific Gas and Electric Company, San Diego Gas & Electric Company and Southern California Edison Company – were selected to administer the EPIC funds and advance novel technologies, tools, and strategies that provide benefits to their electric ratepayers.

The Energy Commission is committed to ensuring public participation in its research and development programs that promote greater reliability, lower costs, and increase safety for the California electric ratepayer and include:

- Providing societal benefits.
- Reducing greenhouse gas emissions in the electricity sector at the lowest possible cost.
- Supporting California's loading order to meet energy needs first with energy efficiency and demand response, next with renewable energy (distributed generation and utility scale), and finally with clean, conventional electricity supply.
- Supporting low-emission vehicles and transportation.
- Providing economic development.
- Using ratepayer funds efficiently.

Lancaster Advanced Energy Community is the final report for the Lancaster Advanced Energy Community Project (Agreement Number EPC-15-069, Solicitation Number GFO-15-312) conducted by Zero Net Energy (ZNE) Alliance. The information from this project contributes to Energy Research and Development Division's EPIC Program.

For more information about the Energy Research and Development Division, please visit the Energy Commission's website at www.energy.ca.gov/research/ or contact the Energy Commission at 916-327-1551.

EXECUTIVE SUMMARY

Introduction

California has set ambitious goals in the next several decades for increasing zero-net energy and reducing greenhouse gas emissions. In the *2007 California Strategic Plan*, the California Public Utilities Commission set the goal for all new residential construction to be zero-net energy by 2020, and for all new commercial construction to be zero-net energy by 2030.[1] Similarly, in the Global Warming Solutions Act (Assembly Bill 32, Nunez, Chapter 488, Statutes of 2006), Governor Edmund G. Brown, Jr. set the goal that California would reduce greenhouse gas emissions to 40 percent below 1990 emissions levels by 2030.[2]

To achieve these goals, California state agencies, local governments, and technology partners must collaborate on innovative solutions to help communities transition to an efficient, low-carbon economy using electricity generated from clean, renewable resources. These communities are investing in clean, resilient, affordable and locally sourced electricity generation and advanced efficiency measures to help their residents and business move to zero-net energy.

The Richmond Advanced Energy Community Project created scalable solutions to support communities transitioning to zero-net energy use and substantially reduce greenhouse gas emissions. The Richmond Advanced Energy Community Project addressed the barriers that efficiency and clean technology programs face when engaging with lower-income households and created solutions to overcome these barriers. While the solutions developed over the Advanced Energy Community Project were targeted towards the City of Richmond, they are designed to be scalable throughout California and beyond.

Project Purpose

This project identified challenges unique to disadvantaged communities in advancing emissions reduction goals. These challenges included lack of financing options, lack of information and outreach, and an absence of policies to leverage cost advantages of zero-net energy construction. To address these, the Richmond Advanced Energy Community project explored ways California communities can meet emissions reduction goals by improving energy resiliency (the ability for the cities to continue delivering critical services despite electrical grid outages or other energy supply disruptions), increasing electric vehicle adoption, advancing zero-net-energy building codes, refurbishing abandoned homes into highly efficient homes for first-time homebuyers, and promoting distributed energy resources.

In addition, the project team sought to design project measures to be scalable and sustainable. Recognizing that if a program does not gain market traction, options to scale our limited, the

1 Full document available at: http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=5305

2 CA SB 32 detail available at: http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_0001-0050/ab_32_bill_20060927_chaptered.pdf

project team worked to ensure that wherever possible, project elements would either be self-funding, or self-sustaining once initial funding was procured.

The overarching purpose of this project was to design solutions that, while applicable to the City of Richmond, would be easily implemented in other communities. Through these interconnected measures, the Richmond Advanced Energy Community Project lays the foundation for Richmond and other communities in California to achieve robust emissions reduction goals.

Project Process

This project was conducted through the joint efforts of key stakeholders from the community of Richmond, as well as the project team. The project team was composed of six collaborating entities:

- **Zero Net Energy Alliance** was the project lead, managed team collaboration and City interaction, and drove electric vehicle policy and program design.
- **Energy Solutions** led the building codes and energy disclosure ordinance work, and the low-income and early adopter program design.
- **Marin Clean Energy** provided key input on planning and program design to ensure that solutions created for the City of Richmond will scale to the greater Marin Clean Energy service area.
- **Olivine** developed the distributed energy resources program and led the energy resiliency work.
- **Sustainable Endowments Institute** developed the plan and framework for Richmond's Green Revolving Fund and added functionality to their fund tracking and transparency tool, the Green Revolving Investment Tracking System.
- **Richmond Community Foundation** led the abandoned homes redevelopment work and initiated and managed the funding of the social impact bond.

The project team worked closely with each other and the City of Richmond to ensure the deliverables represented the aggregate best thinking and to provide consistency across key elements of the project.

For project deliverables to best address the requirements of Richmond, the project team worked closely with the City of Richmond stakeholders in all dimensions of the Richmond Advanced Energy Community Project. The Richmond Environmental Manager, Adam Lenz, was the principal liaison from the city to the project. The project team also collaborated closely with the Planning and Building departments in designing the building energy disclosure policies and the zero-net energy reach code. In the vehicle electrification work, the project team worked closely with the city's fleet manager and the Richmond port director. While developing the Energy Assurance Plan, the project team collaborated closely with the city's emergency services team. This close collaboration allowed for frequent feedback from community stakeholders and rapid iterations cycles. Through this collaboration, the project team was able to verify that the solutions being designed would be useable in real-world applications.

Project Results

This project developed and advanced a series of plans, policies, and programs that support Richmond in achieving its climate and public health goals.

Plans

- **Energy Assurance Plan.** Mitigated risks to the City of Richmond's energy supplies in the event of a grid outage or other energy shortage. Given Richmond's vulnerability to natural disasters, the Energy Assurance Plan identified critical energy resources to be protected to ensure critical city services could continue operations in the event of an emergency. This project resulted in the City Building Distributed energy Resources (DER)/Solar program, which wants to install solar photovoltaics on all municipal buildings and energy storage on all buildings that serve critical disaster response purposes.
- **Electric Vehicle Action Plan.** Defined key programs and policies that accelerate using electric vehicles and infrastructure, which is critical to Richmond achieving its Climate Action Plan objectives. Immediate results of this plan included updates to the Richmond Zoning Ordinances to reduce barriers to installing electric vehicle chargers in multi-unit developments as well as the development of the Electric Vehicle Charger Incentive Program. One element that proved important to the development of the Electric Vehicle Action Plan was ensuring policies would address issues faced by residents of Richmond; therefore, changing zoning for multi-unit dwellings and ensuring low-income access to electric vehicles emerged as a major focus.
- **Green Revolving Fund Plan.** Made possible ongoing funding of clean energy and mobility projects with "recycling" of savings into additional sustainability initiatives. This plan became an important tool in creating key stakeholder buy-in around the benefits of a Green Revolving Fund.

Policies

- **Zero-Net Energy Building Codes.** Established zero-net energy and energy efficiency benchmarks in residential and city-owned buildings that exceed the state-required code.
- **Building Energy Savings Ordinance**. Enhanced requirements for building energy performance benchmarking, reporting and transparency. In hand with policy development, the project team also used Maalka, a software solution that supports the city in compliance tracking and providing data to the public for market-driven efficiency projects.

Programs

- **Rehabilitation of Abandoned Homes to Zero-Net Energy Standards.** Demonstrated using a "social impact bond" to purchase and rehabilitate formerly abandoned homes to achieve a zero-net energy standard, re-selling them to first-time Richmond home buyers. The zero-net energy home designs used in this component of the project naturally

gained market traction and are being expanded to other affordable housing developments in Oakland and the surrounding communities.

- **Zero-Net Energy Early Adopter Program for multi-family new construction.** Designed a set of instruments to support zero-net energy multifamily new construction, including the Zero-Net Energy Decision tool, which helps developers and designers identify feasible and least-cost pathways to compliance. The program also includes a zero-net energy incentive to support and reward early adopters, as well as zero-net energy performance monitoring.
- **Low-Income Energy Efficiency Program**. Addressed the twin challenge of lack of information about eligibility for available efficiency programs, and lack of contractor coordination on efficiency program measures. The Low-Income Program creates both a single point of contact for electricity customers as well as a coordinated contractor platform to ensure full transparency about all available program measures.
- **Distributed Energy Resources Program**. Integrated distributed solar, energy storage, demand-side management assets, and potential microgrid resources into a cohesive community energy network design. With a multi-phased approach, the program plans to target low-income households in addition to larger commercial customers.
- **City Building DER/Solar Program.** Developed solar and storage projects for on-site solar photovoltaic for all municipal buildings, as well as battery storage for City of Richmond facilities that provide vital services in the event of emergencies. This component emerged as a critical part of the Richmond Energy Assurance Plan.

These individual plans, policies, and programs are tightly integrated, forming a comprehensive advanced energy plan for the City of Richmond.

To ensure the tools and frameworks developed in the Richmond AEC Project can be leveraged by a broad stakeholder group and implemented by other communities, the project team has outlined a comprehensive awareness and engagement plan.

The team will create a website dedicated to the Richmond AEC project and related zero-net energy tools. This site will include the project background, introductions and explanations of all key deliverables, along with links to the deliverables. The site will provide a comprehensive introduction to the project and detailed resources allowing other communities to leverage and build on project findings.

In addition to an accessible online database, the project team will continue leveraging conferences and industry events to promote project findings. The team already has discussed project work at several workshops and conferences, including the 2017 American Council for an Energy-Efficient Economy summer study and in a keynote at the 2017 EV to Grid Conference in San Francisco. Various program components have also been presented to the Richmond City Council. Additional engagements will be identified for 2018.

Benefits to California

The benefits created by the Richmond Advanced Energy Community Project accrue to multiple stakeholders:

- **The City of Richmond** has essential tools to advance electric vehicle adoption, increase energy resiliency, improve residential building efficiency, and advance commercial building energy disclosure for energy retrofit projects. Through Phase I activities alone, 1.1 megawatts of solar photovoltaic and 2.3 megawatts of energy storage will be installed on municipal buildings, thus lowering ongoing city energy costs.
- Based on Phase I of the advanced energy community project, **residents of Richmond** will experience a reduction in air pollutants and greater options for electric vehicle charging. Additionally, residents in neighborhoods being addressed by the abandoned homes project will experience less blight.
- **Marin Clean Energy** can leverage the distributed energy resources from the municipal building solar/storage RFI, low-income, and early adopter zero-net energy programs developed during this project to scale throughout Marin Clean Energy service territory.
- The distributed energy resource program will mitigate energy demand peaks from large customers, increase demand response resources, and **strengthen the grid**.
- The Advanced Energy Community Project can reduce GHG emissions by 8,225 metric tons by 2030 through activities undertaken in Phase I alone, helping the State of California achieve its emissions reduction goals. Additionally, other communities in California can leverage these tools and frameworks to create scalable emissions reduction impact. While these tools are particularly targeted towards disadvantaged communities with low-income populations, they can be deployed in any community looking to lower its greenhouse gas emissions impact. By created easily useable frameworks and templates, tools from this project can be leveraged by other communities to accelerate their own advanced energy community use and avoid "reinventing the wheel". Key project developments to reduce costs and increase feasibility of advanced energy community uses include:
    - **Policy Frameworks:** The zero-net energy codes and the Building Energy Savings Ordinance developed during this project serve as policy templates that can be deployed by other communities. While a community can choose to customize the specific goals and regulations to meet community-specific goals, the pre-existing plans should at least reduce the development efforts required.
    - **Program plans:** Similar to the policy frameworks, the many programs developed over the course of this project can be used as templates by other communities. While specific details of each program will need to be tailored to each community in which they are deployed, the program plans should provide community stakeholders a framework from which to develop their own plans, thus reducing program development costs.
    - **Technology developments to support Green Revolving Funds:** The Sustainable Endowments Institute added additional functionality to their Green Revolving

Investment Tracking System. New functionality included the ability to apply different utility pricing scenarios to understand the impacts of different tariffs, deploy custom carbon emissions factors to account for institutions with on-site generation, and finally, ENERGY STAR Portfolio integration to allow immediately transfer of data between the Green Revolving Investment Tracking System building and Portfolio Manager. These tools can be used by institutions both in California and nationwide.

While the advanced energy community toolkit developed during this project was designed for application within communities in California, many of these tools can be extended to communities in states beyond California. The project team expects that these tools will spread to create many advanced energy communities within California and beyond.

CHAPTER 1: Introduction

The Richmond Advanced Energy Community (AEC) Project (project) Final Report provides a summary of the accomplishments of the Richmond AEC Project, co-sponsored by the Zero Net Energy Alliance and the City of Richmond. The project has been funded by the California Energy Commission, the City of Richmond, and local partners. The goal of the Richmond AEC project was to pioneer zero-net energy (ZNE) solutions that will be adopted and scaled up by communities throughout the state, including disadvantaged communities. To achieve this goal, the project team developed innovative financial, policy, and program models that can substantially reduce greenhouse gas (GHG) emissions and other harmful pollutants. Key project strategies and initiatives include:

1) Accelerating the transition to electric vehicles.
2) Reducing building energy use.
3) Increasing the use of renewable and distributed energy resources (DERs).
4) Increasing energy resilience through enhanced energy assurance planning.
5) Developing ZNE and building energy saving ordinances.
6) Promoting low-income ZNE homes through innovative retrofit strategies.

Key project partners included Energy Solutions, Olivine, Marin Clean Energy (the community choice energy provider serving Richmond and other communities in the counties of Marin, Napa, Solano, and Contra Costa), the Sustainable Endowments Institute, and the Richmond Community Foundation.

The toolkit created through this project will be available online and distributed to local governments, developers, builders, and other stakeholders. Through broad use of these tools, policies, programs, and plans, the project team expects to empower Richmond and other communities in California to achieve a ZNE future.

Approach and Key Partners

The Alliance team worked closely with stakeholders from the City of Richmond and their community choice aggregator, MCE (formerly known as Marin Clean Energy), and experts in the field. Key subject matter experts included: Energy Solutions (focused on energy efficiency policy and strategy), Olivine (focused on Distributed Energy Resources and Energy Assurance Planning), Sustainable Endowments Institute (focused on green revolving fund development), and the Richmond Community Foundation (focused on innovative financing of energy efficient affordable housing), and the ZNE Alliance (focused on comprehensive ZNE strategy deployment and scale-up, and electric vehicle ecosystem development.) The City of Richmond's Environmental Management and Planning team acted as the local public agency hub for program development in the Richmond AEC project, while MCE was closely involved to ensure strategic integration

and alignment on a territory-wide basis as Richmond's primary load service entity (LSE). Regular meetings were held with City and MCE stakeholders to ensure that ZNE solutions would meet the immediate needs of the Richmond community, while scaling to serve the full MCE territory wherever feasible and appropriate.[3]

Phase I of the Richmond AEC Project focused on designing innovative technical, policy, and financial solutions to advance the community's sustainability, public health, and emissions reduction goals, and initiating the scaled demonstration and deployment of these solutions. There were three types of solutions developed in the Phase I: Plans, Policies, and Programs.

Plans

- **Energy Assurance Plan** – defined strategies to enhance energy resilience and mitigate risks to the city's energy supplies in the event of a grid outage;
- **Electric Vehicle Action Plan** -- articulated key programs and policies to accelerate deployment of Electric Vehicles and infrastructure;
- **Green Revolving Fund Plan** -- defined ongoing funding mechanisms to support clean energy and mobility projects – with "recycling" of savings into additional sustainability work.

Policies

- **ZNE building codes** -- established ZNE and energy efficiency benchmarks in residential and City-owned buildings;
- **Building Energy Savings Ordinance** -- enhanced requirements for building energy performance benchmarking, reporting, and transparency

Programs

- **Rehabilitating abandoned homes to zero-net energy standards** – demonstrated using a "social impact bond" to purchase and rehabilitate formerly abandoned homes to achieve a ZNE standard, re-selling them to lower-income Richmond families;
- **Zero-net energy Early Adopter Program for multi-family new construction** – Designed a set of instruments to support zero-net energy multifamily new construction, including the Zero-Net Energy Decision tool, which helps developers and designers identify feasible and least-cost pathways to compliance. The program also includes a zero-net energy incentive to support and reward early adopters provided a toolkit for building owners and developers to construct multi-family homes to a ZNE standard, as well as zero-net energy performance monitoring.

3 Notably, more than 90 percent of Richmond electric utility customers are enrolled with MCE, while the balance have remained with PG&E. MCE currently has a proposal pending with the CPUC to directly administer its own energy efficiency programs. If approved, it would be the first CCA to take over this responsibility and the related rate-payer based funding stream.

- **Low-Income Energy Efficiency Program for single-family home retrofit** –accelerated the retrofit of low-income single-family homes to a ZNE standard
- **Distributed Energy Resources Program** – provided an integrated design and operational framework for distributed solar, energy storage, demand-side management assets, and potential microgrid resources
- **City Building DER/Solar Program** -- developed solar and storage projects for on-site solar PV and battery storage systems for City of Richmond facilities.

Each of these components of the AEC Project is designed to seamlessly integrate into a larger whole that advances all key elements of a comprehensive community ZNE vision – including energy savings, emissions reduction, community resiliency, electric mobility, and sustainable funding.

CHAPTER 2:
Planning

To implement solutions that increase energy resiliency, accelerate EV adoption, and create a sustainable source of funding for efficiency projects, a comprehensive planning and use roadmap is required. This chapter describes the planning and framework developed in the Richmond AEC project, and how these solutions will enable Richmond to advance its sustainability and public health goals.

Energy Assurance Plan

The Energy Assurance Plan (EAP) ensures that community assets essential for public safety and disaster response are available in the event of a grid outage or other emergency. In addition, the EAP looks to maximize these energy assurance planning co-benefits:

- Improve the reliability of electricity delivery within the City of Richmond.
- Secure energy supply in the event of an electric energy disruption.
- Offset current energy use with clean energy technologies.
- Deploy additional DERs.

To achieve these goals, the EAP includes a comprehensive review of:

- Existing energy demand, supply, and infrastructure (including electricity and other fuel types).
- Existing energy governance plans, programs, regulations, ordinances, policies, and codes.
- Existing emergency management frameworks.
- Existing community key assets, including critical facilities and equipment.
- Existing community hazards and potential risks.
- Proposed strategies to increase energy resilience.

The EAP included the City of Richmond General Plan, the Emergency Operations Plan, and Climate Action Plan, and the Contra Costa Hazard Mitigation Plan as resources. With the EAP, Richmond has an integrated and up-to-date resource to guide current and future energy assurance planning and project deployment.

Key Community Assets

The Richmond EAP identifies key operating assets of the City of Richmond. The asset identification exercise grouped critical facilities into the following broad categories:

- Community services and public facilities
- Public health
- Housing and schools
- Water supply facilities

- Wastewater management facilities
- Stormwater management facilities
- Transportation infrastructure
- Flood management infrastructure
- Energy infrastructure
- Solid waste/hazardous materials management facilities
- Parks, natural areas, and ecosystem
- Commercial and industrial assets

Once these assets were categorized, the project team began creating a Richmond Energy Profile, the first step to prioritizing the resources most critical to ensuring reliable energy supply during an emergency event.

City of Richmond Energy Profile

The energy profile defined in the EAP provides a basic overview of energy supply and demand in the City of Richmond. With this understanding, the city is better equipped to determine solutions and prioritize projects that safeguard critical operations during an energy disruption or emergency. The profile also looked at other sources of energy besides electricity that support city operations and identified opportunities to shift to cleaner energy technologies.

The EAP presents supply and demand information by the following energy types -electricity, natural gas, crude oil, ethanol, biodiesel, and propane. Each section describes the energy landscape from the state to the city level by energy type. The sections provide information on supply, significant infrastructure, dependencies, demand, and potential vulnerabilities. These vulnerabilities guided the development of the Plan's objectives, projects, and actions.

Potential Hazards

Hazard profiles provide a basic understanding of risk exposure within the community. The hazard profile section of the EAP coupled with the plan's risk assessment guided the plan's formally identified actions and projects to safeguard critical city operations necessary to respond and recover from grid outages and other emergencies. Key hazards addressed include:

- Earthquake
- Flood
- Wildfire
- Dam Failure
- Landslide
- Severe weather (for example, extreme heat and wind events)
- Drought
- Hazardous material release

These sections provide a general description of the hazard, the location and extent of the hazard within the city, the history of the hazard, and the probability of the hazard occurring. This information has been used to identify potential vulnerabilities and inform response and recovery efforts.

EAP Objectives and Strategies

With understanding of the City's key assets, energy supplies, and potential hazards, specific objectives and strategies were outlined to increase the City's energy resilience and reliability. The objectives were:

- Develop governance to support and advance energy assurance efforts to develop reliable energy sources for public safety key assets.
- Implement energy assurance adaptation and protective measures to protect energy infrastructure and resources.
- Expand community energy assurance education and awareness program.
- Enhance understanding of existing conditions to advance energy assurance efforts.

Altogether 52 strategies were identified and evaluated for each EAP objective. Table 1 illustrates a sampling of the strategies organized by the four objectives. For each strategy, an evaluation method was developed to assess priority and feasibility. The EAP rates each strategy relative to seven industry-standard activity domains – social, technology, administrative, political, legal, economic, and environmental (also known as STAPLEE). A scale of 1 to 5 is used to designate the criticality of the item – 1 designates the most challenging or unfavorable situation, 5 indicates the issue has been addressed satisfactorily.

In addition to presenting STAPLEE ratings, the EAP presents information for each strategy to help the City of Richmond understand project implementation details, including the responsible department, the time frame, and estimated costs. The EAP does not provide priority weightings among the 52 strategies. Given different time frames and costs associated with implementation, the City of Richmond could decide to implement strategies with less favorable STAPLEE ratings based on lower cost, or complexity or both. Readers and interested stakeholders are encouraged to view the entire EAP for a complete listing of the 52 strategies, with associated STAPLEE ratings and project estimates.

Table 1: Sample Strategies for EAP Objectives

Objective 1- Develop Governance		
A- Regulations		**Strategy 1.1.** Assess municipal Building Codes to identify opportunities to revise code to incorporate energy assurance components into design (e.g., pre-wire for back-up generators, site design to maximize natural light) and/or to promote Green Building
B –Plans		**Strategy 1.6.** Maintain and formalize an Energy Assurance Strategic Working Group to participate and join other planning efforts
C - Programs	Protective	**Strategy 1.10.** Promote Smart Growth and Complete Neighborhood development (for example, mixed-use, cluster development)
	Incentive	**Strategy 1.14.** Leverage and support current rebate programs (for example, BayREN Home Upgrade, Free Solar Program, Green House Call, Energize Richmond, East Bay Energy watch, and MCE Commercial Energy Efficiency) to improve efficiency of existing buildings

Objective 2- Implement Energy Assurance Adaptation and Protective Measures		
A – Hazard Reduction	Structural	**Strategy 2.1.** Identify capital improvement projects that can support and/or can incorporate energy assurance efforts (for example, solar into remodeling/structural upgrade projects)
	Non-structural	**Strategy 2.2.** Ensure all city critical facilities' energy infrastructure is properly strapped and secured and/or is elevated if necessary
B- Energy Efficiency		**Strategy 2.3.** Update government facilities to Zero Net Energy (ZNE)
		Strategy 2.8. Identify options to leverage and expand Electric Vehicle (EV) program, including the EV Action Plan
C –Energy Resiliency		**Strategy 2.9.** Advance the procurement, installation, and strategic operations of electrical storage in city facilities
		Strategy 2.14. Identify options to leverage Chevron assets, especially during disasters

Objective 3- Expand Community Education and Awareness	
A- Schools	**Strategy 3.1.** Expand school programs to work with/educate students on energy assurance actions for residents
B- Residents	**Strategy 3.3.** Develop and/or expand citizens' campaigns (for example, CERT, Richmond Neighborhood Coordinating Council) to educate and encourage energy conservation and renewable energy
C- Businesses	**Strategy 3. 6.** Work with businesses to promote energy conservation, incorporating alternative energies, and support Climate Action Plan (CAP) efforts

Objective 4- Enhance understanding of existing conditions		
A- Energy	Supply	**Strategy 4.3. I**nventory and map solar installations within the City
	Demand	**Strategy 4.4.** Conduct an energy audit of critical facilities to identify opportunities for energy efficiency and DER deployment
B- Hazard	Exposure	**Strategy 4.5.** Coordinate with State and Contra Costa County to better understand potential hazard exposure in County and City
	Vulnerability	**Strategy 4.6.** Coordinate with State and Contra Costa County to better understand potential hazard vulnerability in county and city
C- Critical Assets		**Strategy 4.10.** Refine the methodology and criteria for identifying critical facilities (public and private)

Source: ZNE Alliance

Next Steps

Key staff, consultants, city experts, Pacific Gas and Electric (PG&E) and MCE staff provided feedback for and contributed to the EAP. In addition, the city intends to coordinate and conduct

additional outreach with the public and other external stakeholders before EAP adoption. This outreach effort will include additional review, feedback, and potential modifications prior to formally adopting the plan.

The EAP is also a *living document* and must be maintained and updated to reflect the most current information. In coordination with the City Manager and Planning Department, the city's environmental manager will be responsible to ensure that the EAP is maintained and monitored on an ongoing basis. Plan review and refinement is important after any major emergency or disaster event. Department heads and emergency preparedness staff serving in the city's Emergency Operations Center (EOC) are committed to conducting an After-Action Report following all major emergencies, at which time the EAP will be evaluated to assess functional, technological, budgetary, political, or other significant changes that might be incorporated.

For more information on the EAP process and findings, please see the *2017 Richmond Energy Assurance Plan.*[2]

Electric Vehicle Action Plan

Transitioning from transportation fueled by polluting, fossil-based sources to low-emission, electrified sources creates robust public health, economic, and sustainability benefits for the City of Richmond. The *Richmond Electric Vehicle (EV) Action Plan* outlines key steps that the City of Richmond can take to advance adopting electric vehicles in the city, city fleets and community. The *Richmond EV Action Plan* identifies best practices in incentive design, EV-friendly building codes and ordinances, fleet transition planning, partnerships, and outreach.[2]

Benefits of Electrified Transportation

EVs powered by renewable energy will reduce the immediate negative effects of vehicle exhaust on public health, while reducing emissions that are driving long-term climate change and its devastating impacts. Further, the near-silent operation of electrified transportation, including electric trucks and buses, will enhance the quality of urban life. Finally, many new and used EVs have an equal or less expensive total cost of ownership, with new EVs widely available for less than $23,000 (including government incentives), and lower-mileage used EVs available for less than $10,000.[4] Fueling and maintenance costs per mile are typically one- third less than the cost of gasoline, diesel, or natural gas. Transitioning to electrified transportation within City operations, and promoting EVs throughout the community, can provide a broad range of environmental, public health, and economic benefits to the City and its residents.

Public Health Benefits

The City of Richmond is one of the first municipalities in the country to institute a *Health in All Policies* strategy and ordinance, which highlights the important secondary effects that public policies have on public health. Policies supporting fossil fuel-based transportation increase air

2 Available at *http://www.znealliance.org/wp-content/uploads/Richmond/Richmond-AEC-Energy-Assurance-Strategic-Action-Plan.pdf*.

4 See https://www.fastcompany.com/40517133/owning-an-electric-car-is-twice-as-cheap-as-owning-a-gas-vehicle and https://www.caranddriver.com/features/three-electric-vehicles-you-can-own-for-less-than-10000-feature.

pollution, which has serious and widespread heath consequences.[5] While air pollution is caused by a variety of sources, including electricity generation and industry, transportation-related sources have the largest impact in the Bay Area.[6] Conversely, policies that discourage vehicles powered by internal combustion engines (ICEs) and advantage EVs can have significantly positive impacts on public health.

Richmond is among the communities designated by the California Environmental Protection Agency (CalEPA) as being most negatively impacted by the effects of pollution. The CalEPA screening tool for assessing environmental impact, CalEnviroScreen, uses 20 indicators, including air quality and asthma rates, to determine which communities are disproportionately affected by environmental pollution and other stressors that affect public health and quality of life.[7] According to CalEnviroScreen 2.0, North Richmond, Central Richmond, South Richmond, and the Richmond Annex are among the areas that are disproportionately impacted by the effects of pollution. On a local and state basis, the toll of vehicle emissions is high, exacerbated in Richmond by the largest refinery on the West Coast.

Environmental Benefits

Battery Electric EVs (BEVs) have zero tailpipe emissions, while Plug-in Hybrid Electric Vehicles (PHEVs) have an internal combustion engine that takes over after the all-electric operating range of the vehicle is reached. To minimize emissions from PHEVs and BEVs, it is important to maximize fueling from 100 percent renewable electricity, and to maximize the availability of public recharging facilities (to ensure that PHEVs maximize their all-electric operation.) Fortunately, Richmond electricity ratepayers have access to MCE's 100 percent renewable electricity product, and the City has elected to pay a modest premium to ensure that all of its electricity – including public charging stations on City property – are powered by 100 percent renewable fuel. Additionally, EVs are more efficient at translating energy into motive power than ICE-powered vehicles, referred to as the energy economy ratio (EER). This further lowers the relative emissions impact of EVs. As Table 2 demonstrates, EVs, even when using the standard California electricity mix, have a 68 percent lower emissions impact when compared with gasoline-fueled ICE vehicles.

Table 2: Full Fuel Cycle Comparison of Alternative Fuels to Standard Gasoline

Fuel / Feedstock	Carbon Intensity (gCO2e/MJ)	CO2e Reduction from Gasoline
Gasoline, conventional	95.86	N/A
Electricity, marginal*	30.80; decreasing to 26.32 by 2020	68%

*Includes the energy economy ratio (EER) of 3.4 for electric vehicles.
Source: CARB LCFS lookup table and CCR sections 95480-95490.

5 Holmes-Gen, Bonnie and Will Barrett, "Clean Air Future: Health and Climate Benefits of Zero Emission Vehicles." American Lung Association, October 2016. Available online at: http://www.lung.org/local-content/california/documents/2016zeroemissions.pdf.

6 Richmond Climate Action Plan, Oakland: http://www2.oaklandnet.com/oakca1/groups/ceda/documents/report/oak045559.pdf, San Francisco General Plan: http://generalplan.sfplanning.org/I10_Air_Quality.htm.

7 https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf.

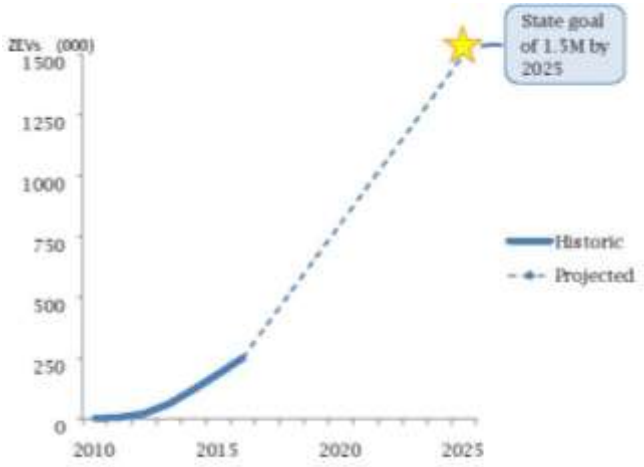
Economic Benefits

While exact calculations vary based on assumptions, it is widely accepted that EVs are equal or less expensive to operate than conventional ICE vehicles based on their total cost of ownership (TCO).[8] While purchase price of EVs can be as much as $5,000-10,000 higher than comparable conventional vehicles, EV fueling costs are generally 50 percent to 90 percent less than the cost of gasoline (depending on gas prices, electricity prices, and efficiency of comparable vehicles). This can easily outweigh the initial upfront cost over a 10-year use period based on average driving patterns. Additionally, as BEVs are technically much simpler than conventional vehicles or PHEVs, their maintenance costs are significantly lower. Further, the increasing range and diversity of EV choices make completely electrifying light-duty fleets a realistic possibility during 2020 - 2030 at a TCO that is lower than conventional vehicles.

Electrification of Transportation in the City of Richmond

Recognizing the many benefits of EVs, by 2025, the State has set a goal to have 1.5 million EVs on the road, with adequate charging infrastructure to support them. California has been making significant progress, but has a long way to go. As of March, 2017, a cumulative 283,836 EVs had been sold in the state, comprising approximately half of all EVs sold in the U.S. (Figure 1). To reach Governor Brown's goal of 1.5 million EVs, this number will have to continue to grow at a compounded annual growth rate (CAGR) of approximately 20 percent per year.[9]

Figure 1: California's Progress Towards 2025 ZEV Goals



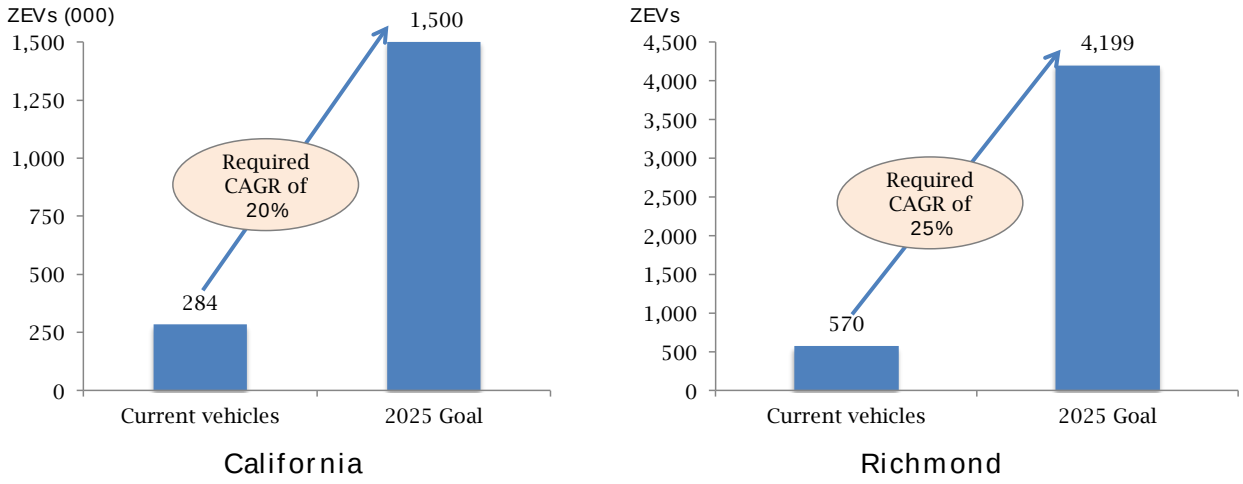
Source: ZNE Alliance analysis, 2017. Based on data from the PEV Collaborative, accessed April 6, 2017 at http://www.pevcollaborative.org/sites/all/themes/pev/files/3_mar_PEV_2017.pdf

8 While EVs are less expensive on a TCO basis for most use cases, there are some, particularly if vehicles are not driven regular or for long distances, where they are not the most affordable option. Prospective buyers are encouraged to explore vehicle cost calculators which can help analyze a variety of factors to estimate TCO. Some reliable calculators are the DOE's at: https://www.fueleconomy.gov/feg/evsbs.shtml and the Alternative Fuel Data Center's at: http://www.afdc.energy.gov/calc/

9 Center for Sustainable Energy (2017). California Air Resources Board Clean Vehicle Rebate Project, Rebate Statistics. Data last updated April 03, 2017. Retrieved April 15, 2017 from https://cleanvehiclerebate.org/eng/rebate-statistics

To do its part in reaching California's 2025 ZEV goals, the City of Richmond must accelerate EV adoption. As of 2017, 570 EVs were registered in the City of Richmond. If Richmond is to support the 1.5 million EV goal in proportion to its population (about.3 percent of the population of California), the City requires 4,199 EVs on the road by 2025. While this is a credible "stretch" goal, it will require an EV CAGR of 25 percent annually–higher than that of California as a whole (Figure 2).

Figure 2: Required Growth to Achieve 2025 EV Adoption Goals – California and Richmond



Source: ZNE Alliance analysis, 2017. Based on data from the PEV Collaborative, accessed April 6, 2017 at http://www.pevcollaborative.org/sites/all/themes/pev/files/3_mar_PEV_2017.pdf and from the RL Polk database; provided via California Clean Cities Initiative, August 2016.

To meet these goals, California Air Resources Board and California Energy Commission programs, utility investments, regional air quality management districts (AQMD) investments, and the City of Richmond must all continue aggressively promoting EV growth. Accordingly, the Richmond EV Action Plan integrates strategies and resources from the state, regional, and local level to accelerate EV use and charging infrastructure development.

Key Opportunities for Accelerating EV Adoption

The EV Action Plan lays out key opportunities and strategies for electric vehicle and infrastructure adoption (Table 3). For a thorough discussion of each of these recommendations, please see the *Richmond Electric Vehicle Action Plan*, available at the ZNE Alliance Richmond Advanced Energy Project website.[10]

10 http://www.znealliance.org/wp-content/uploads/Richmond/Richmond-AEC-Electric-Vehicle-Action-Plan.pdf

Table 3: Opportunities Identified for Accelerating EV Adoption

Category	Action Item	Next Steps
1. Incentives and support	**1.1: Incentivize deployment of public, commercial, and residential EV charging,** including support for low-income households *(outlined in the Draft Incentives Framework on page 40)*	Finalize plan and bring to City Council for review by August, 2018
	1.2: Identify incentives and measures to promote private EV fleet adoption	Engage local fleet owners re. potential for incentives to support electrification, leveraging EV Alliance work on the E-Fleet Accelerator project[11]
2. EV-friendly building and zoning ordinances	**2.2: Develop and deploy EV friendly zoning ordinances**	Bring draft ZNE Ordinance to City Council for Review
		Include EV chargers in new City of Richmond Form Based Code
3. City operations	**3.1: Develop and achieve goals for City EV fleet adoption**	Prioritize electrification of relevant vehicles based on funding options in chapter 2 of the EV Action Plan
	3.2: Develop opportunities to electrify Port vehicles	Partner with Port tenants to attract funds for EVs where feasible
	3.3: Integrate EV-ready infrastructure into Richmond Energy Assurance Planning, DER Programs, and the ZNE Homes Pilot Program	Continue integration of plans and programs
4. Outreach, awareness and partnership	**4.1: Design and deploy EV consumer awareness strategies**, including Ride and Drive events, where feasible and appropriate	Develop plan with potential partners – including dealerships, BAAQMD, East Bay Clean Cities, REACH Strategies, Charge Across Town, and other EV stakeholders – to host Ride and Drive events accessible to Richmond residents and workers
	4.2: Develop school partnership to promote school bus electrification	Develop plan with WCCUSD stakeholders for E-Bus adoption based

11 The EV Alliance, a sister organization to the ZNE Alliance, has been awarded California Energy Commission funding to develop E-Fleet transition plans in six counties from Santa Cruz through Santa Barbara. Tools and strategies developed for that project, including valuation and siting models, original equipment manufacturer (OEM) and finance company relationships, and incentive strategies, will be applied to accelerate fleet adoption of EVs in the Richmond context.

		on available Prop 39 and HVIP incentives
	4.3: Identify potential EV charging deployments in conjunction with solar and energy storage	Following implementation of City EV charging incentive Program, identify potential sites for integrated EVSE, solar, and storage installations
	4.4: Collaborate with PG&E to support highest-priority EV projects (as ratepayer funded EV programs are authorized by CPUC)	Develop plan for deployment of PG&E resources

Source: ZNE Alliance, 2017

Next Steps

The EV Action Plan is currently pending approval from Richmond City Council, with action expected by June 2018. In the meantime, two key elements of the draft plan are moving ahead. The first is an update to the Richmond zoning ordinance that facilitates EV charger installation in multi-unit developments. The second is an EV charger incentive program, to be discussed in Chapter 4 of this document.

For more details on Richmond's strategy to advance the electrification of transportation, please see the *Richmond EV Action Plan.*[12]

Richmond Green Revolving Fund Plan

A green revolving fund (GRF) is an investment program providing financing within an organization to implement energy efficiency, renewable energy, and other sustainability projects that generate cost savings. These savings are tracked and used to replenish the fund for the next round of green investments, establishing a sustainable funding cycle while cutting operating costs and reducing environmental impact.

A GRF is an important tool for the City of Richmond to employ in its efforts to reduce energy use and the city's carbon footprint. Establishing a GRF provides a compelling opportunity to attract new investment, including grants from public and private philanthropic sources, since operating savings from GRF-funded projects will be re-used many times as they are returned to the GRF. The Richmond GRF is currently pending funding; once this is secured, all the elements are in place to begin GRF operations.

Financial Structure of a GRF

GRFs are typically used to provide capital for energy efficiency projects aimed at reducing a city's environmental footprint and operating budget. To determine eligibility for funding within a GRF, institutional sponsors set standards for project feasibility, energy savings, GHG

12 http://www.znealliance.org/wp-content/uploads/Richmond/Richmond-AEC-Electric-Vehicle-Action-Plan.pdf

reduction, and return on investment (ROI). These criteria are analyzed with the help of utility companies and third-party energy engineers.

Financial savings generated by energy efficiency and resource conservation projects are returned to the sponsor's GRF until the initial investment is paid off. After the payback period is complete, an established percentage (typically 30 percent) of the annual savings generated from each project are returned to the fund for the remaining useful life of the project/equipment or until the fund reaches its initial capitalization goal (for example, $1 million) whichever comes first. The Sustainable Endowments Institute has created the Green Revolving Investment Tracking System (GRITS), a custom web platform for managing energy, financial, and carbon data for green revolving fund projects, to simplify tracking and measurement across diverse project types.

GRFs can embrace a wide range of projects, from simple projects with quick paybacks to larger projects with longer payback periods. While no formal limits are set, GRF guiding committees generally concentrate on individual projects in the range of $5,000 to $300,000 with a payback of 10 years or less. The following criteria will be used to evaluate and prioritize projects under consideration for the GRF, with the expectation that these criteria will be refined over time:

- Payback period
- Carbon reduction potential
- Resource conservation impact
- Community educational opportunity
- Schedule overlap with connected larger capital projects

Typical projects will include:

- High efficiency lighting/networked lighting
- Lighting and heating, ventilation and air conditioning (HVAC) occupancy sensors
- High efficiency HVAC
- Lighting and HVAC controls
- High efficiency kitchen equipment
- Insulation
- Renewable energy
- Metering
- Cogeneration
- Water-saving plumbing fixtures

In general, projects that do not exceed $150,000 use engineering data to estimate cost savings, while larger projects may require installing additional sub-metering systems to fully capture actual energy efficiency project performance data. The GRF committee generally decides whether exact or estimated savings are appropriate for each project.

If necessary, modified savings repayment plans may be designed or approved by consensus of the committee either from the start in a project's lifespan or later. For example, most GRF loans are considered "full cost loans," meaning that the internal GRF loan will cover the entire cost of all materials, labor, and anything else required to complete the project. In certain cases when Richmond is undertaking larger capital projects, the GRF Committee may choose to make an "incremental cost loan" whereby the GRF would provide the difference in capital required between standard technology being installed and higher performance technology that uses less energy or water. In this case, the GRF is only providing a small piece of the overall project cost, which is specific to the upfront extra capital needed to invest in the higher efficiency technology. The savings paid back to the GRF would therefore be based on engineering data calculating how much energy/water is saved compared to the standard technology.

In all cases, project proposals will take advantage of local, regional, or federal incentives and rebates for energy efficiency and renewable energy projects. When these incentives or rebates are received, 100 percent of the funds should be deposited into the GRF account for use in the next round of projects.

Advancements in GRF Software for Richmond and AEC Deployment

Additional capabilities were added to GRITS specifically to assist the City of Richmond and other advanced energy and ZNE-focused communities to benefit from the GRF approach. The expanded capabilities of GRITS 2.0 will assist the City of Richmond and other communities and institutions across the country in better project tracking, managing, and sharing of results. New capabilities added as part of GRITS 2.0 include custom carbon emissions factors, utility pricing scenarios, ENERGY STAR portfolio manager API integration, and publicly accessible GRITS data.

Custom Carbon Emissions Factors

The Sustainable Endowments Institute, developer of GRITS, has added custom carbon emission functionality that provides the ability to input precise carbon emissions factors that then provide accurate carbon accounting for any project's carbon reduction impact. GRITS currently provides accurate carbon savings calculations by incorporating publicly available data from the U.S. Environmental Protection Agency's eGRID national database. For users such as the City of Richmond and other institutions that have their own on-site energy generation, GRITS now can manage multiple custom carbon emissions factors to the project or building level to ensure accurate carbon emissions savings calculations for each project.

Utility Pricing Scenarios

Another new feature added to GRITS is the capability to track multiple utility pricing scenarios. This important new functionality allows GRITS users to save different utility price escalator rates, or other price models that involve fluctuating resource prices over time. This allows for more accurate modeling and calculation of key financial metrics including payback, return on investment, internal rate of return, and net present value. To provide as conservative an estimate as possible in forecasting a project's financial performance, GRITS by default maintains the same energy price annually over the expected lifetime of the project. However,

the reality is that energy prices are projected to rise in future years. To allow for more accurate calculation of financial metrics, it is critical to apply proper utility pricing escalation scenarios. GRITS' new utility pricing scenarios allows the City of Richmond and all other GRITS users to save an unlimited number of different utility pricing scenarios and then apply them to projects to better model how different utility costs impact the financial case for a project. This is also helpful to model the impact of a customer that may choose to "opt up" to a 100 percent renewable product, which is available through Richmond's MCE Community Choice service provider, and becoming more available from utilities nationwide.

ENERGY STAR Portfolio Manager API Integration

ENERGY STAR Portfolio Manager is a free tool provided by the U.S. Environmental Protection Agency and is widely used by cities to track building level energy consumption. GRITS now has an application program interface (API) that links a user's Portfolio Manager account to their GRITS account allowing for immediate transfer of key building data to GRITS from Portfolio Manager. This will allow the City of Richmond and all other GRITS users to very conveniently populate the GRITS database by first importing all relevant building data from Portfolio Manager, rather than through manual input. If a city has dozens or hundreds of facilities, this can easily save 50 plus hours of staff time.

Making GRITS Data Publicly Accessible

GRITS has also implemented several new features to allow the City of Richmond to share its project data and overall energy, financial, and carbon savings data publicly. First, the Sustainable Endowments Institute built a public dashboard that allows a GRITS user to create a dashboard that displays pre-determined fields focused on overall carbon savings, energy savings, financial returns, and other key benefits generated from completed projects in GRITS. This will allow Richmond to share its progress with the public without having to manually update a separate public web page of statistics, as the data will be a live feed from GRITS. Second, the team built a "get sharable link" capability to allow a user to fully share the results of an individual project with anyone through a simple link. And finally, the team built a GRITS Public Library capability that will allow the City of Richmond and any other GRITS users to select some or all of their projects to be shared in detail through a new GRITS Public Library. The ZNE Alliance team believes that GRITS will prove highly useful as a common tracking platform for Energy Commission grantees and other cities throughout California, and intends to work closely with Energy Commission and relevant organizations, such as the Local Government Commission, to develop plans for scaled adoption.

CHAPTER 3: Policy

Policy is an important lever in advancing a community's efforts to reduce emissions since policy changes can have uniquely broad and long-term impacts not always possible through programmatic activities. The Richmond Advanced Energy Community Project leveraged policy to promote building efficiency efforts via the ZNE Reach Code addressing building energy efficiency performance, and the Building Energy Savings Ordinance (BESO), addressing building energy information disclosure.

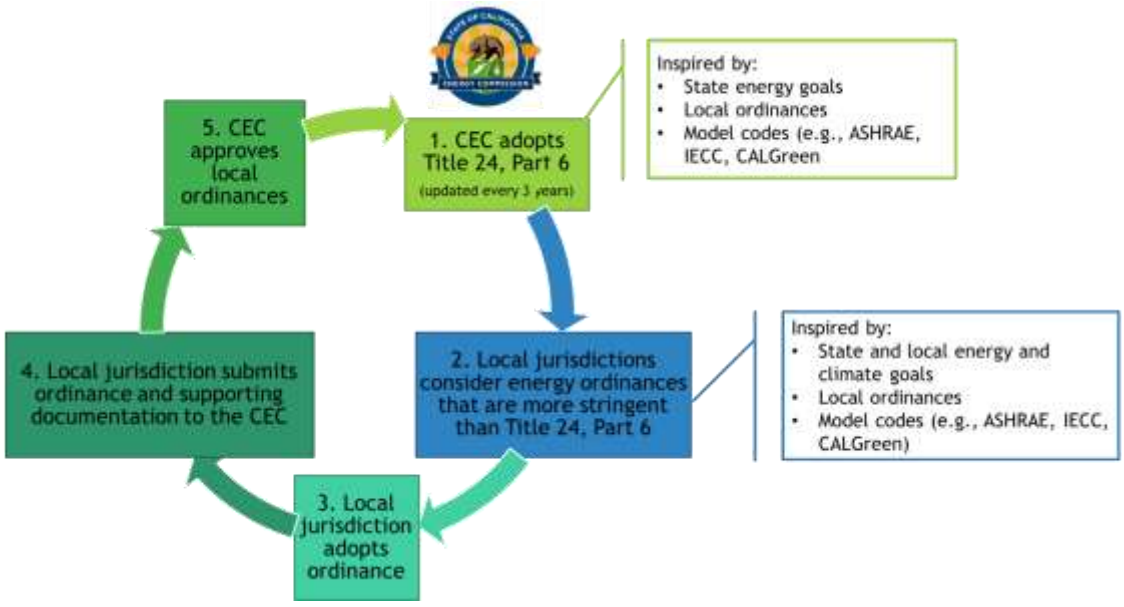
ZNE Reach Codes

The California Building Energy Efficiency Standards (Title 24, Part 6) establishes minimum energy performance requirements for all newly constructed buildings in California as well as requirements for major alterations to California buildings.

Per goals set by the California Public Utilities Commission and the California Energy Commission (http://www.californiaznehomes.com/), planners and policy makers expect that the 2019 Title 24, Part 6 Standards will advance newly-constructed single family homes towards ZNE or close to offsetting annual electricity consumption, although the exact definition and implementation of this requirement is not finalized. The 2019 Title 24, Part 6 requirements are expected to take effect on January 1, 2020.

Local jurisdictions or municipalities may consider and adopt standards that go beyond Part 6, including CALGreen Tiers (Part 11) or customized reach codes. After adoption, the jurisdiction or municipality must submit a package to the California Energy Commission for approval. Figure 3 describes the entire process.

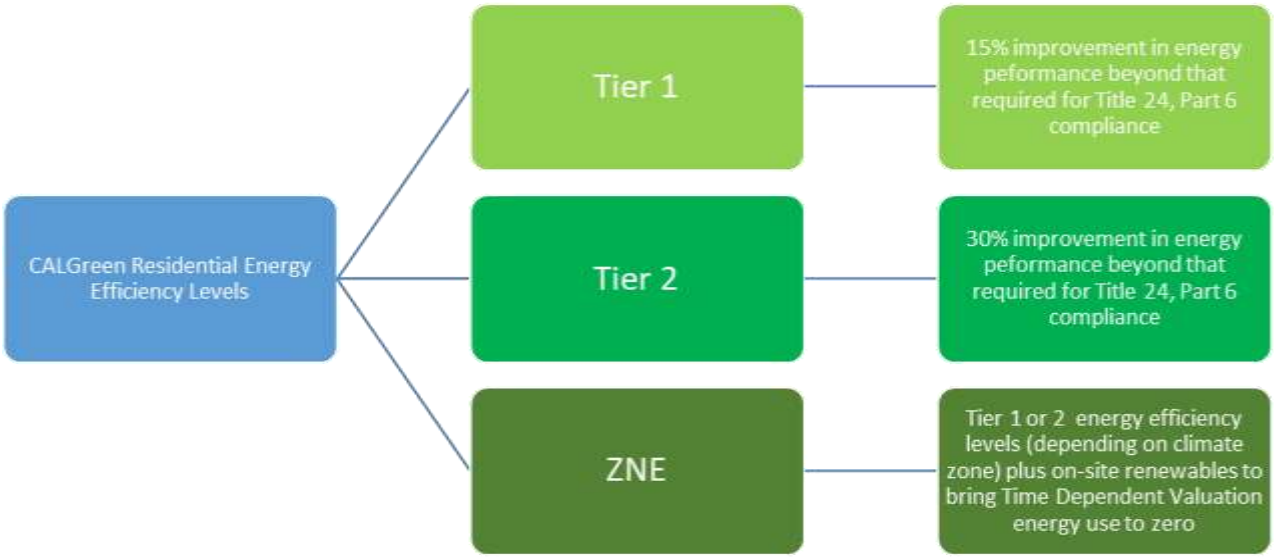
Figure 3: California Energy Commission Title 24 Local Ordinance Process



Source: http://www.energy.ca.gov/title24/2016standards/ordinances/, accessed 2017.

CALGreen provides several pathways to exceed the Title 24, Part 6 requirements, as shown in the Figure 4. The CALGreen levels provide a simple and straightforward approach to higher efficiency buildings with two tiers, one 15 percent better than Title 24 and one 30 percent better. The ZNE pathway can be pursued by implementing either the 15 percent or the 30 percent tier and by adding on-site renewables to achieve an energy design rating (EDR) of zero.

Figure 4: CALGreen Tiers



Source: Energy Solutions Analysis, 2017.

ZNE Reach Code for the City of Richmond

The City of Richmond has an opportunity to get out in front of forthcoming state regulations to improve local knowledge and understanding of ZNE construction and to advance objectives outlined in the City's *Climate Action Plan* – including **Objective 1: Increase Energy Efficiency of Buildings and Facilities, and Objective 2: Increase Use and Generation of Renewable Energy.** Specific City climate action strategies addressed by the ZNE Reach Code are summarized in Table 4.

Table 4: California Climate Action Plan, City of Richmond – Building-Related Strategies

Strategy		2020 MT CO2e	2030 MT CO2e
Objective 1: Increase Energy Efficiency of Buildings and Facilities		**55,197**	**261,728**
Strategy EE1	Leverage Existing Programs and Rebates to Improve Efficiency of Existing Buildings	43,758	145,860
Strategy EE2	Leverage Existing Funding Programs and Financing Tools	supporting	supporting
Strategy EE3	Promote Green Building	11,439	115,867
Strategy EE4	Outreach and Education to Promote Energy Conservation and Renewable Energy	supporting	supporting
Objective 2: Increase Use and Generation of Renewable Energy		**64,719**	**113,620**
Strategy RE1	Increase Local Solar Energy Generation	3,074	8,422
Strategy RE2	Promote and Maximize Utility Clean Energy Offerings	48,602	57,390
Strategy RE3	Promote Conversion From Natural Gas to Clean Electricity	13,043	47,709

Source: City of Richmond, 2015

Within the City's *Climate Action Plan*, Strategy EE3, **Promote Green Building**, includes these elements tied directly to the proposed ZNE Reach Code and related actions:

- EE3.1 The City will continue to evaluate enhancing the California Building Code with "reach codes" that consider deeper green building practices, ZNE design, and water savings opportunities.
- EE3.3. Incorporate green building measures into new City-owned buildings and redevelopment projects.
- EE3.6. Provide expedited permitting for new construction and renovations that include specified energy efficiency upgrades and green building measures.
- EE3.78. Promote innovative design (for example, ZNE buildings) and the incorporation of green building best practices in new residential and commercial development and major renovations by providing information on green building techniques at the permitting counter and on the City's website.
- EE3.9. Ensure staff fluency with Title 24 energy code updates and provide user-friendly guidance and assistance to local builders and homeowners.

Joining other cities in California now implementing ZNE policies, Richmond has been able to leverage key precedents and research to support developing its own policy and programs that will significantly upgrade energy performance. In particular, Richmond has leveraged the *CALGreen Cost Effectiveness Study* prepared for PG&E in 2016[13] that demonstrates clear cost-effectiveness for the ratepayer from implementing CALGreen Tiers for certain California climate zones, including Climate Zone 3, where the City of Richmond is located. Additionally, the homes being developed as part of the Richmond Community Foundation Social Impact Bond (Chapter 4) have supported the ZNE Reach Code policy development by showcasing the

13 Davis Energy Group, Inc., Enercomp, Inc., Misti Bruceri & Associates, LLC. (2016) CA Statewide Codes and Standards Program Title 24, Part 11 Local Energy Efficiency Ordinances: CALGreen Cost Effectiveness Study. Prepared for Marshall Hunt, Codes and Standards Program, Pacific Gas and Electric Company. September 2016.

feasibility of all-electric ZNE homes passing Title 24 compliance. Working with the City staff, Energy Solutions developed a staff report with a proposed ordinance and an introductory policy concept report laying out the initial framework of the policy and complementary voluntary programs. The policy is summarized in Table 5 (with monetary incentives to be determined following further analysis):

Table 5: Proposed City of Richmond ZNE Reach Code (as of November 21, 2017)

New Construction Type and Major Alterations*	Effective Date	Proposed Requirement	Monetary Incentives for All-Electric Design	Additional Incentives
Single Family	July 1, 2018	Zero Net Energy (EDR of Zero)	$X per home	Fast-track processing of development applications and permits
Multi-family	July 1, 2018	15% more efficient than 2016 Title 24 if mixed-fuel. 80% solar for both mixed-fuel and all-electric.	$X per unit, with a cap of $Y per building, $Z per unit for affordable housing	Fast-track processing of development applications and permits. If ZNE, will receive a density bonus of 10%.
City Buildings	July 1, 2018	Zero Net Energy (EDR of Zero)	N/A	N/A

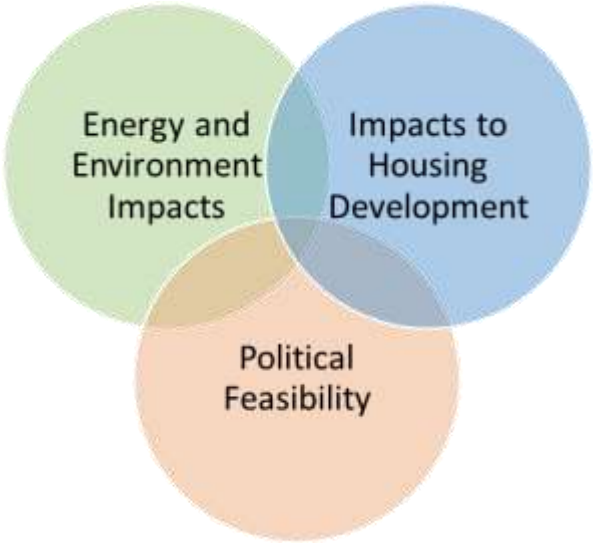
Source: Energy Solutions Analysis, 2017.

*"Major Alterations" means any change to 75% or more of the square footage of the building or changes to all of the following: building's water-heating system, space-conditioning system, lighting system, electrical power distribution system, and envelope that is not an addition.

Criteria for Evaluation of Policy Options

The team explored potential policy options and evaluated the choices across multiple dimensions to find the best balance of positive impacts. This balance of factors is shown in the Figure 5:

Figure 5: Policy Evaluation Criteria



Source: Energy Solutions analysis, 2017

Energy and Environmental Impacts

Each policy option offered different impacts, such as electrical and gas savings and their associated cost savings, as well as greenhouse gas emissions and air toxin reductions. As one of the most aggressive reach codes adopted by any local California jurisdiction, the proposed policy would offer significant environmental benefits, including a positive impact to public health from improved air quality and reduced pollution.

Impacts to Housing Development

Beyond the positive impact of improving energy efficiency and increasing renewable energy in the City, options were evaluated against the positive and negative impacts they could have on housing development. City staff was clear that the code must not be so onerous as to drive housing developers out of the City of Richmond to surrounding areas. However, with the right set of incentives, it was agreed that a ZNE program could *increase* local in-fill and transit-friendly housing development due to density bonuses and "green halo" effects. These options were viewed favorably by the housing developers that responded to outreach. Results of the outreach confirmed that high-visibility ZNE-focused policies can serve to *attract* forward-thinking developers and better meet the needs of health-sensitive residents, thereby further strengthening Richmond's revitalization based on its "health in all policies" approach. The City of Richmond acceleration of a ZNE ordinance will re-brand and re-position the City as a "green city" and help counteract previous adverse publicity regarding Richmond's environmental health.

Political and Administrative Feasibility

Each policy option was also considered relative to its technical and administrative feasibility; the appetite of City leadership to pursue robust environmental and public health goals, and how residents and key stakeholders would respond. In meetings with City staff from the City

Manager's office, and the planning and building departments, the team developed a shared appreciation of ZNE goals when balanced between long-term policy changes and near-term program impacts. As staff bandwidth is always an issue in California municipalities, it is noteworthy that in the experience of other jurisdictions assessed by Energy Solutions, the workload increase for permitting and inspection staff to review ZNE-specific building requirements is not excessive, and reflects the policy regime that will be coming by 2020. Earlier implementation of more robust standards also locks in additional savings for building owners and residents than would be the case otherwise, a clear political selling point for all stakeholders. Further, cost-effectiveness data on ZNE buildings shows that ZNE new construction and ZNE retrofits can be cost-effective on a life-cycle basis. Additionally, for new construction this can be achieved without additional up-front cost.

Next Steps for ZNE Reach Code Implementation

On October 24, 2017, the Richmond City Council voted unanimously for a second City Council meeting to receive the full staff report. The City staff is currently reviewing the latest revision of the Staff Report, which included additional input from Energy Solutions, and is planning to bring this recommendation to City Council in June, 2018

Building Energy Savings Ordinance

As part of its *Existing Buildings Energy Efficiency Action Plan* (September 2015, CEC-400-2015-013-F) and Assembly Bill 802 (Williams, Chapter 590, Statues of 2015), on October 11, 2017, the California Energy Commission adopted a statewide requirement for building energy performance benchmarking, reporting and transparency for existing commercial and residential buildings more than 50,000 square feet (and above 17 utility accounts for residential), as well as requiring that data be accessible to building owners and occupants upon request, beginning in June 2018 (pending final approval). An overview of the proposed requirements is summarized in Figure 6.

Figure 6: California Energy Commission Benchmarking Path Forward

Source: AB 802 Rulemaking Overview, California Energy Commission 2016.

The theory behind a benchmarking and disclosure policy is that as more building performance data is collected and shared, more energy reduction opportunities will be recognized by customers and solution providers, translated into financed projects in the field, and achieved. More than 20 cities across the country have adopted such policies focused primarily on energy use (as of January 2018). The figures below present a schematic and conceptual summary of this process.

Figure 7: Reporting and Transparency

Source: Institute of Market Transformation 2015

Figure 8: Building-Level Benchmarking & Assessment Process and Workflow

Source: Energy Solutions analysis, 2017.

When energy use information is made available to building owners and occupants, data show that conservation and efficiency measures follow. With data publicly available, comparisons can be facilitated between similar buildings in peer groups and coordinated outreach can be mobilized by contractors and solution providers, utilities, local government, and state agencies. These stakeholders typically respond by identifying and prioritizing buildings with the largest energy and greenhouse gas reduction opportunities, with the city (or in some cases the utility) sharing responsibility for tracking progress across the entire building fleet. One recent study showed that in a set of large buildings, energy benchmarking and reporting alone decreased energy use intensity by 14 percent over a three-year period.[14]

14 Meng, Hsu, & Albert, Measuring Energy Savings from Benchmarking Policies in New York. 2016.

To ensure “apples to apples” data sharing, the City of Richmond will use ENERGY STAR Portfolio Manager as its primary format for building energy data collection. This builds on existing use of Portfolio Manager for internal building tracking. Portfolio Manager is used widely across various building types, offers user training, allows streamlining of utility data, and is **the** recommended benchmarking and reporting application due to its broad availability and technical capabilities.

BESO for the City of Richmond

After reviewing more than a dozen cities’ benchmarking and related ordinances, the ZNE Alliance consultant team led by Energy Solutions drafted a staff report with a proposed ordinance aligned closely with the City of Berkeley Building Energy Saving Ordinance (BESO), which was adopted in December, 2015. The Berkeley ordinance is closely aligned with similar efforts in Austin, Texas and Portland, Oregon, since it expands the scope of buildings addressed to include all residential building types **and** requires an energy assessment. Few benchmarking ordinances nationally have required the buildings within scope of the ordinance to complete an energy assessment. If energy assessments are included in the ordinance, it is also more common for the scope of requirements to apply to nonresidential building types, and in some cases large multi-family complexes. Mandatory assessments help building owners to obtain independently validated information on the potential for specific energy saving measures to produce a defined ROI that is financeable largely or entirely through expected savings. This information in turn leads to higher rates of actual energy retrofit project completion and higher savings achieved. The Richmond BESO requires disclosure of benchmarking report information and energy assessment results for all nonresidential buildings, and the disclosure of residential energy assessments at the time of sale. Reports are required to be filed with the City, the seller, the buyer, and the renter dependent on whether the seller complies with the ordinance or passes on this obligation to the buyer. In either case, the assessment must be completed as a condition for the sale to be executed.

This proposed ordinance is still under consideration by City staff. There has been some discussion about excluding the assessment at the time of sale requirement given the administrative complexity, and limited staffing. Implementing this element of the policy poses a challenge to Richmond, and potentially other resource constrained cities, because of the administrative systems set-up required to enable this new process. The ZNE Alliance team is working closely with the City to evaluate the most cost-efficient path forward, and identify potential new grant sources to cover the initial project set-up costs. If one-time set-up and initial operating costs can be covered through external sources, the ongoing costs of the program should be stable and modest.

Software Solution

To efficiently and comprehensively administer a benchmarking policy, cities require software to track and coordinate results. Fortunately, the software market has responded with numerous robust tools and platforms for building energy data management. To guide software selection for the City of Richmond, the team defined the overall goal for the platform as *facilitating*

streamlined data acquisition and transfer to inform energy and emissions reductions efforts achieved through behavior change and retrofit projects. The platform must also meet workflow requirements across these multiple user groups with distinct objectives: city staff, building owners, and utilities. The desired outcome is to facilitate data exchange and project management through one platform (to the extent feasible) and create optimal time and resource efficiencies and maximum stakeholder and community benefit.

Use Case Identification

Stakeholders in the BESO and building energy information management process include city staff members in charge of program administration, building owners or managers who must comply with the ordinance, and utilities holding the energy use data record.

City Staff

The primary role of the City staff is to administer and enforce the BESO, so the software platform must have the core functionality of compliance tracking. The City staff will be the heaviest users of the platform and therefore will need to navigate through the system on a regular basis. The City staff will primarily be concerned with the following actions:

- Identify and select buildings for compliance.
- Notify building owners.
- Review submitted data for compliance requirements.
- Track compliance status.
- Provide technical assistance for building owners.
- Administer reminders and fines, as necessary.
- Analyze the city's building stock portfolio to track achievement of *Climate Action Plan* goals.
- Target outreach to building with program opportunity.

Building Owners and Managers

Building owners, designees, or both, such as building managers, are required to comply with the BESO in a timely manner. Once informed that the building must submit compliance materials to the City, the process should be as straight-forward as possible. The stakeholder group of building owners/managers is primarily concerned with the following actions:

- Find information about BESO compliance.
- Navigate the compliance workflow.
- Gather compliance materials, including building characteristics and energy data.
- Submit requested materials to the City.
- Stay informed of compliance status.
- Receive confirmation about compliance approval.
- Pay incurred fees (if applicable).
- Identify next steps to implement energy savings.

Utility

Utilities hold the energy use data necessary to comply with the BESO, making them a key stakeholder to consider in the business requirements for a platform. Utilities are also generally interested in obtaining building characteristics data to supplement energy program design and implementation. The mutual interest in whole-building energy profiles would be best leveraged through the following actions:

- Receive requests for energy data record from authorized individual(s) or City or both.
- Deliver energy data record to authorized individual(s) or City or both.
- Establish a continuous flow of future energy data streams.
- Retrieve building characteristic from authorized buildings.
- Analyze the building stock for trends and savings potential.

Electric utility customers in the City of Richmond are served by MCE and PG&E, with MCE owning approximately 90 percent of all commercial and residential customers, including the City of Richmond. The City has also "opted up" to the 100 percent renewable tariff at a modest price premium over the standard MCE offering, which is approximately 50 percent renewable. Currently, MCE has an *Energy Efficiency Business Plan* pending with the CPUC, and will likely be authorized to take over much of the ratepayer funded energy efficiency (EE) portfolio previously managed by PG&E in the relevant MCE service territory. This development makes MCE the most important player in developing a building EE Program strategy in collaboration with the City of Richmond. Additionally, ZNE Alliance is now collaborating with leaders of a state-funded Local Government Innovation project focused on MCE territory. This effort is known as the Building Energy Efficiency Optimization Project and is primed by MCE and led by TerraVerde Renewables. This effort, which is complementary to the Richmond AEC initiative, intends to plan and develop a common building EE approach across the MCE territory. While this project launched in November 2017, ZNE Alliance (as a partner) is collaborating closely with project leaders to ensure that software and programmatic solutions developed for the Richmond AEC project are adapted and scaled on an MCE territory-wide basis, and that additional innovations developed through the Local Government Innovation project are integrated into the Richmond effort.

Tools Explored & Recommendation

Energy Solutions performed a market assessment and evaluated a number of options that could potentially satisfy all three use cases (City, building owner, and utility). This list included:

- Internal tools at Energy Solutions
- SEED Platform (Department of Energy's open-source platform)
- Maalka
- Helios
- Lucid
- Opower

Based on a comprehensive assessment, including reference checks, demonstrations and test-driving the tools, the team recommended Maalka for the first phase of the Richmond effort. Maalka provided a mature set of data handling tools, is focused exclusively on assisting governments in implementing building EE initiatives and BESOs, and has strong connections to other relevant state and local government agencies in California and nationally that are engaged in similar projects. The team also worked closely with Helios, and determined that there may be additional functionalities provided by the Helios platform in the area of project discovery and project financing that may warrant integrating Helios tools in the future. To facilitate this integration, the team requested a scope of work and budget from Maalka and Helios to provide future data integration. Because of the larger scope and complexity of the Helios platform, it was determined that it would only make sense to move forward with Helios in Richmond after MCE determined it will support Helios going forward. This may take several additional months, however, the Maalka software will allow Richmond quickly begin with its own building energy data, and enable MCE to evaluate the platform for potential territory-wide scale-up, in conjunction with Helios or as a standalone solution.

Next Steps in BESO Implementation

The next step for BESO implementation is to pilot the Maalka software solution for the City-owned buildings and prepare for a future effective date requiring the balance of the City's building stock. With regard to ZNE policy implementation, the next step for the City is to advance the staff report to City Council for full consideration.

CHAPTER 4:
Programs

The AEC initiative is a "three-legged stool" that includes plans, policies, and programs as part of a holistic and synergistic approach to accelerating ZNE outcomes. The programs discussed in this chapter include the rehabilitation of abandoned homes to ZNE standards; the ZNE Early Adopter Program for multi-family new construction; the Low-Income Energy Efficiency Program for single-family home retrofit; and the City Building DER/Solar Program.

Richmond Abandoned Homes

There are currently an estimated 1,000 vacant and abandoned single family homes in the City of Richmond. The City's code enforcement department actively manages 150 to 200 of these properties, spending $7,000 per home annually on cutting weeds, boarding up windows, and removing items illegally dumped at the properties. Blighted, abandoned, and vacant properties pose significant risks to the welfare of residents as well as to the City's economy and environment. These properties depress property values, degrade neighborhoods, and attract squatters. Additionally, property taxes, assessments, parcel taxes, bond issues, and solid waste disposal bills all go unpaid, costing the City, county, school district and special districts millions of dollars in revenue. Finally, blight prevents private investment in neighborhoods because it undermines the value of real estate.

At the same time, first time homebuyers are unable to purchase homes in Richmond, despite property values among the lowest in the San Francisco Bay Area. Would-be local family buyers must compete with investors and speculators with better credit or all-cash transaction capabilities. SparkPoint Contra Costa, the local financial services collaborative, has experienced significant challenges in helping its first-time homebuyers purchase a home. While SparkPoint buyers can qualify for the mortgage at the list prices, they cannot compete with cash and other investment buyers who bid up the prices of homes. The social impact bond and ZNE retrofit home program target the financing and market access challenges of the local family buyers, as well as energy cost reduction.

Key innovation – Social Impact Bond

A social impact bond is a type social impact investing in which a commitment is made to pay for improved social outcomes that result in public sector savings. If the group receiving the proceeds can improve the targeted social condition, the investors are paid back with some interest; if it fails, the investors lose. The bonds have been used to reduce recidivism rates for criminals released from prison and to reduce teenage pregnancy rates. The four primary challenges of establishing a social impact bond to fund sustainable programs are:

1. **Finding sustainable funding for programs:** Private foundations and governments have for decades been funding experiments and start-up programs to prove whether social interventions work. While social interventions, in particular the benefits of cleaning up

blighted neighborhoods, have been demonstrated across the country, the challenge has been ensuring ongoing financial stability once seed money has dried up.

2. **Producing a real return on investment:** Not all interventions, no matter how beneficial, can result in an actual financial return, but there are enough that there is an attractive menu of possibilities.
3. **Convincing those who benefit to share with the program:** The source of the money to repay the bondholders is the financial benefit realized from the program. To ensure bondholders are repaid, those who receive program benefits must provide a share of the savings in return.
4. **Attracting investors:** The market for social impact bonds is new, and the programs bear above-market risks. There are, however, investors willing to invest, some out of philanthropic motives, others because they are incentivized to do so. The former includes private and family foundations willing to make "program-related investments" (PRI) and socially-responsible mutual funds. The latter include banks that must meet their Community Reinvestment Act obligations. Banks are eager to invest their CRA funds in social impact bonds, and are content with modest returns. In the long run, however, the viability of these bonds depends on being able to deliver risk-adjusted market-rate returns.

Richmond Abandoned Homes Program Supported by Social Impact Bonds

In 2015, the Richmond Community Foundation (RCF), a non-profit 501c(3) corporation, and the City of Richmond, with the key support of John Knox, the city's bond attorney and partner with Orrick Herrington Sutcliff, brought together key stakeholders to create new strategies and financing mechanisms for dealing with blight. The result was the Richmond Housing Renovation Program (RHRP) also known as the Abandoned Homes Social Impact Bond.

The bond is a partnership between the City of Richmond, RCF, and Mechanics Bank, also located in the City of Richmond. The social impact bond issued by the City of Richmond is a five-year bond. The City will loan the bond proceeds to RCF. Mechanics Bank has committed to purchasing the entirety of the bonds. The proceeds of the bonds are deposited into a program fund, from which RCF may withdraw funds to acquire, hold and rehabilitate properties. Union Bank acts as the bond trustee for the account, and will handle the acceptance and disbursement of bond funds; the maintenance of Reserve funds; and the custody of investments. The social impact bond is paid solely from the proceeds generated from the program, with no liability for repayment on the City's part. The more successful the program, the better the return will be on the social impact bond. As such, the repayment of the bond will come entirely from the success of the program.

RCF has committed to renovating targeted, blighted houses in specific neighborhoods for purchase by graduates of the SparkPoint program for first-time homebuyers, with construction performed by local contractors. The contractors are required to hire from the City's RichmondBuild program, a job training program in the building trades. The newly occupied homes improve quality of life and support property values in the neighborhoods and improve

the City's budget picture by reducing code enforcement costs and eliminating property tax delinquencies.

The goal for the AEC project was to add the third benefit to the social impact bond program for a full triple bottom line approach (social, economic, environmental),: making these single-family homes ZNE. The benefits of ZNE construction are an overall decrease in cost over the life of the home. While there are some incremental upfront costs, the reduced energy costs result in an estimated net benefit.

Energy Solutions has been assisting the RCF team with modeling of the homes in CBECC-Res compliance software to inform the necessary steps to get to ZNE. An additional layer that the team introduced was all-electric appliances, which aligns with the Richmond Climate Action Plan goal to fully decarbonize. The team is still evaluating the overall impacts of electrification, but there is some evidence of reduced upfront costs when comparing to mixed-fuel due to the benefit of avoided gas meter installation.

As of December 2017, RCF has completed the permitting, planning, and construction of three homes, with another 12 homes in the queue for 2018 and a total of 100 homes planned over five years. The developer responsible for two of the homes is also planning to replicate the ZNE design in 10 more homes in Oakland, demonstrating the organic scalability of this work.

In the effort to upgrade a Title 24 compliant home to a ZNE home, several challenges have surfaced that have been overcome. The first has been the unfamiliarity of the builders and architect with the efficient technologies, especially all-electric heat-pump water heaters and space heaters. The Energy Solutions team provided guidance on the sourcing and installation of these technologies. The second challenge was that space constraints with the first group of abandoned homes impeded installation of the electric water heater. Due to the homes' design, the common practice of locating heat pumps in the attic was infeasible. Some negotiation and creativity were required to place the heat-pump storage tank with exhaust ducts in the storage closet.

An additional program feature has been integrating solar photovoltaics (PV) by the Grid Alternatives program, which provides up to 5kW solar PV at low-cost. The team has coordinated with Grid Alternatives regarding the PV sizing and installation process to ensure significant net benefit for low-income homeowners.

ZNE Early Adopter Program

Program Context

The ZNE Early Adopter Program Design is targeting the multi-family new construction industry to create a complete toolkit for Richmond to reach ZNE. The City of Richmond already has access to many programs that support multi-family retrofit, including:

- PG&E Multifamily Upgrade Program.
- MCE Multifamily Energy Efficiency Program.

- Bay Area Regional Energy Network (BayREN) Multifamily Building Enhancements Program.
- City of Richmond Energy Efficiency Rebates for Multi-Family Residential Homes.

The single family new construction industry is further along in gaining broad acceptance of ZNE practices and has some support from the PG&E California Advanced Homes Program (CAHP) Zero-Net Energy and CAHP Master Builder Initiative. However, the current PG&E program only offers basic deemed incentives on a per device basis, and the BayREN Home Upgrade and Advanced Home Upgrade programs still require a substantial incremental investment from the homeowner to achieve ZNE.

The bias of many in the multi-family new construction industry is that ZNE is not yet cost-effective in this sector. Very few multi-family ZNE buildings have yet been built, and the only existing support is the PG&E California Multi-Family New Homes Program (CMFNH). Based on the gaps determined, the ZNE team determined to focus its efforts by sector (single family/multi-family) to address challenges unique to each. The Early Adopter Program addresses the multi-family new construction challenge while the ZNE Low Income Program addresses single family retrofit. (More information on the single-family initiative is provided in the ZNE Low Income Program section to follow).

To align with the City of Richmond Climate Action Plan Strategy #EE1 and to support greater utilization of existing programs, the ZNE Early Adopter Program will complement the existing PG&E multi-family CMFNH Program and will not be a new, stand-alone program. Together, these programs are designed to advance both city and state-level policy goals, including the California Public Utilities Commission's Energy Efficiency Strategic Plan goal of achieving ZNE in all residential new construction by 2020 and all commercial new construction by 2030[15].

The state's New Residential Zero Net Energy Action Plan 2015-2020 identifies a number of strategies specifically for low-rise multi-family new construction -- including developing technical tools for designing and modeling multi-family ZNE buildings, financial incentives for early adopters, and education and training for multi-family building occupants. The ZNE Early Adopter Program in Richmond enables these strategies by providing design support, incentives, and performance reports to building occupants. Additionally, a voluntary program to collect data on multi-family new construction will help enable data-driven decisions to inform the ongoing policy-making process on a Statewide ZNE Multi-family mandate.

Program Objectives

The ZNE Early Adopter Program was designed of overcoming the following hurdles in the ZNE effort of the multi-family new construction industry:

- Builders and developers assume that ZNE multi-family construction is not cost-effectively feasible before they even have data on their project characteristics

15 CA Public Utilities Commission, California Energy Commission. (2015) CA Energy Efficiency Strategic Plan: New Residential Zero Net Energy Action Plan 2015-2020. June 2015.

- Multi-family new construction still comes with a cost premium in many situations that limit projects from pursuing full ZNE
- There is not enough data regarding the operation of a ZNE designed multi-family building to support data driven decisions regarding future programs and building codes.

Program Design

The ZNE Early Adopter Program will support the existing PG&E California Multi-family New Housing program (CMNHP) to drive ZNE outcomes in multi-family new construction via a *ZNE Decision Tool*, a *Full ZNE Incentive,* and ZNE performance monitoring.

ZNE Decision Tool

In place of a static program measure list, the ZNE Decision Tool is a software program used during early-phase design of low-rise multi-family new construction. This tool helps developers and designers identify feasible and least-cost pathways to compliance with the pending Richmond Multi-Family Ordinance (RMFO) and ZNE building performance. Even if project developers still choose not to pursue ZNE performance, they would do so knowing the relative cost and performance trade-offs. The Early Adopter ZNE Program will complement the existing PG&E CMFNH rebate program by providing design options that meet the minimum energy efficiency level required to participate in CMFNH.

Full ZNE Incentive

The Early Adopter ZNE Program defines a ZNE building as a building in which the time dependent valuation (TDV) of energy consumed over a year is equal to the TDV of on-site generation[16]. This corresponds to an EDR score of 0. The *CALGreen Cost Effectiveness Study* found that multi-family buildings in Richmond -- which is in climate zone 3 -- would require an incremental cost of $7,740 per unit to get to ZNE. Based on the efficiency and PV packages prescribed in the report, these buildings would qualify for $210 per unit in CMFNH incentive payments, also known as "kickers." The ZNE Early Adopter Program will cover the remaining incremental cost and offer an incentive of $7,530 per unit for one year, with the requirement that cost information is collected to determine the true incremental cost. By offering an incentive that is closer to meeting the full incremental cost gap for achieving ZNE, the program will have a larger dataset of ZNE projects to analyze. With this data set, the project team will be able to determine an updated Full ZNE Incentive amount in the second year of the program that accurately covers the actual incremental cost, refined with a total of two years' worth of data. This longer performance period also gives designers and home residents the opportunity to fully tune building systems for ZNE performance, which is an ongoing and essential process required of nearly all ZNE buildings.

16 Shirakh, M., Meyer, C., Pennington, B., (2017) 2019 Building Energy Efficiency Standards ZNE Strategy: Staff Workshop Presentation. California Energy Commission Building Standards Office. April 2017.

ZNE Performance Monitoring

To continue to drive ZNE building design in the multi-family new construction industry, more data is needed to enable data driven decision making by program and policy stakeholders. This decision making and code development will lead to effective programs and policies to support a quicker adoption of ZNE building design in the multi-family sector. To facilitate that data collection, the ZNE Early Adopter Program will require the customer, as an eligibility requirement for the ZNE Incentive, to authorize access to three years of net electricity and natural gas consumption interval data. This interval data will then be analyzed to determine whether the building meets the California Energy Commission's code definition of ZNE, which is an EDR ≤ 0 over the course of year or whether the building meets a different performance standard, such as zero net site energy (kBtu ≤ 0).[17] Either way, it will be valuable for ZNE stakeholders to collect this data and related information (for example, number of occupants), to better understand how ZNE-designed buildings perform in practice. The benefit to the customer includes monthly performance reporting for each tenant, providing monthly and cumulative year to day net energy consumption compared to the building goal of ZNE. This will improve occupant and owner awareness of specific energy system use patterns, including plug load impacts.

Low-Income Program

Program Context

The low-income program enables the cost-effective efficiency upgrading of appliances in public housing. As the Richmond AEC project developed, the team realized that significant energy efficiency upgrades had already been performed in much of Richmond's affordable housing stock. After discussions with the city of Richmond staff and reviewing current low-income programs, the team found that existing, single family homes of low-income residents were in greatest need for efficiency program support. Similar to the strategy for the ZNE Early Adopter Program, the Richmond Low-Income Program (RLIP) will complement the existing low-income energy programs operating in Richmond to further leverage the funding and technical resources already available.

Program Objectives

There are multiple barriers to overcome in the low-income sector and not all can be overcome with one program. The RILP narrowed its focus to address the barriers listed below, in order to significantly increase participation in existing low-income programs:

17 The Energy Design Rating (EDR) is an alternate way to express the energy performance of a home using a scoring system where 100 represents the performance of a building meeting the envelope requirements of the 2006 International Energy Conservation Code (IECC). A score of zero or less represents the energy performance of a building that combines high levels of energy efficiency and/or renewable generation to "zero out" its TDV energy use. EnergyPro includes the ability to calculate an EDR as required in the CALGreen energy provisions (Title 24, Part 11) for new construction projects. Note that this rating will not appear for additions and alterations. The EDR is similar to the energy rating index in the 2015 IECC and the 2014 Residential Energy Services Network (RESNET) standards. The lower the score, the more efficient the building. Buildings complying with the current standards are more efficient than the 2006 IECC, so most newly constructed buildings will have EDR scores below 100 (if an EDR were calculated for an older, inefficient home, the score could go above 100). Buildings with renewable generation such as photovoltaics (PV) can have a negative score.

1. Lack of awareness of eligibility for low-income energy programs and confusion about opportunities to participate in multiple programs.
2. Lack of contractor coordination across multiple existing low-income programs, resulting in a resident potentially missing opportunities to leverage all available funding and programs.

Program Design

The RILP has two principal coordination tasks to increase participation and effectiveness of existing low-income programs: 1) Establishing a single point of contact for program participants and, 2) Contractor coordination and education.

Single Point of Contact

There are seven low-income energy support programs operating in the city of Richmond. Many of these programs have different eligibility requirements and eligible measures. With so many options and rules to navigate, it is inherently difficult for a customer to optimize their utilization of these programs, especially given that customers, on average, spend only nine minutes per year interacting with their utility, which is the primary conduit for much of the relevant program information.[18] Therefore, the RLIP will provide a team of low-income residential efficiency experts as a single point of contact that customers can connect with to determine program eligibility and understand application processes. The RLIP Program will support community job development by recruiting a team locally and training them to become low-income program experts. These RLIP team members will speak a variety of languages and understand local community issues to further facilitate communication and trust with potential program participants. The RLIP Team will be available to utility customers via phone, email, and in person at community events.

Contractor Coordination

Contractors play a key role in the execution of many low-income programs, as they are directly working with customers and their homes to determine applicable energy savings measures. In some programs, contractors are also the main lead development team. Unfortunately, not all contractors are aware of all programs, leaving the opportunity for missed energy savings. Therefore, the RLIP will facilitate contractor education regarding the multiple low-income programs. The goal is to empower contractors to install all of the measures needed to facilitate cost-efficient energy savings for the customer – which also typically increases revenue per customer for the contractor. The second program component will institute a contractor coordination online platform, operated by the RLIP Team, to connect customers to contractors based on contractor performance. This will overcome many of the existing challenges of contractor selection for residents. The installation appointment can be scheduled online with the customers RLIP team member or through an online platform. The contractor performance rating system will build on the existing TradePro Connect platform developed by Energy

18 https://www.accenture.com/_acnmedia/Accenture/next-gen/insight-unlocking-value-of-digital-consumer/PDF/Accenture-New-Energy-Consumer-Handbook-2013.pdf

Solutions and currently deployed in the PG&E territory. TradePro Connect was also selected for an investment in the California Large-Scale Procurement funding initiative to enable statewide scale-up. This multi-faceted contractor support platform will empower contractors in Richmond and other disadvantaged communities to facilitate greater energy savings for customers.

Electric Vehicle Incentive Program

In concert with developing the EV Action Plan, the project team worked with the City of Richmond to develop an EV charger incentive program. By addressing the up-front cost barriers of residential charging installation (in rental and owner-occupied housing), the proposed City program will allow more households to take advantage of the low operating costs of EVs, which are typically 75 percent less than equivalent internal combustion vehicles. Program funding will be made available to Richmond residents and business under three categories: single-family, multi-family and commercial (Table 6).

Table 6: Incentive Overview

Program	Base Incentive Amount	Equity Incentive Amount- Low/Medium Income households	Limit of Chargers
Single-family	$500 per charger	Max of $1,000 per charger*	One (1) per electric utility account
Multi-family	$1,000 per charger	Max of $1,500 per charger at qualifying multifamily properties*	Ten (10) per multifamily complex
Commercial	$1,000 per charger	Max $1,500 per charger for Non-profit organizations	Five (5) per commercial address

Source: ZNE Alliance, City of Richmond analysis, 2017

*Resident is participating in PG&E CARE program.

**Defined as any affordable housing property or any property where 66% or more of the building residents are at 80% or below of the Average Median Income (AMI). Properties that fall under this category are required to sign a Regulatory Agreement that ensures they meet AMI requirements.

Program Strategies

The City and ZNE Alliance have defined these key program policies and strategies to ensure that the EV charging incentive program is a success:

- **Focus on permanent infrastructure**: Reimbursements will only be offered for permanent (hard-wired) charging installations and related electrical capacity improvements, with a focus on multi-family charger access that enhances equity and provides a long-term community return on the infrastructure investment
- **Streamlined reimbursement:** Reimbursement and documentation requirements are designed to ensure user friendliness, limit administrative burden, and encourage applicants from all segments of the community.

- **Equitable support:** Additional funds will be available to qualifying applicants for the residential multifamily and commercial programs to support EV use by low and moderate-income households and small businesses.
- **Robust outreach:** The City will work closely with relevant stakeholders – including our utility partners at MCE and PG&E, and electric vehicle and EV charging station OEMs and dealers, to ensure that City residents are fully informed of the EV charging incentive program.

The team expects the EV Charging Incentive Program to be reviewed and enacted by City Council in early 2018.

City Building Solar Program

Project Team Role

The City of Richmond has 31 facilities previously assessed for on-site solar PV and battery storage potential. As part of the AEC initiative, Olivine was engaged to build on this earlier work and prepare a solar and storage request for proposals (RFP) for municipal facilities. Stemming from strategies developed in Richmond's *Energy Assurance Strategic Plan*, the City wanted to incorporate DER technologies into its own buildings to bolster resilience and energy assurance. Municipal facilities assessed by Olivine for applicability in the solar and storage RFP include key assets like dispatch centers and fire stations, as well as community centers and public use facilities. Olivine's role was to screen the facilities and assist in developing an RFP document for the facilities passing the screening process.

Description of Work

The first phase of the task was to determine which sites to include in the RFP based on a criterion of minimum system size. The team estimated the PV system size that would be necessary to cover 100 percent of the facilities load. This was done using local insolation/ weather data to determine the average annual solar yield (kWh/kW) that can be expected in the Richmond area from a PV system. From the average annual solar yield, and the annual energy consumption of the facility, the solar system size can be easily estimated. Facilities that did not meet the minimum size threshold were eliminated for consideration on the RFP, as they were deemed too small to warrant interest from potential developers.

In the next step, a more thorough analysis was completed on qualifying sites to determine the optimal size of a potential battery storage system. This was performed using the NREL System Advisor Model in conjunction with an internally developed script to simulate various solar and battery system sizes. Through an iterative process, the net present value (NPV) of the PV systems and battery systems was determined, and the combinations that yielded the highest NPV were selected for inclusion in the RFP.

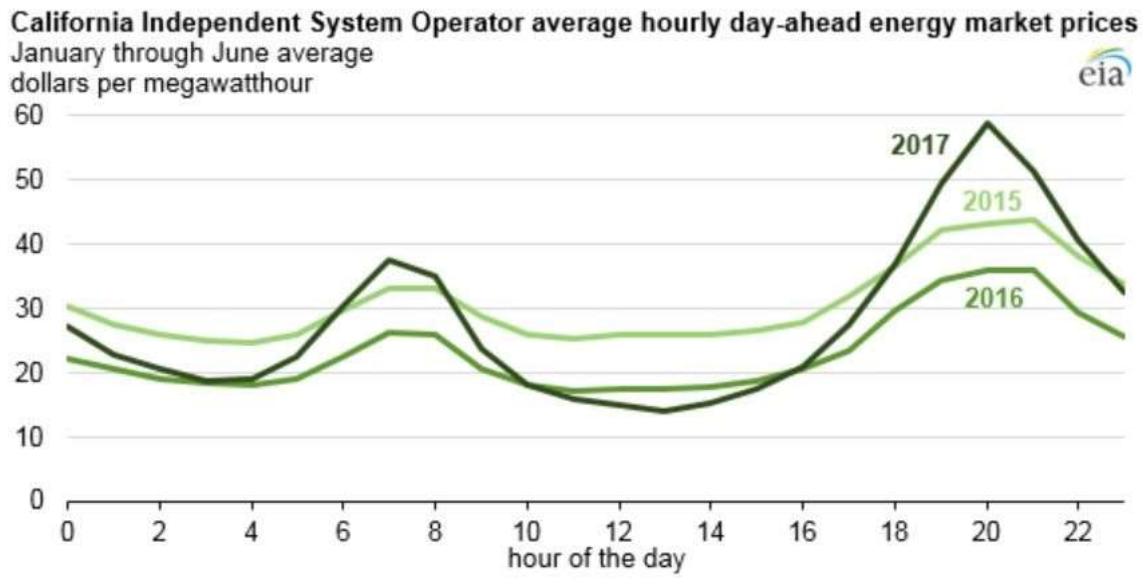
In the final step, Olivine provided technical and programmatic support to draft key sections of the RFP document. Olivine also provided recommendations on RFP distribution.

Distributed Energy Resources Program

The goal for the Richmond Distributed Energy Resources (DER) Community Program is to develop and pilot a scalable DER Community Program consistent with the integrated policy and planning framework developed through the broader AEC Project, leveraging existing programs and initiatives to support developing a grid-integrated ZNE community.

The Pilot DER Community Program is designed to use DER technologies, including demand response (DR), to mitigate the impact of price spikes during the *evening ramp*, a time period when net energy demand on the distribution grid increases sharply due to the drop off in solar production coincident with increased demand as people return home in the evening. According to a July 2017 report from the U.S. Energy Information Administration, the evening ramp has intensified in recent years with corresponding increases in average hourly day-ahead energy market prices.[19] Figure 9 shows that average hourly day-ahead energy market prices during the evening ramp have increased to nearly $60 per megawatt-hour in the first half of 2017 – compared with $35 per megawatt-hour in the same period in 2016. These price increases suggest a growing premium for flexible energy resources, including resources from DR programs.

Figure 9: CAISO Average Hourly Day-Ahead Energy Market Prices (January to June)



Source: U.S. Energy Information Administration, based on ABB Energy Velocity, 2017.

The Richmond DER Community Program is designed to create an aggregation of diverse customers from several sectors within the City of Richmond, including large Commercial & Industrial (C&I) customers, municipal buildings, and residential households, with specific options targeted to low-income households. The aggregated loads from these diverse customers will be used to provide services to the grid through participation in applicable DR and DER

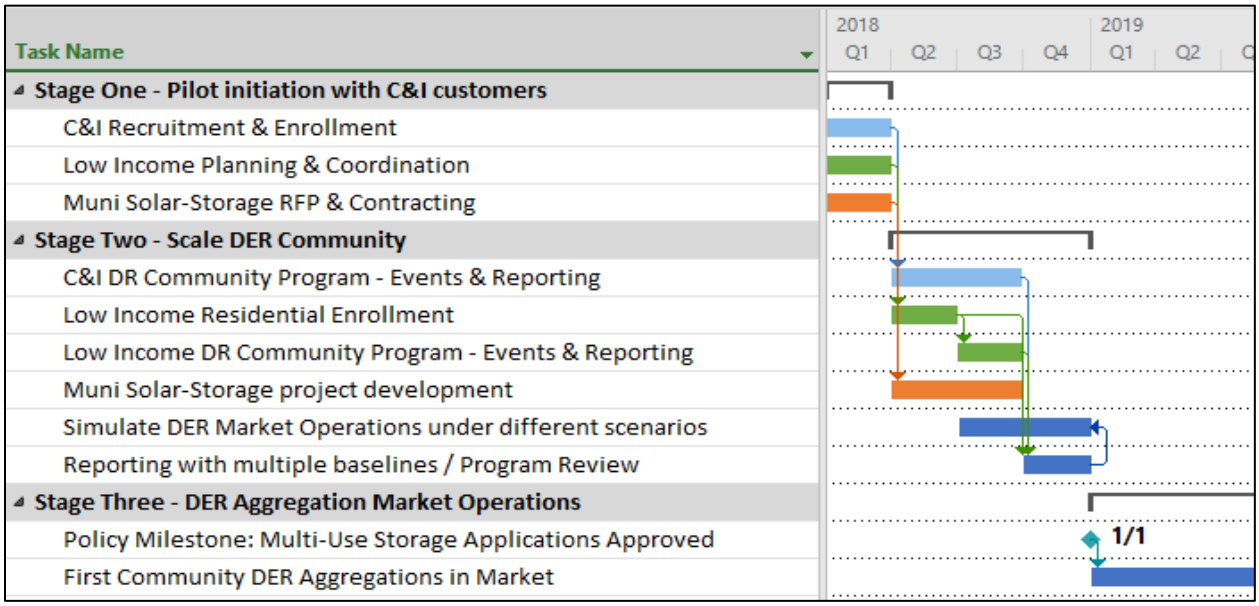
19 Cabral, L., Booth, B., & Peterson, C. (July 24, 2017). California wholesale electricity prices are higher at the beginning and end of the day. *Today in Energy.* Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=32172

programs. By shifting load from the evening ramp period, the DER Community Program offers the possibility of creating multiple value streams including:

- **MCE Energy Procurement Savings:** The local load serving entity (LSE), Marin Clean Energy, would benefit by avoiding the need to purchase more expensive and non-renewable energy in the day-ahead (DA) and real-time (RT) markets to cover procurement shortfalls during the evening ramp.
- **Customer Savings:** Program participants would benefit from energy bill savings (from reduced energy and demand charges) and greater control over energy costs.
- **Grid Benefits:** Grid operators would benefit from access to an energy resource with ramping flexibility that can improve grid resilience and penetration of renewables.
- **Community Energy Resilience:** The local community would also benefit from increased grid resilience (for example, from fewer blackouts) and the many environmental benefits associated with higher penetration of renewables.

As Figure 10 shows, the DER Community Program is proposed to be rolled out in three stages, with the focus in the first quarter of 2018 on enrolling commercial and industrial (C&I) buildings in Richmond. The program administrators propose to start with outreach to C&I customers because of lower acquisition costs per customer, and larger energy savings per customer. The ultimate goal of the Richmond DER Community Program, however, is to create an aggregation of customers from multiple sectors that reflect the diversity of Richmond's community.

Figure 10: Richmond DER Community Program Staging



Source: Olivine Analysis, 2017

By focusing Stage One efforts on coordinating with existing low-income program offerings in the City, the program administrators expect to significantly lower the acquisition costs per residential customer -- and to begin enrolling residential customers in the DER Program by April 2018. Activities in the first stage will position the DER Program for expansion in the

second stage by identifying points of coordination with existing residential low-income programs and by releasing a request for proposal (RFP) to install solar and storage in Richmond's municipal buildings. During the second stage, which is anticipated to run from April 2018 to September 2018, the DER Community will be scaled to include low income residential customers, municipal buildings, and additional DR and DER enabling technologies.

In the second stage of the program, program participants will be called upon to participate in DR events with the objective of shifting load from the evening peak. Reports will be provided based on these events to educate participants and to improve the program design. In addition to demonstrating the capabilities of DR, program administrators will also simulate aggregations that include customer-sited generation resources, such as solar and storage that can supply net energy to the grid. Simulation will show the capabilities of a DER Aggregation (DERA) to provide grid services beyond load curtailment.

Policy barriers currently prevent energy storage systems from participating in California Independent System Operator (California ISO) markets due to limitations on multiple-use applications, but program administrators expect those policy barriers to be removed by 2019. If so, the results of the DERA simulations will position the Richmond DER Community to be one of the first DERAs to participate in California ISO markets going into 2019 (identified as Stage Three in Figure 10).

The benefit of the DER Community Program is that otherwise disparate DER resources can be aggregated to provide more value streams than otherwise would be available to individual facilities. Services offered in the Richmond DER Community Program will include:

1) Using Olivine's DER valuation model to aggregate meter and energy use data from participating facilities to identify stacked value streams.
2) Providing expert advice on available market opportunities.
3) Developing and testing operational strategies to maximize value for MCE, the City of Richmond, and for DER Community Program participants.

CHAPTER 5:
Next Steps and Conclusion

Next Steps

To ensure that the tools and frameworks developed in the Richmond AEC Project can be leveraged by a broad stakeholder group and implemented by other communities, the project team has outlined a comprehensive awareness and engagement plan.

First, the team will create a website dedicated to the Richmond AEC project and related ZNE tools. This site will include the project background, introductions and explanations of all key deliverables, along with links to the deliverables. The site will provide a comprehensive introduction to the project and detailed resources allowing other communities to leverage and build on project findings.

In addition to an accessible online database, the project team will continue leveraging conferences and industry events to promote project findings. The team already has discussed project work at several workshops and conferences, including the 2017 American Council for an Energy-Efficient Economy (ACEEE) summer study and in a keynote at the 2017 EV to Grid Conference in San Francisco. Various program components have also been presented to the Richmond City Council. Additional engagements will be identified for 2018. Chapter 5

By overcoming barriers to low-income program adoption and focusing on the needs of lower-income households in all project activities, the Richmond AEC project advances an inclusive and equitable approach to accelerated clean energy and clean mobility deployment. The project team expects that this approach will continue to gain momentum and that project benefits will be widely shared throughout the state of California and beyond.

Conclusion

The City of Richmond has taken a strong stand on public and environmental health, and demonstrated extraordinary policy leadership in championing leading edge initiatives. Richmond's leadership role in the AEC Project further strengthens the city's commitment and capability to reduce local emissions, improve public health outcomes, and ensure that solutions improve the lives of *all* residents.

Each community that adopts the solutions developed through the Richmond AEC project will further build momentum for emissions reduction goal attainment as a realistic aspiration for all communities. Through widespread uptake of these value-creating solutions in all communities, including those classified as disadvantaged, the AEC project team is dedicated to ensuring that all Californians benefit from the advancement of our shared clean energy and climate goals.

GLOSSARY

Term	Definition
BayREN (Bay Area Regional Energy Network)	One of the regional energy networks created by authorized by the CPUC in 2012, BayREN serves the San Francisco Bay area. BayREN is composed of local governments and administers energy efficiency programs without utility oversight.
BESO (Building Energy Savings Ordinance)	Commercial building energy usage benchmarking and disclosure ordinance. The object of a BESO is to enable market opportunities for efficiency improvements by making data on building energy usage publicly available.
CCA (Community Choice Aggregator)	Public energy providers authorized by 2001 California legislation that fulfills the energy procurement, customer programs, and community engagement roles of electricity provision, while allowing the existing IOU to fulfill transmission, distribution, and grid maintenance roles.
California ISO (Independent System Operator)	A nonprofit public benefit corporation charged with maintaining grid stability and reliability in California.
CPUC (California Public Utility Commission)	Regulatory body overseeing electricity and natural gas IOUs, in addition to telecommunication and transportation providers.
Climate Zone (CPUC)	CPUC categorization of 16 California regions with similar weather patterns and similar anticipated energy needs.
DERA (Distributed Energy Resource Aggregation)	Aggregation of Distributed Energy Resources that enables grid services beyond load curtailment, such as storage as a supply resource. While regulations do not currently allow DERAs to provide grid services, regulatory pathways are expected to be created by 2019.
DR (Demand Response)	wholesale and retail electricity customers choosing to respond to time-based prices and other incentives by reducing or shifting electricity use, particularly during peak demand periods. With demand response, changes in customer demand become a viable option for addressing pricing, system operations and reliability, infrastructure planning, and other issues.
EPIC (Electric Program Investment Charge)	The Electric Program Investment Charge, created by the California Public Utilities Commission in December 2011, supports investments in clean energy technologies that benefit electricity ratepayers of Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company.

EVSE (Electric Vehicle Supply Equipment)	The charging equipment used to supply an electric charge on an electric vehicle battery.
EAP (Energy Assurance Plan)	A community plan assessing whether community assets essential for public safety and disaster response are available in the event of a grid outage or other energy emergency. EAPs generally provide recommendations for improvement.
GRF (Green Revolving Fund)	An investment program providing financing within an organization to implement energy efficiency, renewable energy, and other sustainability projects that generate cost savings. These savings are tracked and used to replenish the fund for the next round of green investments.
LSE (Load Serving Entity)	Entities that have been granted authority by state or local law, regulation or franchise to serve their own load directly through wholesale energy purchases.
MCE (Marin Clean Energy)	A Community Choice Aggregator serving Marin and Napa Counties.
PG&E (Pacific Gas and Electric)	An investor-owned electrical utility (IOU) serving much of Northern California.
Reach Code	Building codes that hold adopting municipalities to higher building efficiency standards than those mandated by state regulatory bodies.
RA (Resource Adequacy)	A program that ensures that adequate physical generating capacity dedicated to serving all load requirements is available to meet peak demand.
Smart grid	Smart grid is the thoughtful integration of intelligent technologies and innovative services that produce a more efficient, sustainable, economic, and secure electrical supply for California communities.
SIB (Social Impact Bond)	A type social impact investment in which public funds are issued with a commitment to delivering social outcomes while also creating public sector savings.

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Appendix A:
Deliverables Created for Project

Appendix A is a summary of all the major documents created for project purposes. This list, as well as links to each deliverable, will be available at www.znealliance.org.

Planning

- **Energy Assurance (EA) Strategic Action Plan** -- quantifies energy demand and supply, and identifies key assets, strategies, and projects that will support the community's Vision for energy resiliency.
- Electric Vehicle documents:
    - **Electric Vehicle Action Plan** – provides a review and synthesis of Richmond's current EV adoption and EV charging infrastructure in the context of local and state goals, and an outline of steps that the city can take to support these goals.
    - **Electric Vehicle Investment Planning Tool** – provides a framework for optimizing investments to achieve vehicle electrification or emissions reduction goals.
- **Green Revolving Fund Guiding Document - outlines** the formation and management of the Richmond Green Revolving Fund, including governance and reporting.

Policy

- **ZNE Reach Code and Ordinance Proposal:** A proposal for city-wide ZNE and near-ZNE requirements covering residential buildings and city-owned buildings.
- Building Energy Savings Ordinance documents
    - **BESO Ordinance Proposal:** A proposal for a city-wide code requiring existing building energy use data and audit information to submitted to the City. The requirements phase in buildings sizes over time, starting with the largest buildings, and expand coverage required by AB 802.
    - **BESO Software Platform Schematic:** A presentation summarizing a conceptual framework for building data software integration to help realize the energy savings benefits of the BESO policy. The framework
    - covers three main uses case for the holistic framework: building owner, city-staff and utilities.

Programs

- Richmond Abandoned Homes Program documents:

    - **Social Impact Bond Financial Model:** an exemplary package of documents needed for the creation Social Impact Bond for Abandoned Homes.
    - **Social Impact Bond Financial Manual:** a summary providing background and guidance for the creation of the Social Impact Bond for Abandoned Homes.
- ZNE Early Adopter Program documents:
    - **ZNE Early Adopter Measure List** – a summary of the dynamic ZNE Decision Tool that could be built to replace a static program measure list. The Tool would be used early in the building design phase to provide measure combinations and costs to reach ZNE, helping design teams to make an informed decision around pursuing ZNE with their project.
    - **ZNE Early Adopter Program Policy Manual** – a manual detailing the ZNE Early Adopter Program including an overview of the program, incentives, process flow, and a measurement and verification plan. The manual can be used to create and manage a ZNE Early Adopter Program.
- Low-Income Program documents:
    - **Low-Income Measure List** – a summary of all energy programs including all low-income programs available in the City of Richmond. This extensive list provided a framework for developing the Low-Income Program that would enable greater coordination among the many existing programs.
    - **Low-Income Program Policy Manual** – a manual providing an overview of the Low-Income Program, the process flow and a description of the single point of contact and additional contractor coordination that the program would provide. The manual can be used to create and manage a Richmond Low-Income Program.
- **City Building Solar RFI:** A Request for Proposals document that the City of Richmond will use to solicit bids for solar plus battery storage systems at thirty-one municipal facilities to support ZNE goals, reduce facility demand charges, and provide back-up power to critical facilities.
- Distributed Energy Resources Program documents:
    - **DER Program Challenges and Opportunities Report:** A review and synthesis of the challenges that the City of Richmond, along with Marin Clean Energy (MCE), the Community Choice Aggregator, face in implementing a robust and sustainable DER Program and the opportunities for utilizing community DERs within the City of Richmond to create value and benefit for the community.
    - **DER Program Enrollment Implementation Plan**: A plan to create an aggregation of diverse customers from several sectors within the City of Richmond to provide both economic and emergency services to the grid

through implementation of demand response and DER strategies, creating value for the City of Richmond, for Richmond residents and businesses, and for MCE Clean Energy (MCE).

- **DER Program Enrollment and Participation Manual:** A document to outline the processes the program administrator will take to streamline customer enrollment and participation for the pilot Richmond Distributed Energy Resources (DER) Community Program.